Early career researchers, knowledge retention and future developments in nuclear waste disposal and related radiation protection

Supplementary material
Pool and Panel Discussion on September 19th, 2025 at safeND2025

Organizers
Tuanny Cajuhi (BGR), Vera Lay (BfS) and Theresa Hennig (GFZ)

Panelists
Alisia Jaros, Christiane Stephan-Scherb, Arnjo Sittig, Moritz Ziegler

Abstract

Radioactive waste disposal and related **radiation protection** is a **sociotechnical challenge** that **demands resilience**, intergenerational **knowledge transfer**, and **interdisciplinary** collaboration. A **key aspect** of ensuring the long-term safety and timely implementation of nuclear waste disposal strategies is **empowering** the **next generation** of researchers. Contributions from young researchers working in various aspects of radioactive waste management will be highlighted in this workshop to emphasize the importance of fostering resilience and knowledge continuity in an area where **safety and timely decision-making** play an **important** role. This **workshop** provides a **platform** for **early career researchers (ECR)*** to present their scientific work — from innovative geological explorations, developments in radiation measurements and protection, experimental and modeling works as well as engineering solutions — while also **fostering interdisciplinary dialogue**. By doing so, we seek to **connect** early career professionals and research field starters with each other and experienced scientists, **create networking opportunities**, and facilitate the **exchange of knowledge**. Contributions from recent strategies in knowledge management and competence retention round up the workshop to allow a comprehensive view that will help to ensure the long-term success and safety of nuclear waste disposal programs as well as appropriate knowledge transfer. Our **workshop format**** includes a **joint discussion** fostered by (1) an **impulse panel discussion** of invited speakers involved in different fields and (2) short presentations from early career professionals and research field starters.

* Up to 7 years after the highest degree as well as research field starters looking for new challenges.
** The workshop format was adapted to: online questionnaire (pool) before and during the event and panel discussion.

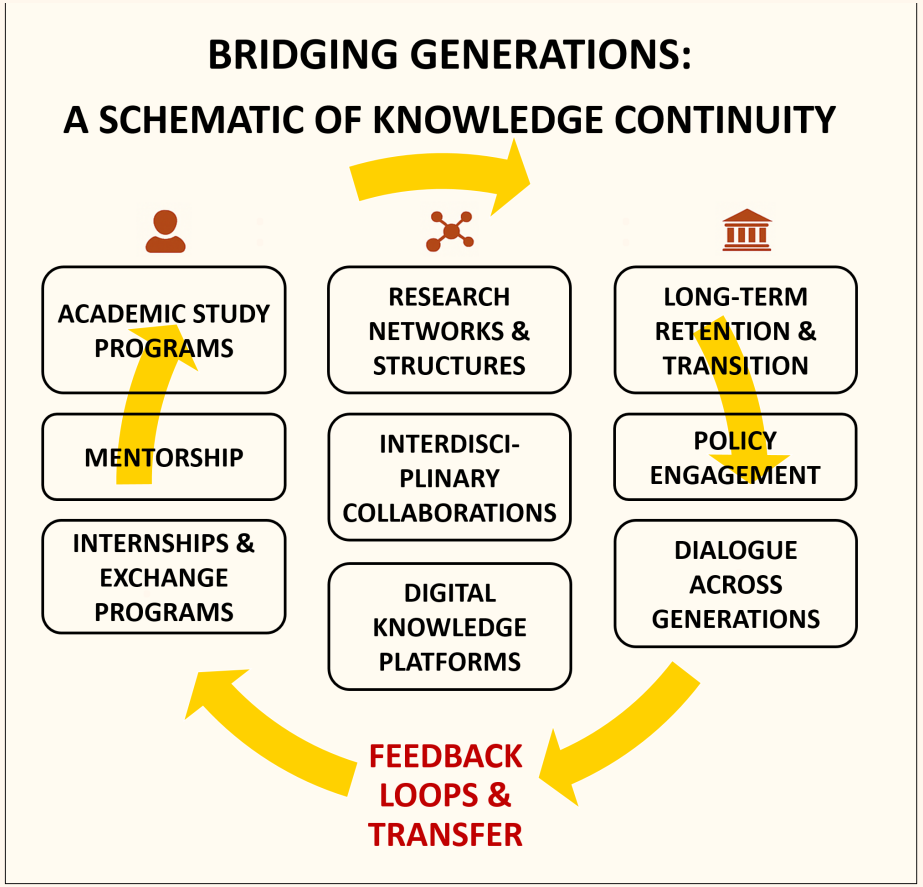
Motivation

Workshop Objectives:

- **Foster cross-generational dialogue** and **resilience** in nuclear waste management and radiation protection.
- **Explore existing challenges** and how to create supportive structures.
- **Identify strategies** for **knowledge transfer** and future development.

Structure & Discussion Highlights:

- Current situation: **What motivates ECRs** to enter the field? What are the **opportunities** and **barriers**?
- Knowledge Retention: **How** can **knowledge** be **transferred** between **generations**? What are **supportive structures**?
- Future Developments: What is **missing**? What **structures** or **practices support** sustainable **engagement** and **retention**?

