

GAiA

ECOLOGICAL PERSPECTIVES FOR SCIENCE AND SOCIETY
ÖKOLOGISCHE PERSPEKTIVEN FÜR WISSENSCHAFT UND GESELLSCHAFT



NARRATIVE FUTURES FOODSCAPE: DESIGNING A SERIOUS GAME NACHHALTIGKEIT UNTERRICHTEN

GAiA is available online at www.ingentaconnect.com/content/oekom/gaia
www.oekom.de | B 54649 | ISSN print 0940-5550, online 2625-5413 | GAiA 34/3, 127–190 (2025)

A Group Delphi on economic perspectives on climate policy measures.

A basis for informing a Citizen Forum

How do economic and consumer researchers assess the different EU policy options to reach net zero greenhouse gas emissions by 2050? The research team of the EU project REAL-DEAL convened twelve experts to evaluate economic measures to implement the Green Deal objectives. This information was one of the major inputs for a subsequent Citizen Forum in Berlin, Germany.

Ortwin Renn , Judith Hermann, Eileen Roth, Luca Johannsen

A Group Delphi on economic perspectives on climate policy measures. A basis for informing a Citizen Forum
GAIA 34/3 (2025): 161–170

Abstract

As one component of the EU project, *REAL-DEAL*, the authors conducted a Group Delphi involving experts from economics and consumer research. Group Delphi processes represent participatory formats aimed at providing a more accurate, fair, and complete representation of expert judgments regarding a specific topic. During the Delphi process in Berlin, twelve experts, representing different schools of economic thought, were asked to assess and evaluate economic instruments and measures to implement the *Green Deal* objectives with a focus on transport, housing, nutrition, and overarching economic issues related to climate protection. The results of the Delphi revealed a large diversity among the experts, in particular on the issue of state interventions into the economy. However, there was broad consensus on rejecting subsidies that encourage non-sustainable practices, and on recommending effective carbon pricing. The outcome of the Delphi was used as information for a subsequent Citizen Forum with randomly selected citizens.

Keywords

Citizen Forum, climate protection, consensus, consensus on dissent, expert judgment, green energy policies, Group Delphi

Prof. Dr. Dres. h.c. Ortwin Renn (corresponding author) | Research Institute for Sustainability – Helmholtz Centre for Geosciences (RIFS) | Potsdam | DE | ortwin.renn@rifs-potsdam.de

Judith Hermann | Deutscher Naturschutzbund | Project officer European Union Climate and Energy Policy | Berlin | DE | judith.hermann@posteo.de

Eileen Roth | City of Mannheim | Climate Action Agency | Mannheim | DE | eileen.roth@gmx.de

Luca Johannsen | Research Institute for Sustainability – Helmholtz Centre for Geosciences (RIFS) | Potsdam | DE | luca.johannsen@rifs-potsdam.de

© 2025 by the authors; licensee oekom. This Open Access article is licensed under a Creative Commons Attribution 4.0 International License (CC BY). <https://doi.org/10.14512/gaia.34.3.11>
Received September 16, 2024; revised version accepted August 21, 2025 (double-blind peer review).

Search for evidence-based judgments on the European *Green Deal*

As part of the EU project *REAL-DEAL*¹, the research teams from the Research Institute for Sustainability (RIFS) at the Helmholtz Centre for Geosciences Potsdam (GFZ) and the Forum for Environment and Development in Berlin, Germany, conducted a Group Delphi process with experts from the fields of economics and consumer research. The research design of the *REAL-DEAL* project combined different participation formats to integrate knowledge, interests, values, and preferences of different constituencies. For the inclusion of knowledge about policy measures to protect the climate, the research team chose the format of a Group Delphi, which aims to represent consensus and dissent among experts about a controversial issue, and to provide arguments and evidence for dissenting views. In total, four combinations of Delphi and Citizen Forums were conducted in different countries as part of the EU project. This paper focusses on the one organized in Berlin. The results of such Delphi rounds were then fed into other consecutive participation processes, as input for prioritizing political actions or addressing trade-offs between conflicting values. In the Berlin case study, the insights from the Delphi workshop were communicated to members of a Citizen Forum in which randomly selected citizens deliberated on policies for reducing carbon dioxide (CO₂) emissions in various sectors, such as housing, nutrition, and transportation.

The major aim of the Group Delphi in Berlin was to produce a comprehensive and evidence-based assessment on the impacts of different economic instruments and measures to implement the *Green Deal* objectives with a focus on transportation, housing, nutrition, and climate action. Depending on economic traditions and schools, expert assessments may vary and even contradict each other. What needs to be done to reach the goals of the *Green Deal* has been widely contested among experts, particularly considering the present polycrisis situation (Liu and Renn 2025). For

¹ More information on the *REAL-DEAL* project can be found on the website: www.tu.berlin/arte/forschung/projekte/real-deal.

providing a fair representation of different scientifically justifiable judgements, the Delphi process produces a map of arguments for dissenting positions so that observers of the dissent can understand the reasons for the various positions. The results, based on consent and reasons for dissent, were presented at a subsequent Citizen Forum on the same topics.

The Group Delphi format

A Group Delphi is a two-day process where experts discuss a specific topic, identify pros and cons of the different options, and rate them on scales from one to ten (Webler et al. 1991, Kuhn 2020, Niederberger and Renn 2018, 2023 a). This format has been applied in various fields, including toxicology (Benighaus et al. 2009), health controversies (Niederberger and Renn 2023 b), and STEM education (Taube et al. 2015). The Group Delphi provides both assessments on a numerical scale and a list of arguments when experts disagree on the correct scale value. Delphi methods are particularly suited for informed judgments that need to be based on evidence but still provide ambiguities and uncertainties so that different conclusions can be drawn. The procedure consists of nine phases which are summarized in box 1.

