

NanoDialogue
of the German Government

Final report

The NanoDialogue of the German Government
6th dialogue phase (2019 - 2023)

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1 Summary

As part of the German Nano Action Plan, the NanoCommission was appointed by the German Government in 2006, thus creating a central, national dialogue platform. The NanoCommission has supported the dialogue between social interest groups on the opportunities and risks of nanotechnologies, thereby contributing to the responsible and sustainable use of nanomaterials.

After the NanoCommission's work was completed in 2011, the discussion format was changed to two-day ExpertDialogues, to which experts were invited in addition to the stakeholders to give presentations. From 2011 to 2023, a total of fourteen ExpertDialogues (dialogue phase 3 to dialogue phase 5) and a conference to mark the 10th anniversary of the NanoDialogue took place.

This report summarises the events of the sixth and final phase of the NanoDialogue. Three events took place during this phase:

- ExpertDialogue "Opportunities and Risks of Active Materials at the Nano Scale" on 21st and 22nd of June 2022
- ExpertDialogue "Review of the NanoDialogue" on 15th of November 2022 and
- International final conference on 22nd and 23rd of June 2023.

Like the previous dialogue phases, the sixth dialogue phase of the German NanoDialogue enabled an objective and constructive discussion on the challenges of nanotechnologies and possible solutions. This dialogue phase also contributed to building mutual trust among stakeholders.

The dialogue on "active, nanoscale materials" and the previous event on advanced materials (fifth dialogue phase) have shown that the dialogue topic "nanomaterials" is now too narrowly defined: technological development has continued and nanomaterials now only account for some of the material innovations. New technological approaches are also accompanied by new challenges for assessment and regulation, some of which lie outside the NanoDialogue's range of topics. In addition, the social assessment processes for nanomaterials have largely been completed: there is a clear direction for further work (by the authorities). These points underline that the sixth dialogue phase was a good time to end the dialogue. The ExpertDialogue to reflect on the NanoDialogue and the final conference provided an appropriate space for this.

The final conference sent out clear signals that emphasised the success of the work on nanosafety on the one hand and highlighted the need to continue the scientific and technical work on nanosafety on the other. It was emphasised that the transfer of

experience and knowledge from the work on nanosafety to new or expanded subject areas – such as advanced materials or safe and sustainable by design – is an important task for the stakeholders who have worked or are working on nanosafety.

2 Zusammenfassung

Im Rahmen des Nano-Aktionsplans wurde im Jahre 2006 die NanoCommission von der deutschen Bundesregierung berufen und so eine zentrale, nationale Dialogplattform geschaffen. Die NanoCommission hat den Austausch gesellschaftlicher Interessengruppen zu Chancen und Risiken von Nanotechnologien unterstützt und damit einen Beitrag zum verantwortungsvollen und nachhaltigen Umgang mit Nanomaterialien geleistet.

Nachdem 2011 die Arbeit der NanoCommission beendet war, wurde das Diskussionsformat in zweitägige FachDialoge geändert, zu denen zusätzlich zu den Stakeholdern jeweils Expertinnen und Experten für Fachvorträge eingeladen wurden. Von 2011 bis 2023 fanden insgesamt vierzehn FachDialoge (Dialogphase 3 bis Dialogphase 5) und eine Konferenz zum 10-jährigen Bestehen des NanoDialogs statt.

Dieser Bericht fasst die Veranstaltungen der sechsten und letzten Phase des NanoDialogs zusammen. In dieser Phase fanden drei Veranstaltungen statt:

- FachDialog „Chancen und Risiken aktiver, nanoskaliger Materialien“ am 21.06.2022 und 22.06.2022
- FachDialog „Rückschau auf den NanoDialog“ am 15.11.2022 und
- Internationale Abschlusskonferenz am 22. und 23.06.2023.

Wie auch die vorhergehenden Dialogphasen ermöglichte die sechste Dialogphase des deutschen NanoDialogs eine sachorientierte und konstruktive Diskussion über Herausforderungen der Nanotechnologien und entsprechende Lösungsmöglichkeiten. Auch diese Dialogphase trug zum Aufbau gegenseitigen Vertrauens der Stakeholder bei.

