Uncertainty communication and public participation in decision-making related to decommissioning of nuclear installations

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RICOMET 2022 Workshop on societal aspects of decommissioning

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Belgian Nuclear Research Centre

Universiteit Antwerpen

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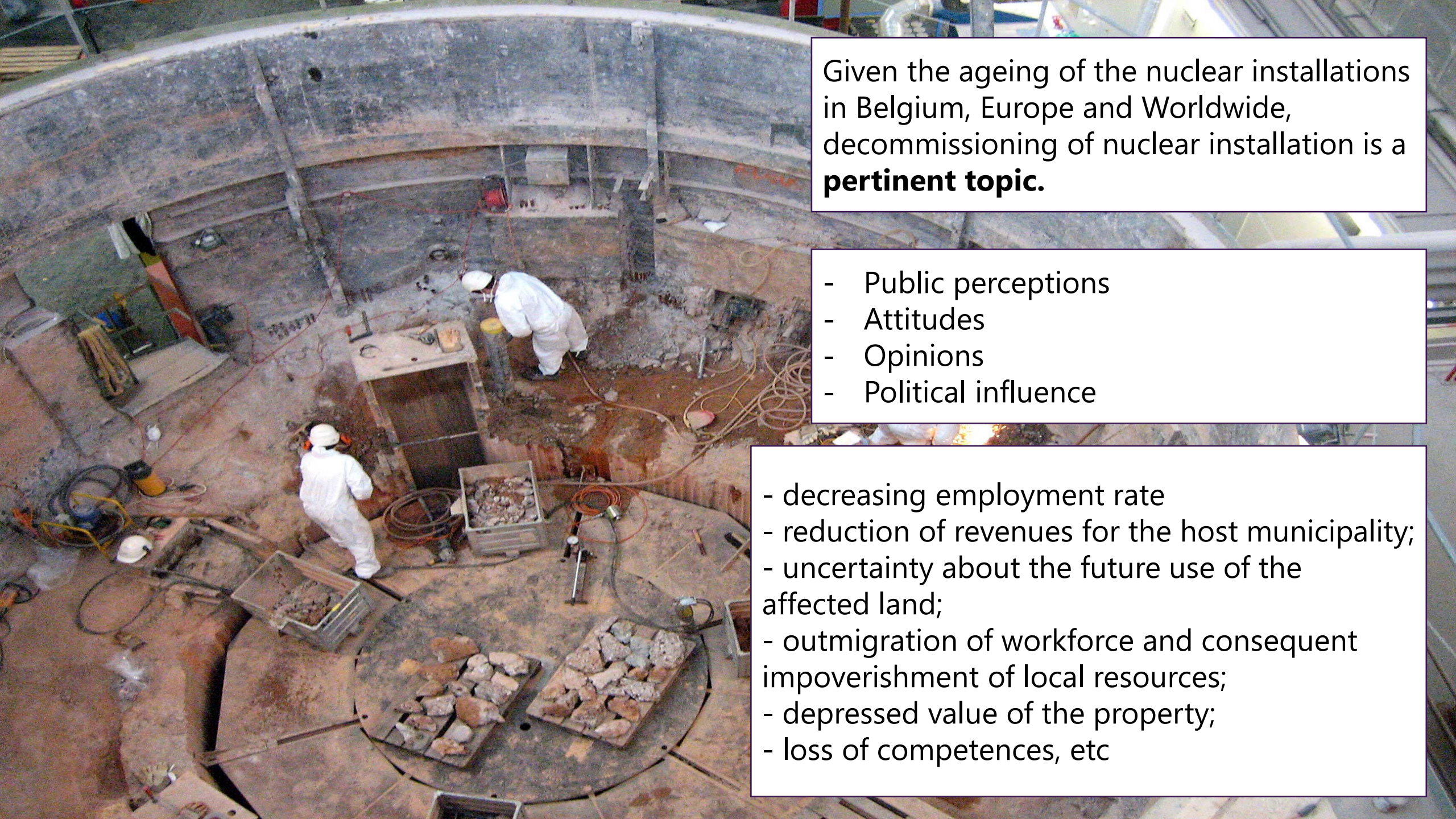

Given the ageing of the nuclear installations in Belgium, Europe and Worldwide, decommissioning of nuclear installation is a **pertinent topic.**

- Public perceptions
- Attitudes
- Opinions
- Political influence

- decreasing employment rate
- reduction of revenues for the host municipality;
- uncertainty about the future use of the affected land;
- outmigration of workforce and consequent impoverishment of local resources;
- depressed value of the property;
- loss of competences, etc

Belgian government confirms closure plans, looks to SMRs

23 December 2021

Share

Belgium's coalition government today said it has agreed to close its existing nuclear power plants by 2025, although it has left open the possibility to keep two units in operation beyond that if energy supplies cannot otherwise be assured. It will also continue to invest in nuclear technology research, including small modular reactors (SMRs).

Source: World Nuclear News

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Source: World Nuclear News

Belgium delays nuclear phaseout amid war worries

The Belgian federal government postponed a planned phaseout of nuclear power Friday, citing "a chaotic geopolitical environment" as the war in Ukraine disrupts energy markets across the European Union.

One reactor at both the Doel and Tihange nuclear power plants will have their lives extended by ten years, the government said in a press release. "This extension will strengthen our country's independence from fossil fuels in a chaotic geopolitical environment," it said.

Source: Politico

A vivid example of social links to a technical task

ISC: Restricted

Social scientists at SCK CEN- PISA group

SCK CEN BAROMETER 2015
- Face-to-face
- N= 1028

SCK CEN BAROMETER 2020-21
- Online: CAWI
- N= 1060

Cross-country comparison: Belgium & Germany
- Germany: Online
- N= 6822
- Partner: IASS, Potsdam

- Belgium: Online
- N= 1060

2015 | 2017-18 | 2020-21 | 2021 | 2021

SCK CEN BAROMETER 2017-18
- Face-to-face

2 samples:
<20 km- *Doel* NPP (N=159)
<20 km-*Tihange* NPP (N=156)

Experiment on psychophysical impact of uncertainty communication on emotions
- Combination of survey with psychophysical measurement of emotions
- N=134 (employees of SCK CEN, VITO and Belgoprocess)

Public attentiveness to nuclear power plants after they’ve permanently stopped producing nuclear energy

55% of Belgians in 2021 have never thought about what happens with an NPP after it has permanently stopped producing nuclear energy. However, there is a slight increase in last 6 years of people who have at least once reflected about this.

