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TNO report

Report on the Roadmap on Carcinogens Expert Seminar on 23 November 2021: Strategies to Reduce Exposure to Process Generated Carcinogens

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Number of pages	24 (incl. appendices)
Number of appendices	2
Project name	Roadmap on Carcinogens Challenge 4.2

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Summary

On Tuesday the 23rd of November 2021, around 50 experts and stakeholders affiliated with carcinogens gathered for an interactive online expert seminar on process-generated carcinogens (PGCs). The goal of the seminar was to bring stakeholders together to contribute to a way forward in regard to process-generated carcinogens in Europe. Different experts could share knowledge on elimination and control strategies. An additional goal was to explore how to accelerate tackling exposure to process-generated carcinogens. The seminar included plenary and breakout sessions. During the breakout sessions, the experts were divided into smaller groups to discuss innovations and solutions to minimize exposure, including current and future control and elimination strategies and techniques as well as drivers for implementation of measures to reduce exposure. Moreover, they discussed strategies to accelerate preventing exposure, focusing on drivers and barriers for the implementation of exposure reduction as well as stakeholder roles in improving implementation of exposure reduction and elimination strategies. It should be mentioned that during the breakout sessions, participants provided input from their own perspective and with specific examples from their field of expertise and therefore must not be interpreted as generalizable experiences.

Prior to the seminar, a survey was sent to those who signed up, to gain preliminary insight. Insights from the survey were used as the base for the breakout sessions.

In the breakout sessions, implementation and control strategies, drivers and barriers to implementation, and stakeholder actions were discussed. In general, drivers and barriers mentioned by the participants were often similar. For example, (lack of) awareness was mentioned as both a driver and a barrier. Some trends were observed as well, such as how conservative culture can limit the potential to reduce exposure to PGCs. Moreover, a broad list of actions were mentioned throughout the different sessions, for many different stakeholder groups. Although some drivers and barriers were mentioned multiple times and some were mentioned occasionally in relation to a specific field or industry, follow-up stakeholder actions shall be discussed in the next workshop in further detail.

This expert seminar in the context of the Roadmap of Carcinogens provided the opportunity to bring stakeholders together to explore how to accelerate reducing exposure to PGCs. The actions identified during this workshop need to be made more specific, and hereafter be appointed to the responsible persons during the next workshop in 2022. For instance instead of 'creating awareness', it needs to be indicated who needs to gain more awareness, and how this should be achieved. This next seminar in 2022 should result in a detailed action plan, including a timeline presenting when the action will take place and who will perform which tasks to reduce exposure to PGCs in European countries.

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Abbreviations

CMD	Carcinogens and Mutagens Directive (CMD)
CMR	Substances that are carcinogenic, mutagenic, or toxic for reproduction
COMED	The Control Measures Efficiency Database
DME	Diesel Motor Emission
H&S	Health & Safety
NEPSI	European Network for Silica
OEL	Occupational exposure limit
OHS	Occupational safety and health
PGC	Process generated carcinogens
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RPE	Respiratory protective equipment
RMM	Risk Management Measures
SDS	Safety data sheets
SLIC	Senior Labour Inspectors' Committee
STOP	Substitution, Technical measures, Organizational measures and Personal protection

1 Introduction

The project Roadmap on Carcinogens aims to create awareness on occupational exposure to carcinogens, and ultimately provides innovative approaches to reduce exposure. Challenge 4.2 of the roadmap focuses on carcinogens created as a by-product during a work process, so called process-generated carcinogens (PGCs). As PGCs are usually not considered for REACH and therefore not labelled and not referred to in Safety Data Sheets, these PGCs need special attention in OSH practice.

To date, millions of worker's in Europe are daily exposed to PGCs; the overall cancer burden attributed to occupational exposures is estimated to be 2-5% since the 1980s (Olsson & Kromhout, 2021 ¹).

In order to get more grip on PGCs, the primary need is to draw a clear definition for PGCs. Furthermore, detailed information is needed on the size of the problem: the prevalence of worker's exposure, sectors and occupations involved, the processes by which PGCs are generated, current elimination and control strategies and barriers for the implementation of these strategies.

On Tuesday the 23rd of November 2021, around 50 experts and stakeholders affiliated with carcinogens gathered for an interactive online expert seminar on PGCs. A broad of participants joined, coming from 18 different (mostly EU) countries. The group of participants ranged from experts and researchers, sector representatives and policy makers to inspectors, social partners, tool manufacturers and focal point members (Figure 1).

