Ariadne-Report

Views of Citizens on Four Future Pathways of the Transport Transition

Results of the Ariadne Citizens'
Conference on the Transport Transition

KOPERNIKUS
Ariadne >> PROJEKTE
Die Zukunft unserer Energie

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CONTENT

SUMMARY

The Ariadne Kopernikus project is shaping a learning process between science, politics, business and civil society in order to provide a broad knowledge base for decisions on the energy transition. Since the beginning of the project, researchers have been working closely with randomly selected citizens on the topics of energy and transport transition. Two citizens' conferences formed the core of this collaboration after one and a half years of project duration. A two-day conference was held in November 2021 in Würzburg on the transport transition, attended by 54 randomly selected citizens and three researchers from the Ariadne Kopernikus project.[1] The subject of discussion was four future pathways which comprise various bundles of measures in the transport sector. These pathways were developed in combination with upstream participation formats with citizens and scientific research in the Ariadne project and are also oriented to the spectrum of the current political debate (Ariadne website 2022).

Deliberation as a method

The discussion between the citizens took place according to the principle of deliberation. This describes the joint weighing of arguments and experience in moderated small groups. In implementation, successful deliberation is characterised by the fact that learning about social issues takes place in dialogue, different

value concepts are respected and listened to, and discussions go beyond individual feelings, i.e. are oriented toward the common good. In the discussions of the citizens' conference, central views and value criteria of the citizens have become clear, which offer orientation both for future research and for political decisions on the implementation of the transport transition.

The results of the discussion offer a valuable contribution to the debate on which future pathways could be supported by large parts of society in the transport transition, which ones are more likely to meet with incomprehension and rejection, and where there is the greatest need for discussion. Four future pathways (bundles of political measures), which were designed by the Ariadne researchers on the basis of the results of the 2020 focus groups and in line with currently discussed policy options, were up for discussion. They share common features such as CO_2 pricing and fleet limits, but differ in terms of further policy design in the underlying socio-political logic (see Appendix). The following four future pathways were discussed: regulation, digitisation and new technologies, a market with a very high CO_2 price, and "new mobility" with new forms of mobility, public transport, cycling and pedestrian-centric planning of transport routes and public spaces. The four future pathways cover the broadest possible spectrum of policy options, supplemented by scientifically substantiated im-

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1 The second Citizens' Conference was held in Kassel on November 21 and 22 2022 on issues related to the expansion of renewable energies. You can find the summary of the results here https://ariadneprojekt.de/publikation/report-results-citizensconference-electricitytransition/.

pacts of the pathways, for example on CO_2 emission savings.

Participants are in favour of the transport transition - under the right conditions

A key outcome of the conference was that all participants supported a climate-friendly transformation of the transport system. At the same time, access to mobility must be guaranteed for all people. The citizens see the expansion of the infrastructure as an essential building block to achieve this. Only if the switch to public transport, bicycles, e-cars, etc. is made possible through appropriate infrastructure and user-friendliness can citizens make their contribution to the transport transition. Participants expressed concern that measures in the transport transition would have an impact on socially vulnerable groups in particular if they were accompanied by price increases and no alternative, low-cost mobility options were available. In general - and under suitable conditions - a large number of the participants hoped for bolder visions for the transport transition and only saw them reflected in one of the proposed pathways ("New Mobility"). Important value themes were also freedom of choice in the selection of means of transport and convenience, but also climate protection, safety and quality of life at the same time. In addition there is a great need for well-prepared information and more transparency on transport policy options. The results serve as an important source of reflection for scientific policy advice and at the same time provide an important contribution in terms of content for the debate on transport policy. The visualisation of value dimensions and socially controversial sticking points claims to increase the quality of orientation knowledge for politics and to place decisions on a broader knowledge base, since, in addition to scientific findings, a wide variety of societal knowledge also flows into the advisory process.

1. BACKGROUND AND SUBJECT OF CITIZEN DELIBERATION: FOUR PATHWAYS TO THE FUTURE

Germany has set itself ambitious climate protection targets which have been further specified by the new governing coalition. The transport sector has a key role to play here, as a large proportion of CO_2 emissions (19 %) in Germany come from the transport sector. The Federal Climate Protection Act, which firmly anchors sectoral targets alongside the national climate protection target, came into force at the end of 2019. The amended Climate Protection Act 2021 further tightened the sectoral climate protection targets. According to this, the transport sector may only emit 85 million metric tons of CO_2 in 2030 - 48 % less than in 1990. But the targets alone do not guarantee success. To achieve them, a package of measures which is supported by society as a whole is needed. That is why the Ariadne Kopernikus project is based on a joint learning process between science, politics, business and civil society. From the outset, citizens have also been involved through dialogue formats in order to integrate their perspectives into the research processes on policy options for the appendix transition.

The dialogue between society and science began in the fall of 2020 with regional online discussions throughout Germany, in which nearly 90 selected citizens talked about the challenges of the transport transition and what is important to them in its implementation. The results were included in the Ariadne research and further deepened in co-creation workshops between science and citizens in spring 2021.

The four scientifically based future pathways are based on current data and research results from renowned Ariadne project partners (DLR[2], PIK[3], MCC[4]). The pathways were prepared for the conference and made available to the participants digitally visualised on a tablet app. The app will be available to the public on the Ariadne website from June 2022[5]. In the following, the pathways with their respective bundles of measures are presented in short summaries (see Appendix 3 for detailed assumptions).

The following future pathways were up for discussion:

1. Regulation through regulatory law

   The central feature of this pathway is the focus on legal requirements and prohibitions in order to achieve climate protection targets. Regulatory measures, such as a significant tightening of fleet limits, are increasingly being used to influence faster market penetration by electrically powered vehicles. Likewise, traffic demand and mobility behaviour are being addressed with measures such as entry bans for combustion vehicles, speed limits and a ban on domestic flights."

3. Market/steering with a high CO_2 price

   The central feature of this pathway is a relatively high CO_2 price at the heart of climate policy: this rises to €300 by 2030 (currently the CO_2 price is around €25 per metric ton of CO_2 in the transport sector). Fossil fuels would become more expensive, which should lead to a decrease in internal combustion vehicles. Other policy measures, such as low city tolls and kerosene taxes, will only be used as an accompanying measure. This would make domestic air travel more expensive and thus less attractive compared to rail travel.
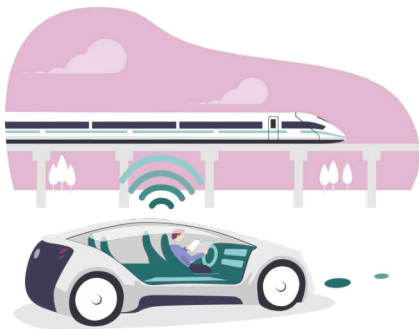
2. Digitisation and diverse technologies

   The central feature of this pathway is an openness to different technologies for powering vehicles (internal combustion engines, e-mobility, man-made fuels produced by ethanol or hydrogen, for example). The pathway relies on innovations, for example in digitalisation and autonomous driving. Incentives (e.g. lower vehicle tax for climate-friendly vehicles) are preferred to bans. The measures are supplemented by a moderate CO_2 price.

4. Change towards "new mobility"

   The central feature of this pathway is a far-reaching transformation of the entire transportation system. This approach envisions fewer spaces for cars, while at the same time expanding pedestrian- and bicycle-friendly infrastructure. New, shared forms of mobility (such as car sharing) are emerging. A reduction in the number of passenger cars is targeted. Local public transport (ÖPNV) as well as walking and cycling are the focus of transport planning and are promoted, while car traffic tends to become unattractive due to tolls and high parking costs.

2. METHOD AND RESULTS

In this chapter the method is briefly described, followed by a summary of the results that apply across pathways, followed by an evaluation of the feedback on each pathway.

2.1 Method and research question

At the citizens' conference in Würzburg in November 2021, 54 randomly selected citizens took part in 8 moderated table groups, with about 7 people per table.

Figure 1: Value criteria with high relevance for citizens in the assessment of political options for the transport transition.
Source: Own representation.

The evaluation is based on the synthesis of the table discussions on the one hand, and on the other hand the results were supplemented by before and post-surveys of the participants, which are part of the accompanying research. The accompanying research examines the quality of the deliberation as well as the learning process used by citizens and scientists, which also includes the reflection of values and attitude changes. The pre-survey was sent out online a few days before the conference, while the post-survey was conducted in writing on site in Würzburg. 45 participants took part in both surveys, on which the before and after comparisons are based. 52 (out of 54) people participated in the post-survey. The appendix contains information on the random selection and the assumptions of the four future pathways.

The conference alternated between information and discussion sections in the plenum with all participants and deliberation phases at the eight tables. The main focus of the table deliberation was on personal experiences and assessments of the four pathways, which the participants then critically discussed. The question was asked: *What advantages and disadvantages do you see for yourself and for society? What is acceptable? And what is not? How should the pathways be revised?* The discussion and assessment of the four pathways by each group was recorded using moderation cards and then written down. In the plenary session, the discussion results were also repeatedly

compared with those of the other tables. In addition, the answers to the post-surveys were evaluated using a qualitative content analysis (Mayring 2010). The resulting value categories served as an interpretation aid in structuring the results of the table discussions and at the same time represent a part of the results. The focus of "value mapping" is on the question of which ethical criteria and conditions citizens use to judge whether or not they find a future pathway desirable (cf. Clarke 2003, Blum et al. 2021).