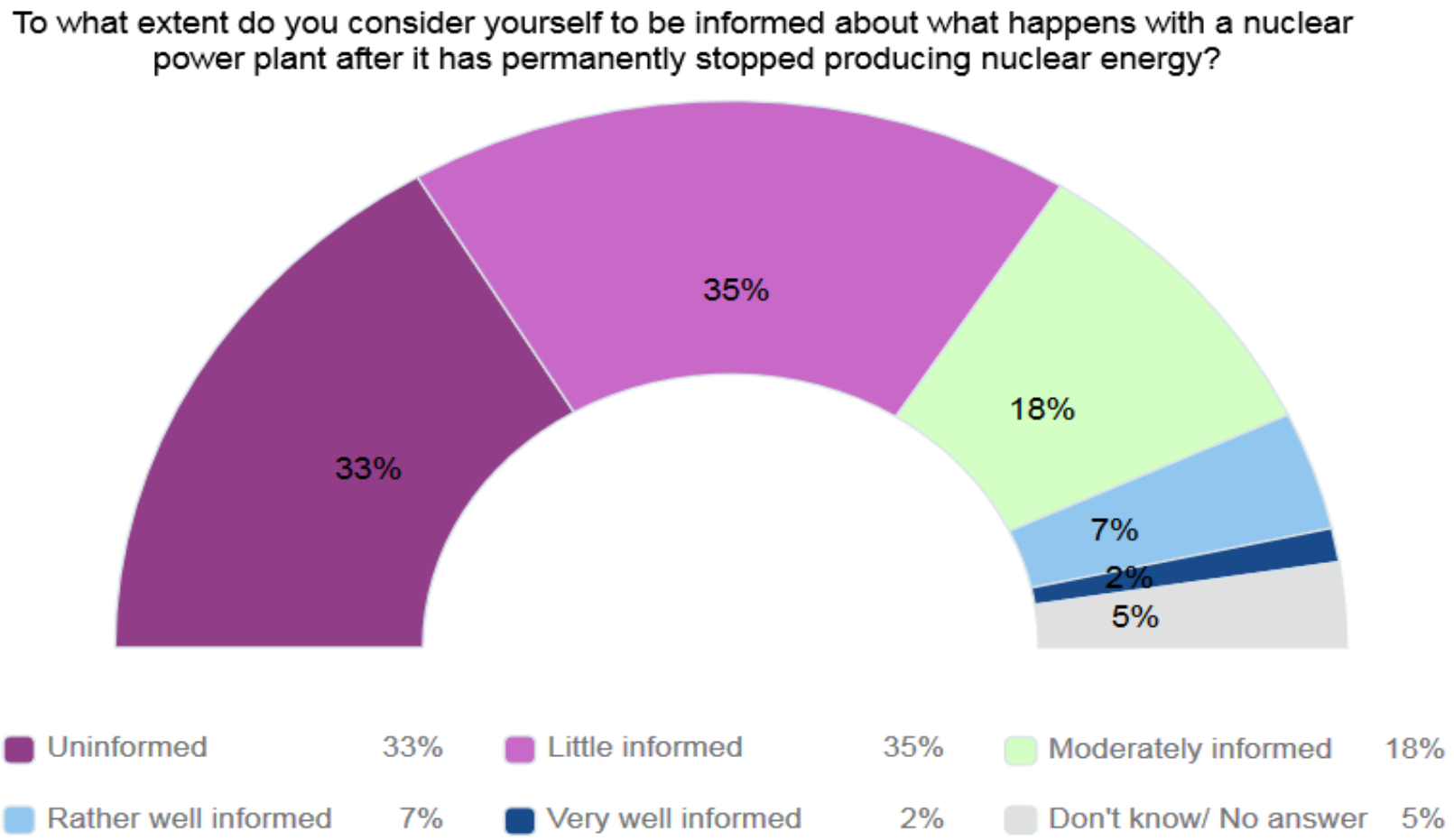
Have you ever thought about what happens with a nuclear power plant after it has permanently stopped producing nuclear energy?

Public reflection about what happens with a nuclear power plant after it permanently stops producing nuclear energy. (2021, N=1060; 2018, N=315; 2015, N=1028) samples are weighted.