Application in Berlin: Selection of experts and procedural design

A Group Delphi process was organized on May 21 and 22, 2024, as an online event from 9:00 am to 12:00 pm by a team of researchers from RIFS and the Forum for Environment and Development in Berlin. The team invited 16 experts from various disciplines, including economics, consumer research, climate, and energy economics. Since the Delphi process is based on small group discussions in which dissenting views should be well represented, it is recommended that the number of participants reach a perfect square number, such as 9, 16, or 25. Then, it is possible to reach a complete permutation from the first group session to the next (Niederberger and Renn 2018, p. 37). At the same time, the group should not be too big to allow for an intensive and engaged discussion. As such, 16 participants seem to be ideal for having enough diversity (e.g., four break out groups with four persons each) and sufficient space for mutual discourse. Unfortunately, due to short term cancellations, only twelve of the invited experts were able to attend. Rather than four subgroups with four members each, we decided to organize three groups with four members each.

The selection of experts for the Group Delphi began with a computer-assisted mapping of specialists in basic and applied research in economics, consumption, and climate economics in the German-speaking world (i.e., ChatGPT and Google were used to identify university departments and research institutes focused on economic analysis of green transformations). The research team aimed to include a range of assessments and posi-

BOX 1: Nine phases of a Group Delphi process

In a Group Delphi process, experts discuss a specific topic, identify pros and cons of the different options, and rate them on scales from one to ten. Dissent and differing viewpoints are discussed and defended throughout (short version of a detailed description from Niederberger and Renn 2018, pp. 33–38).

Phase 1: Development of the questionnaire

In the context of the research question, a questionnaire with a numerical scale is developed. The aim is to collect expert judgments on the assessment of options or policies based on certain evaluation criteria (such as effectiveness or fairness).

Phase 2: Selection of the experts

Experts are selected with different points of view on the topic and who represent relevant but different disciplines.

Phase 3: First plenary session

The Group Delphi process and the topic are introduced. The procedure and the structure of the questionnaire are explained to the participants.

Phase 4: First group session

All participants are randomly divided into groups of three to four people. Each group is asked to complete the questionnaire. A group consensus is sought, however minority votes are allowed.

Phase 5: Second plenary session

The results of the group sessions are shared with all participants. If a group has not reached a consensus, the persons whose assessment deviates most from the mean value are asked to defend their views.

Phase 6: Second group session

The participants are again divided into small groups, this time according to the principle of systematic rotation. The groups are asked to complete the same questionnaire, taking into account what they have learned in the plenary discussion.

Phase 7: Iteration of the process

Steps 5 and 6 are repeated until there are no more significant changes in the groups' answers. This usually happens after two or three rounds.

Phase 8: Evaluation of the results

The ranges of the numerical results from the last round are used as the best expert estimates for the topic addressed.

Phase 9: Validation

The results and justifications are sent to all participants for final comments or for reconsideration of the topic.

tions across disciplines, such as economics, psychology, and consumer research, with a focus on economics as taught at universities or applied in non-university research institutes.

In a second step, specific experts were identified through internet searches (i.e., institutional websites, lists of scientific committees or advisory boards, lists of publication databases like Scopus or Google scholar), and personal recommendations. This yielded a list of nearly 100 individuals. A short list was created based on:

- scientific competence (e.g., position, publication record),
- expertise in relevant topics, with emphasis on economics,
- diversity (range of perspectives within economics), and
- availability to attend both days of the Delphi process.

To ensure diversity, a classification tableau was developed listing disciplinary background, school of thought (e.g., neoliberal to post-growth), institution, academic reputation, and gender. Experts were shortlisted if they met a minimum threshold (i.e., H-index of 15 from Google Scholar or other publication data bases, such as Scopus, or, if no H-index was available, ten or more peer-reviewed papers over the last five years) and reflected balance across categories. Priority was given to those with broader publication records. This iterative process yielded 16 selected experts, of which twelve ultimately participated.

The expert questionnaire covered policy options for climate protection in three application areas (i.e., transport, housing, and nutrition). It also included questions about general actions for climate protection, such as carbon pricing. It focused on evaluating the effectiveness, efficiency, and social acceptability of measures for achieving *Green Deal* goals. It was designed by the authors of this paper and reviewed by the entire EU project consortium. It is included in appendix 1². The authors also moderated both plenary and group sessions. The agenda and structure of the Group Delphi are detailed in appendix 2². As expert views stabilized after the second plenary, the organizers decided against a third group round. The results of the second plenary were considered final. The numerical results of the first and final (second) plenary sessions, and their justifications are shown in appendices 3 and 4².

Results of the Group Delphi process

Basic positions of the participants

The Delphi results must be interpreted in light of the expert group's composition. Due to the systematic selection of participants, four main positions on the role of "market and state" were represented among the twelve experts (cf. Andrews 2010):

Market purists (two experts): This group relies on markets to address climate change. One participant even saw potential benefits in climate change, such as higher agricultural yields and Arctic resource access. Both experts opposed state interventions, like fossil fuel pricing or subsidies, and favored deregulating energy markets, expecting innovation to deliver solutions.

Market pragmatists (four experts): While recognizing climate change as serious, these four experts supported market-compatible approaches, such as CO₂ caps, fossil fuel taxes, and incentives for climate-friendly behavior, while rejecting direct bans (e.g., on combustion engines), aiming to preserve individual and economic freedom.

Market interventionists (four experts): These four individuals regarded markets as inadequate on their own and called for robust state action. They supported regulatory measures (e.g., banning

fossil fuels), but also behavioral interventions (e.g., meat-free days in public institutions). Markets are valued for efficiency; however, they should operate under strong state rules.

Post-growth advocates (two experts): They rejected growth-driven economics and called for a transformation toward an economy oriented to the common good. The state should not only regulate climate policy but lead a shift away from profit-driven market structures.

Given these divergent starting points, consensus was rare. Overlaps were mostly between pragmatists and interventionists, while purists and post-growth advocates held opposing views. Including all positions was deemed crucial, even if the extreme viewpoints (i.e., purists and post-growth advocates) represent minorities amongst economists (Jerneck et al. 2011). Delphi effectiveness lies not in majorities, but in comparing all academically relevant positions that are mentioned in the literature (Colander 2009, Heise 2020). It aims to clarify overlaps, expose real disagreements, and explain differing arguments (Kuhn 2020). Political evaluation – in this case performed by a Citizen Forum – can then assess these arguments based on shared values and visions of the common good.