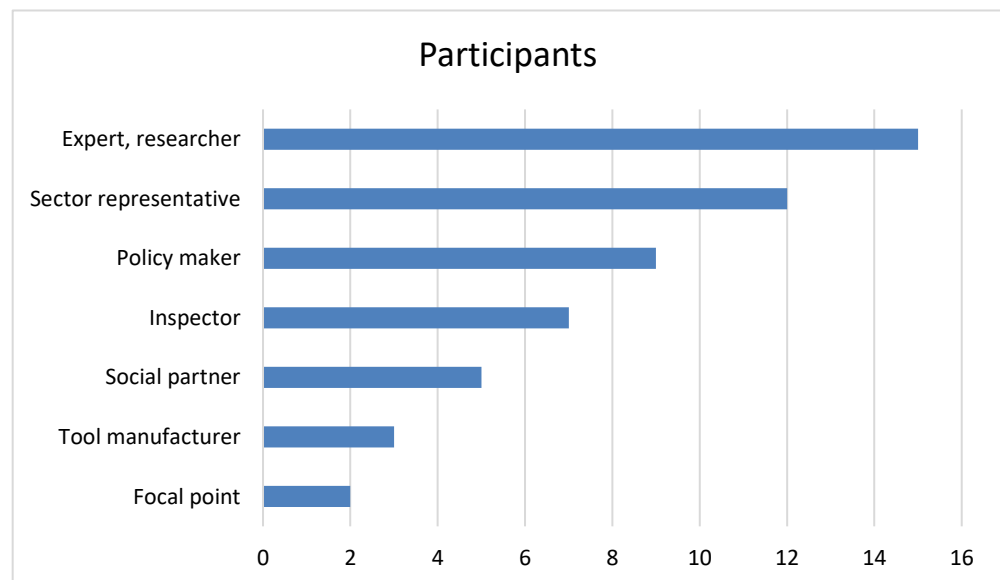


Figure 1. Visualization of expert seminar participants ranged per field.

¹ Olsson, A., & Kromhout, H. (2021). Occupational cancer burden: the contribution of exposure to process - generated substances at the workplace. *Molecular Oncology*, 15(3), 753-763.

The goal of the seminar was to bring stakeholders together to contribute to a way forward in regard to process-generated carcinogens in Europe. Different experts could share knowledge on elimination and control strategies. An additional goal was to explore how to accelerate tackling exposure to process-generated carcinogens.

The seminar included a presentation on the current state-of-art surrounding process-generated carcinogens. Moreover, the Austrian inspection campaign on silica dust construction sites and in the mining industry was presented. Afterwards, the results of the preliminary survey, asked to be filled in prior to the seminar, was presented as well as the objectives and explanation of the breakout rooms.

In the breakout sessions, the experts were divided into smaller groups to discuss innovations and solutions to minimize exposure, including current and future control and elimination strategies and techniques as well as drivers for implementation of measures to reduce exposure. Moreover, they discussed strategies to accelerate preventing exposure, focusing on drivers and barriers for the implementation of exposure reduction as well as stakeholder roles in improving implementation of exposure reduction and elimination strategies.

This report provides an overview of the workshop program, the results of the survey held prior to the workshop, a summary of the presentations during the workshop, the results of the breakout sessions, conclusions and next steps.

It should be mentioned that during the breakout sessions, participants provided input from their own perspective and with specific examples from their field of expertise. Therefore, the breakout session input as reported in Chapter 3, 4, 5 and 6 must not be interpreted as generalizable experiences, but should rather serve as a basis for the derivation of stakeholder actions.

2 Preliminary Survey Results

Prior to the seminar, a preliminary survey was sent to potential attendants (i.e. persons who signed up for the workshop), and was completed by 24 out of the total of 53 (=44%) applied attendants. The following chapter will discuss the survey results.

2.1 Potential drivers and barriers

18 potential drivers and/or barriers were compiled related to the decision-making process within companies to take measures to prevent exposure ². For each factor, the respondents were asked to indicate whether they considered the current way in which this factor is addressed needs major improvement, improvement, whether it was sufficiently addressed. It was also possible to answer 'I do not know'. Figure 2 provides an overview of the answers of the experts on the 18 barriers/drivers. The barriers/drivers, ordered in those which are in need of the most improvement to those which are sufficiently addressed according to the input given by experts, included:

1. Awareness of long term latency, no direct health effects
2. Actual data exposure at the workplace
3. Adequate knowledge within the firm
4. Top- and line management involvement
5. Urgency and awareness of the problem
6. Enforcement – inspection by labour inspectorate
7. Effective methods, tools and equipment
8. Competent supportive structures
9. Pressure from workers (council)
10. Adoption of the 'hierarchy of controls'
11. Fulfilment of legal obligations (legislation, exposure limits)
12. Resources/money
13. General OSH culture in a company
14. Innovation/Research and development
15. Sectoral support – practical guidelines, development of good practices, advisors and coaches
16. Company policy, procedures and rules
17. Financial incentive (subsidies, tax deduction etc) for companies to invest
18. Order/pressure by client

There was not one barrier/driver which was convincingly found to be sufficiently addressed by the participants in the survey. All of the factors had at least half of the experts mentioning it needs (major) improvement.