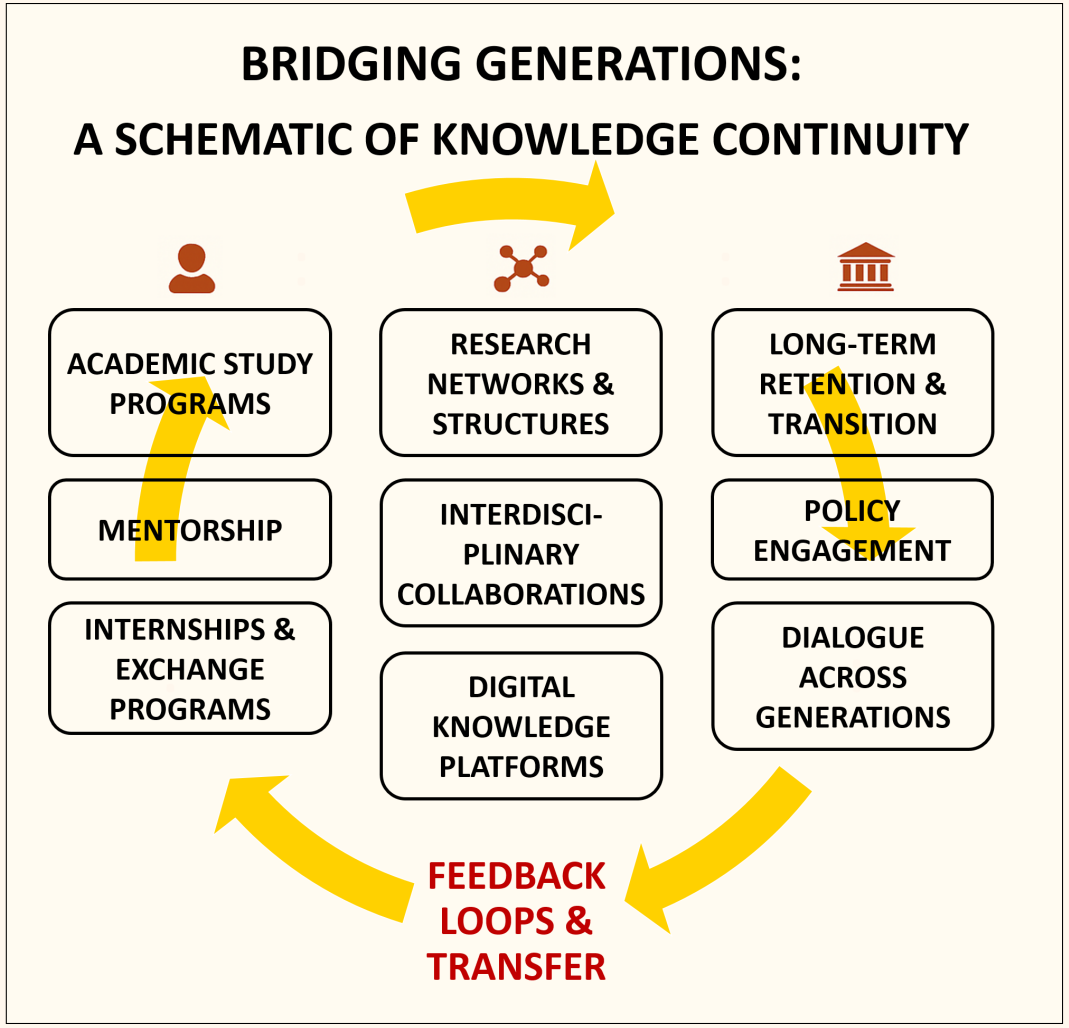


Outline

- **Questionnaire prior to the workshop**

- **During the workshop:**
  - Questions for panelists;
  - Live polls with audience for direct discussion;
  - Marked by symbol with number of participants answering.

- **Discussed topics:**
  - Current situation;
  - Challenges;
  - Possible solutions.



Arnjo Sittig

Role: Political representative

Has been a **member** of the **National Citizens Oversight Committee** since 2021, where he represents the younger generation and citizens. Studies sociology in Chemnitz.

Why did you join the workshop?

"We need many people, especially young people, to help us find a site for a final repository. Above all, I want to learn from others."

Prof. Dr. Christiane Stephan-Scherb

Role: Research

Full professor for mineralogy and geochemistry at the Martin-Luther-University Halle-Wittenberg. She studied mineralogy at the University of Leipzig, obtained her PhD at the FU Berlin, where she also held a junior professorship for seven years.

Why did you join the workshop?

"As a lecturer and researcher I see it as my duty with pleasure to motivate young people and early career scientists to work on nuclear waste disposal, since it is a long-term transgenerational task with high societal relevance where knowledge transfer for the experts of tomorrow is crucial."

Dr. Moritz Ziegler

Role: Early Career Network

Co-initiator of the **DECAY Days**. PostDoc at the Technical University of Munich interested in 3D geomechanical numerical modeling, its uncertainties and methods to reduce them.

Why did you join the workshop?

"I joined the workshop out of interest to discuss with colleagues in comparable situations and to offer other ECS insight into my own life as ECS."

Alisia Jaros

Role: Qualification Network

Runs the **Radiation Protection Qualification Network** and works at the Federal Office for Radiation Protection (BfS). She holds a B.Sc. in Physics from the Technical University of Munich.

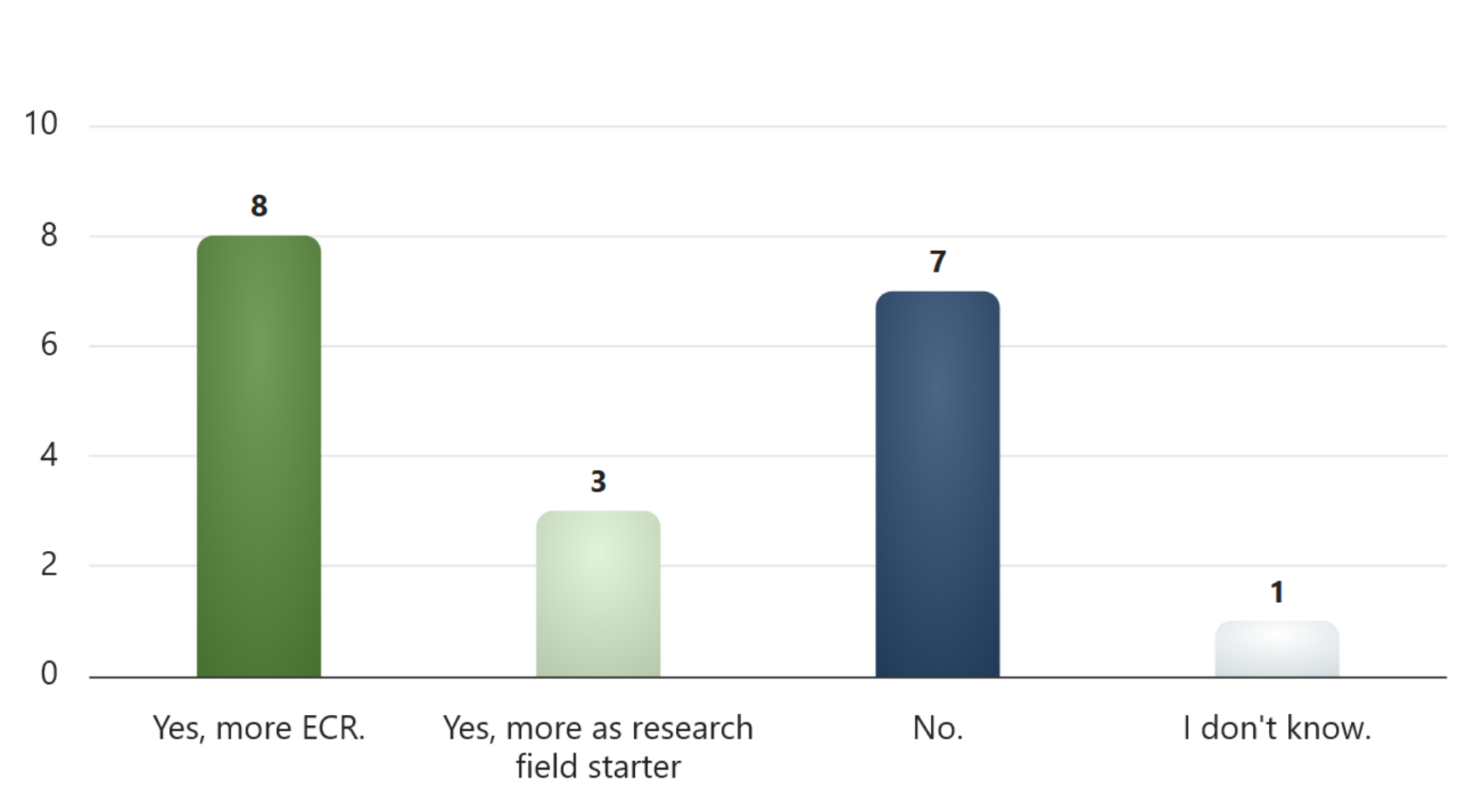
Why did you join the workshop?