Climate protection and mobility

The Delphi process examined several policy measures on climate protection and transport. These measures included many items, such as more deregulation, speed limits on highways, the extension or rejection of subsidies in transportation (e.g., tax privileges for corporate fleets, subsidies to buy electric cars, etc.), offering free public transportation, and introducing road tolls (in German *Maut*) in cities. These measures were selected by the research team on the basis of newspaper articles and their personal assessment of the dominant topics in public discourse during this time.

During the first round of deliberations, experts discussed the cost-effectiveness of a highway speed limit, amongst other measures. Most agreed it would cut CO₂ emissions at minimal cost. Some, however, pointed to indirect costs, especially time delays, that would be hard to quantify yet could be potentially significant. As opinions remained stable into the second round, a further discussion in the second plenary was deemed unnecessary. In terms of the measure's social compatibility, most experts expected initial resistance to speed limits yet believed acceptance would rise over time, citing similar experiences in other European countries. Despite concerns over civil liberties, most viewed the measure as socially fair. Co-benefits, such as fewer accidents and reduced stress, were also mentioned.

There was broad consensus in the first round (and confirmed in the second round) on removing climate-harmful subsidies – especially eliminating diesel privileges and phasing out tax benefits for company cars. However, subsidies for purchasing electric vehicles were more contested. Some argued they disproportionately favor wealthier individuals, while others stressed their

2 <https://doi.org/10.14512/gaia.34.3.11.suppl>

TABLE 1: Approval and disapproval of statements, economic instruments, and policy measures to implement the European *Green Deal* objectives, by each of the three expert groups after the second round of deliberations. All expert responses (both consent and dissent) are included. These measures were listed in a questionnaire given to the participants and discussed during a Group Delphi process that took place in Berlin, DE, on May 21 and 22, 2024, as part of the European Union's *REAL-DEAL* project.

ECONOMIC INSTRUMENTS AND MEASURES (FROM QUESTIONNAIRE)	GROUP 1	GROUP 2	GROUP 3
apply individual ecological consumption budgets	✓	✓	
implement adequate CO ₂ pricing	✓ (X)	✓	✓
make rail travel more attractive (instead of air travel)	✓	✓	✓
invest in rail expansion	✓	✓	✓
ban short-haul domestic flights	✓ (X)	✓	✓
promote research and development for battery solutions for electric vehicles	✓		
abolish free certificates for the aviation sector in the European Emissions Trading System	✓	✓	
use fuel prices as a steering instrument		✓	
implement speed limits on highways	✓	✓	✓
the likelihood of high acceptance of speed limits	X	✓	✓
remove climate-harmful subsidies	✓	✓	✓
make public transport free	X	✓	X

Notes: ✓ all experts approved, X all experts disapproved; ✓ the majority approved, but one participant remained neutral and one disapproved; (X) all experts approved except for one. No check means that the group has not given an answer to this question due to time constraints. Each group consisted of three to four experts.

importance for accelerating adoption in a short time frame. In the second round, concerns were raised about the environmental costs from an increased demand in electric vehicles (e.g., rare minerals).

The experts agreed that ridership on public transport would rise by only 20 to 30%, if the government offered free transportation to all citizens. As a result, this measure was considered inefficient due to high costs. Experts referred to the 49 EUR *Deutschlandticket* (that has since increased to 58 EUR), noting that it primarily increased use among existing public transport users, with little impact on car drivers. By the second round, nearly all agreed such policies should not be prioritized.

Among other policy options included in the questionnaire were regulatory prescriptions (e.g., banning combustion engines or setting CO₂ quotas; table 1). The two market purists opposed them rigorously, citing consumer autonomy. All other participants supported such regulatory interventions. A road toll was widely seen as a market-aligned alternative to city driving bans. The proposed ban on domestic flights gained strong support – especially from centrist groups – who viewed rail as a viable alternative with negligible time loss when accounting for airport procedures. Less attention was given to options such as promoting research for battery development, ending free emission certificates for aviation under the EU Emission Trading System, or raising fuel prices beyond CO₂ pricing.

Experts were also encouraged to propose additional measures for making the transport sector more sustainable. Suggestions ranged from tax incentives for companies to reduce emissions (mainly backed by market purists) to car-free cities, and domestic flight bans (covering all of Germany and close neighboring

countries, not just short distance flights as suggested in the questionnaire). Other ideas included expanding bike lanes and shifting freight to rail, though feasibility concerns were raised due to the current infrastructure. The responses of the experts to measures that they had proposed during the discussion is listed in table 2.

Experts demonstrated much creativity in proposing additional sustainability strategies. Policies using monetary incentives, education, voluntary commitments, or infrastructure improvements gained the most support. Suggestions such as more deregulation or greater consumer/corporate freedom were only backed by market purists (e.g., lifting diesel car bans in inner cities in favor of voluntary measures). They argued that voluntary compliance to sustainability goals would be more efficient and, in the end, more effective compared to regulatory requirements even if the latter were based on financial incentives. Strict regulatory standards that prohibit or impede individual freedom were rejected by both market purists and most market pragmatists.

Climate protection and housing

The Delphi process also examined several policy measures on climate protection and housing. The questionnaire included four questions on policy measures for reducing fossil fuel consumption for heating private homes. Similar to transportation, the experts could evaluate monetary incentives, such as subsidies or taxes, and regulatory prescriptions, such as phasing out fossil fuel heating systems by a specific date. The familiar pattern of market purists being skeptical about policies that include strict regulations prevailed over both rounds, however the debate ended with more robust agreement.

TABLE 2: Approval or disapproval of selected policy measures that participants suggested to achieve the goal of climate neutral mobility by 2045 in Germany (experts wanted to use the more ambitious German standards for climate neutrality, rather than the EU standards with a target date of 2050). These measures were discussed during a Group Delphi process that took place in Berlin, DE, on May 21 and 22, 2024, as part of the European Union's REAL-DEAL project.