The following four clusters of values emerged from the value criteria: Climate Protection and Change, Worries and Concerns, Feasibility, and Communication and Trust (see Figure 1). In the discussions at the citizens' conference, justifications from different areas were combined, as, for example, many both support change and have concerns and worries at the same time. There is broad agreement that access to social participation and mobility must be guaranteed for all people.

2.2 Method reflection

The following section includes self-reflection provided by ifok (organisation and moderation) complemented by empirical accompanying research of the MCC Berlin. .

Interaction in the plenum under pandemic conditions

The citizens' conference was characterised by a high level of general satisfaction on the part of the citizens with the course of events, the moderation and the event logistics. Due to the pandemic, the number of participants was reduced from the target of 65 to 54. The concept and methodology of the conference also had to be adapted in order to keep contact between participants to a minimum. Thus, the small groups worked exclusively within their own group. Exchange of content between the table groups only took place in writing via feedback forms or in the plenum via short presentations. Longer or more in-depth discussions between the groups were therefore not possible.

Diversity of perspectives within the groups

Even though participants were randomly selected, not all society perspectives were always represented at the tables. This is related, among other things, to the central challenge that very few people with low educational qualifications responded to the invitation to participate. It is important to improve on this in the future, for example, to motivate more non-academics to participate. In terms of the criteria of gender, age and geographic origin, however, the group was sufficiently representative and thus significantly more diverse perspectives were represented than in classic participation formats (see Appendix 2).

Discussion of the future pathways in terms of their effects and inclusion of the value level

A major challenge for the table moderators was to "reconcile" the different demands of the conference: conveying technical knowledge about the energy transition, referring to justifications of values, and discussing personal as well as social impacts of specific measures. Furthermore, there was a great variety of topics to be discussed in a future pathway (bundle of measures). In addition to the demanding task of facilitating the discussion, the moderator's tasks also included providing support in using the tablet app. Considering the complexity, the table group discussions went well to very well overall. Even though citizens were not able to choose the topics at their table, they were motivated and lively in their participation in the discussion, even on less "attractive" topics. The table moderators repeatedly tried to establish a connection to the reality of the citizens' lives and to make the different perspectives visible (e.g., from an urban and rural point of view). In addition to the variety of tasks, the participants' ability to establish a reference to values varied. Sometimes there was not enough time to go into depth and some participants found it difficult to justify why certain things were important to them. For the most part, however, the discussions were respectful and allowed for an exchange of different perspectives.

Knowledge transfer and app

Deliberation requires that participants have access to the state of current knowledge in order to be able to discuss the topic as well informed as possible. The knowledge about the transport transition that was necessary for the discussion was provided on the one hand via presentations by the Ariadne researchers at the beginning of the conference, during which the Future Pathways were presented. In addition, further information on the Future Pathways was available to participants in an app for independent browsing and reference. Participants were also able to ask questions to the Ariadne researchers present during the small group discussions via an online app or directly in the plenary session. From ifok's point of view, conveying the complex knowledge of the transport transition using the app was challenging: the topic is extensive and multifaceted, and the time for conveying knowledge through the app had to be balanced with the time required for the participants' discussions. The app turned out to be less than optimal due to its text-heavy nature. Nevertheless, a clear "leap in knowledge" on the part of the participants could be recorded between the first and second day. Thus, on the second day, participants were familiar with the essential basic principles and technical terms relating to the transport transition and were able to understand complex interrelationships relating to the transport transition.

The surveys and interviews of the accompanying research showed that a large majority was satisfied to very satisfied with the app and had only wished for more time to deal with its contents in advance. About 89 % perceived the app as positive for the quality of the discussion in the small groups. However, the fact that individuals stated that they felt overwhelmed with the app remains a challenge.

Nevertheless, in ifok's experience, advance information is not read by all participants. This makes for uneven knowledge levels and starting conditions among participants at events. Therefore, the technical inputs focused on the con-

ference itself. However, due to the circumstances described above, there was not enough time to read in at the citizens' conferences. In the future, therefore, even more time should be scheduled so that participants can familiarise with the app themselves or, if they wish, in small groups.

The most important findings from the citizens' conference are summarised below. The following is first a list of the topics that were discussed in several table groups and at different times. After that, feedback on the four future pathways is presented in a collected form.

3. RESULTS OF THE DELIBERATION
MAIN POINTS OF DISCUSSION

The following aspects were fundamental concerns in the discussion of the various pathways that should receive special attention in any further development.

▶ **Right to mobility:** For many table groups, the expansion of infrastructure was a prerequisite for justifying political measures if mobility is understood as a service of general interest. Affordable and comprehensive local public transport (LPT) - demand-oriented, especially in rural areas - is important for many participants, as are safe bike pathways and good long-distance rail connections. In this context, the "market" pathway was perceived as unfair by some participants if products and services become more expensive via the CO_2 price, but no sustainable or cheaper alternatives were available. One example is a strong increase in the price of fossil fuels without a corresponding improvement in the availability of public transport for people in rural areas, who are often dependent on their own cars.

▶ **Social impact and fairness:** A major concern of many citizens is that measures in the transport sector should be designed in a socially equitable way. This means taking into account the different challenges in urban and rural areas as well as the different economic conditions. Price incentives for lower-CO_2 mobility were generally seen as a useful control mechanism. However, these price increases should not unilaterally disadvantage financially weaker households if they had no alternatives available to them to date.

In the area of sharing models, access barriers were a common theme, for example digital barriers for people without access or little experience with digital tools. The inhibition threshold should be as low as possible and the offer flexible. The topic of accessibility, for example for wheelchair users, was

Figure 2: Participants' different perceptions of justice.
Source: Own representation.

Polluter pays principle (→ CO_2 price)	Equal rules for all (→ regulation)
Equity	
Distributive justice 1) Fair design of pricing mechanisms 2) Land justice (→ new mobility)	Climate protection for future generations (→ all pathways)
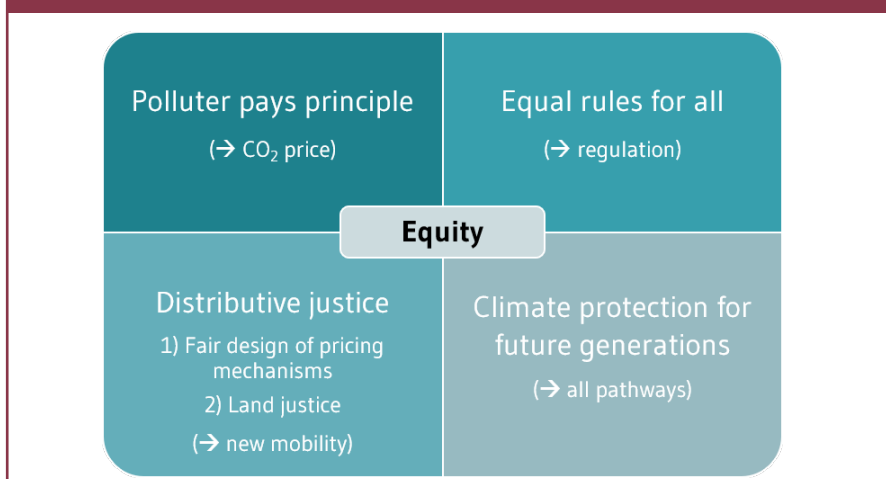
also mentioned as an important condition at some tables.

In general, there were different ideas of justice (see Figure 2):

1. Polluter pays principle,
2. Equal rules for all,
3. Financial justice with regard to the socially weak,
4. Justice as responsibility to protect the climate in order to preserve livelihoods for future generations.

▶ **Affordability and financing:** A redistribution of revenues from price control instruments, such as the CO_2 price, was welcomed as a compensatory measure. Some participants also suggested using (part of) the revenue to improve infrastructure or to promote public transport and rail (e.g., through compensation in the form of free public transport tickets or Railcard). A staggered repayment that benefits socially weaker households more than higher incomes was felt to be more socially just. Nevertheless, there is a need for further discussion among citizens on the question of how the revenue from the CO_2 price should be used fairly.

▶ **Criticism of the focus on private transport:** One feedback across all small groups was that the pathways - with the exception of "New Mobility" - place too much emphasis on private transport, which was described as "not forward-looking" in the survey. For a credible transport transition, a stronger focus on the further development of public transport is important for the revision of the pathways, as well as a reduction of private vehicles. Otherwise, there could be no talk of an ambitious transport transition, which, according to feedback from the pre-survey, would call into question the credibility of the entire participation process.

▶ **Consideration for self-determination in political framework conditions:** An overriding theme in many groups was freedom of choice in the selection of means of transport and social participation. Regulations and measures which restrict personal mobility (e.g., high CO_2 prices, city tolls) were viewed critically by some, especially if there are no adequate alternatives, but advocated as necessary by others. Interference by the state in this freedom was perceived in mixed terms. In the view of many the regulatory pathway encroached too much on freedom rights. Surveys of the participants show that rising costs are seen as a restriction of personal freedom in the choice of means of transport. Some expected a problem of acceptance in the pathway of regulation because of the restrictions imposed by prices and bans. On the other hand, however, it was emphasised that clear political framework conditions can create acceptance for the transport transition.