When asked whether any barriers or drivers were missing in this list, multiple were mentioned in the survey. These included insufficient data on the impairment of worker health in relation to hazards, the need for a better definition of risk-assessment based on realistic data, and the fact that for carcinogens the problems are co-factors that can affect the health of workers and how people should be aware of that. Moreover, factors such as inclusive awareness, control of labour inspection, beyond sectoral exchange of knowledge and good practices and participation on time of industries to set up the limit values were mentioned as factors that need attention.

² [Drivers and barriers for psychosocial risk management: An analysis of the findings of the European Survey of Enterprises on New and Emerging Risks \(ESENER\) | Safety and health at work EU-OSHA \(europa.eu\)](#) + own expertise

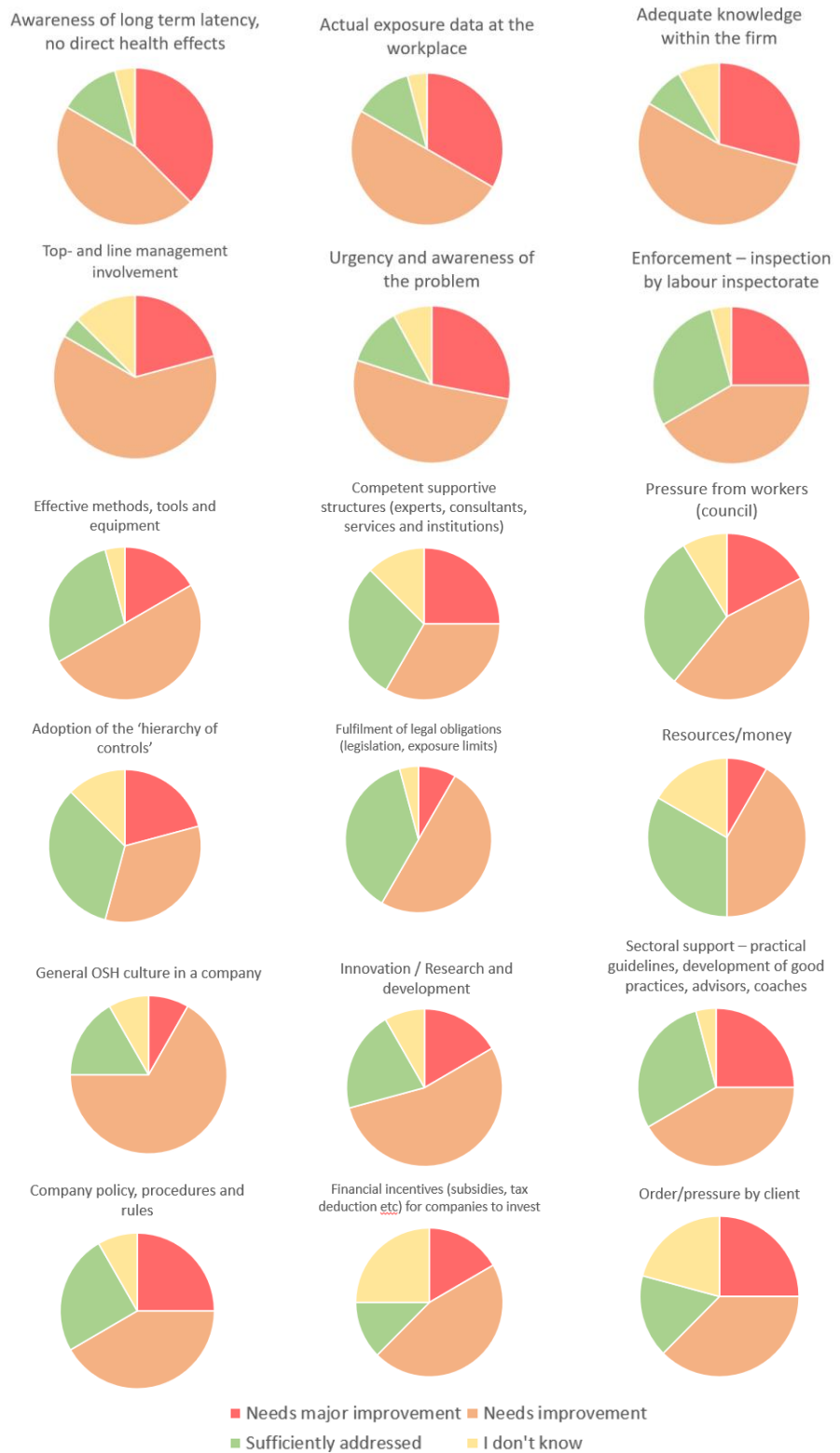


Figure 2. Outcome of the survey results collected prior to the seminar, filled out by 24 workshop participants (44% of applied attendants).