ECONOMIC INSTRUMENTS AND MEASURES (PROPOSED DURING THE DISCUSSIONS)	GROUP 1	GROUP 2	GROUP 3
deregulate (primary reliance on market mechanisms)	X (✓)	X	X (✓)
tax reductions for using fossil-free fuels	X (✓)	X	✓
convert public transportation services to private companies	✓	X	X
create car-free city centers	✓ (X)	✓	✓
switch freight transport from road to rail	✓	✓	✓
expand cycling paths	✓	✓	✓
charge tolls in city centers	✓ (X)	✓	✓ (X)
implement reliable CO ₂ pricing	✓	✓	
reduce climate-damaging subsidies	✓	✓	
expand green energy infrastructure	✓	✓	✓

Notes: ✓ all experts approved, X all experts disapproved, ✓ the majority approved but one participant remained neutral and one disapproved; (✓) all experts disapproved except for one, (X) all experts approved except for one. During the discussion the item "adequate CO₂ pricing" from the original questionnaire (table 1) was changed to "reliable pricing" since there was disagreement about what "adequate" would mean. But all agreed that the pricing should be reliable and consistent so that private companies have financial security over time.

The debate on subsidies for switching heating systems from fossil fuels to renewable sources revealed key differences. Market purists opposed subsidies due to concerns over market distortion, while all other groups supported targeted interventions, especially for low-income households. Initially, the proposed subsidy levels varied widely – from 0 to 50 % of investment costs. However, by the second round, most experts converged on recommending 10 to 20 %. Three main reasons were cited for this moderate level: 1. renewable heating would likely lower long-term costs, making investments economically viable; 2. high subsidies risk inflation and price increases; and 3. the market would not be able to meet demand spikes caused by generous subsidies.

In contrast, higher subsidies were advised for insulating existing buildings, since the return on investment is slower. Experts noted that insulation usually happens only when full renovations are planned (typically once in a lifetime), so high subsidies would ensure an ambitious insulation standard. Additionally, experts supported income-based subsidy scaling, with more aid for low-income households. This would enable energy improvements in older homes and preserve existing housing stock, avoiding the environmental costs of new construction.

Experts were more skeptical about the impact of smart home technologies on climate protection. They saw little potential in subsidizing computerized room heating controls, calling them marginal or appealing mainly to technology enthusiasts. Smart systems might lower fossil fuel use but wouldn't eliminate it within the next 25 to 30 years, failing to meet both EU and German decarbonization targets. While not opposed to smart home technology, the experts did not recommend public funding for it. However, many saw promise in smart systems for commercial and industrial use, though that lay outside this Delphi's scope.

Another item from the questionnaire, the assessment of a near-term ban on fossil-fuel heating (by 2025 or 2026), was broadly rejected as socially unacceptable. Instead, most favored gradual transitions through targeted subsidies. Market interventionists and post-growth advocates supported tightening building codes to phase out fossil fuel-based heating systems, however, they agreed with the other experts that a rigid short-term deadline would be disruptive. A particularly interesting proposal was the introduction of a staggered "bonus" system wherein early adopters of renewable heating would receive higher subsidies than those who delayed taking action.³ This was seen as an effective possibility to speed up diffusion and was supported by all participants except the two market purists. None of the participants objected to expanding district heating where settlement density and infrastructure would permit it.

Experts could suggest new measures for reducing household heating emissions. Box 2 (p. 166) summarizes both preformulated options from the questionnaire and newly proposed options from the discussions. During the second round, the items listed in the original questionnaire and those proposed by the experts merged into one list since some of the original measures were modified or converged into new items. All suggestions were thus compiled and shared with participants for review before round two. Unlike the discussions on climate protection and mobility (tables 1, 2), these suggestions were not rated by the three groups. The suggestions represent additions that each group proposed to meet the objective of climate protection (box 2, p. 166).

>

³ This measure had been introduced as a *Klimageschwindigkeits-Bonus* (climate speed bonus) in the *Bundesförderung für effiziente Gebäude* (BEG, Federal support for efficient buildings, www.energiewechsel.de/KAENEF/Redaktion/DE/Dossier/beg.html) in Germany in January 2024.

BOX 2: Proposed policy measures to reduce greenhouse gas emissions in private homes

These measures were discussed in a Group Delphi process that took place in Berlin, DE as part of the EU's *REAL-DEAL* project. The list is a combination of preformulated measures that had been presented to the Delphi participants, and modifications as well as further suggestions made by the experts during the process.

- strict regulations for new construction, particularly in terms of requisite insulation
- public subsidies for the renovation of old buildings, which should be socially staggered
- market-effective CO₂ pricing (that has a clear influence on demand)
- building-specific renovation roadmaps with staggered subsidies for early and late adopters (i.e., bonus system)
- promotion of research and installation of technologies that provide renewable energies
- promotion of photovoltaic systems for private households
- use of income from CO₂ pricing to promote energy-efficient refurbishment (rather than a payback system for all households)
- promotion of municipal supply and decentralized generation of heat and power
- awareness of best practices and dissemination of knowledge through campaigns
- creation of open data banks for existing buildings, generated by each municipality
- more investment in low-income housing (i.e., apartment buildings) with green energy supply
- expansion of district heating
- administrative simplification and de-bureaucratization

Climate protection and nutrition

Another major section of the questionnaire was devoted to measures that promise to reduce greenhouse emissions caused by food, nutrition, and eating habits. A total of four policy measures were mentioned in the questionnaire. These measures reflect dominant topics of the food discourse in society and represent prominent requests in the national Citizen Assembly on nutrition and food.⁴ However, the final selection of topics was done by the research team based on these sources and their familiarity with the issue. An overview of the four items, the experts' responses, and some comments that were given to justify their positions are provided in table 3.

In the area of food and nutrition, there was surprisingly little disagreement amongst the experts. For instance, adjusting value added tax (VAT) to make vegetables cheaper and meat more expensive was seen as only marginally effective and problematic for public finances, especially if it led to lower overall tax revenues. All experts agreed that exempting climate-friendly foods from VAT would have limited impact on consumer behavior. While they all agree that price differences do influence food choices, VAT exemptions alone were not seen as sufficient to significantly shift consumption patterns.

⁴ www.bundestag.de/resource/blob/984354/39efba25c218ee935e26f786abb-ce81c/Empfehlungen_buergerrat.pdf

Experts also noted challenges in implementing and communicating a carbon-based classification or labelling system for all food items. Such a system would be especially burdensome for small businesses. Instead of focusing on carbon labels, most experts favored highlighting relative costs, including externalities, that go beyond the VAT rate. Relying on information, labelling, and education would have limited effects and would not be sufficient to reach the EU decarbonization goals. However, in combination with financial incentives, including lowering the VATs for "green" food items, a package of soft policies could have an additional effect, and might help to boost acceptance of higher prices for carbon-intensive food.