"We strive to bring together the different initiatives and stakeholders concerned with maintaining expertise in radiation protection. **Therefore, the perspective of early career professionals is very important to us**, as the overarching goal is to ensure a sufficient number of well-qualified employees in the field of radiation protection."

Intro & Status: Situation of Early Career Researchers (ECR*)

* up to 7 years after the highest degree
as well as research field starters looking for new challenges.

#1 Would you call yourself ECR or a research field starter?



Intro & Status: Panel discussion

Interest & Attractiveness of the topics radioactive waste, radiation protection and related

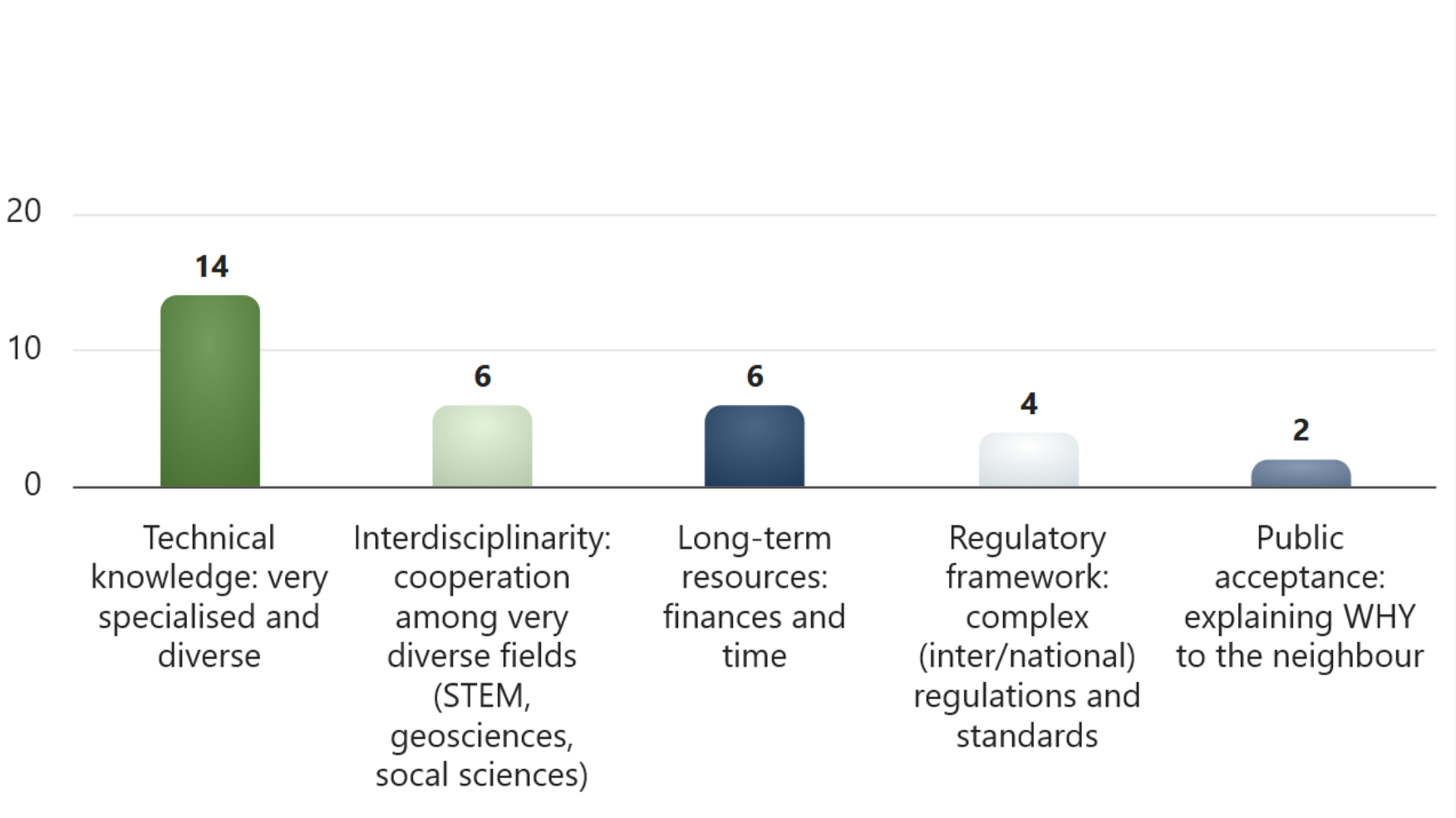
Life of **ECR** and **Field Starters**

Interest on studying about radioactive waste disposal and radiation protection

"It's a very broad topic with interesting interdisciplinary challenges."

Knowledge retention

#2 What was/is your biggest challenge when you started to work in the field?



Knowledge retention
Panel discussion

Supporting Early Career Researchers and field starters

"There are so many different individual challenges in the field of DGR. Overview workshops/meetings with contributions from different specialists (or ECR) can provide a good overview and form bonds between ECRs."

Knowledge retention
Panel discussion

"In the Radiation Protection Qualification Network we have nine different project teams working towards various goals. At least seven of these teams aim to support young talent in one way or another:

- developing a Catalogue of Occupational Profiles in Radiation Protection, specifically designed to be provided to students who are considering a career in the radiation protection field;
- creating a database of different international qualification opportunities such as summer schools, courses, excursions, and funding options for young talent, enabling them to enhance their qualifications and explore different areas within radiation protection;
- aiming to introduce radiation protection as a potential career field to school pupils.

We are truly grateful to have found so many dedicated individuals who are now specifically addressing this challenge."