▶ **Comprehensibility and clarification, predictability and transparency:** Education and information provision were emphasised as important building blocks for the implementation of new mobility concepts. In relation to strict regulations, such as in the pathway of the same name, these would help to generate a better understanding of policy measures and facilitate changes in mobility habits. For more technological or conceptual mobility innovations, information and education also pick up those whose technical know-how is less developed. But there was also a clear desire to better understand the CO_2 price redistribution mechanisms. Similarly, many of the participants wanted more transparency regarding the eco-balance of e-cars and clarity about what contribution they make to a sustainable future.

For citizens, the introduction of a CO_2 price was highly important in terms of planning and transparency. Citizens would like to receive information at an early stage. In addition to concerns about the high individual financial burden of a high CO_2 price, some participants were also concerned about the potentially negative effects of the CO_2 price on the German economy (competitive disadvantages).

▶ **Quality of life and health:** In addition to the effect of reducing greenhouse gas emissions, the topics of quality of life, health (less noise, better air, less particulate matter), convenience, flexibility and traffic safety were important concerns. In particular, the reduction of the number of vehicles played a role, which was welcomed by many table groups. However, the measures should take into account that rural areas are still more dependent on the private car.

▶ **Safety and data protection:** In discussions on the speed limit as well as on "new mobility" and infrastructure, it became clear across all tables that increased safety in everyday life is a strong value which is important to citizens. Technologies such as autonomous driving were seen as too unsafe in some cases. In addition, data protection is an important concern for many in

AFTER SURVEY: RESTRICTIONS ARE ACCEPTABLE IF EVERY-ONE PARTICIPATES

Notably, a large majority viewed the "regulation" pathway as desirable (85 %) and effective (89 %). In addition, 87 % of respondents in the online feedback (n=33) agreed with the following statement: "Statutory regulations and rules are needed to ensure that individuals do enough to protect the climate." This illustrates that a majority of citizens see a regulatory framework as a condition for effective implementation of the transport transition ("fast achievement of climate targets - everyone must participate") and are to a large extent willing to accept restrictions. However, measures should be socially acceptable.

the digitalisation of transport, as citizens were sceptical about the use of their own data by third parties.

▶ **Pros and cons of new space allocation in city centres:** Another frequently debated topic was the extent to which mobility measures such as parking fees and city tolls change city centres. While some feared an extinction of the inner cities or higher rental prices, others were looking forward to a redesign, more green space, better living quality and more traffic safety.

4. EVALUATION OF THE FUTURE PATHWAYS

The content-related feedback from the citizens' conference provides information on the advantages and disadvantages that the participants attested to the pathways and their effects in the context of the deliberation. Table 1 provides an overview of the different perspectives and content ratings. The dimensions of "effectiveness," "equity," "responsiveness," "health, safety, quality of life," and "trust and transparency" were not given in the discussions of the pathways. They were used here to increase the clarity of the results.

Table 1: Overview of feedback from citizens on the content of the four future pathways
Source: Own representation.

	Pathway 1: Regulation	Pathway 2: Digitisation and technologies	Pathway 3: Market/CO$_2$ price	Pathway 4: New mobility
Effectiveness (achievement of climate targets)	<u>Positive</u>: Very effective, fast implementation	<u>Negative</u>: Insufficient climate effect <u>Positive</u>: Efficiency and optimisation	<u>Negative</u>: Low effectiveness <u>Positive</u>: Effective due to polluter pays principle	<u>Positive</u>: Effective climate and environmental protection, attractive alternatives (cycling, walking, public transport)
Equity (fairness, social impact, barriers).	<u>Positive</u>: Joint effort, concerns all <u>Negative</u>: Severe limitations	<u>Negative</u>: Rising costs for mobility are socially unjust	<u>Negative</u>: Unfair, as alternatives are lacking, unfair load	<u>Negative</u>: Severe restrictions for people driving, digital barriers exclude people
Proximity to citizens (restrictions, costs, convenience)	<u>Negative</u>: Alternatives are lacking, especially in the countryside	<u>Positive</u>: Convenience and mobility for all	<u>Negative</u>: Higher costs for consumers → Restriction	<u>Negative</u>: Loss of convenience
Health, safety, quality of life	<u>Positive</u>: Flight ban reduces noise, speed limit reduces traffic fatalities	<u>Negative</u>: Autonomous driving too unsafe for individual traffic	-	<u>Positive</u>: Increased quality of life, more meeting spaces <u>Negative</u>: Loss of safety when using public transport
Trust and transparency	More transparency on life cycle assessment & e-mobility desired	More transparency on life cycle assessment & e-mobility desired	Distrust for handling revenues	Doubts about feasibility of the pathway in rural areas

Feedback on the content of the deliberation is the main result of the citizens' conference. This is supplemented by the post-conference survey from the accompanying research (see Figure 3 and Figure 4). After the conference, the citizens were asked individually how close to the citizens/remote from the citizens, effective/ineffective, fair/unfair they felt the pathways were on a scale of -3 to +3 (see Figure 3 and Figure 4). 52 of 54 participants provided their ratings in the post-survey. Further results of the accompanying research, in particular the before/after ratings of the four pathways, can be found below in section 4.5.

4.1 Future pathway "Regulation"

Positive effects

▶ **High effectiveness and rapid implementation:** The participants emphasised that the pathway enables effective and rapid climate protection, as it reduces resource consumption and CO_2 emissions in transport (see Appendix 3). In addition, it is seen as an important support to change one's own behaviour (*"would help me to fight my weaker self"*). According to the survey, the speed with which measures can be implemented is a key strength of the pathway. This is also reflected in the survey: 89 % see the pathway as effective - in a comparison of all four pathways, this is the highest value.

▶ **Climate protection as a joint effort:** A positive aspect was that the regulations would apply equally to everyone and would therefore be fair. Clear rules are also seen as important by citizens, because they provide better orientation for the population (*"decision-making aid"*). However, there must be good alternatives which offer a certain level of convenience (e.g. taking the train, e-cars).

▶ **Health and safety:** The pathway was perceived positively because of the speed limit and flight ban for domestic flights, since these promote safety and health in addition to their climate impact (*"Save lives!"*, *"reduces aircraft noise"*).

Negative effects

▶ **Less self-determination:** Restriction of personal freedom was seen as negative, which is why a ban on combustion vehicles was rejected by some participants. The main criticism was that bans would be difficult to accept if good alternatives were lacking. A central condition was therefore that new mobility offers had to be available and corresponding infrastructure had to be created - especially in rural areas.

▶ **Environmental protection and sustainability:** Participating citizens wanted transparency in the life cycle assessment of e-vehicles and their energy requirements.

Notes and ideas for the revision of the pathway

▶ **Education, comprehensibility and transparency:** Citizens see a great need for education and better comprehensibility and communication of measures and new technologies in the context of the transport transition. Positive effects and bene-

Figure 3: Effectiveness, fairness, closeness to citizens
Percentage of positive ratings (n=52)
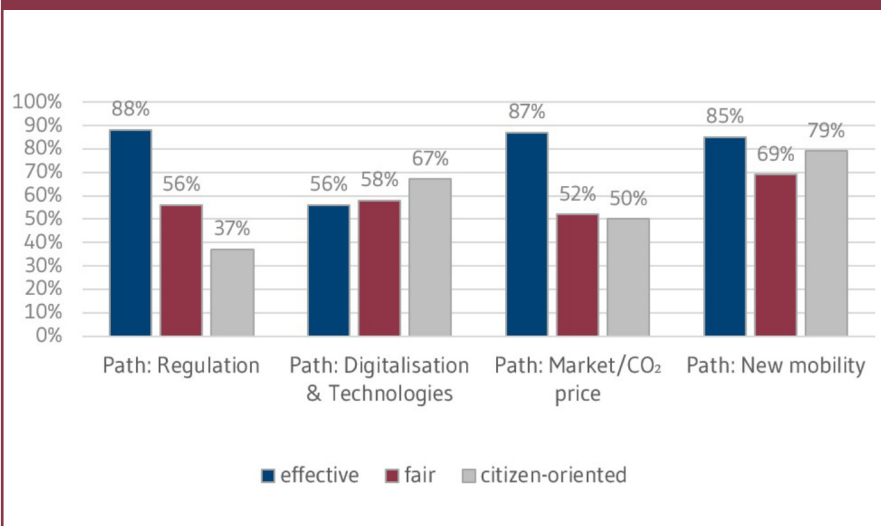
Figure 3: Post-survey (percentage): The figure shows that the "Regulation" and "Mark/CO_2 price" pathways are perceived as effective after deliberation, but as moderately fair and close to citizens. The opposite is true for the Digitisation and Technologies pathway, which is seen as relatively citizen-centric but only moderately effective. Only the New Mobility pathway was positively assessed by a clear majority of more than two-thirds in all three areas.

Figure 4: Justice
(Mean values, n=52)

Figure 4: Post-survey (mean values): Figure 4 shows that the New Mobility pathway received the highest rating on average. The market/CO_2 price pathway, on the other hand, was perceived to be the least equitable.