Der Dialog zu „aktiven, nanoskaligen Materialien“ und die vorhergehende Veranstaltung zu advanced materials (fünfte Dialogphase) haben gezeigt, dass das Dialog-Thema „Nanomaterialien“ mittlerweile zu eng gefasst ist: Die technologische Entwicklung ist weitergegangen und Nanomaterialien machen nur noch einen Teil der Materialinnovationen aus. Mit neuen Technologieansätzen gehen auch neue Herausforderungen für die Bewertung und Regulierung einher, die teilweise außerhalb des Themenspektrums des NanoDialogs liegen. Zudem sind die gesellschaftlichen Bewertungsprozesse für Nanomaterialien weitgehend beendet: es gibt eine klare Richtung für die weitere Arbeit (der Behörden). Diese Punkte unterstreichen, dass die sechste Dialogphase ein guter Zeitpunkt war, um den Dialog zu beenden. Der FachDialog zur Reflexion des NanoDialogs sowie die Abschlusskonferenz haben hierfür einen angemessenen Raum gegeben.

Die Abschlusskonferenz hat deutliche Signale gesendet, die einerseits die Erfolge der Arbeit zur Nanosicherheit hervorgehoben haben und andererseits die Notwendigkeit

verdeutlichen, die wissenschaftlichen und technischen Arbeiten zur Nanosicherheit fortzuführen. Es wurde betont, dass der Transfer von Erfahrungen und Wissen aus den Arbeiten zur Nanosicherheit in neue bzw. erweiterte Themenfelder – wie etwa Advanced Materials oder Safe and Sustainable by Design – eine wichtige Aufgabe der Akteure ist, die zur Nanosicherheit gearbeitet haben bzw. arbeiten.

3 Introduction

As part of the German Nano Action Plan, a central, national dialogue platform was created in 2006 with the appointment of the NanoCommission by the German Federal Government. The NanoCommission has supported the dialogue between social interest groups on the opportunities and risks of nanotechnologies and thus made an important contribution to the responsible and sustainable use of nanomaterials.

The NanoCommission worked in two dialogue phases: 2006 - 2008 and 2009 - 2011. The results of the work, including the recommendations to the federal government, are documented in a final report. Reports from the NanoCommission's working groups and thematic groups are also available.¹

Following a recommendation by the NanoCommission, the NanoDialogue on the opportunities and risks of nanotechnologies was continued from 2011 in two-day ExpertDialogues. In the third (2011 - 2013), fourth (2013 - 2015) and fifth dialogue phase (2016 - 2019), further ExpertDialogues were held, as well as a conference to mark the 10th anniversary of the NanoDialogue.² The topics of the ExpertDialogues ranged from assessment tools for nanomaterials and nanoproducts, databases, nanomedicine, water, food and the automotive industry to the topic of "advanced materials" in the last ExpertDialogue of the fifth dialogue phase.

In the sixth and final phase of the NanoDialogue, which is described in this report, a substantive ExpertDialogue was held on the topic of "Opportunities and Risks of Active Materials at the Nano Scale". Due to the Covid19 pandemic, this first ExpertDialogue of this dialogue phase was postponed several times. As the actual meeting of stakeholders was one of the success factors of the NanoDialogue, the dialogue was not continued online.

The second ExpertDialogue of this dialogue phase was held as a one-day workshop with a number of key stakeholders and without presentations. This created the space to jointly reflect on the NanoDialogue and discuss ways in which the NanoDialogue could be presented at the final conference. In this way, the work of the NanoDialogue could be appreciated, and the successes, challenges and solutions be evaluated and assessed from the perspective of all stakeholder groups.

¹ https://www.bmuv.de/fileadmin/Daten_BMU/Download_PDF/Nanotechnologie/nanodialog_1_abschlussbericht.pdf and 2. and <https://www.bmuv.de/themen/chemikaliensicherheit/nanotechnologie/nanodialog/dialogphase-2-2009-2011>

² <https://www.bmuv.de/themen/chemikaliensicherheit/nanotechnologie/nanodialog>

The international conference "How the world deals with materials on the nanoscale" was the last event of the German government's NanoDialogue and officially ended the dialogue in its previous form.