2.2 Actions for different fields of expertise

The respondents were asked what their field of expertise could do in addition to what is already done to minimize exposure to process-generated carcinogens. It should be noted that the results below are opinions/observations of respondents who answered this specific question and therefore should be interpreted as such.

2.2.1 *Policy makers (n=4)*

Policy makers mentioned that they could first of all strengthen awareness on the problem. Furthermore, it was mentioned that policy makers could stimulate inspection to address PGCs in general and that the government could use its power more as an employer and contractor. Best practices, information and knowledge on the subject should be shared more actively by policy makers in different countries. Lastly, policy makers mentioned how they should support the establishment of structures that ensure awareness is raised on how help should be provided.

2.2.2 *Researchers (n=7)*

In addition to what is already done, it was mentioned that more and clearer guidance should be given from the side of the researchers. Additionally, education at all levels should be accelerated and inspection work should be strengthened.

2.2.3 *Inspectors (n=3)*

Inspectors emphasized the importance of stimulating beyond-sectoral cooperation. Moreover, more defined positions on how to control process-generated or recirculating airborne carcinogens should be present. Lastly, this field of expertise mentioned how further engagement of the industry is necessary to raise awareness on process-generated carcinogens.

2.2.4 *Sector representatives (n=8)*

More attention needs to be paid to aligned exposure methodologies according to sector representatives. When data is gathered in a uniform way, benchmarks can be made and the most appropriate control can be applied.

2.2.5 *Tool manufacturers (n=2)*

Tool manufacturers mentioned that commercial benefit needs to be tackled to reduce exposure. It was also mentioned that there should be more possibilities for e.g. HSE (dust-free) training for customers.

2.3 New innovations and measures

The respondents were asked whether they were aware of any new innovations and measures currently developed to minimize exposure to process-generated carcinogens. Those mentioned included that there is a lot of development in on-tool extraction systems for e.g. respirable silica, welding fume or wood dust. Digitalization is mentioned as an important new innovation.

3 Implementation and Control Strategies: current and future strategies and solutions (breakout session 1)

In the first breakout session, both current and future elimination and control strategies for process-generated carcinogens were discussed.

The STOP strategy was one of the current control strategies discussed. The strategy describes the hierarchy to follow to control exposure and stands for Substitution, Technical measures, Organizational measures and Personal protection. When discussing the STOP strategy, multiple things were mentioned. Firstly, multiple strategies were mentioned that can substitute current practices, including functional substitution, systems with lower particle emission (diesel motor emission (DME), and electric aggregates. Discussing technical control measures, it was mentioned that awareness needs to be raised on why the use of improved equipment is so important, as the lack of awareness limits the use of improved equipment such as dust extraction systems. In addition, in regard to Personal protection, participants said that it needs to be taken into account that personal protection is not always a solution in certain workplaces. Also, there is a need for more knowledge and expertise provision to companies in general for them to be better informed about possible strategies to control exposure. Future data pools might have a potential role in tackling this. Although the STOP strategy has much potential and should be maintained and regulated, it was also discussed that it is not implemented sufficiently and should be better implemented in the future.

Furthermore, it was mentioned that there is a need for good online database platforms as well as more expertise to increase awareness on what is currently available to eliminate and control process-generated carcinogens. It was emphasized that guidance on best practices currently exists such as the NEPSI 2.0³, ANSES⁴ and the EU Directive on the protection of workers from the risks related to exposure to carcinogens or mutagens at work⁵. Toolkits are available but due to low or lack of awareness on the importance of applying them, implementation might be lacking.

Regarding future strategies it was mentioned that digitalization can avoid possible workers' exposure in some circumstances. By easing and digitalizing the way particles are measured, exposure can decrease. For example, by using a real-time respirable silica sensor, the worker's awareness of the dangers on the workplace can increase as they are directly confronted with exposure levels. This method is primarily useful in situations where particles are not visible. Moreover, in construction work exposure to PGCs should be avoided/eliminated as much as possible. For example, butene blocks can be used directly with additive construction or 2D printing instead of sawing the blocks and consequently lead to worker exposure. Similarly, this method can apply for metals or other composite materials. Also, the potential of robotics and artificial intelligence should not be overlooked. Moreover, to increase the implementation of future strategies, it was suggested to make strategies a requirement by e.g. European legislation, possibly resulting in demonstrating the abilities of the working methods and compliance with the best existing technology.