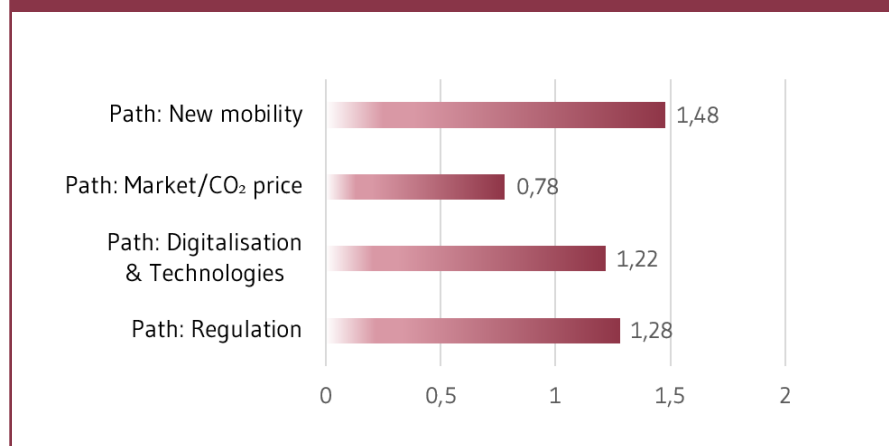fits of change should be emphasised and better communicated. One table group also proposed an educational campaign which is understandable to all, with the support of science, for example on the topic of fleet limits, taxation of e-cars (depending on size and weight), social compatibility of measures. In addition, information and education from the federal government was also needed. Transparency of measures was considered important and an open approach - including negative aspects - was desired.

▶ **Reduction of private vehicles:** During revision of the pathway, the focus should be on the goal of "fewer private vehicles". A bonus should therefore only be paid for first cars, as this would otherwise set the wrong incentives for second or third cars. Also, a bonus-penalty system should be designed in such a way that it tends to reduce the number of private cars where possible and socially acceptable. One idea from participants was that people in the countryside should receive a "bonus" for zero-emission cars, while people in the city should be taxed with a "penalty" - regardless of the vehicle. This is based on the vision that attractive alternatives (public transport) exist in inner cities which are difficult to implement in rural areas.

▶ **Regulation and effort also for the private sector:** It was suggested that fleet limits should also apply to company cars and the company fleets, so that the number of e-cars increases rapidly. The business sector would have to focus more on medium and small vehicles in its fleet mix (with some sector-specific exceptions). In addition, companies should be required to provide charging stations in their parking lots.

4.2 Future pathway "Digitisation and technologies"

Positive effects

▶ **Convenience and mobility for all:** What citizens particularly appreciate about this pathway is that it involves few personal restrictions, yet reduces emissions and has a positive impact on quality of life. Citizens see these positive effects, for example, in fewer cars in the city centre and greater comfort through less stress in road traffic, for example through convenient autonomous driving. Autonomously driving feeder shuttles were welcomed as they are also attractive for the rural population and especially for elderly, very young and disabled people. The digital barriers of new technologies should therefore be low enough that all these target groups can benefit from them.

▶ **New technologies and efficiency:** People who rated the pathway as desirable in the survey have confidence in the potential of new technologies (e-mobility, autonomous driving, digital networking and control), as they would create alternatives and increase efficiency, control and safety in the transport system. Incentives, such as subsidies of small and medium-sized e-vehicles, were considered useful in this regard. Intelligent control and optimisation of traffic was welcomed, insofar as data protection is taken into account.

Negative effects

▶ **Financing, affordability & fairness:** With regard to the new infrastructure, there was a need for clarification on how this should be financed, as high costs were feared (e.g. charging stations also in rural areas). Higher parking fees were welcomed by one table, as this would allow more space and quality of life in city centres, while other tables saw them more as a new financial burden and thus a major constraint. In general, rising mobility costs hit people with low incomes the hardest. However, in the opinion of the citizens, mobility should not become a luxury good and should continue to be affordable for everyone.

▶ **Insufficient climate impact:** Negative responses in the survey indicated that the pathway was not effective enough (*"misses 2030 climate targets"*) and that the number of vehicles was too high (*"too much focus on private transport"*). It was recommended to reduce private cars in the future and therefore to use autonomous driving only in public transport. Many participants were in favour of pursuing the pathway in combination with the other pathways: *"Digitisation complements the other pathways"*.

▶ **Safety and autonomous driving:** Some perceived autonomous driving as too unsafe and therefore questioned the safety and feasibility of combining autonomous shuttles and private transport. It was also suggested that "fully autonomous driving" should only be used for public transport and not for private cars. In addition, the population should be better informed about autonomous driving.

Notes and ideas for the revision of the pathway

▶ **Education and training:** In this future pathway, too, participants wanted more education and information about new technology, especially about autonomous driving

and its safety. When revising the pathway a requirement was not to forget the general public despite all the progress of the new technologies. One question which impacted the citizens was: What impact will the technological change have on jobs?

▶ **Reducing journeys through home office and delivery services:** Home Office should be promoted to avoid journeys, but this would require a better digital infrastructure in Germany. Local provision for limited and elderly people is necessary and should be supported, for example by promoting delivery services.

▶ **Financing:** The vehicle tax should be retained as a proven and accepted source of revenue. Care should be taken to ensure that taxation continues to be more beneficial without a car than with an e-car.

▶ **Data protection:** The source code for digital systems for the transport transition should be open so that security vulnerabilities can be identified ("open source"). Experts, such as the Chaos Computer Club (CCC), should be involved here to create trust and increase the number of users, which would lead to more climate protection.

BEFORE AND AFTER SURVEY:

According to the survey, the pathway gained 13 percentage points in approval through deliberation (76 % before, 89 % after), but lost its second place to the regulatory pathway in the choice of favourite pathway and was selected by only 11 % (24 % before). The pathway was perceived as effective by 75 %, equitable by 57 %, and responsive to citizens by 67 % (n=52).

▶ **Include used cars:** Bonus models should also be considered in the used car market. During a growing market for used e-vehicles it will also be possible for people with lower salaries to opt for an e-car. However, this could still be subsidised by the state as well.

▶ **Monitoring of the measures:** Participants suggested that the success of the measures should be checked by means of a regular standardised evaluation and that the measures should be adjusted if necessary.

▶ **Title:** The pathway title would be better as "Technology & Innovation".

4.3 Future pathway "Market/CO_2 price"

Positive effects

▶ **Effective climate protection:** People who supported the pathway particularly appreciated its high effectiveness in climate protection and the polluter-pays principle, which was seen as fair: *"Those who produce a lot of CO_2 should also pay more."* Habits, such as frequent and long driving, would be broken by changing prices and new incentives.

Negative effects

▶ **Low effectiveness:** The climate impact was doubted by some, because high prices in everyday life would not automatically lead to behavioural changes. People who depended on their cars and had no alternatives (especially the rural population) would (have to) continue driving anyway.

▶ **Higher costs:** It was viewed negatively that the CO_2 price increase would have an impact on previous lifestyles and make it more difficult to plan living costs in the short term. Social cushioning was seen as very important.

▶ **Social impacts seen as unfair:** Many were critical of price-based instruments and saw a high CO_2 price

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primarily as an unfair burden on consumers and people with low incomes. In the view of many participants, a negative aspect is that people with low incomes and the rural population would be additionally burdened financially. This is unfair, especially if there is no access to functioning public transport infrastructure. Before the CO_2 price is significantly increased, participants believe that the transport infrastructure must be promoted so that climate-friendly alternatives are available, especially in rural areas (*"public transport infrastructure, faster for the country, subsidies for transport associations e-fleet"*). Otherwise there would be a risk of financial disadvantages for citizens who are willing to switch but cannot do so due to a lack of mobility alternatives. A negative evaluation of the pathway was justified as follows: *"Infrastructure is missing and would be a prerequisite before high prices are announced"* (post-survey).

▶ **Distrust about the handling of revenues:** Some indicated that they were not convinced about mechanisms of redistribution (*"bureaucratic monster"*, *"it hits especially the countryside and low-income people"*). There was mistrust about how the money would be used and a doubt about the administrative feasibility of revenue recapture. The participants pointed to a possible acceptance problem due to actual or perceived injustice.

▶ **Need for deliberation:** Fairness and social impacts remain a controversial topic and should be reflected and taken up by Ariadne research on the future of transport. Furthermore, there is a high need for further in-depth discussion of fairness and social impacts of the transport transition with citizens.

Notes and ideas for the revision of the pathway

▶ **Comprehensibility, transparency and predictability:** Some positive evaluations of the survey were

linked to the condition that the revenues from CO_2 pricing be redistributed to ensure the social compatibility of the pathway. A future vision of the pathway and how the money would be used should be apparent to better understand the CO_2 price. It also became clear that transparency is particularly important to citizens: they want to know exactly how revenue from the CO_2 price is used. In addition, people and the business community would need to know what to expect (*"predictability"*).

▶ **Fairness of reimbursement:** One specific proposal for fair implementation was that the redistribution of part of the revenue should only be paid out to lower earners up to a certain income limit, while the rest should go into an investment fund for sustainable infrastructure. Another proposal was to introduce the reimbursement in two stages: until 2030 with a choice between direct reimbursement or in the form of a free public transport ticket, and from 2030 only as a free public transport ticket. This would leave time to provide climate-friendly infrastructure during the first stage, which could actually be used in the second stage.