The purpose of the conference was to present the NanoDialogue to an international audience and thus pass on the experience gained. The conference was also intended to create the framework within which approaches to the safe handling of nanomaterials from all over the world could be presented and discussed. Last but not least, the aim was to reflect on what activities could be carried out in the future to ensure the safe handling of nanomaterials and novel materials.

The following chapters describe the events of the sixth dialogue phase. The last chapter shares observations made by the moderator.

4 ExpertDialogue “Opportunities and Risks of Active Materials at the Nano Scale”

4.1 Framework of the ExpertDialogue

The first ExpertDialogue of the sixth dialogue phase was planned back in 2020. Due to the Covid19 pandemic, it could only take place on 21st and 22nd of June 2022 on the premises of the Ministry of the Environment.

A total of 13 presentations were given on different active nanoscale materials. All but one of the speakers came from universities and research institutes. Due to the Covid-related distancing rules, fewer stakeholders were invited than in previous dialogues.

4.2 Contents of the lectures

The dialogue began with a general introduction to the topic, which also included a proposal for a definition of active materials. In addition, a distinction was proposed between types of active materials based on the type of their energy conversion.

After an introductory overview, the use of active, nanoscale materials as nano-carriers and their diverse possibilities for transporting active ingredients and the targeted release of active ingredients were discussed in more detail for the field of medicine. Other possible uses of active, nanoscale materials in medicines were presented as well as the possibilities of using active, nanoscale materials in the manufacturing process of pharmaceuticals. Another presentation highlighted research into new diagnostic methods that can detect the presence of pathogens, for example, more efficiently and reliably by using active nanoscale materials.

In the field of electronics, quantum dots in displays were one of the applications presented, which have advantages over conventional materials due to their low sensitivity to heat, oxygen, light and water, among other things. A second application example was electronic noses, which could be used, for example, in the diagnosis of illnesses, the freshness control of food or the search for drugs and explosives.

It has been reported that active nanoscale materials could be used in high-performance materials, e.g. to detect damage to rotor blades and aircraft turbines, as well as in concrete to repair bridges. DNA molecules could themselves be used as “high-performance building blocks” for active, nanoscale structures, e.g. for sensors or nanocarriers.

Another presentation focussed on the possible future use of electroactive polymers as building blocks for “artificial muscles”, which could be used in technical products such

as medical dosing pumps. The final application example for active, nanoscale materials was research into so-called photosensitisers for the purification of drinking and wastewater, which are intended to catalyse the degradation of (persistent) pollutants through the formation of reactive oxygen species.

Many of the presented applications of active nanoscale materials are still being researched and are therefore not yet available on the market.

The presentation and discussion on the topics of “Regulation and ethics“ revealed doubts as to whether the risks posed by active, nanoscale materials are sufficiently regulated. It was noted that test methods for identifying hazardous properties are missing or not applicable, polymers are insufficiently covered by regulation and the definitions of chemicals legislation do not fit active, nanoscale materials. Regulations and guidelines for the assessment of nanocarriers in various EU laws were discussed and the inter-agency working group on advanced materials was presented. The ExpertDialogue ended with thoughts on taking responsibility for innovation (with active nanoscale materials) and ethical aspects of handling (active) nanoscale materials.

4.3 Key aspects of the discussion

The proposed distinction between active and passive nanoscale materials was discussed several times during the ExpertDialogue, as slightly different criteria can be used for this distinction. The development of a definition or the delimitation and grouping of active nanoscale materials was viewed critically, partly because there is currently no need for such a definition.

Another recurring topic was the relationship between the structure and function of active nanoscale materials and the associated potential risks. The focus here was on the (eco)toxicity and persistence of materials, but also on the potential challenges of using biological structures (DNA/RNA) as building blocks. There was also a need to discuss the environmental impact (critical raw materials, complex extraction of materials) and their (eco)toxicity with regard to the (inorganic) starting materials for the production of active, nanoscale materials. Some stakeholders asked about challenges in waste treatment, but these could only be answered in general terms or not at all in this context due to a lack of information.