³ [Nepsi | The European Network on Silica](#)

⁴ [ANSES report](#)

⁵ [Directive \(EU\) 2019/983](#)

4 Drivers to Implementation (breakout session 1)

In accordance with the drivers that were provided in the preliminary survey, the experts were invited to discuss drivers for implementation of measures to reduce exposure to PGCs during the first breakout session. The input discussed during the sessions are gathered into Table 1 and divided in different categories.

Firstly, **increased awareness** is one of the drivers that has been discussed greatly throughout the different sessions. It has been mentioned that, when there would be more awareness on the severity of the problem and how reduced exposure actually leads to less negative health effects at the workplace, this could drive positive change. This could be done by e.g. more dissemination in the media (e.g. television), by providing guidance on how to perform a proper risk assessment, by identifying best practices and spreading those by means of clear communication and action plans. Moreover, **increased enforcement of the current regulation** could drive stakeholders to take effective action.

Making stakeholders aware of how implementing measures to reduce exposure to PGCs can positively impact both time and resources were discussed as drivers as well. Using safer tools influence both time and resources in a way that less cleaning is needed and more sufficient planning can be done, as well as how the maintenance can be less expensive and less investment in safety measures such as masks are needed.

The **culture** of a company can also drive stakeholders to make positive changes when the culture would allow for both clients and employees being able to pressure or demand employers to include safer measures.

Furthermore, **clear responsibilities** have been mentioned as drivers for change. It was discussed how there could be a big role for trade unions, insurance companies and labour inspections as well as the government to make sure that the employers take responsibility in providing safer workplaces, with input from workers.

Lastly, **awarding** has been discussed as an impactful driver for positive change in terms of implementation of measures to reduce exposure to PGCs. By awarding companies and workers for using dust-free equipment, this can drive others to take similar action. Also, working with bonuses instead of fines has been mentioned as a driver that can result to positive change. It is so far unclear from the workshop who should give these awards.

Table 1. Drivers mentioned to be of great importance as discussed during the breakout sessions.

Awareness	Regulation	Time-saving	Financial resources	Culture	Responsibility	Awarding
Exposure on television - Role of media - Storyline in movie/series	Implement OELs and regulate them	Using safe tools will save time (less cleaning)	Lower costs for maintenance of improved tools	Clients control market, they can pressure but also need pressure from authorities	Pressure from workers, big role for trade unions	Award worker and companies for using dust free equipment
Awareness of positive health effects at the workplace	Increased regulation by inspectors and government	Sufficient planning	Less investment in RPE and masks	Culture in which employees can speak up without fear to lose their job	Role for insurance companies when thinking of good social insurance	Bonusses instead of fines
Put more victims on stage and let them tell their story			Invest resources in correct things such as training for employees		Labour inspection/ authorities and governments should take responsibility, with input from workers	
Proper risk assessment, identify best practices						
Clear communication and action plans						

5 Barriers to Implementation (breakout session 2)

During the second breakout session, barriers for implementation of measures to eliminate and control exposure of PGCs were discussed. The input that was collected during this session was allocated to categories as presented in the top row of

As becomes clear from the table, barriers to implementation of control strategies are present on various fronts. There was no barrier standing out specifically or put forward by all break out session groups.

Lack of awareness in general was mentioned, and specifically for workers, subcontractors (construction) and safety engineers.

Various comments were made on inspection. Barriers mentioned were a **lack of inspection** and monitoring and the low risk of possible consequences following an inspection.

Conservativeness of (mostly small) companies, employers and inspectors was considered a barrier. A **conservative culture** hampers the use of novel tools and innovation to reduce exposure. Specifically for underground mining, a lack of maturity of technology seems to be present. Next to conservativeness in a company culture, a **stringent culture** may exist in several countries in which workers do not speak up about the working conditions, afraid of losing their contract. In this way, employers might not be sufficiently pushed to care for safe working procedures or state-of-the-art equipment.

Financial resources were considered to complicate implementation of measures, primarily because of conflicting priorities, i.e. the balance between financial resources, time investment and employability of staff is difficult to establish. Furthermore, it was mentioned that there is unwillingness to invest in prevention and that economical savings on prevention exist. One of the reasons for a lack of investment was considered being due to the lack of immediate results in terms of a health effect or return of investment.

Notably, not many barriers were mentioned in relation to authorities, policy or legislation, yet a lack of inspection exists in this area.

Regarding knowledge and information, it was said that **contextual and adequate knowledge is often missing** in firms. Also, exposure data may be of very low quality, wrong methods may be used to gather information, and exchange of knowledge between sectors may be lacking.

Table 2. Barriers mentioned to be of importance as discussed during the second breakout session.