Source: Hoti, F., Perko T. & Turcanu C. (2021): SCK CEN Barometer

ISC: Restricted

Belgium: Perceived level of information

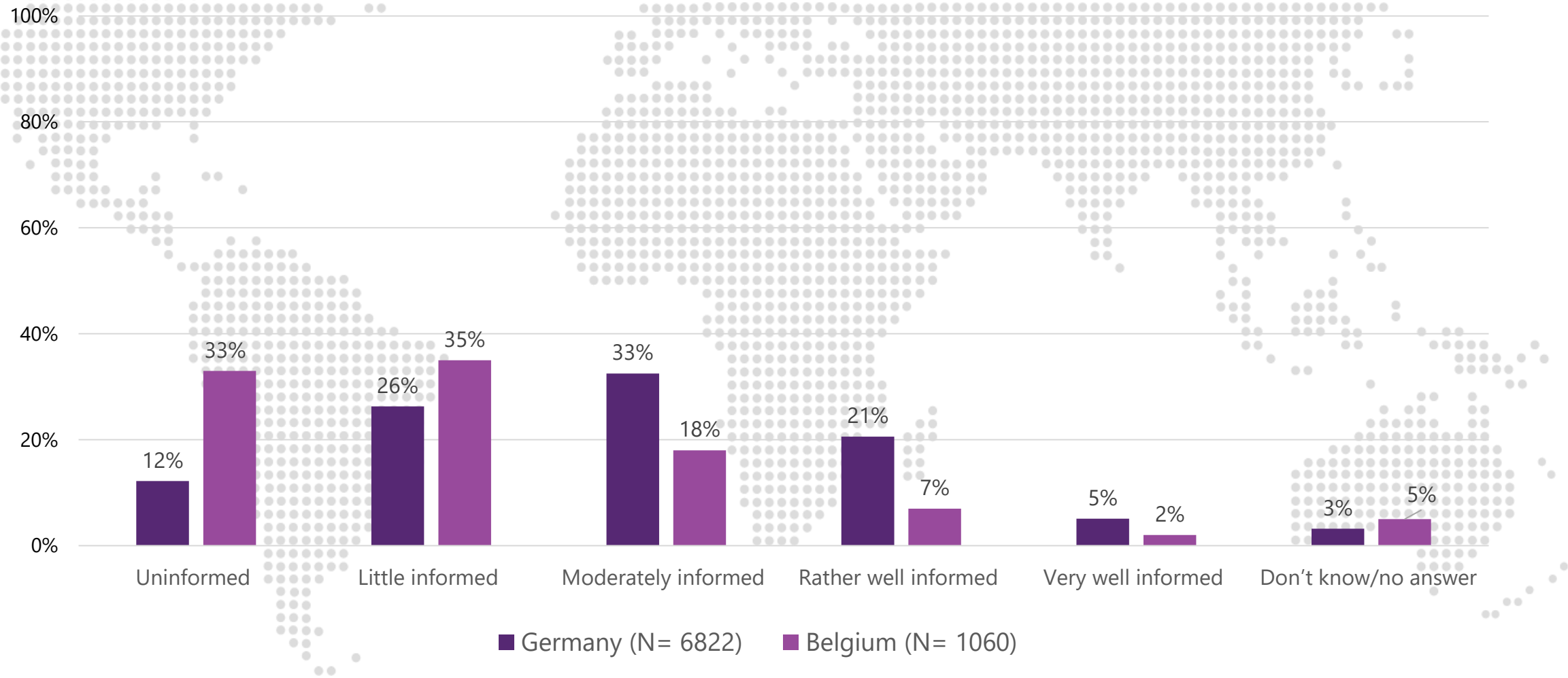


2021: *(N= 1060, weighted sample)*

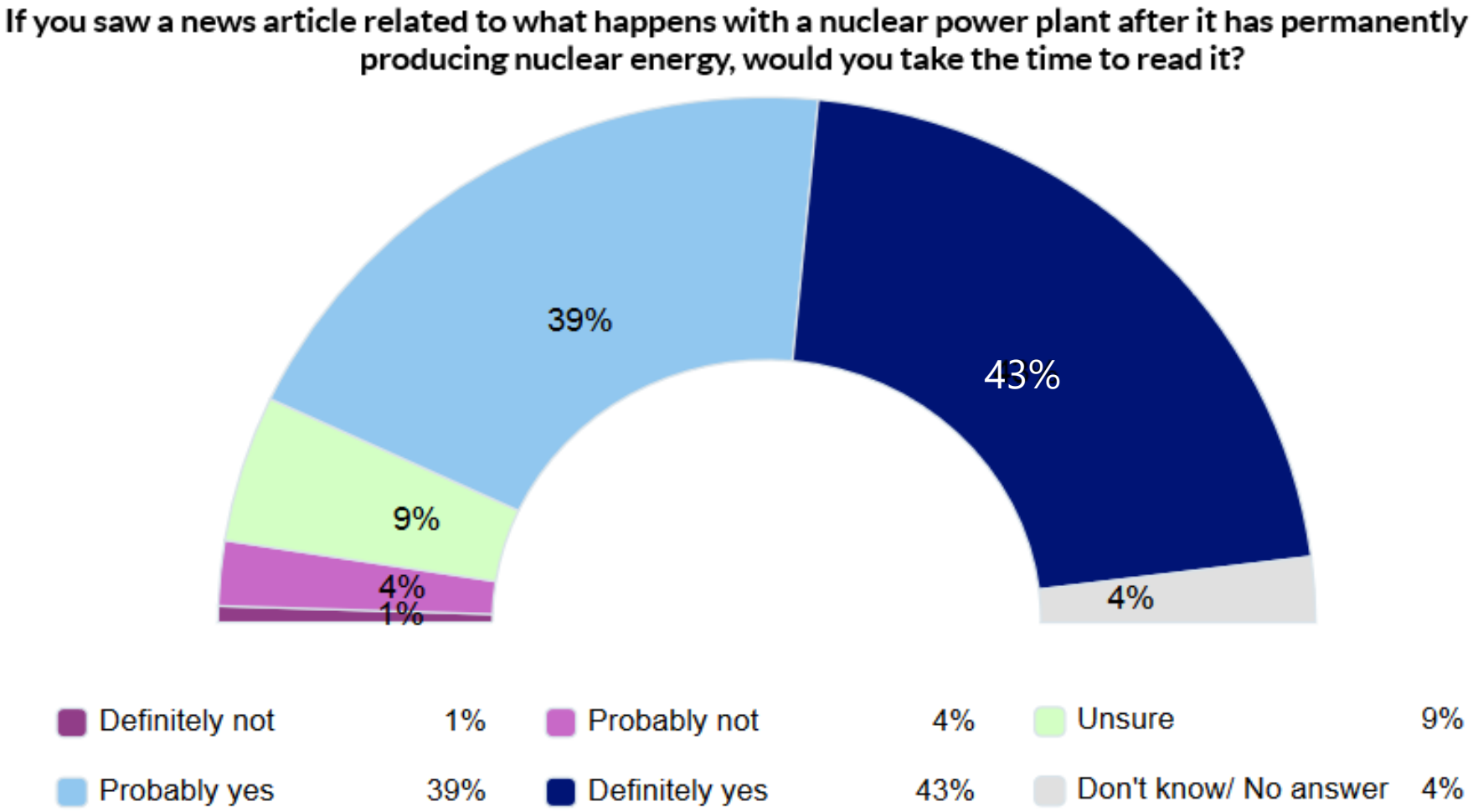
Source: Hoti, F., Perko T. & Turcanu C. (2021): SCK CEN Barometer

Germany-Belgium comparison: Perceived level of information

2021: To what extent do you consider yourself to be informed about what happens with a nuclear power plant after it has permanently stopped producing nuclear energy?