▶ **EU level and international trade:** In the view of the participants the CO_2 price must be coordinated internationally. It was discussed that tariffs

at the EU external borders are necessary to compensate for the price increases due to the CO_2 price. A consensual arrangement in the EU was important. Policymakers should therefore consider compatibility with European legislation.

▶ **Improved communication:** Transparency, for example by listing the refund amount on the fuel receipt.

4.4 Future pathway "New mobility"

Positive effects

▶ **Effective climate protection and environmental protection:** It was seen as positive that the long-term energy requirement will decrease, which will protect both resources and the climate (*"reduce trips, reduce emissions"*). According to the survey, the pathway is desirable because it encourages people to fundamentally rethink mobility. This also includes the promotion of new technologies, such as the switch from internal combustion vehicles to electromobility.

▶ **Attractive alternatives:** One strength of the pathway is that it offers alternatives, flexibility and a wide range of options. A close cycle of free or low-cost public transport and an expanded bicycle infrastructure as well as car sharing and e-mobility were mostly seen as very positive.

▶ **More quality of life:** An increasing quality of life was expected through this pathway (*"city centre more lively and greener"*, *"meeting spaces"*, *"more space to live, fewer dangers"*). The vision of a car-free city centre was perceived very positively, because it would reduce noise, CO_2 and particulate matter pollution, which in turn would have a positive impact on health and safety. If there were 75 % fewer cars, new open spaces would be created. The increased quality of life in cities was also positively highlighted in the survey (*"less stress"*, *"more open space"*, *"good for health"*).

Negative effects

▶ **Loss of individual mobility and freedom:** Restriction of private mobility and fewer parking spaces were seen as negative by some. For the rural population in particular, it was mostly inconceivable to do without individual mobility under current conditions. There was scepticism in some quarters as to whether the private car can really be so restricted in the "car nation of Germany".

▶ **Loss of convenience and safety:** The restriction of private mobility was partly perceived as a loss of convenience and safety (*"cycling in rainy weather is unpleasant and dangerous"*). Therefore, it should be possible to take bicycles on public transport (suburban rail, trams, buses). Unsafe public transport routes were also perceived as negative, which affects personal well-being. In addition, intensive use and congestion were expected due to free public transport.

▶ **Concerns about e-mobility:** Some saw the repair and disposal of e-cars as problematic. Related to this was the need for transparency regarding the life cycle assessment and environmental impact of e-vehicles. A strong increase in e-mobility could lead to a high demand for electricity at peak times, which could have a negative impact on grid stability.

▶ **Doubts as to whether mobility will be made possible for all:** The comprehensive change could have a negative impact on vulnerable groups. People who have difficulty coping with new (digital) offerings should be supported. In addition, accessibility must always be taken into account when designing new infrastructure and alternative services, and implemented where possible.

▶ **Doubts about feasibility in rural areas:** Criticism was voiced that the pathway could not be implemented in rural areas or that the needs of

the rural population had not been sufficiently taken into account.

Notes and ideas for the revision of the pathway

▶ **Exceptions for special groups:** Professional groups such as doctors, nurses and caregivers, as well as craftsmen and service providers should continue to be allowed to travel the necessary distances by car in order to reach their destinations. It was also suggested that residents should continue to be able to park near their (inner-city) homes.

▶ **Shopping in everyday life:** Many journeys in everyday life are taken to deal with shopping errands. There were isolated concerns about whether and how families should manage their bulk shopping using car-sharing. One suggestion for urban neighbourhoods and rural areas was that regional development and supply should be encouraged (e.g., small grocery stores) so that good local supply eliminates the need for many trips.

▶ **Construction measures:** The following infrastructure ideas were suggested as additions to the pathway: park and ride infrastructure, bicycle parking and repair service at the station, parking for cargo bikes, structurally separated bus lanes to allow for fluid travel.

▶ **Mobility for all and control:** Pedestrians should also be considered in urban planning in order to avoid conflicts between cyclists and pedestrians. It must be ensured that cyclists abide by the rules and that respectful coexistence in traffic is possible.

▶ **Work and employers:** Work meetings are increasingly taking place online, which may further reduce traffic in the future. Employers should offer company bicycles (incl.

e-bikes) instead of company cars and communicate this option.

▶ **Need for deliberation:** Despite the very high popularity of the pathway, there were also concerns and scepticism. In particular, the redistribution and repurposing of public space remains a controversial issue. It follows that the assumptions of the New Mobility Pathway should be reflected and addressed, especially by Ariadne research. There is also a high need to discuss the assumptions and implications of the pathway in more depth together with citizens.

BEFORE AND AFTER SURVEY:

The "New Mobility" pathway received the broadest approval in the survey (91 % before, 96 % after). Through deliberation, the pathway lost slightly in approval, as some switched to a combination of pathways. In the end, 47 % chose "New Mobility" as their favourite pathway (previously 51 %).
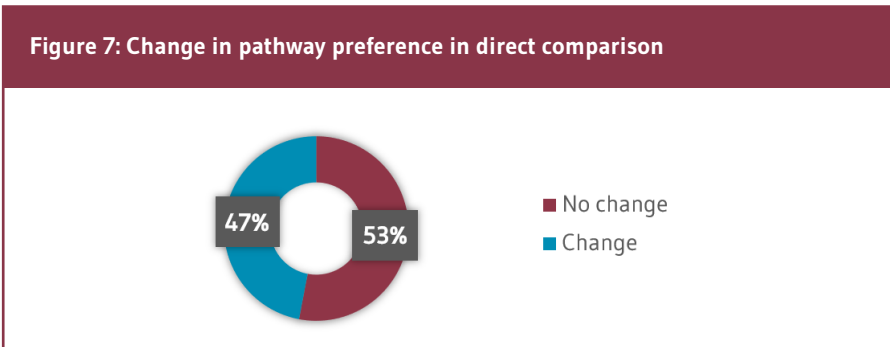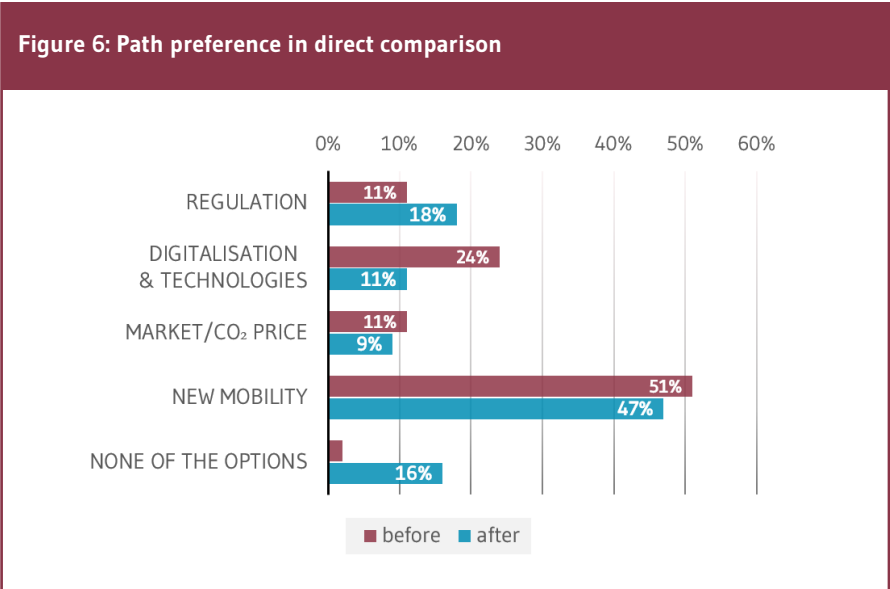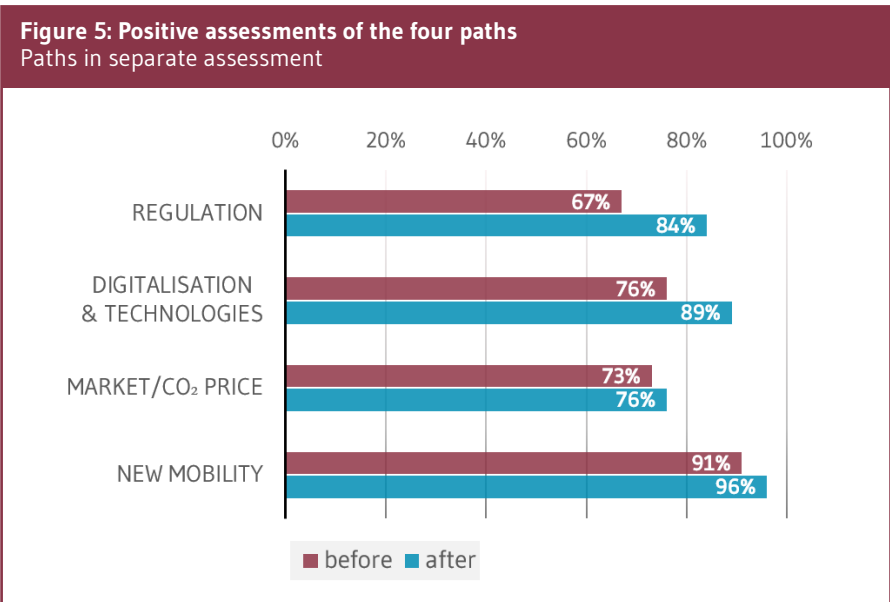
4.5 Before and post-surveys with participants of the citizens' conference

The pre-survey was sent out online a few days before the conference, while the post-survey was conducted in writing on site in Würzburg. 45 of 54 participants took part in both surveys, which is the basis for the before and after comparisons in the following three figures. First, each pathway was rated separately on a scale of -4 (not at all desirable) and +4 (very desirable). Subsequently, respondents were asked which of the four pathways most closely matched their own ideas.