The issue of public canteens offering vegetarian or vegan meals sparked the only significant disagreement in this section. The two market purists independently demanded full consumer choice without state interference. Pragmatists supported regulation requiring vegetarian or vegan options alongside others. The remaining expert groups favored public canteens offering only vegetarian or vegan meals, considering this a justified measure to serve the public good. In contrast to this divergence, all experts supported requiring canteens to meet health and ecological standards, such as offering organic meat or regional, healthy products.

Toward the end of the session, the discussion moved from the topic of food and nutrition to a more general discussion on imposing an absolute CO₂ cap for each individual (starting with food and extending to energy and other commodities). Two interventionists and the two advocates of a new market order proposed a binding, individual CO₂ cap. Under such a system, each person would have a maximum CO₂ allowance and could freely choose how to use it, eliminating the need for specific consumption regulations. This would require reliable information and feedback systems on the carbon footprint from food purchases. Although pragmatists and market purists opposed this idea, they acknowledged that an individual cap aligns more closely with market principles than direct consumption regulations.

This discussion of personal carbon caps led to a broader debate on economic strategies for addressing climate change, which is described in the following section.

Overarching climate protection and economic order

Despite a broad range of expert perspectives, all but one participant agreed that adding environmental costs to fossil fuel pricing is economically and politically advisable. Some disagreement remained about the extent of climate-related damage, with two of the twelve experts suggesting potential external benefits, such as productivity gains in cold regions (e.g., Siberia, Canada), new Arctic shipping routes, and access to raw materials. Still, all agreed that environmental costs outweighed these potential benefits.

All experts, except the market purists, supported government action to internalize hidden fossil fuel costs. While purists rejected state intervention entirely, the rest favored measures like auctioning emission certificates or implementing CO₂-based levies.

TABLE 3: Rating of proposed policy measures to encourage sustainable food practices for enhanced climate protection during a Group Delphi process by the European Union's *REAL-DEAL* project on May 21 and 22, 2024 in Berlin, DE. These measures were presented to experts from the fields of economics and consumer research who were asked to rate their acceptability. VAT: value-added tax.

PROPOSED MEASURES	RESPONSES	COMMENTS
VAT exemption for fruit and vegetables	medium effectiveness for reducing meat consumption; low efficiency in terms of cost-benefit ratio	relative prices are important, but many other factors also play a role in nutritional decisions; meat would probably still be too cheap to bring about real nutritional change, even if fruit and vegetables were exempt from VAT
VAT exemption according to CO ₂ footprint of food items	limited effect on consumer acceptability, but probably acceptable for consumers if the overall VAT is not higher than today	difficult to implement, especially for small businesses and markets
food labelling to illustrate CO ₂ footprint	limited effectiveness on consumer behavior; low-cost option	majority would rather be guided by the costs than by information on the carbon footprint, however, the educational aspect is encouraged
days on which public canteens would offer only vegetarian or vegan food	responses from 1 day a week to 7 days a week	all agree that canteens should be sensitive to ecological and health criteria; most experts preferred that all food choices are provided, including both vegetarian and meat options

For pragmatists, tradable certificates were preferable, as they allow the government to cap emissions while letting the market set prices. There was a wide consensus that carbon pricing should be high enough to shift behavior toward clean alternatives. With only two exceptions, estimates converged in the second round and are summarized in box 3.

Experts emphasized the need for an ongoing evaluation to assess whether pricing or certificate strategies achieve the intended steering effects. Flexibility and responsiveness were key priorities for all.

Use of carbon pricing revenues was fiercely debated. The questionnaire included three options: 1. per capita redistribution (i.e., each household receives the same amount); 2. reinvesting the surplus from carbon pricing for climate protection infrastructure; and 3. redistribution to low-income households. The participants chose to add a fourth option: 4. targeted redistribution of energy-saving investments for low-income households. Each of the four options were ranked according to a scale from one to five (one being the lowest priority and five being the highest priority). While per capita redistribution (option 1) had some support (scoring from one to three), most experts preferred investing in option 2, fossil-free infrastructure (which scored from four to five), or option 3, aiding low-income households (scoring three to four). However, the most preferred option turned out to be option 4: targeted subsidies for low-income households to reduce fossil fuel dependence. This option was strongly supported (scoring a five from all experts, except the two market purists). There were some questions as to why per capita redistribution, which is normally preferred by economists, received such low scores. This decision was justified with concerns surrounding fairness (i.e., equal payouts ignore income disparities) and worries that the extra income could be spent on anything, rather than specifically on sustainable goods or services. In contrast, a targeted redistribution to low-income households would avoid the drawbacks of flat redistribution and would link financial support to

BOX 3: Proposed temporal staggering of CO₂ pricing per ton of CO₂ emitted into the environment

The suggested range covers the agreed upon estimates of all expert respondents after the second plenary of a Group Delphi process in Berlin, DE. The prices are meant to reflect the environmental costs of fossil fuel consumption.

2026–2030:	€70–200
2031–2035:	€100–250
2036–2040:	€250–300
after 2040:	>€300

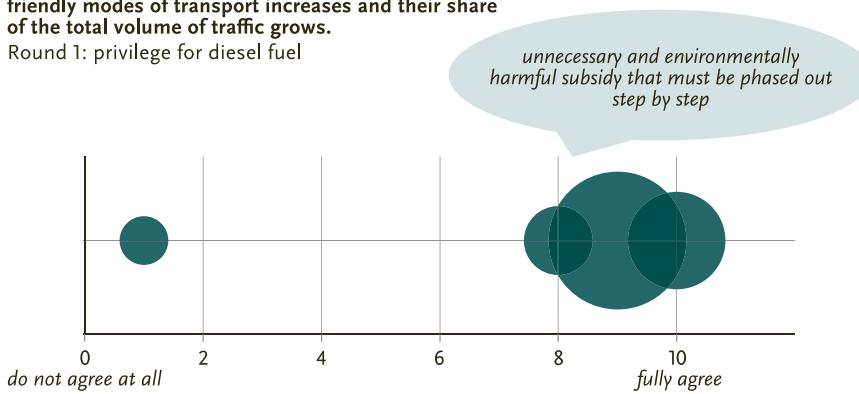
specific sustainable behaviors. All agreed with this argumentation except for the two market purists. They argued that such a nuanced redistribution scheme would impose high administrative burdens and costs, would involve significant difficulties to identify eligible recipients, and would be a non-justifiable intervention into the market (which would be hard to defend).