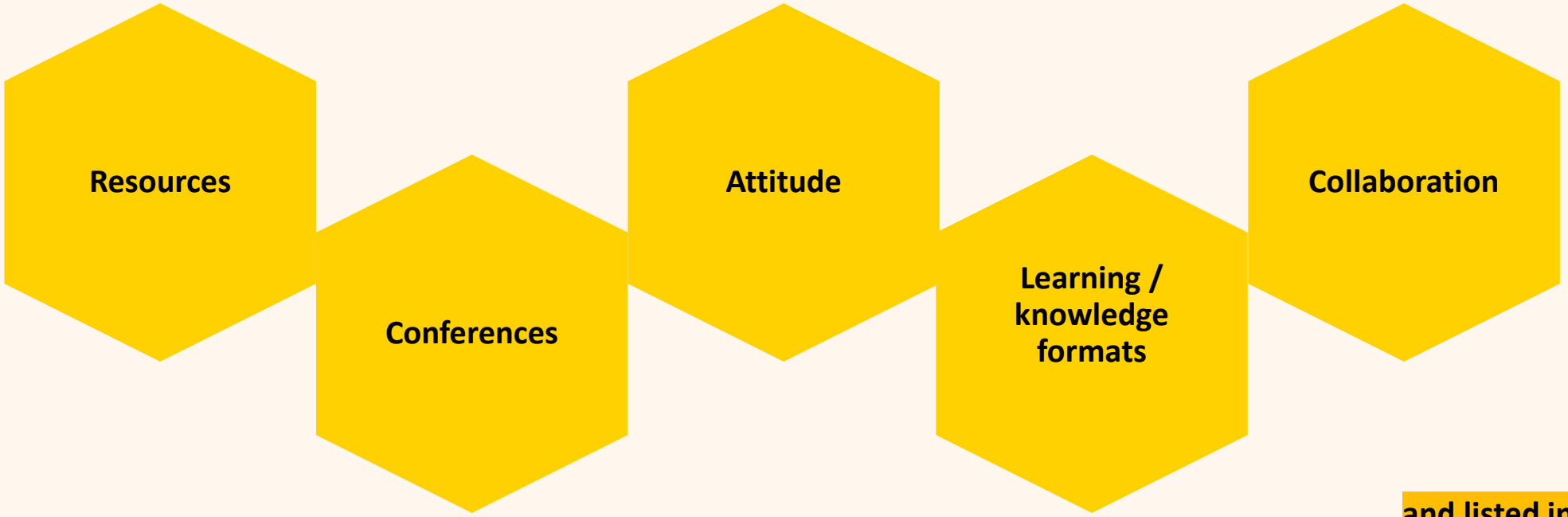
#3 Wishes to provide best possible knowledge retention?*

All Answers: Money and Mentoring are mentioned twice.
Next slide shows a list of all answers, clustered afterwards to five different topics.

***Original question:** If you think of your own activity in nuclear waste management or radiation protection, what would be your wishes to provide the best possible knowledge retention? *Think of up to five topics/skills (keywords).*

#3 Wishes to provide best possible knowledge retention?

The obtained answers were clustered into



and listed in the following

#3 Wishes to provide best possible knowledge retention?

Resources

- More time to write and maintain documentation;
- Money;
- Write knowledge retention into the StandAG;
- More study opportunities at universities;
- More public outreach to increase knowledge on the topic;
- Attractive, secure jobs to keep staff turnover low;
- Modern technical tools, as AI.

Conferences

- Conferences dedicated to DGRs;
- Sessions at special conferences on a certain discipline;
- Easy access to conferences and lower the hurdle to participate in conferences;
- Regular conferences like these;
- Small circle conferences with only 100 participants and one room only.

Learning / knowledge formats

- Short and engaging videos;
- Simple and impactful literature;
- Fix places of exchange, information etc., e.g. Mont Terri URL with its visitor center and similar;
- Better reporting practices. Rather than internal reports, use more modern methods for reporting like websites and scientific publications. Also things that update automatically over time e.g. based on data;
- Open exchange to experts;
- Standardized database structures (“less confusing”).

Collaboration

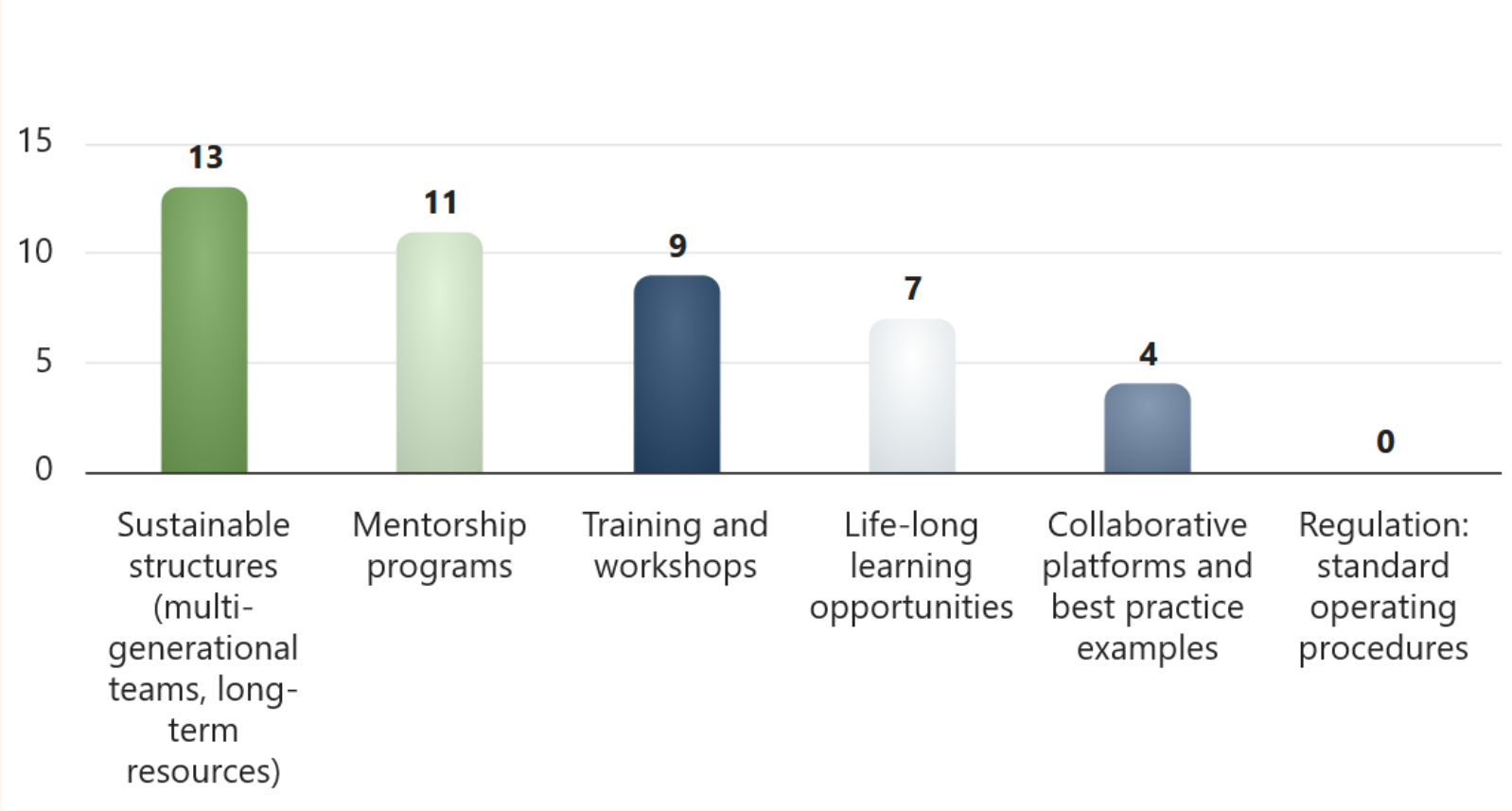
- Partnerships;
- Interns
- Buddy program with experienced and early career researchers;
- Good Knowledge Transfer between experienced and new researchers via Student Jobs or active mentoring, also Training on the Job;
- Mentoring;
- Mentorship over several years, tied to research projects;
- Networks;
- Intergenerational collaboration;
- Increase exchange outside a professional matter;
- Employment of new people while the senior people are still around rather than afterwards.