Management involvement	Financial resources	Legislation	Company attitude	Information/Knowledge	Technology / Equipment	Small companies (SMEs/micro companies)	Training	Inspection	Awareness	Health & Safety experts
Resistant layer in the middle management	Conflicting priorities (money, time, staff)	Agreed regulations among EU member states (e.g. different exposure limits DME or asbestos)	Conservative inspectors	Contextual information is missing	Lack of maturity of technology (e.g. underground mining)	Lack of expertise	Lack of training of employers	The risk of an inspection is very low	Lack of awareness of the problem and where to find solutions	Lot of different health and safety issues need to be addressed by H&S experts
Management does not show to take RRM seriously	Price and time competitiveness (challenges of the market, self-employers)		Conservative employers	Adequate knowledge of the firm is often missing	Insight in the costs of technical measures	Conservative		Lack of inspection (construction)	Lack of awareness of workers on dust exposure – convinced that they do not need equipment	
	Unwilling to invest		General OSH culture in companies	Very poor exposure data	Additions to make the tool safe is regarded impractical	Lack of safety engineers		Lack of monitoring due to high sampling costs	Lack of awareness among safety engineers	

6 Stakeholder Actions (breakout session 2)

During breakout session 2, potential future stakeholder actions were discussed. The input from the workshop participants for this section was assigned to categories as presented in Table 3.

Most actions were assigned to specific groups of stakeholders such as labour inspection, authorities, employers, sector organization, trade unions or employees. Yet, certain actions were mentioned to be necessary for all stakeholders, which are **creating awareness** and **cooperation among stakeholders**. The action to **stimulate and initiate inspection** was mentioned multiple times as an action for different stakeholders (labour inspections, authorities, manufacturers).

6.1 Actions for authorities

The majority of actions was appointed to authorities/policy makers, and included enforcement of inspection, **funding for novel equipment** and also legislative actions such as **amendments on the CMR directive**, **establishment of novel OELs** and **follow-up after implementation of OELs**.

6.2 Actions for tool manufacturers

Various tasks were allocated to manufacturers. It was said that they should involve the workers to **tailor tools to the need of the workers**, and moreover that they should **provide education**, preferably on the latest equipment. As a marketing strategy for manufacturers, it was mentioned that **creating financial** incentive would be of help for promotion of best health and safety performance. Regarding the latter, **initiation of campaigns** might be a strategy to promote best H&S performance.

6.3 Actions for labour inspections

Several actions were allocated to labour inspection. It was mentioned that it would be helpful if inspection would **focus on one sector** instead of multiple. Also, **inspection efficiency** was pointed out, i.e. monitor only when necessary and use existing exposure databases. In addition, it was discussed that safety engineers should demonstrate that there is a lack of monitoring and hence to **stimulate the market to perform monitoring**. Furthermore, regarding monitoring, it was said that monitoring reports should be improved by adding more contextual information, and that monitoring should be performed by competent persons.

6.4 Actions for small companies

Small companies were specifically mentioned during the breakout sessions multiple times (Chapter 5) and likewise, actions were formulated for these companies. **Creating awareness** and **spreading information** on e.g. measures and exposure was considered to be of importance. Yet, no specific action was formulated to solve this issue of a conservative culture, which is often the case in these companies. Finally, it was said that employers should **inform workers with specific training** to improve the current process technology to avoid/reduce exposure, and to put in place **control systems** to prevent exposure and accidents.

Table 3. Stakeholder actions and responsibilities as discussed during the second breakout session.

All stakeholders	Labour inspection	Authorities / Legislation / Policy	Conservative/Small companies	Manufacturers	Employers	Workers / Employees	Safety engineers	Other / Action not directed to specific stakeholder
Creating awareness	Enforcement of inspection	Enforcement of inspection	Spread information	Involve worker to tailor tools to the need of workers	Inform workers with specific training to improve the current process technology to avoid/reduce exposure, and to put in place control systems to prevent exposure and accidents	Gain responsibility to be there for colleagues/family	Stimulate market to monitor	Improve transfer of data and knowledge in companies about new carcinogens
Cooperation among all stakeholders	Concentrate on one sector in a union-wide action (SLIC ⁶)	Give follow-up after implementation of OELs	Create awareness on measures and exposure	Legal control and inspection		Information should be present in the language of the workers	Get better informed	Create better monitoring data/reports with contextual information
	Only monitor when necessary	Support (start funding/financial help for example 10% of the costs of new innovative equipment)		Campaign (temporary effect)			Demonstrate that more monitoring is necessary	Monitoring should be done by competent persons

⁶ The Senior Labour Inspectors' Committee (SLIC): <https://ec.europa.eu/social/main.jsp?catId=148&intPageId=685>