Views diverged on economic growth. Purists and pragmatists saw growth as vital for financing climate action, while others argued for limits on emissions and resource consumption. Purists trusted the market mechanisms alone. Others – particularly interventionists and advocates of a new economic order – supported combining markets with regulation; escalating to stricter tools only if softer measures fail. Pragmatists accepted partial market failure and endorsed financial incentives, like subsidies for green products and taxes on harmful behaviors, as well as clearly defined state targets to meet climate goals by 2045 in Germany and 2050 in all EU countries (i.e., the European *Green Deal*).

Advocates of a post-growth economy called for individual CO₂ limits and promoting “sufficiency lifestyles.” Yet all experts, except the two purists, agreed that softer tools, like tax cuts for low-emission behaviors, should take precedence if effective. Purists maintained that current market structures are sufficient to address climate change.

FIGURE 1A: Visualization of the Group Delphi results for the Citizen Forum on climate protection that took place in Berlin, DE, from June 7 to 9, 2024, as part of the EU *REAL-DEAL* project. Example of a question that most experts agree on (consensus). The different sizes of the circles represent the number of experts agreeing with the numerical assessment (i.e., bigger circles equals more experts agree).

Environmentally harmful subsidies must consistently be reduced so that the competitiveness of environmentally friendly modes of transport increases and their share of the total volume of traffic grows.
Round 1: privilege for diesel fuel



Integration of the results into the Citizen Forum

Around two weeks after the Group Delphi (from June 7 to 9, 2024), a thematic Citizen Forum was held. A Citizen Forum is composed of randomly selected citizens that convene for a short period of time to discuss a topic and, as a rule, develop policy recommendations for decision-makers (Felicetti 2014, Dryzek 2015). Using a stratified random sampling approach, 63 participants were selected to ensure demographic diversity across criteria such as age, gender, education, and climate knowledge. This recruitment strategy ensured that the participants of the Citizen Forum were representative of both urban and rural areas in Berlin and Brandenburg; allowing for a broad range of perspectives to be considered. Participants were asked to discuss policies for reducing greenhouse gases from their personal and everyday perspective.

The results of the Berlin Citizen Forum have been reported in the *REAL-DEAL* documents⁵ and will be published in another journal article. For this paper, the focus is on the use of Delphi results to inform randomly selected citizens. The organizers used them as in-depth information points for each session where one of the Delphi topics was discussed. Recordings of the Group Delphi process (which had been audiotaped) helped explain the pro and con arguments for various policy

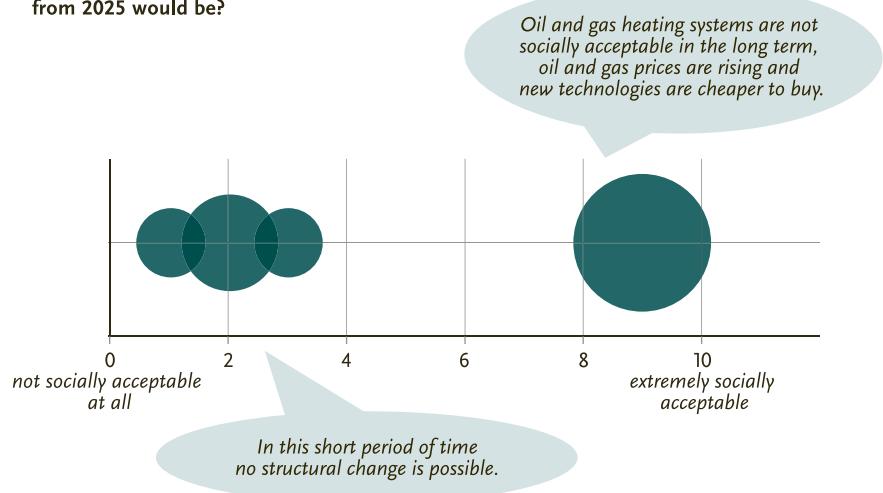
measures. Participants were encouraged to draw their own conclusions from the range of views, decide which measures seemed sensible, share their assessments during the group discussions, and adjust their viewpoint as discussions evolved. This was done to foster tolerance for different perspectives. The responses to the individual items (questions and statements about measures) from the Group Delphi were also prepared as an exhibition with posters (see figures 1a, 1b, and 1c). These visualizations helped the participants to familiarize themselves with the variations in the experts' assessments.

How was the integration of the Group Delphi information rated by the participants of the Citizen Forum? In response to the item "Please rate, on a scale from one to five, to what extent you felt better informed and prepared for your task of evaluating measures through the results

of the Delphi process that took place before the Citizen Forum. One means you did not feel informed at all and five means you felt optimally informed." A majority (62.5%) of the 34 participants who answered this item responded with a four or five, with five meaning that the participants felt optimally better informed and one meaning that they felt not at all informed by the expert Delphi results (see figure 2). The fairly low response rate (54%) was a result of those who did not participate in the survey at all (13 people) and those who did not fill in this specific item (16 people). We have no empirical data about the motivation of those who did not respond.