Attitude

- Stop thinking about knowledge management as THE solution;
- Be open to new approaches and new knowledge;
- Open and transparent communication;
- Diverse disciplines joining to spread knowledge and opinions;
- Show more initiative from myself and ask more “stupid questions”.

Future developments

#4 How can we best ensure knowledge transfer among the generations



In accordance with the answers to the previous question #3, sustainable structures (e.g. money) and direct mentoreship programmes are seen as most critical.

Future developments: Panel discussion

What is missing?

Study programs: more specific, more general, more attractive?

“Best practices” and lessons learned

Influence of digitalization

“More ECR-dedicated event”

“General courses at universities instead of a special DGR Master”

Future developments

How to continue after the workshop?

#5 Outlook: What can I do to improve knowledge retention within my team?

Keep informed about opportunities for collaboration
Kick off a meeting between young professionals
Actively use datasets from DGR search for my research.
discussion
Keep contact
Standard operatinal procedures
Wiki page
Intergenerational Team
Regular exchange
Communication
None
Documentation
Social Media
Lecter series
Open publication of code and ideas
Student seminar series
If I have the funding, I'd definitely allow possible PhD students to attend meetings related to DHR research

Future developments

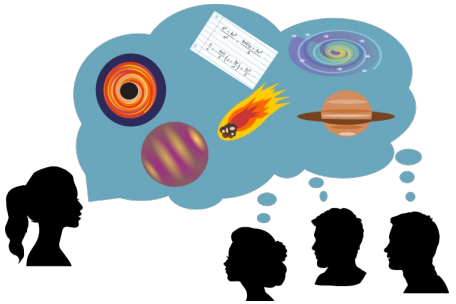
Influence of digitalization

“If you don't know what to do,
form a working group” ...or ask ChatGPT

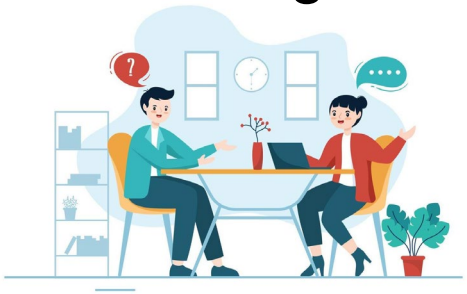
Documentation & archiving

How can knowledge transfer in science be ensured across several generations?

Societal Engagement



Education & mentoring

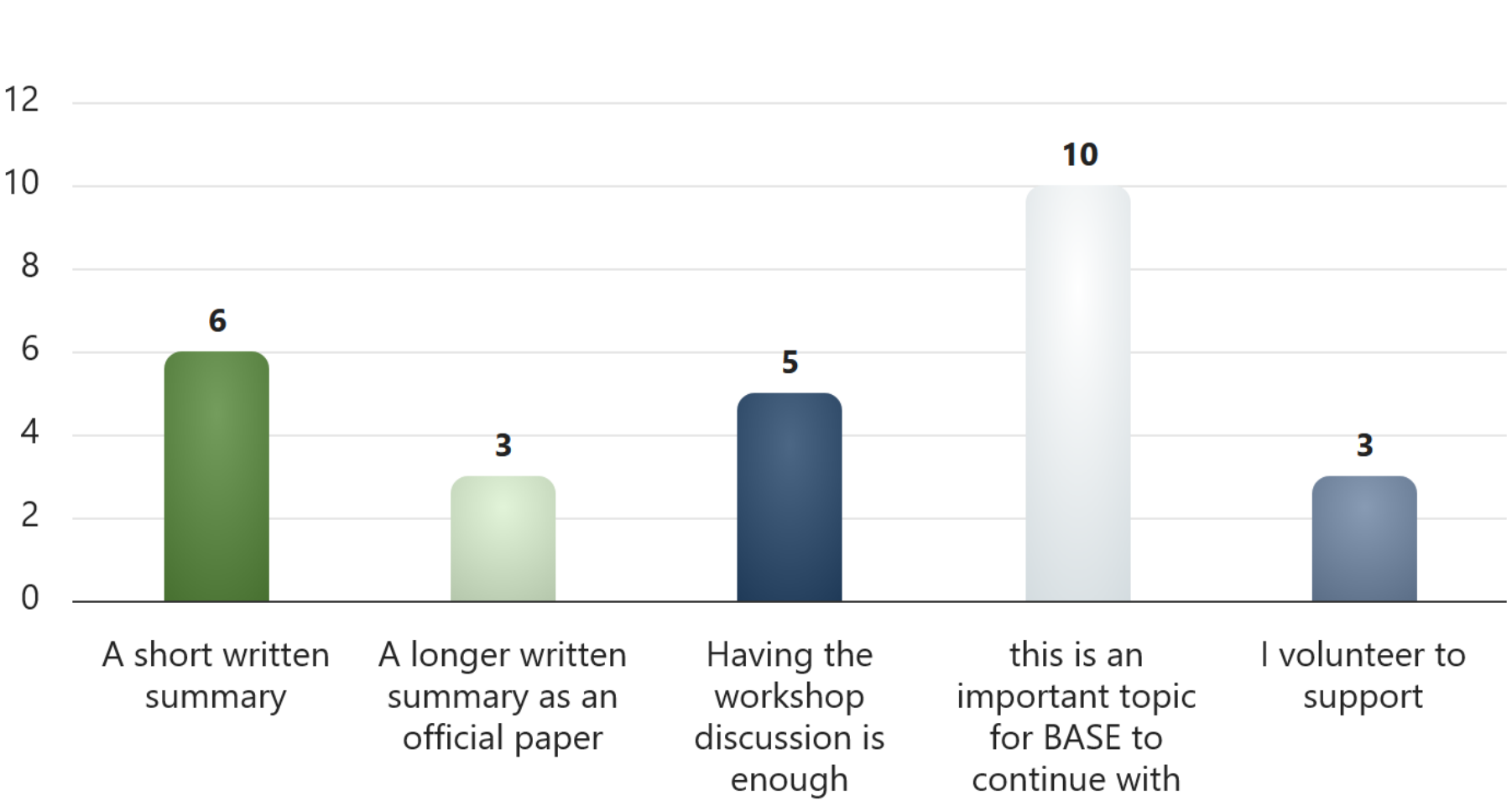


Scientific Communities

Technological support

Generational management

#5 What would you wish as an outcome?