Interest in media information concerning NPPs after they permanently stop down producing nuclear energy



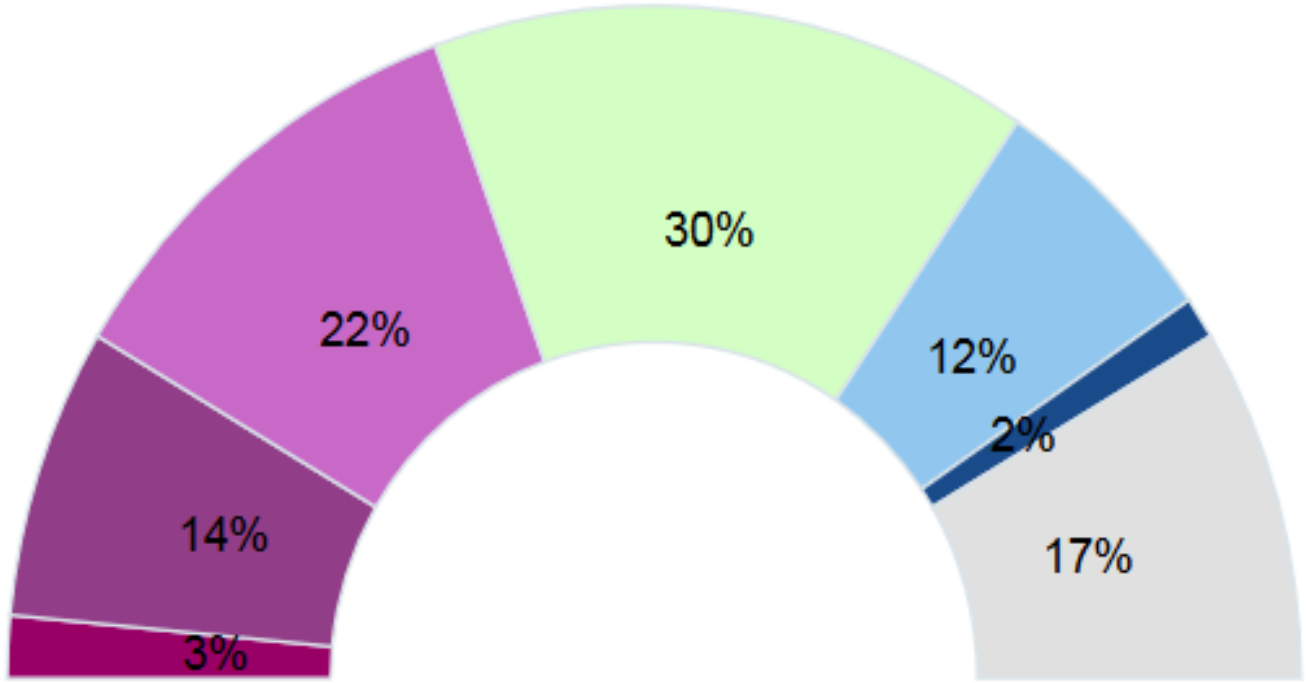
2021: *(N= 1060, weighted sample)*

Source: Hoti, F., Perko T. & Turcanu C. (2021): SCK CEN Barometer

ISC: Restricted

Perception of risks from nuclear power plants after they permanently stop producing nuclear energy

How do you perceive the potential risk to your health from nuclear power plants in Belgium after they have stopped producing nuclear energy?



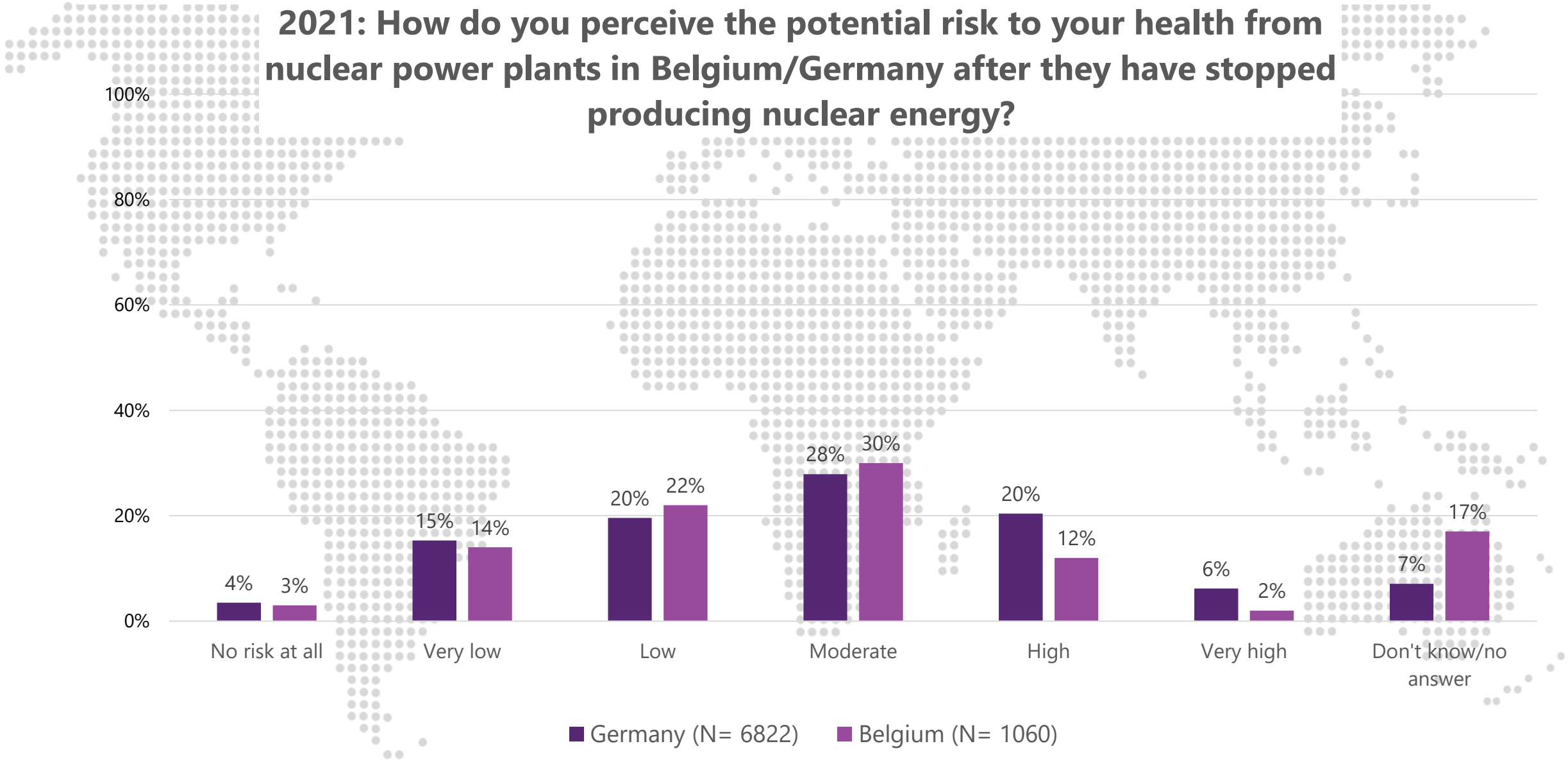
No risk at all	3%	Very low	14%	Low	22%
Moderate	30%	High	12%	Very high	2%
Don't know/ No answer	17%				