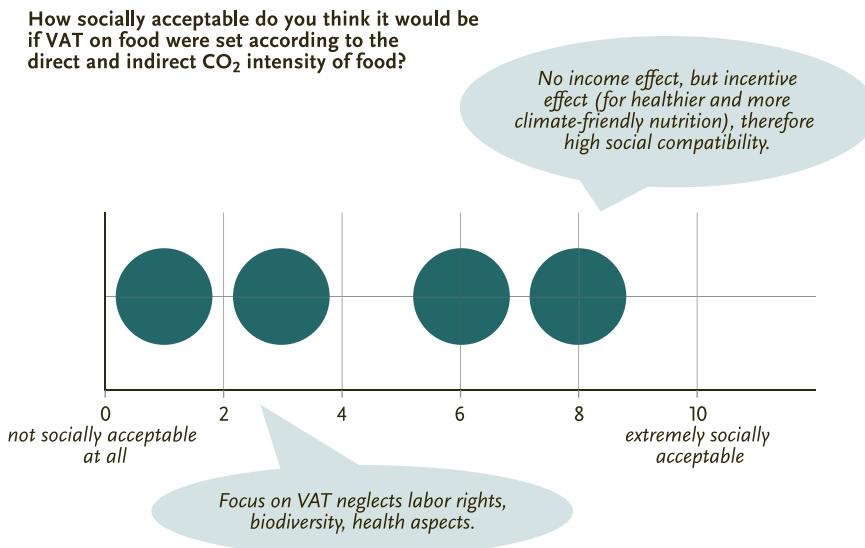
FIGURE 1B: Visualization of the Group Delphi results for the Citizen Forum on climate protection. Example of a question where the experts' positions were polarized.

How socially acceptable do you think a ban on new oil and gas heating systems from 2025 would be?



⁵ www.rifs-potsdam.de/sites/default/files/2025-04/10_realdeal-factsheet_case_ca_germany.pdf

FIGURE 1C: Visualization of the Group Delphi results for the Citizen Forum on climate protection. Example of a question where expert judgments varied substantially. Please note: The poster included a typo (VAT instead of CO₂) in the bubble at the lower left side. However, during the discussion the mistake was acknowledged and corrected.



Conclusions

The main aim of a Group Delphi is to identify areas of agreement and divergence on controversial issues, uncover reasons for disagreement, and map overlaps and differences across positions (Kuhn 2020). In the Berlin case, the topic (i.e., climate protection, economic order, and consumer behavior) was broad and contested, with participants representing a wide spectrum from market purists to proponents of a post-growth economy.

All but the two market purists agreed that markets alone cannot bring about a climate-neutral economy. The two market purists even differed in their reasoning. One doubted the need for climate policies because the problem was not judged as urgent or serious. The other was convinced that climate measures are necessary, but that market forces would be the best solution to deal with this problem. All other participants saw state intervention as both necessary and democratically legitimized given the urgency of climate change, existing policy objectives, and legal targets for climate neutrality. However, opinions diverged on the acceptable degree of such interventions. Market pragmatists and most interventionists preferred market-compatible tools like emission certificates, levies, subsidies, and incentives, especially to assist low-income groups and support initial transitions. Public services, such as canteens, should prioritize climate goals

without curtailing individual freedoms. Some interventionists and advocates of a post-growth economy called for stricter regulations, arguing that behavioral nudges and financial incentives would be insufficient on their own. For these groups, bans on fossil heating, urban driving restrictions, or personal emissions limits were legitimate tools.

Notably, nearly all experts (except one) agreed on the need to price CO₂ and other climate-damaging emissions. Whether via certificates, levies, or a hybrid model, the majority of experts agreed that prices need to be high enough to serve as a stimulus for initiating long-term behavioral shifts. Revenues should be reinvested in climate-resilient infrastructure and targeted support for those disproportionately affected by fossil fuel price increases.

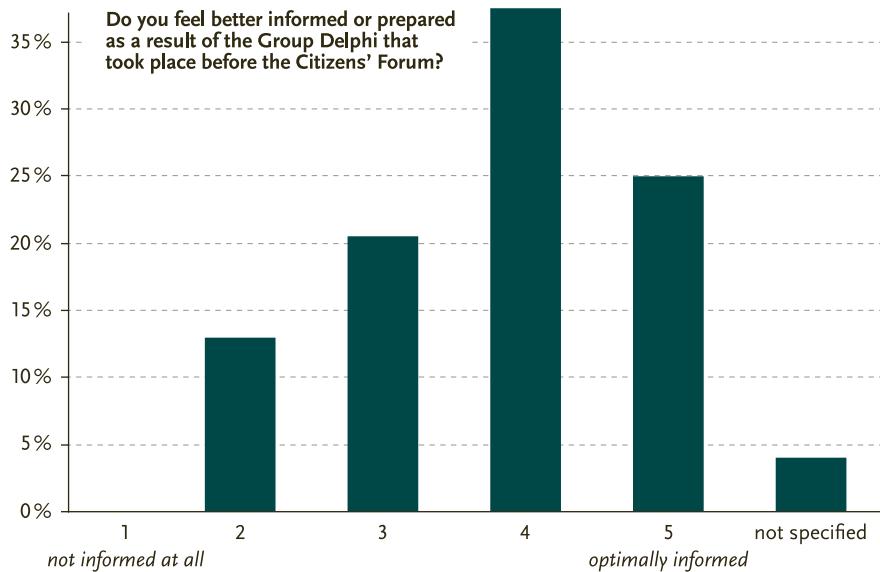
There was also consensus that current fossil fuel prices do not reflect their environmental and social costs. All experts supported phasing out subsidies that

counteract green transformation efforts, such as tax breaks for company cars, subsidies for using fossil fuels in transport or heating, or business privileges not aligned with climate goals.

Key differences centered on the role of efficiency (referring to both energy efficiency and cost efficiency). Market purists prioritized it as the guiding principle in both economic and environmental policy, trusting in market solutions. Other groups val-

>

FIGURE 2: Responses from Citizen Forum members (N=34 out of 63) to the information provided by the Group Delphi participants in Berlin, DE. The question was asked after the Citizen Forum panel was terminated. This was the only quantitative question in the citizen questionnaire about the Delphi process.



ued efficiency but emphasized that sustainability and fairness must also guide policy. Most saw evidence of market failure in addressing environmental challenges. Ultimately, the debate about the ideal balance between market forces and regulatory intervention reflected not just empirical assessments, but also normative convictions.