This supplementary material summarises the points discussed. Nevertheless, the topic is essential for future developments – on a personal level, but even more on the institutional/political level.

Results of the questionnaire **prior** to the workshop

Questionnaire before the workshop

- **Questionnaire prior to** the **workshop** to ask questions similar to those discussed during the workshop itself.

- **Link was shared** during the conference (see handout on the right):
  - as **print-outs** during the breaks
  - as a **poster** during the „Young SafeND“
  - as a **Linked-In post**

- **13 participants** in total

Workshop W5 (Friday 19.09.): Early career researchers*, knowledge retention and future developments in nuclear waste disposal and related radiation protection

*up to 7 years after highest degree as well as research field starters looking for new challenges

How can we best ensure **cross generational dialogue** and resilience in nuclear waste management and radiation protection?

Share your thoughts beforehand by scanning the **QR code (all career stages).** You are welcome to join the discussion this Friday!

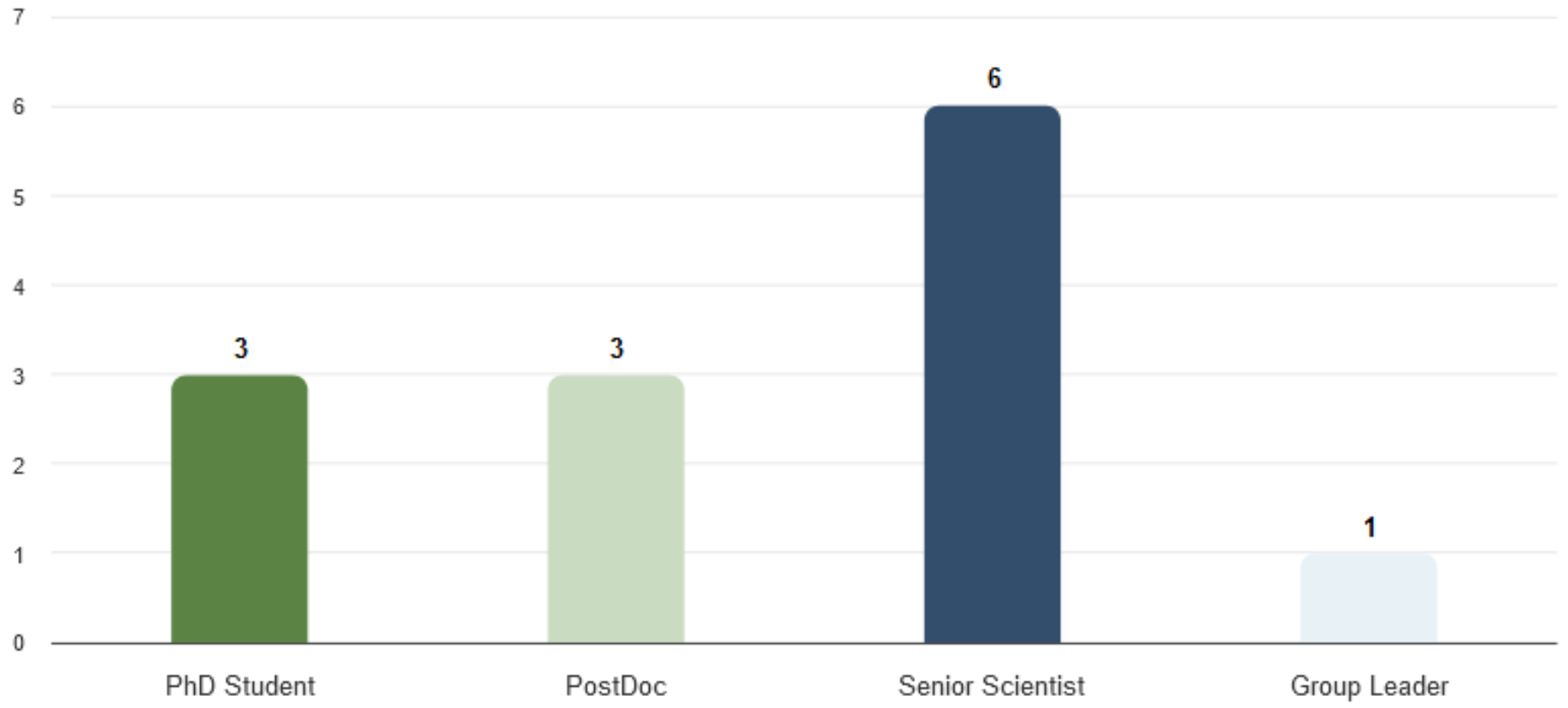
Questionnaire before the workshop

1. Frage:

What is your current career stage?

Untertitel: Please select the one you think fits best.