All stakeholders	Labour inspection	Authorities / Legislation / Policy	Conservative/Small companies	Manufacturers	Employers	Workers / Employees	Safety engineers	Other / Action not directed to specific stakeholder
	Use existing exposure databases e.g. COMED	Intensify health surveillance based on epidemiology		Education (on latest equipment)				Take into account the circular economy - reduction of risk in one area may increase the risk further down the supply chain
		Detect new processes		Financial incentive				Enforcement of Trade Union/Works Council
		Extend CMD annex I with new PGCs		Promotion of best health and safety performance as a marketing tool				Incentives for research (Experts and Researchers)
		Create new OELs						
		Include in legislation a requirement for employers to use the best available technologies instead of used technologies						
		Involve worker to tailor tools to the need of workers						
		Campaign (temporary effect)						
		Education (on latest equipment)						

All stakeholders	Labour inspection	Authorities / Legislation / Policy	Conservative/Small companies	Manufacturers	Employers	Workers / Employees	Safety engineers	Other / Action not directed to specific stakeholder
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Financial incentive

Promotion of best health and safety performance as a marketing tool

Include knowledge in vocational education training

Dedicated inspection campaigns on national or EU level

Bring knowledge together across borders

Create better link between researchers and safety engineers

7 Conclusion, Discussion and Future Steps

7.1 Seminar objective, main results and conclusion

The goal of this expert seminar was to bring together stakeholders to share knowledge on elimination and control strategies and to discuss thoughts to accelerate reduction of exposure to PGCs in Europe. About 55 experts from over 18 different countries attended the seminar. The preliminary survey (circulated prior to the workshop) already provided interesting first insights into how stakeholders look at different drivers and barriers to reduce exposure, and to what extent the participants thought they needed to be addressed. Moreover, during the breakout sessions, multiple interesting ideas on drivers, barriers and stakeholder actions to reduce exposure to PGCs were discussed and noted. These results should feed further orientation and derivation of stakeholder actions.

Below, we summarize the most importance findings, which will feed into potential future steps and concepts for the next workshop.

In general, **drivers** and **barriers** mentioned were often similar, e.g. a driver mentioned was 'awareness', and a barrier 'lack of awareness'. Also, drivers and barriers were both quite versatile (Table 1 & 2). Several trends were observed: an example of a factor that was mentioned multiple times was how a conservative company culture can limit the potential to reduce exposure to PGCs. Moreover, awareness was one such factor that has been mentioned multiple times as being needed to reduce exposure to PGCs, which was also clearly visible in the survey results. Also, lack of inspection and monitoring was mentioned to be an important barrier. A broad list of actions was already mentioned throughout the different sessions, for many different stakeholder groups (Table 3). Although some drivers and barriers were mentioned multiple times and some were mentioned occasionally in relation to a specific field or industry, follow-up **stakeholder actions** shall be discussed in the next workshop in further detail.

For both the preliminary survey as well as the discussion in the breakout rooms, there was no full consensus on what currently needs the most attention. This shows that the issue surrounding PGCs is a versatile problem, and needs to be tackled on multiple sides and from multiple perspectives.

7.2 The workshop: feedback and lessons learned

In this section, it will be discussed what we learned from the workshop regarding the representation of sectors by the participants, the topics discussed, the online format and the survey preceding the workshop.

The preliminary survey was completed by 44% of the participants who initially applied to attend the seminar. Also, the participants that filled out the survey were primarily researchers and sector representatives, and few policy makers, tool manufactures and inspectors. The survey was not filled out by social partners or focal points. Thus, the results need to be read with the knowledge that the results cannot easily be generalizable, and that certain sectors are more represented than others. Nonetheless, the survey results affirm the barriers and drivers mentioned during the breakout sessions and help formulating future steps.

Moreover, the variety and number of participants ensured a broad group of stakeholders participated in the seminar. However, there is a difficulty in the representability of the results, as viewpoints given were provided by personal experiences of the participants. Of course, these were experts in this field of expertise which goes beyond their personal experiences. Nevertheless, it is hard to generalize a representable ranking of what aspects need the most attention and what is most urgent to tackle, which is clearly a topic for the next seminar in 2022.

The duration of the seminar (3 hours), as well as the number of participants (58) enabled to give presentations and perform breakout sessions of considerable duration. As a result, multiple barriers, drivers, and stakeholder actions were identified, which will be used as input for the next workshop which is dedicated to elaborate further on follow-up stakeholder actions to the issues identified.

Positive feedback was provided by the participants after the workshop, as collected by an evaluation survey after the workshop. The topic was indicated to be relevant, the organisation was perceived as being very good, and participants indicated that they would like to continue and stay involved in this group. Moreover, the quality of the virtual venue and connecting to the online meeting was indicated to be very good by the majority of the participants.