The discussion on the regulation of active nanoscale materials focussed on the topics of “transparency“ regarding the presence of these materials in products and in the supply chain as well as the possibilities of improving the availability of information with the planned European “Digital Product Passport“. Other topics included monitoring obligations and the development of test methods that can be used for active nanoscale materials.

At the end of the ExpertDialogue in particular, it was discussed that the assessment of the benefits and risks of using active nanoscale materials is considered very complex. It would require cooperation between different specialist areas and far-reaching considerations regarding the impact of new technologies on society.

The documents for the preparation and follow-up of the ExpertDialogue are published on the website of the Ministry of the Environment.³

4.4 Final consideration

The ExpertDialogue on active nanoscale materials met with great interest from the scientific community and the authorities. It was suggested that this could be due to active nanoscale materials being associated with possible new assessment issues, which would trigger a great need for information. The ExpertDialogue was a good opportunity to obtain more information and to exchange ideas with stakeholders.

In contrast, no companies and only a few civil society organisations could be persuaded to participate. The companies' lack of interest is attributed to the fact that they either conduct their own research and just use such materials, but do not want to publicise this for competitive reasons, or that the discussion was too far from their daily work and practice. Representatives of civil society groups did not participate in particular because, although the topic was interesting, it was stated not to be a priority for their work and was therefore not supported by their organisations.

A wealth of information and knowledge was shared at the ExpertDialogue. The following were emphasised in particular as opportunities arising from the use of active nanoscale materials:

- Opportunity to develop new technologies to solve challenges for which no processes were previously available,
- Efficiency gains in the manufacture and/or utilisation of products,
- Options for replacing toxic materials,
- Integration of different functionalities in one material and
- Improvement of existing technologies and materials.

³ <https://www.bmu.de/download/6-dialogphase-fachdialog-1-chancen-und-risiken-aktiver-nanoskaliger-materialien>
OPPORTUNITIES AND RISKS OF ACTIVE MATERIALS AT NANO SCALE

The following challenges were identified:

- Possible toxicity and ecotoxicity of the materials
- Diverse methodological and technical challenges in the assessment of (eco)toxic properties (test methods, risk assessment methods),
- Environmental impact in the production of materials, e.g. high consumption of energy and resources, use of critical raw materials
- Uncertainties about emissions and risks and, above all, recovery and recycling in waste treatment
- Ethical aspects, such as access to innovations or responsibility for the use of innovative materials, or the assessment of their consequences.

5 ExpertDialogue “Review of the NanoDialogue - from 2006 to today“

5.1 The framework of the dialogue

The ExpertDialogue “Review of the NanoDialogue - from 2006 to today“ took place on 15th of November 2022. Only some of the stakeholders who have been involved in the NanoDialogue for many years were invited to this one-day event in order to obtain key perspectives and experiences from and with the Federal Government's NanoDialogue and to evaluate the joint work. In addition, the participants were to be invited to present the NanoDialogue at the final conference.

The discussion at the ExpertDialogue was structured on the basis of a number of questions that were sent to the participants in advance. Over the course of the dialogue, some of the answers were repeated as the topics of the questions overlapped, meaning that some questions could ultimately be summarised.

5.2 Review and discussion of the NanoDialogue

After a presentation summarising the topics of the NanoDialogue as a whole, the stakeholders discussed the organisation, opportunities for participation, selection of topics, success factors and effects of the NanoDialogue on national and international political processes, among other things.

The participants in the ExpertDialogue reaffirmed the central and overarching goal of the NanoDialogue: The creation of a framework for the responsible full utilisation of the opportunities offered by nanotechnologies while limiting the associated risks.

However, according to the stakeholders, the specific objectives of the NanoDialogue have changed over time: In the first and second dialogue phases (NanoCommission), recommendations on the responsible use of nanomaterials were to be formulated for the Federal Government. This was accompanied by a strong goal-orientation and binding nature of the discussion, which was particularly important for some stakeholders.