2021: *N= 1060, weighted sample*

Source: Hoti, F., Perko T. & Turcanu C. (2021): SCK CEN Barometer

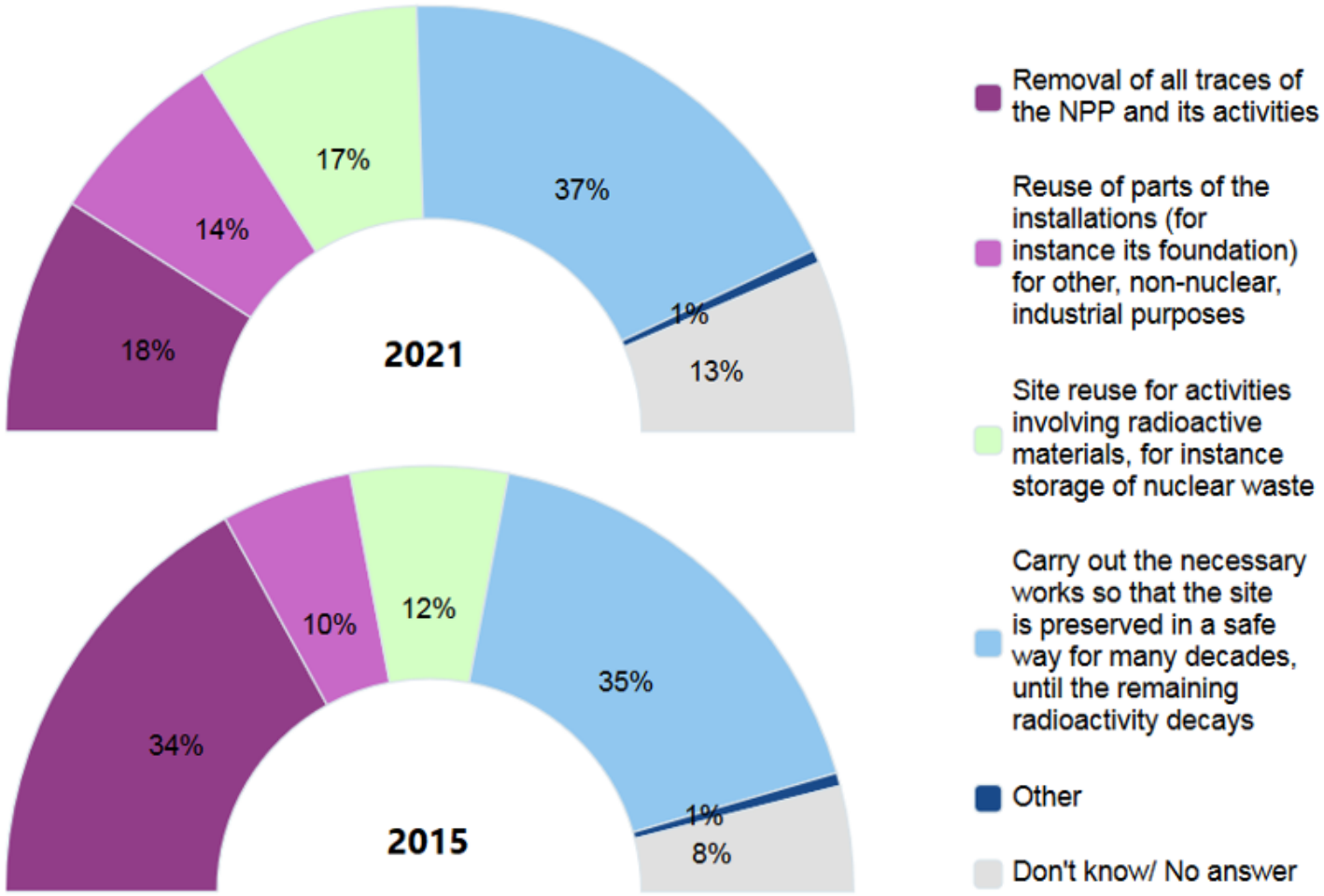
ISC: Restricted

Germany-Belgium comparison: Risk perception



Public expectations about the outcome of decommissioning

In your opinion, what should happen with Belgian nuclear power plants after they have permanently stopped producing nuclear energy?