The Delphi method does not manufacture consensus. Its value lies in clarifying agreements and disagreements and the rationales behind them (Schulz and Renn 2009). This transparency can enrich political discourse and support policymakers in making informed decisions. Within the *REAL-DEAL* project, Delphi findings helped shape the agenda and the information input for Round Tables, Citizen Forums, and other participatory formats. While the data from these participatory formats are still being analyzed, preliminary results suggest that the insights from the Group Delphi processes (the Berlin Delphi was one of three) assist citizens to grasp complex interrelations between markets, governments, and individual behavior. The results of the Group Delphi reflect, on the one hand, robust assessments on controversial topics, and, on the other, portray accurately the different values and positions.

Acknowledgements: The authors are grateful to the Delphi participants for their engagement, and the members of the Citizen Forums for their involvement in the research process. We also want to express our gratitude to the Research Institute for Sustainability – Helmholtz Centre for Geosciences (RIFS), Potsdam, DE for providing organizational and logistical assistance, as well as financing the open access fees for this paper.

Funding: Funding for this study was provided by the EU for the *REAL-DEAL* project.

Competing interests: OR is a member of the *GAIA* Editorial Board. He declared his dual role as author and editor in the submission process and abstained from discussions and decisions about the manuscript.

Authors' contributions: OR: first draft of the paper, all revisions during the review process; JH, ER, LJ: preparation of appendices, processing of data, first draft of tables and figures; OR, JH, ER, LJ: co- working on final draft for submission.

Informed consent statement: Informed consent was obtained from all subjects involved in the study.

References

Andrews, J. 2010. *The Economist book of isms: From abolitionism to zoroastrianism*. London: Profile Books.

Benighaus, C., O. Renn, M. Ruddat, H. TNO Van de Sandt, K. van Leeuwen, K. Kroese. 2009. Acceptance of ITS – Results from a Group Delphi questionnaire. *SETAC Europe Proceedings 2008*. Brussels: REACH Symposium.

Colander, D. 2009. Complexity and the history of economic thought. In: *Handbook of research complexity*. Edited by J. B. Rosser. Cheltenham, UK: Edward Elgar. <https://doi.org/10.4337/9781781952665.00027>.

Dryzek, J. S. 2015. Deliberative engagement: The forum in the system. *Journal of Environmental Studies and Sciences* 5: 750–754. <https://doi.org/10.1007/s13412-015-0299-8>.

Felicetti, A. 2014. Citizen forums in the deliberative system. *Democratic Theory* 1/2: 95–103. <https://doi.org/10.3167/dt.2014.010210>.

Heise, A. 2020. Comparing economic theories or: Pluralism in economics and the need for a comparative approach to scientific research programmes. *Journal of Philosophical Economics* 13/2: 162–184. <https://doi.org/10.46298/jpe.10740>.

Jerneck, A. et al. 2011. Structuring sustainability science. *Sustainability Science* 6: 69–82. <https://doi.org/10.1007/s11625-010-0117-x>.

Kuhn, R. 2020. *Das Gruppendelphi: eine diskursive Methode zur Ermittlung von Expert*innenurteilen*. PhD diss., University of Stuttgart. <https://doi.org/10.18419/OPUS-10806>.

Liu, H., O. Renn. 2025. Polycrisis and systemic risk: Assessment, governance, and communication. *International Journal of Disaster Risk Science*. <https://doi.org/10.1007/s13753-025-00636-3>.

Niederberger, M., O. Renn. 2018. *Das Gruppendelphi-Verfahren*. Wiesbaden: Springer.

Niederberger, M., O. Renn. 2023a. The Group Delphi process in the social and health sciences. In: *Delphi methods in the social and health sciences: Concepts, applications and case studies*. Edited by M. Niederberger, O. Renn. Wiesbaden: Springer. 75–91. https://doi.org/10.1007/978-3-658-38862-1_4.

Niederberger, M., O. Renn (Eds.). 2023b. *Delphi methods in the social and health sciences: Concepts, applications and case studies*. Wiesbaden: Springer. <https://doi.org/10.1007/978-3-658-38862-1>.

Schulz, M., O. Renn. 2009. Das Gruppendelphi: Konzept und Vorgehensweise. In: *Das Gruppendelphi. Konzept und Fragebogenkonstruktion*. Edited by M. Schulz, O. Renn. Wiesbaden: VS Verlag für Sozialwissenschaften. 11–22. https://doi.org/10.1007/978-3-531-91511-1_2.

Taube, D., O. Renn, A. Hohlt, A. 2015. STEM education from a comparative transnational perspective: Results of a Group Delphi process. In: *International science and technology education: Exploring culture, economy and social perceptions*. Edited by O. Renn, N. Karafyllis, A. Hohlt, D. Taube. London: Routledge. 191–215.

Webler T., D. Levine, H. Rakel, O. Renn. 1991. A novel approach to reducing uncertainty: The Group Delphi. *Technological Forecasting and Social Change* 39/3: 253–263. [https://doi.org/10.1016/0040-1625\(91\)90040-M](https://doi.org/10.1016/0040-1625(91)90040-M).



Ortwin Renn

PhD in social psychology. Retired scientific director of the International Institute for Advanced Sustainability Studies (IASS), Potsdam, DE. Professor emeritus for environmental sociology and technology assessment at the University of Stuttgart, DE. Director of the non-profit company DIALOGIK. Research interests: risk governance, stakeholder and public involvement, and sustainable development. Member of the *GAIA* Editorial Board.



Judith Hermann

Master's degree in international development studies from Philipps University of Marburg, DE. Worked as a policy officer in the Europe-wide *REAL-DEAL* project at the German NGO *Forum on Environment and Development*. Policy officer for EU Climate and Energy Policy at Deutscher Naturschutzbund. Research interests: national and international sustainability policy, implementation of the 2030 *Agenda*, and the link between sustainability and economy.



Eileen Roth

Master's degree in political science and public law from the University of Heidelberg, DE. 2021 to 2024, policy officer on Sustainable Development at the German NGO *Forum on Environment and Development*. Since 2024, climate policy advisor to the Deputy Mayor of the City of Mannheim, DE. Since 2025, strategic head of the city's Climate Action Agency. Research interests: sustainable energy transformation, climate protection policies.

Luca Johannsen

Bachelor's degree in sociology from Potsdam University, DE. Former graduate student assistant at the Research Institute for Sustainability – Helmholtz Centre for Geosciences, Potsdam, DE. Research interests: citizen participation, sustainable energy transformation.