The stakeholders agreed that in the later dialogue phases (ExpertDialogues), the focus was primarily on continuous exchange and the opportunity for in-depth consideration of specific issues. This was accompanied by the fact that no specific recommendations or products were developed, but the dialogue itself was enhanced. The in-depth discussion of individual aspects and fields of application was only made possible by the change in format from the NanoCommission to the two-day ExpertDialogues. Within the framework of the ExpertDialogues, new knowledge was conveyed through

presentations, a broad, scientific and technical perspective was made possible and thus a basis for the fact-based, in-depth discussion was created.

According to the stakeholders, the NanoDialogue was well integrated into the overall context of the discussion on nanomaterials and linked to parallel processes and (research) projects via so-called “bridge persons“. The stakeholders described the choice of topics as appropriate and “organic“, moving from a broad, fundamental discussion to a more specific and application-orientated approach.

In the opinion of all participants, the NanoDialogue has achieved its goal of bringing stakeholders together and establishing a good communication culture. It has thus helped to objectify the discussion. The stakeholders confirmed that they had learned a great deal through the professional exchange and the new perspectives on a topic and that they had brought new knowledge and experience into their organisations.

Civil society stakeholders said that the NanoDialogue was an early and low-threshold opportunity to bring environmental and consumer interests into the discussion and thus influence developments. Representatives of the authorities also found the NanoDialogue helpful because it had contributed to the coordination and clarification of positions both within an authority and between authorities.

The participants highlighted the fact that the risks and benefits of nanotechnologies were always considered in parallel as a key reason for the success of the NanoDialogue. In this way, the aim of enabling the opportunities of nanotechnologies and taking the risks into account was achieved. Other success factors were also emphasised: the commitment of the Federal Ministry for the Environment, the neutral process moderation, the transparent preparation and follow-up of the events, the involvement of all stakeholders and the multidisciplinary composition of the participants, as well as the trustful interaction with each other, the existence of a protected space (e.g. no media), the high level of transparency as well as established trust. Further factors were the transparent preparation of the events, the high level of expertise of the participants, the focus on specific fields of application and the participation of people who have passed on the results of the NanoDialogue in other contexts and brought discussions from other projects into the NanoDialogue.

5.3 Final consideration

The exchange at the ExpertDialogue and the reflection on the NanoDialogue were very helpful for the evaluation of its work from the stakeholders' perspective. Overall, the evaluation showed that the NanoDialogue fulfilled its objectives and that the stakeholders rated the joint work positively.

6 International conference “How the world deals with materials on the nanoscale“

6.1 The framework of the conference

The international final conference took place on the 22nd and 23rd of June 2023 in Berlin at the Tagungswerk and was organised in cooperation with the OECD. A total of around 150 participants attended the conference⁴

At a meeting of the OECD Working Party on Nanomaterials (OECD WPMN) in June 2022, the conference was announced and presentations were requested that demonstrate the safe handling of nanomaterials in the various countries. The type of contributions was not limited and “small“ examples were also encouraged to illustrate the diversity of possible approaches.

Once the proposals received had been reviewed, some of them were concretised in direct discussions and grouped thematically for a programme. Further speakers were approached in order to “close gaps“. For example, the topic of “nanomedicine“ was represented by additional speakers. Furthermore, representatives from various organisations were brought in for the final discussion.

The NanoDialogue was presented in the first session as a “time travel through the NanoDialogue“: Representatives of the six dialogue phases were asked to report on their experiences from and with the NanoDialogue in the form of a short conversation with the moderator. The moderator had organised short online meetings with almost all “time travellers“ in the run-up to the conference to prepare for the session. In addition, the moderator's questions and the stakeholders' answers were coordinated in advance. For each dialogue phase, images of relevant events or publications were compiled and shown with a presentation in the background. A short introduction was prepared for each dialogue phase, stating the time period and the topics discussed.

6.2 Summary of the conference programme

State Secretary Christiane Rohleder (BMUV) opened the conference with a welcoming speech and an introduction to the conference topic. Mr Bob Diderich welcomed the participants from the OECD.