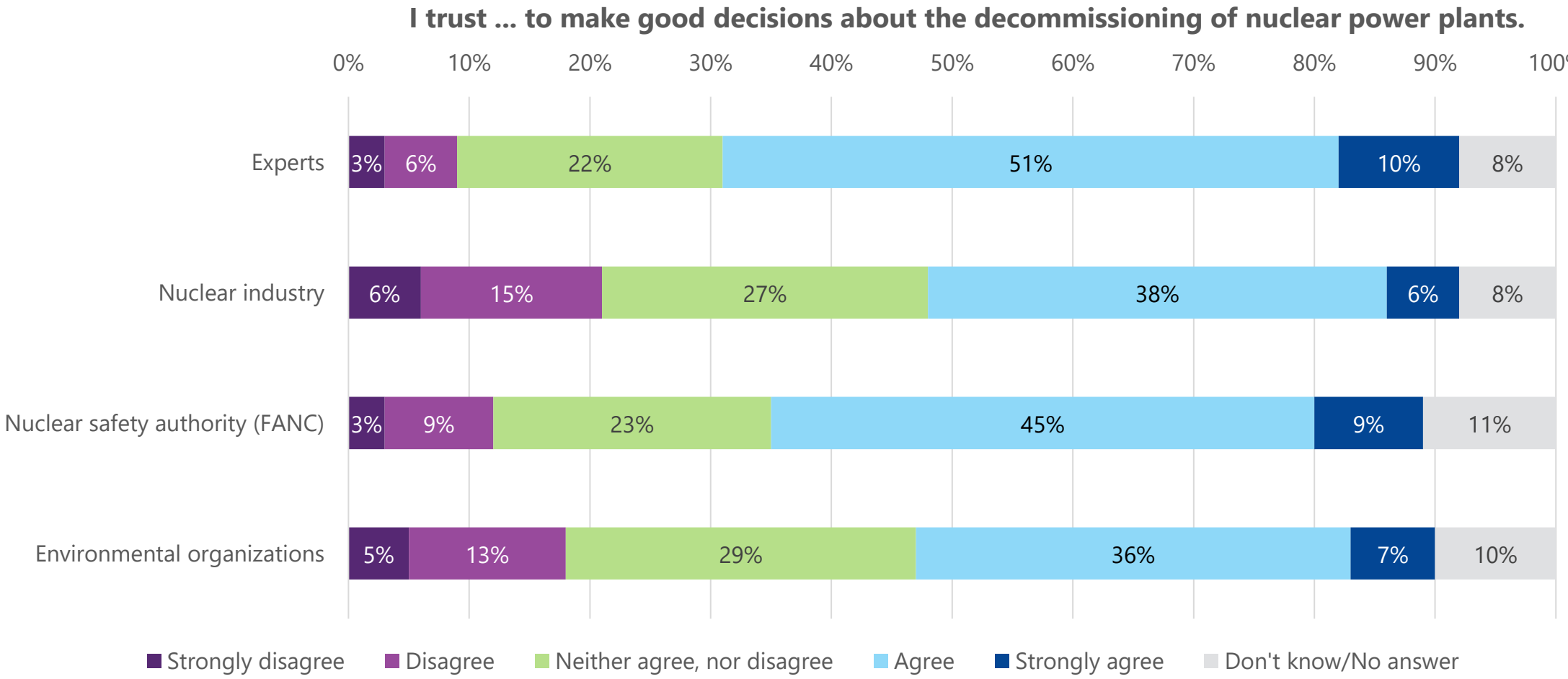
Similar positions among the local residents in 2017

Expectations about the outcome after they permanently stopped producing nuclear energy. (2021 N= 1060; 2015 N=1028), weighted samples

Source: Hoti, F., Perko T. & Turcanu C. (2021): SCK CEN Barometer

Trust in various actors to make good decisions about decommissioning

Trust in various actors to make good decisions about decommissioning

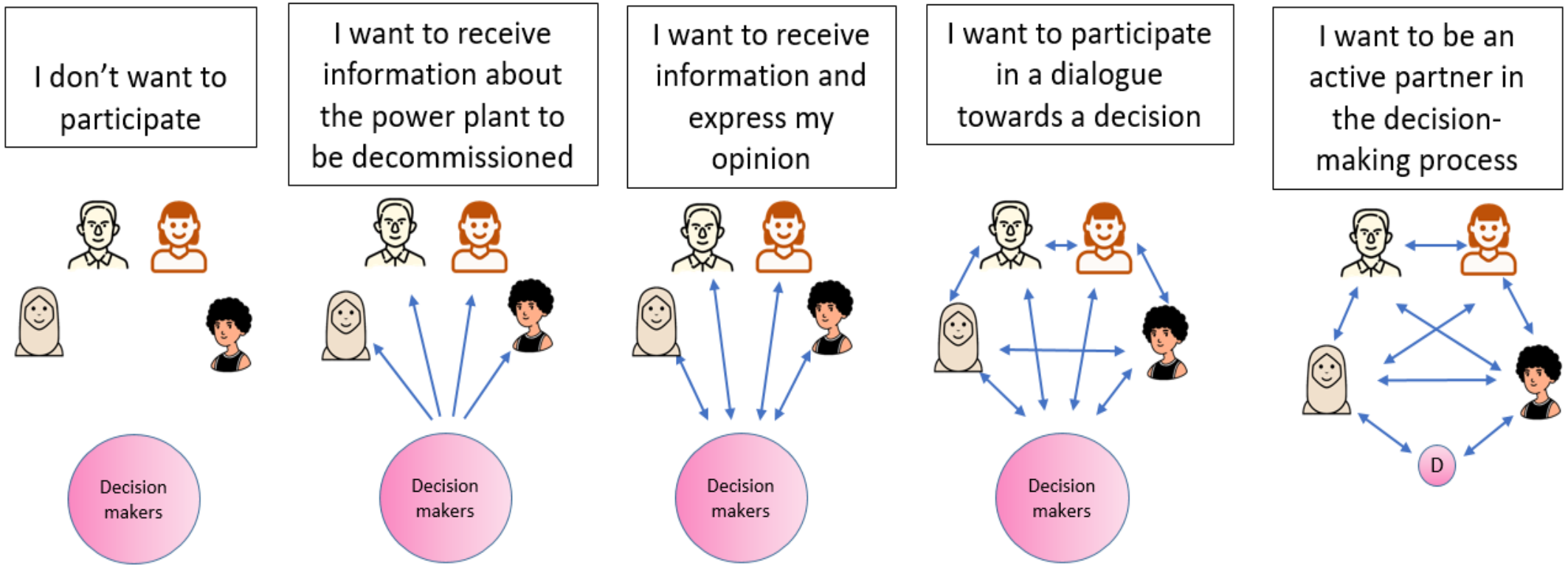


2021: *Trust in different actors to make good decisions about decommissioning. (N= 1060, weighted sample)*