Fragetyp: Single Choice



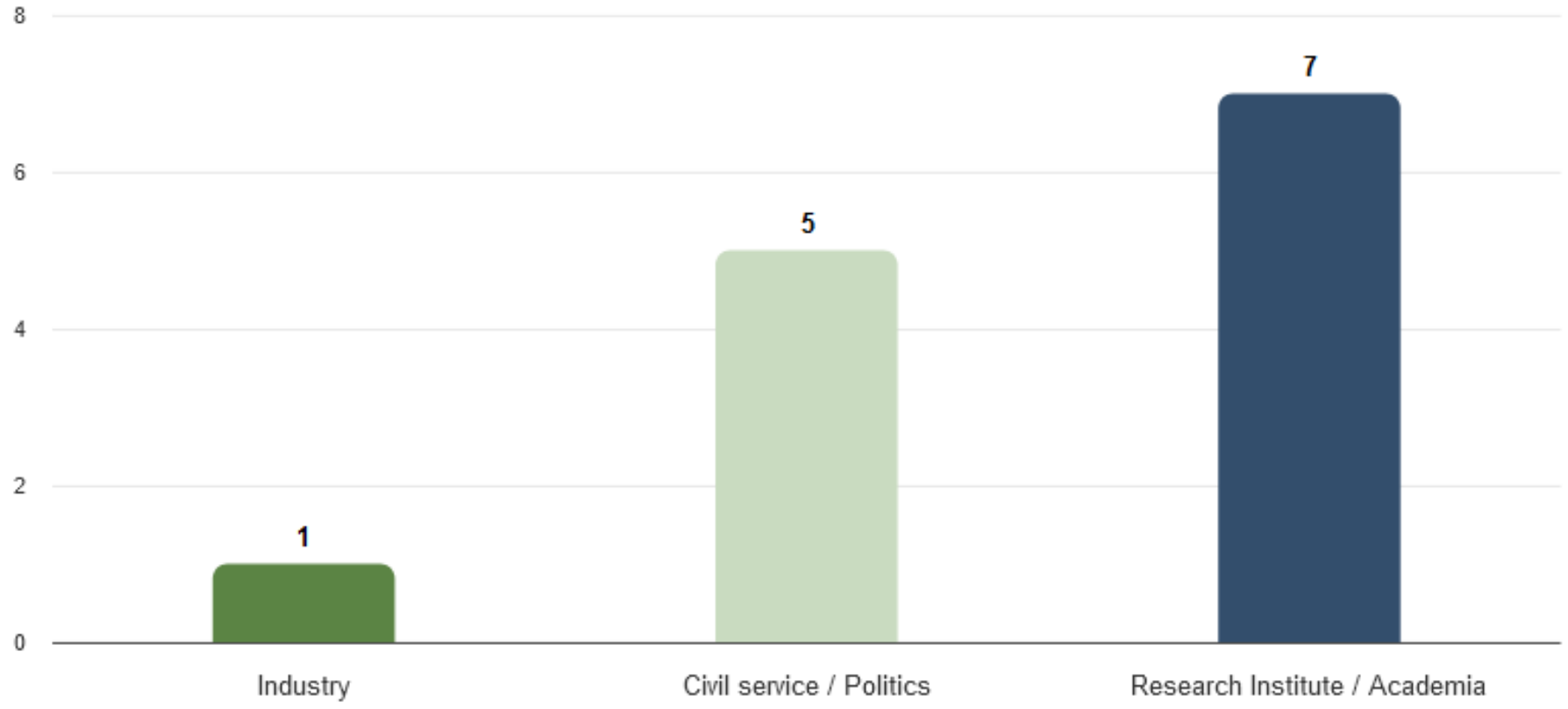
Questionnaire before the workshop

2. Frage:

What is your background, i.e. in which field are you working currently?

Untertitel: Please select the one you think fits best.

Fragetyp: Single Choice



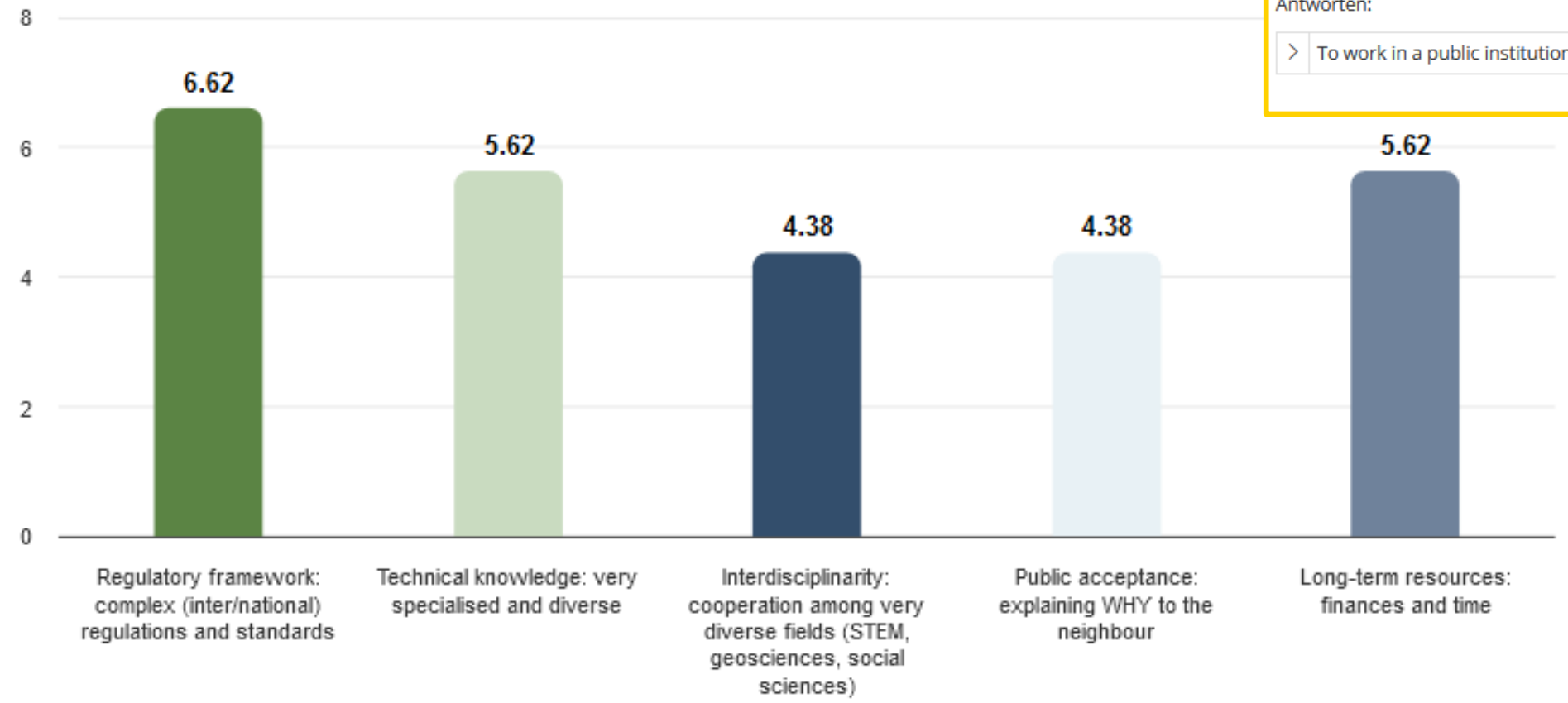
Questionnaire before the workshop

3. Frage:

What was/is your biggest challenge when you started with the topic of radiation protection / nuclear waste management?

Untertitel: Please move the slider between 1 (no problem at all) and 9 (massive challenge).

Fragetyp: Numerische Werte (mehrere Schieberegler)



4. Frage:

Any additional challenges you want to mention?

Fragetyp: Freitext

Antworten:

- To work in a public institution/authority/regulator office.