Figure 5 shows that all pathways received more positive ratings after the citizens' conference than they did when asked separately one after the other. Both the percentage evaluation and the mean values show that after the conference, the "New Mobility" pathway achieved the highest approval rating (3.11), followed by digitisation/technologies (1.93), regulation (1.82) and market/CO_2 price (1.2).

Figure 6 shows that the "New Mobility" pathway was the most popular. The biggest winner of the deliberation was the regulation pathway. The biggest loser was the diverse technologies and digitisation pathway. In the end, 16 % voted for "none of the options," reflecting a desire for a combination of pathways, which about two-thirds of respondents favoured.

Figure 7 shows that just under half of the respondents changed their pathway preference. This look at the individual level shows that a change in perspective occurred more frequently than one would initially assume at the group level.

Figure 5: Positive assessments of the four paths
Paths in separate assessment

Figure 6: Path preference in direct comparison

Figure 7: Change in pathway preference in direct comparison

5. PATHWAY COMBINATIONS

One goal of the citizens' conference was to provide feedback to Ariadne Science regarding the further development of the four pathways. Two-thirds favoured a combination of different pathways. Of these, just under a third (30 %) preferred a combination of all four pathways. Even slightly more people (38 %) favoured a combination of two pathways. The most popular combinations were as follows:

1. All four pathways
2. "New mobility" + "Regulation"
3. "New Mobility" + "New Technologies & Digitisation"
4. "New Technologies & Digitisation" + "Regulation"

All 4 Pathways: 30 % of respondents argued for full integration of all four pathways because all four had effective elements to consider and none of the pathways alone was enough. In the words of one participant: *"Only all pathways together lead to the goal"*.

New mobility + regulation: The combination of regulatory laws and bans as well as progressive measures from the "New mobility" pathway, such as low-cost public transport, was seen as an ambitious variant that could be implemented quickly (*"Combination of pathway 1+4 so that something happens quickly"*).

New mobility + technologies (and CO_2 price): One table group ended up advocating a combination of modern technologies and measures to promote new forms of mobility: *"Autonomous shuttles, free public transport, expansion of cycling and walking infrastructure."* Another group made a similar suggestion: *"Public transport expansion, cycle pathways, car sharing, urban transformation and digitisation."* Some also suggested a 3-way combination with the market/CO_2 price pathway, but this is basically already included in the 2-way combination, as a higher CO_2 price is also envisaged (429 EUR per ton/2045 vs. 715 EUR per ton/2045 in the market pathway). This is only flanked in a more targeted manner by further measures.

Technologies + regulation: Some participants argued that digitisation and new technologies should play a role in all scenarios, but that this pathway alone was not effective enough to reduce the number of cars and climate damage. The regulatory pathway was seen as effective but less citizen-centric than the other pathways. Since the two pathways complement each other well, it was suggested that they be combined.

6. SUMMARY AND OUTLOOK

The aim of the conference was for participants to discover the complexity of the different future pathways for the transport transition through the app as well as the discussion and to encourage them to exchange their opinions intensively and to listen to other points of view. This goal was achieved. Participants discussed advantages and disadvantages of the pathways for themselves personally and for society and asked critical questions to science. The quality of the substantive feedback is high because the positions on the pathways are well founded and also reflect society's values. Different realities of life, such as urban and rural, young and old, and different experiences in everyday work and family life, came together in the discussions and led to lively debates. Despite their different backgrounds, what was particularly important to most participants was that the bundles of measures are ambitious enough to reduce traffic and cut climate-damaging emissions in the transport sector. Nevertheless, fairness in terms of distributional issues and social impacts is of paramount importance when it comes to the specific design of transport policies. There is still a need for discussion and understanding since there are different perceptions of fairness in the area of transport and mobility. In the end, there was broad agreement that no pathway is perfect, but that all have their advantages and disadvantages and that a combination of pathways makes sense. The survey makes clear that the "New Mobility" pathway received the

highest level of agreement and was perceived by a clear majority to be both effective, equitable and responsive to citizens. In contrast, the "market/CO_2 price" pathway was least preferred in a direct comparison. There are concerns about its effectiveness and a major concern that low-income households would not be able to afford the high prices for mobility, which was perceived as unfair. Despite this, a majority rated the "market/CO_2 price" pathway as desirable in the separate assessment, again emphasising the importance of making it socially equitable. In the further development of the pathways, values such as convenience, health and quality of life, as well as the ecological sustainability of new technologies, should be given special consideration in addition to the criteria of climate protection and justice, in the view of the participants. As far as the political process is concerned, citizens wished for better communication of independent and comprehensible information (e.g. on e-mobility and its life cycle assessment) as well as more transparency in the planning and implementation of measures, for example on the redistribution of revenues from the CO_2 price. Based on the feedback from the citizens, the Ariadne researchers will reflect and further develop their own assumptions and models. The second goal, to provide input to the scientific community, was thus also achieved. In order to complement the policy advice of science with further perspectives, these results will be discussed with stakeholders from politics,

business and organised civil society. This will be incorporated into the citizens' summit to be held at the beginning of 2023, at which citizens will once again deliberate on selected specific issues of the transport transition pathways, present their findings, and stakeholders will comment directly on them.

Appendix 1: Conference schedule

Saturday, 13.11.2021

Time	Programme item
10:30	Arrival and registration of participants, Corona test
11:30	**Start of the conference:** welcome, aim of the conference, getting to know each other
12:15	Introduction to the transport transition
13:15	Lunch break
14:15	Discussion and exchange in small groups on the transport transition
16:30	Coffee break
16:55	Presentation of the results of the discussion on the transport transition
18:30	**End of the first conference day**

Sunday, 14.11.2021

Time	Programme item
	Breakfast at the hotel, Corona test
08:30	Arrive
09:00	**Start of the second day of the conference:** discussion and exchange in small groups on policy options
11:55	Coffee break
11:10	Presentation of the results; feedback to the other small groups.
12:10	Lunch
13:10	Revision of policy options in the small groups.
14:30	Coffee break
14:45	Presentation and consolidation of the results
16:00	**End of the Ariadne citizens' conference on the transport transition**

Deliberation in small groups in three phases

The aim of the first deliberation phase was to discuss the impacts of all future pathways in the table groups and to create an understanding of what the respective pathways entail and what impacts they have according to science. To this end, the questions of how which pathway interferes with the lives and environment of the participants, what would change for them, what impacts they see and whether they consider these impacts to be positive or negative were discussed. In addition, the overall societal impact of the individual questions was discussed and open questions and points were collected.

The aim of the second deliberation phase was for the participants to discuss a future pathway and its implications in greater depth at their table and to discuss the individual positions and feedback from the first deliberation phase. To this end, the content and implications of the pathway were recorded once again. Subsequently, it was discussed whether the pathway seems sensible and feasible for the implementation of the energy transition and what should be taken into account during implementation.

In the third and final deliberation phase, the results from the first two deliberations were to be recapitulated. A comparison of the results with other table groups was to serve as a basis for adapting, expanding and merging the bundles of measures of the pathways. To this end, participants were asked how the pathway could be supplemented, improved or changed, whether it could be combined with other set screws, and whether there were other setscrews that had not yet been considered. Finally, the effects of the revised future pathways were discussed.

Appendix 2: Overview of random selection and composition of participants

Why a random selection?

At the Ariadne Citizens' Conferences, participants should be as diverse as possible and representative of the population in Germany. A random selection and invitation of citizens increases this chance. This is because, on the one hand, all citizens have the same chance of being drawn and, on the other hand, demographic criteria are used for the selection. In addition, random selection makes it easier to recruit people from disadvantaged groups who are often not otherwise reached for civic participation events. As part of the recruitment process, ifok wrote to 775 people inviting them to the Citizens' Conference on Transport Transition. Of these, a total of 138 people registered for the Citizens' Conference on Transport transition.

Random selection according to criteria

To ensure that the selection of participants is as diverse and representative as possible, ifok took into account the criteria of educational attainment, migration background, gender, size of place of residence, federal state, and age for the Ariadne Citizens' Conference. ifok based its selection on the German census data from 2011 as well as figures from the Federal Statistical Office from 2021. The selection was carried out throughout Germany and aims to depict a "mini-Germany". Potential participants were asked to provide information on these criteria when they registered. This enabled ifok to invite a selection of registered individuals after the recruitment phase was completed, which was as close as possible to the demographic composition of Germany. Thus, not all registered individuals were invited. However, within certain demographic and statistical characteristics, all registered persons were taken into account and included in the selection, as experience has shown that the response rate of these groups of persons is low. These are the following groups of persons:

• Individuals who have a secondary school diploma or no diploma,
• Persons with a migration background.