⁴ There were significantly more registrations; some participants did not sign the signature list.

The NanoDialogue was presented in the first block of the conference. The moderator spoke to the representatives from the six dialogue phases about their experiences, why they consider the work in the NanoDialogue to be important and helpful, what they brought to the discussion and what they took away from the discussion. Two representatives were invited to the stage for each dialogue phase and all stakeholder groups had their say. At the end of the so-called time travel, some questions from the audience were answered.

A presentation on nanosafety activities in South Africa looked at the German NanoDialogue from a non-European perspective. It was reported on which aspects of the German NanoDialogue was given particular attention in the South African Dialogue and what plans there are to involve company's and civil society more.

The general discussion at the session's end critically questioned whether and to what extent the German NanoDialogue can be used as a model for other countries or topics and pointed out, among other things, limitations due to cultural differences. The balanced nature of the discussion and the constructive cooperation between the stakeholders over the long period of the NanoDialogue were highlighted by the audience as exceptional.

Mr Diderich (OECD) closed the thematic block on the Federal Government's NanoDialogue with a summary and his conclusions from the discussion, which were carried over to the rest of the conference.

The second thematic block of the conference was dedicated to legal regulations for the safe handling of nanomaterials. In the presentations, the development of regulation on nanomaterials in the EU and the need for further action were presented. The obligations of manufacturers of nanomaterials in US chemicals legislation and the work of the US EPA on the assessment of materials were explained. There was also a report from Canada on the national regulations and the specific challenges for the risk assessment of nanomaterials. An overview of the political framework in India was given, focussing on the guidelines and support offered to the industry. "Soft regulatory approaches", which are being implemented in Malaysia and are based on voluntary standards and information, among other things, were also presented.

In the concluding discussion on this thematic block, differences between the regulations were discussed and synergies and opportunities for cooperation between regulatory authorities were explored.

In the third thematic block of the conference, measures were presented that can support the implementation of regulatory requirements for the safe handling of nanomaterials. The first example came from the United Nations Institute for Training and Research (UNITAR), which provides guidelines and organises training courses on the safe handling of nanomaterials in various countries and regions around the world.

One contribution provided information on a study to investigate the content of nanomaterials in various consumer products, the results of which were used to enter into dialogue with companies and to call attention to the lack of labelling. In Sweden, as part of a national strategy, cooperation between science and authorities has been improved, various (research) reports and guidelines on the safe handling of nanomaterials have been published and an information platform has been established.

The participants were able to continue their intensive discussions over dinner in the basilica of the Bode Museum.

The second day of the conference began with the topic of standardisation and testing methods. The activities of the OECD Working Party on Synthetic Nanomaterials (OECD WPMN) were presented and it was emphasised that the impetus from the NanoDialogue had supported the discussion. In its contribution, the Malta Initiative addressed the improvement of processes and procedures for the standardisation of OECD test methods and explained their future challenges. The National Metrology and Testing Laboratory in France gave a presentation on the “NanoMeasureFrance“ initiative, which supports the development and application of methods for characterising and testing nanomaterials.

In the discussion on this topic, the great importance of standardisation work was emphasised several times and it was critically noted that it was important to integrate science more closely into the work. In addition, funding must be provided to ensure that applicable and up-to-date test methods for nanomaterials are available.

In the third conference block, nano-based technologies for purifying water were presented. Various materials and projects for (decentralised) (waste) water purification as well as the development of a standard test to check the functionality of these purification systems from the USA were presented. Furthermore, projects for wastewater treatment in Colombia, including the utilisation of waste as substrates for nano-based surfaces, were presented. In the discussion, various questions were clarified and the opportunities offered by the use of nanomaterials to protect water resources were emphasised.

Two market analyses were presented on the topic of “nano product safety“: In Malaysia, the Ministry of Science, Technology and Innovation identified nanoproducts on the domestic market and reviewed some of them in terms of their safety. In the UK market, consumer products containing nanomaterials were identified and analysed to see what information was available. A third presentation discussed the use of carbon nanotubes to improve material qualities and to produce new, low-energy data storage devices. Questions of understanding were clarified in the discussion.