Source: Hoti, F., Perko T. & Turcanu C. (2021): SCK CEN Barometer

Public participation intention concerning decommissioning

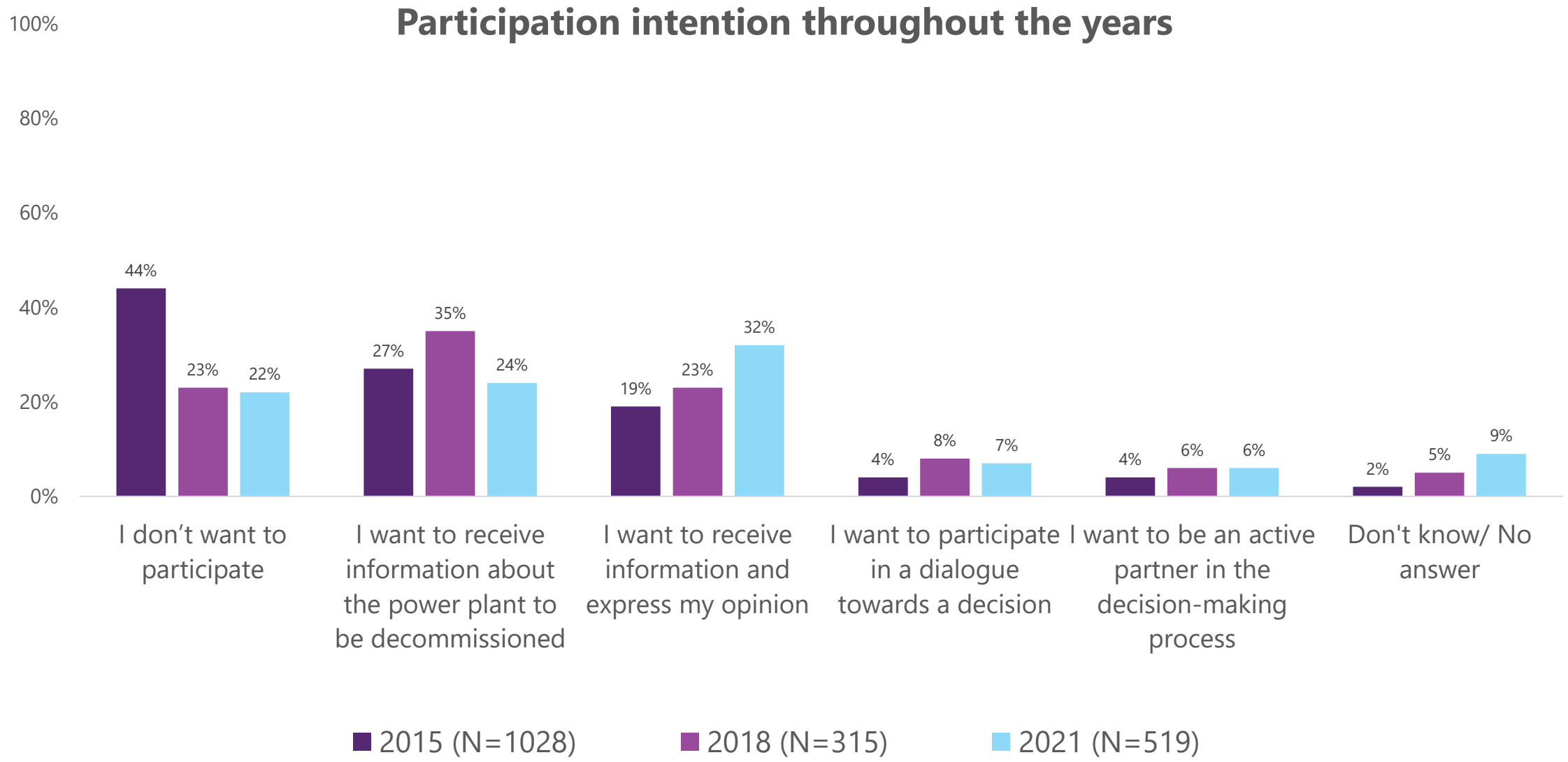
Q: If there is an initiative to involve citizens in the decision-making process concerning decommissioning of nuclear power plants in Belgium (offered at flexible dates and hours), and anybody could participate, to what extent would you like to do so?



Answering categories indicating level of participation intention used in Barometer 2021 (graphical card).

Source: Hoti, F., Perko T. & Turcanu C. (2021): SCK CEN Barometer

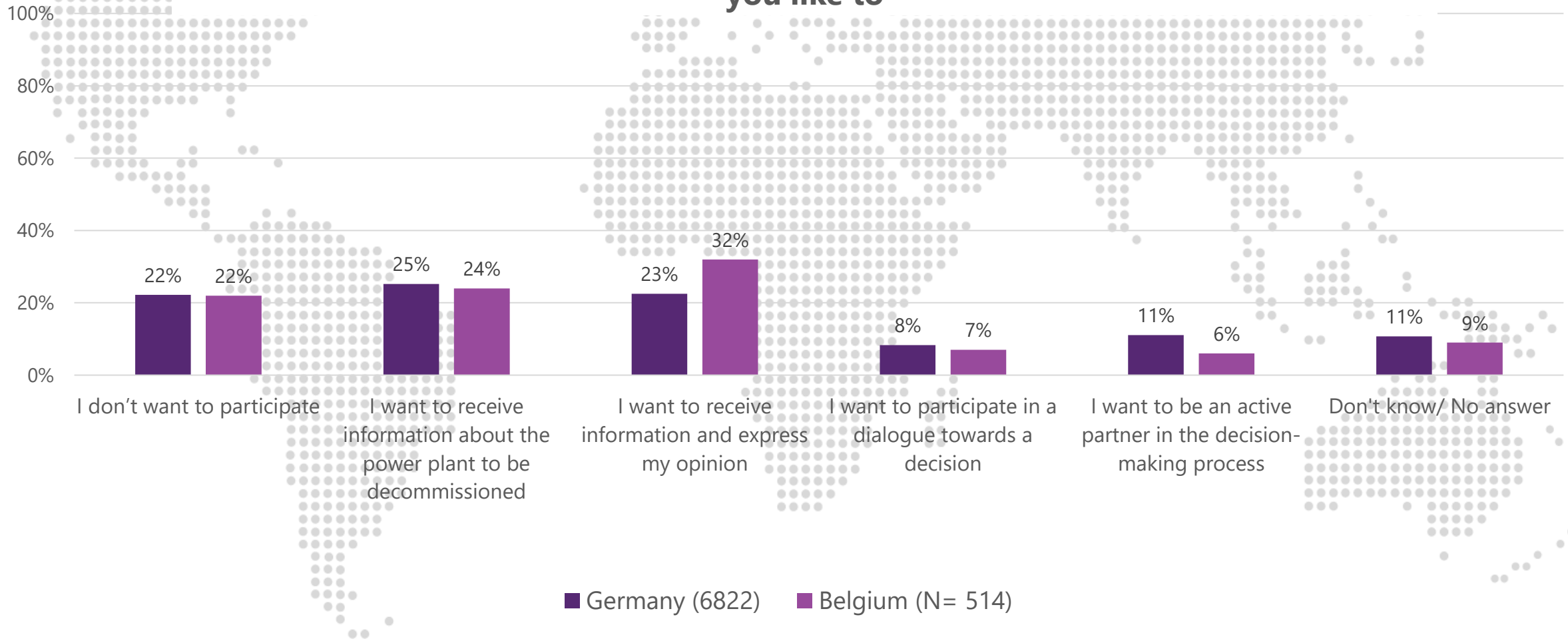
Intention to participate in decisions concerning decommissioning