Composition of participants according to criteria

A total of 54 randomly selected people took part in the Citizens' Conference on Transport Transition. The target number of 65 participants was not reached. Due to the increasing incidence of Corona in October/November 2021, some selected citizens decided not to participate, others did not want to or could not participate due to the local 2G rules (participation only for vaccinated or recovered persons) and cancelled at short notice.
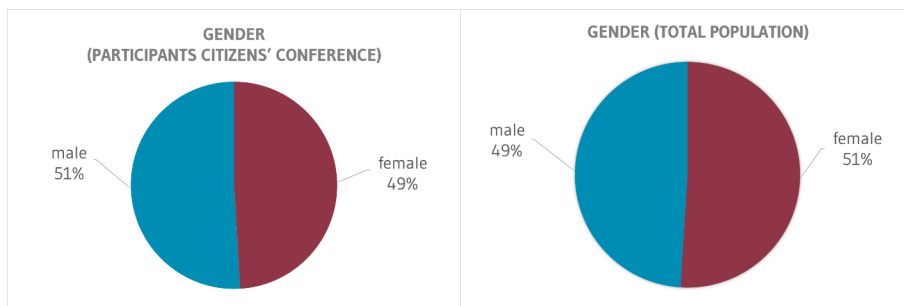
The 54 participants were divided as follows: 29 men (approx. 54 %) and 25 women (approx. 46 %). Most of the participants were between 51-65 years old (39 %), followed by the 31-50 age group (31 %) and the over-65 age group (17 %). Only 7 participants (13 %) were younger than or equal to 30 years of age.
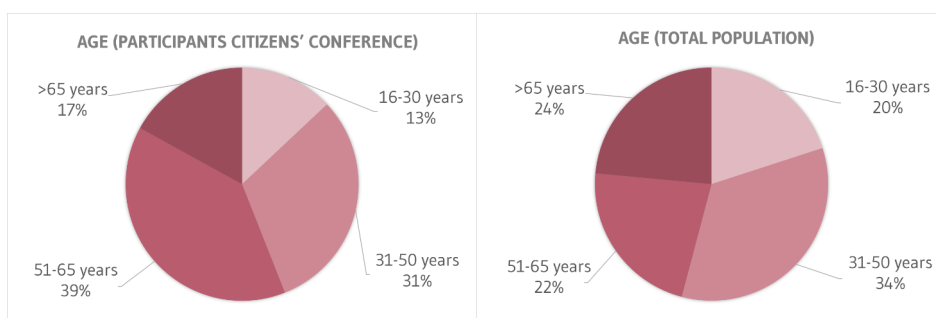
The majority of participants (around 91 %) did not have a migrant background and had a university or college degree (around 56 %), followed by completed vocational training (26 %). 11 % of participants had a high school diploma (Abitur/Fachhochschulreife), followed by Realabschluss (secondary school)/comparable school diplomas (4 %) and Hauptschulabschluss/qualifizierter Hauptschulabschluss (secondary school) (2 %). At 56 %, university graduates were significantly overrepresented compared with the national average (18 %). This is related to the key challenge that very few people with low educational qualifications responded to the invitation to participate.

EDUCATIONAL ATTAINMENT
(PARTICIPANTS CITIZENS' CONFERENCE)

University or college degree 56%
Other 18%
Vocational training 26%

EDUCATIONAL ATTAINMENT
(TOTAL POPULATION)

University or college degree 18%
Other 35%
Vocational training 47%
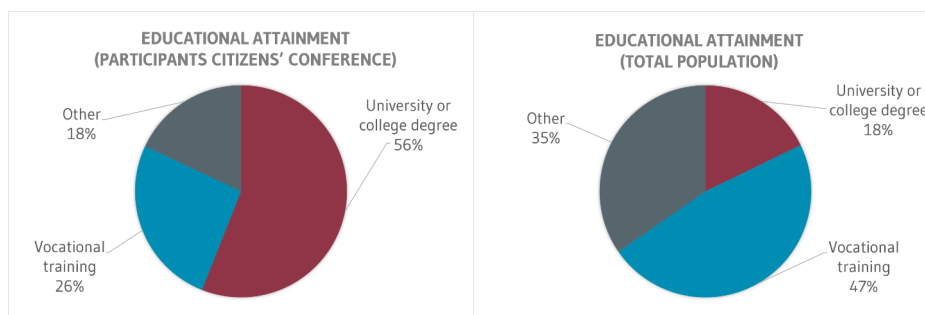
Participants live predominantly in large cities with more than 500,000 inhabitants (26 %), followed by cities with 5,000 to 20,000 inhabitants (22 %), and with 100,000 to 500,000 inhabitants and 20,000 to 100,000 inhabitants (about 20% each). About 11 % of participants live in communities with fewer than 5,000 residents. Overall, around 67 % of participants live in cities with at least 20,000 inhabitants.

SIZE OF PLACE OF RESIDENCE

Citizens' Conference   Total Population
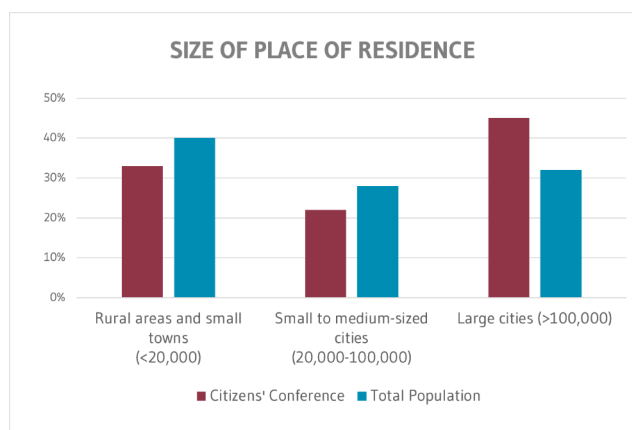
Most participants live in Bavaria (around 20 %), followed by North Rhine-Westphalia (around 17 %) and Lower Saxony (around 11 %). The fewest participants came from the German states of Brandenburg, Mecklenburg-Western Pomerania, Saxony-Anhalt and Thuringia, each with around 2 %. No participants from the federal states of Bremen and Saarland took part in the citizens' conference. A representative east-west distribution was achieved (28 % east and 72 % west).

Approximately 13 % of the participants (focus group participants) took part in the first round of citizen participation in so-called online discussions at the end of 2020. For 87 % of the participants, on the other hand, it was the first participation in an event within the Ariadne project.

Appendix 3: The assumptions of the four future pathways in detail

Policy Pathway **Setscrews / design options**	**Regulation** Bans, subsidies, infrastructure	**Digitisation & Technologies** No bans, infrastructure, digitisation	**Market / CO₂ price** Strong CO₂ price	**New mobility** Strong transformation
Fleet limits	Fleet limits will be reduced for fleet averages of new passenger car registrations by 26 % in 2025 compared to 2021, by 65 % in 2030, and thereafter successively to -100 % by 2045	Fleet limit values will be reduced by 55 % for fleet averages of new passenger car registrations in 2030 compared to 2021 according to the planned EU regulation and thereafter successively down to -100 % by 2045	Fleet limit values will be reduced by 55 % for fleet averages of new passenger car registrations in 2030 compared to 2021 according to planned EU regulation and frozen at this value	Fleet limit values will be reduced by 55 % for fleet averages of new passenger car registrations in 2030 compared to 2021 according to planned EU regulation and frozen at this value
	Fleet limits will be reduced for fleet means of new truck registrations under the law by 15 % in 2025 compared to 2021, 30 % in 2030 for heavy-duty vehicles and 60 % for light-duty vehicles, and thereafter successively to -100 % by 2045	Fleet limits will be reduced for fleet means of new truck registrations under the law by 15 % in 2025 compared to 2021, 30 % in 2030 for heavy-duty vehicles and 50 % for light-duty vehicles, and thereafter successively to -100 % by 2045	Fleet limits will be reduced by 15 % for fleet means of new truck registrations under the law in 2025 compared to 2021, and by 30 % for heavy-duty vehicles and 50 % for light-duty vehicles in 2030	Fleet limits will be reduced by 15 % for fleet means of new truck registrations under the law in 2025 compared to 2021, and by 30 % for heavy-duty vehicles and 50 % for light-duty vehicles in 2030
Ban on new registration of internal combustion vehicles	Ban on new registrations of internal combustion vehicles (incl. PHEV) from 2035 onwards	/	/	/
Speed limit	120 km/h on highways, 80 km/h on all other non-local roads	/	/	120 km/h on motorways, 80 km/h on all other non-urban roads, 30 km/h within built-up areas
CO₂ price	Price in 2025 according to previous plan 55 Euro/t CO₂, rising successively to 100 Euro/t CO₂ by 2030, then rising successively to 173 Euro/t CO₂ by 2045; revenue is refunded to citizens in a revenue-neutral manner	Price in 2025 according to previous plan 55 Euro/t CO₂, rising successively to 65 Euro/t CO₂ by 2030, then rising successively to 131 Euro/t CO₂ by 2045; revenue is refunded to citizens in a revenue-neutral manner	Price in 2025 according to previous plan 100 Euro/t CO₂, rising successively to 300 Euro/t CO₂ by 2030, then rising successively to 715 Euro/t CO₂ by 2045; revenue is refunded to citizens in a revenue-neutral manner	Price in 2025 according to previous plan 100 Euro/t CO₂, rising successively to 180 Euro/t CO₂ by 2030, then rising successively to 429 Euro/t CO₂ by 2045; revenue is refunded to citizens in a revenue-neutral manner
Taxes				
Energy tax	Energy tax on diesel to be aligned with energy tax on gasoline as of 2022	Energy tax on diesel to be aligned with energy tax on gasoline as of 2022	Energy tax on diesel to be aligned with energy tax on gasoline as of 2022	Energy tax on diesel to be aligned with energy tax on gasoline as of 2022
Vehicle tax/ bonus-penalty system	From 2026, a high bonus on new registrations of small and medium-sized zero-emission vehicles will be financed in a revenue-neutral manner through a high penalty on new registrations of internal combustion vehicles, in return for which the annual vehicle tax payable will be eliminated from 2026 onwards	From 2026, a high bonus on new registrations of small and medium-sized zero-emission vehicles will be financed by a low penalty on new registrations of internal combustion vehicles plus further government subsidies, in return for which the annual vehicle tax payable will be eliminated from 2026 onwards	From 2026, a low bonus on new registrations of small and medium-sized zero-emission vehicles will be financed in a revenue-neutral manner by a low penalty on new registrations of internal combustion vehicles, in return for which the annual vehicle tax payable will be eliminated from 2026 onwards	From 2026, there will be a high penalty on new registrations of internal combustion vehicles
Toll				
Mileage-based passenger car toll	From 2030, a mileage-based charge per kilometre driven will be levied to compensate for revenue losses from the energy tax,	From 2030, a mileage-based charge per kilometre driven will be levied to compensate for revenue losses from the	/	/