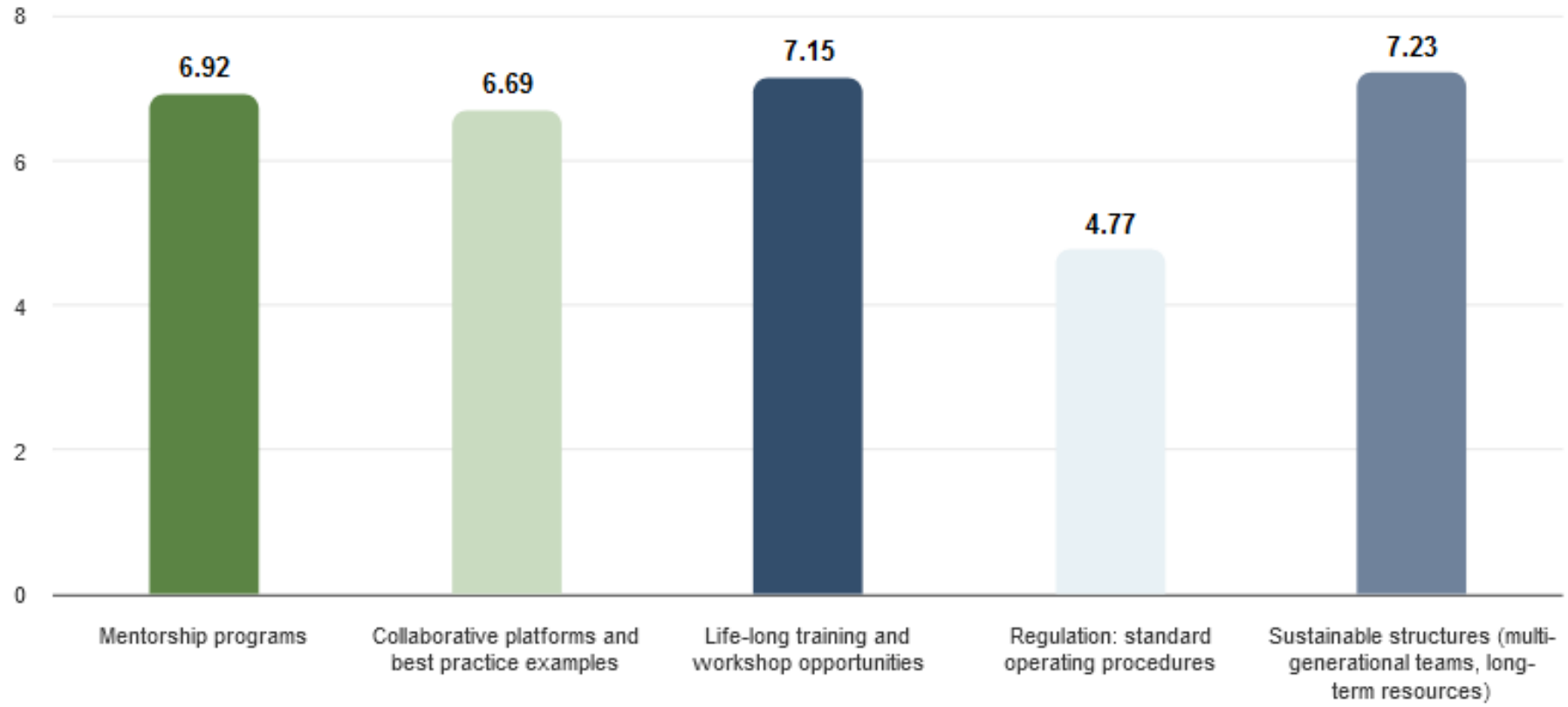
Questionnaire before the workshop

5. Frage:

How can we best ensure knowledge transfer among the generations?

Untertitel: Please move the slider between 1 (not helpful at all) and 9 (very effective).

Fragetyp: Numerische Werte (mehrere Schieberegler)



Questionnaire before the workshop

5.1 Folgefrage: (Antwort Life-long training and workshop opportunities >= 6)
Which learning formats do you find most helpful?
Fragetyp: Freitext
Antworten:

>	Webinars, seminars, direct contact
>	International collaborations.
>	Mentorship / knowledge databases
>	Specific Open Webinars, Independent online learning

5.2 Folgefrage: (Antwort Sustainable structures (multi-generational teams, long-term resources) >= 6)
Which specific structures do you find most helpful for knowledge transfer?
Fragetyp: Freitext
Antworten:

>	Networks.
>	PhD
>	Making strong and long term national groups with less consultancies.
>	multi-generational teams, long-term resources, Life-long training and workshop opportunities
>	Databases
>	Supervisors that are working in the same field.
>	In-person workshops, shared Project work
>	Personal discussions

5.3 Folgefrage: (Antwort Collaborative platforms and best practice examples >= 6)
Do you have good examples for collaborative platforms or best practice examples you have used yourself?
Fragetyp: Freitext
Antworten:

>	The opportunity to go to conferences is a huge collaborative platform.
>	The CoP platform for Linux at BASE and the emerging Seminar series at DECOVALEX.
>	OpenGeoSys Benchmarks

Questionnaire before the workshop

6. Frage:

In an ideal world, which topics would early career researches learn first to succeed in the field of nuclear waste management or radiation protection?

Untertitel: Think of up to five topics/skills (individual keywords)

Fragetyp: Freitext

Antworten:

>	Numerical methods Radionuclide transport Flow and transport properties of porous media Scientific programming Presentation/ writing skills
>	Radiation protection, nuclear physics and geology.
>	There is no one answer because the problem of nuclear waste is socio-technical and invloves many disciplines. It is a long lasting learning process to discover its complexity. You start what is closer to your background and build/expand further with the relevant topics that are emerging nationally at the time.
>	physical processes, geoscience, regulations, standards
>	Mathematics
>	Regulation Space for failure
>	- a broad overview of the many different aspects and professions required for DGR management. - importance of communication with the public.
>	Hidden rules and players; Networks; funding options
>	Better interconnections between other young researchers to exchange and find similarities

Questionnaire before the workshop

7. Frage:

Any further hints or comments?

Fragetyp: Freitext

Antworten:

> You need to define "early career". We always think of young people at the beginning of the carreer. But there also could be senior people from other backgrounds that just want another challenge. We should also create possibilities to include such people.

Thanks to this prior comment, we clarified our understanding of
„Early career researchers (ECR)“ in accordance with the workshop abstract:

ECR = up to 7 years after the highest degree as well as research field starters looking for new challenges.

Summary

- Workshop „Early career researchers, knowledge retention and future developments in nuclear waste disposal and related radiation protection“ took place on Friday, 19.09.2025.
- Prior questionnaire was answered by 13 people, live questionnaire by up to 19 people.

Main Findings based on our experience obtained via the questionaries and workshop:

- **Central interest:** Knowledge transfer is a critical concern for both ECRs and experienced researchers.
- **Challenges:** For their initial professional start, participants found the greatest challenge lay in the very specialized and diverse technical knowledge. Overall, the biggest systematic challenges are seen as long-term resources scarcity (funding and time allocation), sheer volume of technical knowledge, and the complex regulatory framework.
- **Solutions:** Beyond improving resources, knowledge retention relies on key factors such as strong collaboration (including mentorship programs), utilizing diverse learning/knowledge retention formats and implementing dedicated conferences for knowledge sharing. Additionally, the attitude toward knowledge sharing is seen as crucial both the individual and broader institutional levels.

Ideas and engagement are existing, concrete steps towards using them are required, and a sustainable framework for motivated individuals needs to be provided by the German authorities.