In the last lecture block of the conference, applications of nanomaterials in medicine were presented and discussed. In addition to an overview of the various ways in which

nanomaterials can be used in medicine, two presentations took an in-depth look at the use of nanocarriers using the example of Covid-19 vaccines.

At the end of the conference, a panel discussion summarised the key messages of the conference and reflected on the discussion from various perspectives. Among other things, the importance of standardising test methods, attracting (young) scientists to nanosafety research and the importance of social dialogue to accompany the introduction of new technologies such as nanotechnologies were discussed.

The conference was concluded by the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection with the note that the ministry is open to further discussions even after the end of the conference.

The documentation of the conference is available on the website of the Federal Environment Ministry.⁵

6.3 Final consideration

The international final conference concluded the NanoDialogue and offered the opportunity to share experiences with stakeholders from other regions of the world. Furthermore, experiences in the safe handling of nanomaterials from many different countries were presented and discussed. The aim of the final conference was to create a platform for a transnational exchange of ideas and to give participants the opportunity to (re)network.

The form and content of the NanoDialogue presentation met with general approval and painted a multi-layered picture of the development of the discourse. The work of the national stakeholders in the dialogue was thus acknowledged.

The final conference also showed that the research and implementation of nanosafety regulation is not over.

⁵ <https://www.bmu.de/themen/chemikaliensicherheit/nanotechnologie/nanodialog/internationale-konferenz-zum-abschluss-des-nanodialogs-der-bundesregierung>

7 Concluding remarks

Overall, a number of trends can be observed over the duration of the NanoDialogue from 2006 to 2023:

- The topics of discussion became increasingly specific - starting with very broad methodological and social evaluation issues and moving on to relatively narrow, technical and scientific topics.
- The trade unions withdrew completely from the dialogue after the NanoCommission came to an end; the number of civil society groups participating in the dialogue declined continuously.
- With the exception of the VCI, industry associations were less and less interested in participating as the dialogue progressed.
- It became increasingly difficult to get companies to give a presentation or even only to participate in the dialogue.
- In the course of the dialogue series, discussions on life cycle and resource-related aspects came much more to the fore.
- While there were always conflictual disputes at the beginning of the dialogue, there were hardly any controversies in the later dialogues.
- Towards the end of the dialogue series, the events that dealt not “only“ with nanomaterials, but also with (nanoscale) novel materials with extended functionalities, gained increasing momentum.

These trends support the decision to end the NanoDialogue in its current form with the final conference. They show that important issues, such as the fundamentals of nanomaterial regulation, have been discussed and that the remaining work is of a more technical and implementation nature that does not require further stakeholder discussion. They also show that society's interest in nanomaterials has weakened over time.

Nevertheless, some topics were repeated throughout the NanoDialogue discussions with unchanged urgency: many stakeholders complained about both the lack of information on the properties of nanomaterials and their uses (in products). The difficulties in risk assessment were emphasised in particular by the representatives of the authorities. The lack of life cycle assessments and the effects of nanomaterials in products on the climate, the circular economy or other impact categories were also continuously pointed out. Civil society stakeholders called for more fundamental discussions on the needs and opportunities for innovation and new products, beyond the issue of specific risk assessments.

The German government's NanoDialogue has made an important contribution to ensuring that the social debate on nanotechnologies in Germany and internationally has been objective and constructive. This has enabled a genuine debate to take place

on the opportunities and risks and has drawn attention to aspects that are necessary for the safe use of the various materials and technologies. In the meantime, development has progressed, with nanomaterials now continuing to be of regulatory interest as a significant part of the large group of advanced materials. In this respect, it is to be hoped that the experience gained from the NanoDialogue will be incorporated into further discussions and passed on to the relevant processes via the stakeholders.

All documents of the German Government's NanoDialogue are available on the website of the Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

<https://www.bmu.de/themen/chemikaliensicherheit/nanotechnologie/nanodialog>