	rate: from 2030: 1 t/km; from 2045: 4 t/km	energy tax, rate: from 2030: 1 t/km; from 2045: 4 t/km		
City toll	/	/	from 2030, each entry into city centres of all cities with a population of 100,000 or more will cost 5 Euro, from 2045 10 Euro	from 2030, each entry into city centres of all cities with a population of 100,000 or more will cost 10 Euro, from 2045 15 Euro
Truck toll	Toll still dependent on mileage and pollutant class, with increase of 1 t/km in 2030 and 15 t/km in 2045, but extended to all state and municipal roads in 2030; in addition, increase beyond pure infrastructure cost levy, with the aim of making road freight transport more expensive and compensating for revenue losses from the disappearance of the energy tax on diesel fuel.	Tolls still dependent on mileage and pollutant class with increase of 1 t/km in 2030 and 15 t/km in 2045, but extended to all state and local roads in 2030	Toll dependent on CO_2, toll with increase of 1 t/km in 2030 and 15 t/km in 2045, extended to all state and local roads in 2030	Toll still dependent on mileage and pollutant class with increase of 1 t/km in 2030 and 15 t/km in 2045, but extended to all state and municipal roads in 2030; in addition, external costs of 50 t/km are internalised through additional criteria in Euro vignette directive
Local driving bans	From 2040, a ban on all internal combustion vehicles entering the inner cities of major cities.	/	/	/
Purchase premiums	Increase in purchase premiums by €2000 by 2025 for small e-cars; reduction by €2000 for large e-cars), purchase premiums expire in 2026 and are replaced by bonus-penalty system (see vehicle tax/ bonus-penalty system).	Purchase premiums expire in 2026 and are replaced by bonus-penalty system (see vehicle tax/ bonus-penalty system)	Purchase premiums expire in 2026 and are replaced by bonus-penalty system (see vehicle tax/ bonus-penalty system)	Purchase premiums expire in 2026 and are replaced by bonus-penalty system (see vehicle tax/ bonus-penalty system)
Charging infrastructure	Charging infrastructure expansion completed by 2030	Charging infrastructure expansion completed by 2030	Charging infrastructure expansion completed by 2030	Charging infrastructure expansion completed by 2030
E-fuels (synthetic fuels)	Quota rules lead to blending of 2 % e-fuels in liquid fuels in 2030 and 91 % in 2045	Push of e-fuels, therefore blending of 10 % e-fuels in liquid fuels in 2030 and 91 % in 2045; car manufacturers can therefore count up to 10 % of internal combustion vehicles sold toward CO_2 fleet targets from 2030 (no restriction for trucks)	No quota rule, but technological development results in blending of 2 % e-fuels in liquid fuels in 2030 and 91 % in 2045	No quota rule, but technological development results in blending of 2 % e-fuels in liquid fuels in 2030 and 91 % in 2045
Parking space in city centres	Parking management with a price of +50 % in 2030 and +100 % in 2045 for free parking and a fee of 500 Euro/year for residents' parking from 2030 and 1000 Euro/year in 2045, parking management for stationary truck traffic	Parking management with a price of +100 % in 2030 and +300 % in 2045 for free parking and a fee of 500 Euro/year for residents' parking from 2030 and 1000 Euro/year in 2045, parking management for stationary truck traffic, parking management will be digitised	/	Public parking space will be reduced by 75 %; in addition, only parking for sharing vehicles will be allowed in the remaining public parking spaces; guidance concepts will be established for trucks in settlement areas and opportunities for micro-transhipment will be created (loading bays, micro-consolidation centres for distribution traffic)
Domestic flights	Domestic German flights will be completely banned from 2030 + at the same	the air traffic tax will be tripled from 2030 to 38.64€/passenger, in addition a double CO_2 price	the air traffic tax will be tripled to 38,64€/passenger from 2030, a kerosene tax of	Domestic German flights will be completely banned from 2030 + at

	time, rail funding will take place	will be charged for air traffic (2025: 110 Euro/t CO_2, 2030: 130 Euro, 2045: 262 Euro), from 2030 a kerosene tax of 330€/1000l kerosene will be imposed	330€/1000l kerosene will be levied from 2030	the same time, rail funding will take place
New City Life, Urbanism	/	/	/	Cities should become "walkable" and as far as possible all opportunities should be accessible within 30 minutes without a car, all multi-lane roads have one lane less (= more space for bike pathways, footpaths, green spaces etc.)
Foot traffic	/	/	/	see new life, urban development
Cycling infrastructure expansion and promotion	Additional funds	Additional funds	Additional funds	Lots of additional funding; increase cargo bike funding from 120kg payload to 50 % of acquisition cost (max. 5,000€) by 2025, 25 % (max. 2,500) in 2025-2030.
Public transport tickets and expansion	Increased federal funding for expansion, stagnant ticket prices	Increased federal funding for expansion; digitisation; passenger transport: public transport automation in the rural/last mile area, therefore slightly increased ticket prices from 2030 onwards.	Increased federal funding for expansion	Free public transport from 2030, significantly increased federal funding for expansion
Rail tickets and expansion	Social tickets, subsidised Railcard (e.g. BahnCard50 half price), ticket prices reduced by 10 %; Deutschlandtakt	Social tickets, subsidised Railcard (e.g. BahnCard50 half price), de facto reduced ticket prices due to price stagnation; Deutschlandtakt, digitisation	Social tickets, subsidised Railcard (e.g. BahnCard50 half price), de facto reduced ticket prices due to price stagnation; Deutschlandtakt	Social tickets, subsidised Railcard (e.g. BahnCard50 half price), ticket prices reduced by 10 %; Deutschlandtakt
Road passenger transport	/	Strong promotion of automation on highways	/	New car registration rate + sharing leads to halving of private car fleet; car routes are coordinated in a system-optimal way, i.e. calculated, proposed and driven for lowest environmental impact
Adjustment of commuter allowance	countersink	/	countersink	First reduction, then abolition
Rail freight expansion	Additional funds, expansion of 900-metre network by 2030	Additional funds, expansion of 740-metre network by 2030	Additional funds, expansion of 740-metre network by 2030	Significantly increased funding, innovation support, expansion of 1000-metre network by 2030; German Freight Cycle; rapid transshipment facilities, logistics clusters, new intermodal vessels.
Road freight	Commercial vehicles with hydrogen fuel cells to be offered by the mid-2020s at the latest; special depreciation option for purely electric delivery vehicles of classes N1 and N2 with a total mass of	Commercial vehicles with hydrogen fuel cells to be offered by the mid-2020s at the latest; special depreciation option for purely electric delivery vehicles of classes N1 and N2 with a total mass of	/	CEP delivery fee of 2 Euro/shipment as of 2030

	max. 7.5 t (one-time in the year of acquisition 50 % of the acquisition costs)	max. 7.5 t (one-time in the year of acquisition 50 % of the acquisition costs); CO_2 monitoring; increased freight utilisation; innovative multimodal and cross-shipping concepts; platooning on highways possible

Scientific sources, methodology and assumptions

A model landscape of the German Aerospace Center (DLR) was used to generate the results and values. The transport demand model DEMO of the Institute of Transport Research was used to simulate transport effects and the technology ramp-up model VECTOR21 of the Institute of Vehicle Concepts of the DLR was used to simulate the consumer behaviour of transport policy options. Values for energy and emissions were calculated based on the results of the two models using consumption and emission factors, respectively. A brief description of the models and initial assumptions for the "Mix" scenario used here as the technology development baseline scenario are described here (p. 315 ff).

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