7.3 Future steps

This expert seminar in the context of the Roadmap of Carcinogens provided the opportunity to bring stakeholders together to explore how to accelerate reducing exposure to PGCs. By discussing multiple drivers, barriers and stakeholders actions, we identified **why** it is important to minimize exposure to PGCs, and **what** is needed to do this. However, in the next seminar we still need to know about **who** has the responsibility to take up the actions, **when** this is needed, and most importantly, **how** this can be done. In other words, the actions identified during this workshop need to be made more specific, and hereafter be appointed to the responsible persons during the next workshop in 2022. For instance instead of 'creating awareness', it needs to be indicated who needs to gain more awareness, and how this should be achieved. This next seminar in 2022 should result in a detailed action plan, including a timeline presenting when the action will take place and who will perform which tasks to reduce exposure to PGCs in European countries.

In preparation for the next seminar, the Challenge Team will further digest the results from this workshop, relate this to the available literature, conduct preparatory research in order to prepare a concrete action plan with the who, when and how. Your input in this process is still highly appreciated and we would therefore like to ask you to digest the information provided in this report and think about concrete steps that can be taken for the factors presented.

Please inform us of any news on the topic of PGCs, and feel free to share any knowledge or insights with the Challenge Team. Keep in mind the who, when and how questions, and let us know if you already have useful input that can help us in preparing the next seminar in 2022. During the next seminar, the objective will be to bring forward a concrete actions plan for stakeholders.

We hope to see you there and look forward to receiving more of your input then, or any time soon!

8 Appendix

A. Meeting agenda

10.00-10.10	Plenary opening
10.10-10.25	Presentation State of the Art on Process-generated Carcinogens
10.25-10.40	Presentation Inspection Campaign Austria: what do we learn? – and short discussion
<i>5 minutes break</i>	
10.45-10.55	Survey results and introduction to break-out sessions
10.55-11.35	Break-out Session 1: Innovations and solutions to minimize exposure
<i>5 minutes break (stay in break-out room)</i>	
11.40-12.20	Break-out Session 2: Strategies to accelerate preventing exposure
<i>10 minutes break</i>	
12.30- 13.00	Plenary conclusion

B. Format PPT break out groups.

Elimination and Control strategies (current/future)	Drivers
<p>Current strategies</p> <p>STOP strategy</p> <ul style="list-style-type: none"> • Substitution • Technical measures (e.g. dust extraction systems) • Organizational measures • Personal protection 	<ul style="list-style-type: none"> • Effective methods, tools and equipment • Competent supportive structures (experts, consultants, services and institutions) • Pressure from workers • Adoption of the 'hierarchy of controls' • Resources, money • Innovation/Research and development • Fulfilment of legal obligations (legislation, exposure limits) • Financial incentives for companies to invest • Order/pressure by client • Clear company policy, procedures and rules • Sectoral support – practical guidelines, development of good practices, advisors , coaches • Good knowledge of OSH experts
<p>Innovation / Future solutions</p> <ul style="list-style-type: none"> • Lot of development in on-tool extraction systems for e.g. respirable silica, welding fumes or wood dust and in electrification of diesel powered machines. • Digitalization can avoid possible workers exposure in some circumstances • Industry invests in diesel emission control, factsheets on controls on handlings powders • [add text] 	<p>Technical measures (Dust extraction systems)</p> <p>[add text]</p>

Barriers	Stakeholder roles
<ul style="list-style-type: none"> • Awareness of long term latency, no direct health effects <p>Lack of:</p> <ul style="list-style-type: none"> • Actual exposure data at the workplace • Adequate knowledge within the firm • Top line management involvement • Urgency and awareness of the problem • Enforcement- inspection by labor inspectorate • Inclusive awareness • Control of labor inspection • Full acceptance of OSH measures as measures in REACH risk management measures • Beyond sector exchange of knowledge and good practices <ul style="list-style-type: none"> • General OSH culture in companies • [add text] <p>[add text]</p>	<p>Policy makers</p> <ul style="list-style-type: none"> • Stimulate inspection to address process generated chemicals in general • Government could use its power more as employer and contractor <p>Tool manufacturer</p> <ul style="list-style-type: none"> • Keep on innovating and have solutions for dust free applications on tools <p>Expert, researcher</p> <ul style="list-style-type: none"> • Support companies with risk assessment and implementing risk management measures • Less administration • To accelerate education at all levels <p>Inspector</p> <ul style="list-style-type: none"> • Stimulate beyond-sectoral cooperation <p>Sector representative</p> <ul style="list-style-type: none"> • Uniform data gathering to benchmark and have most appropriate controls in place • [add text] <p>[add text]</p>