(2021, N= 1060; 2018, N=315; 2015, N=1028), weighted samples

Germany-Belgium comparison: Public participation intention

2021: If there is an initiative to involve citizens in the decision-making process concerning decommissioning of nuclear power plants in Belgium/Germany (offered at flexible dates and hours), and anybody could participate, to what extent would you like to



Communication about uncertainty related to decommissioning
Survey embedded experiment

Citizens do not know what decommissioning or dismantling is

Challenge: How to explain it in a plain language for our survey?

"After they have permanently stopped producing nuclear energy, nuclear power plants must be decommissioned.

This entails four steps:

- *dismantling of the installation*
- *dismantling of the infrastructure,*
- *the remediation and clearance of the buildings,*
- *the demolition of these buildings.*

After these steps, the radioactivity is only present in the form of traces."

Source: Royal Decree, 2016

Survey embedded experiment: 4 experimental groups

Finally, experts are uncertain about the financial costs of decommissioning a nuclear installation.

Does uncertainty communication influence participation intention?

	Dependent variable: Participation intention (hypothetical scenario)				
Explanatory variable	Model 1	Model 2	Model 3	Model 4	Model 5
	Estimate	Estimate	Estimate	Estimate	Estimate
Gender	-.796***	-.797***	-.557**	-.594**	-.722**
Education	.104**	.105**	.104**	.087*	.138**
Experimental group		-.176	-.172	-.188	-.036
Perceived level of information					145
Interest					95*
Risk perception					48
Worry vs. Tranquility					36
Disinterest vs. Interest					61***
Anger vs. Calmness					051
Trust in different actors					004
It is my duty as a citizen to participate in such activities					33***
Attitude towards participation					536***
	N= 497 Pseudo-R^{2d}= .07	N= 497 P.-R^2= .07	N= 426 P.-R^2= .13	N= 378 P.-R^2= .27	N= 308 P.R^2= .46

Who?

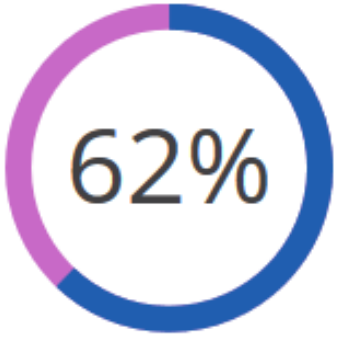
- **Men**
- **Higher educated**
- **More interested in the topic**
- **Civil duty to participate**
- **More positive attitude towards participation**

[a]1 = not involved; 2 = receive information; 3 = receive information and express opinion; 4 = participate in dialogue towards consensus; 5 = active partner.
[b]Ordinal logistic regression. Link function: logit. Bold font marks significant coefficients.
[c]The estimate gives the increase in log(odds), where the odds of an event with probability p is defined as odds(p) = $p/(1 - p)$.
[d]Nagelkerke's R2. A value closer to 1 means a better model.
*$p < 0.05$; **$p < 0.01$; ***p<0.001

2021: *Regression analysis with participation intention as DV*

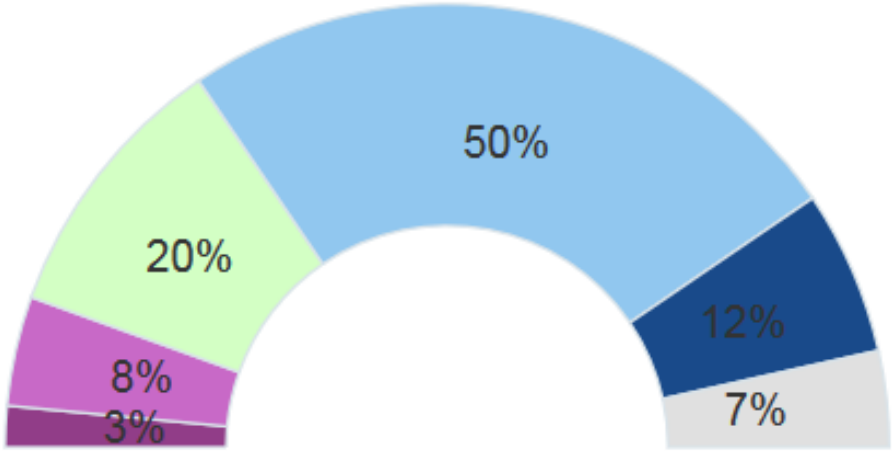
Source: Hoti, F., Perko T. & Turcanu C. (2021): SCK CEN Barometer

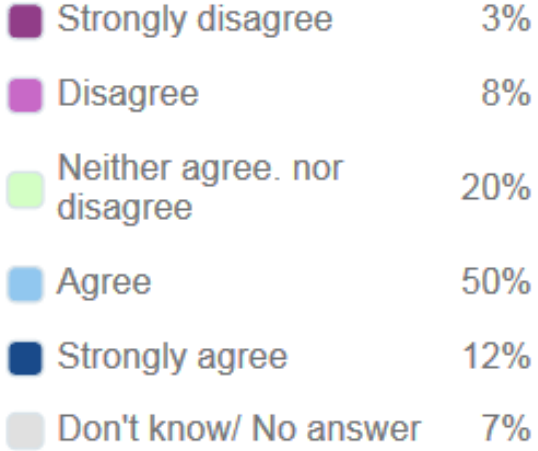
Preference for receiving uncertain information about decommissioning



of the participants **agree or strongly agree** that they want to be informed about the decommissioning of nuclear installations **even if some aspects are uncertain.**

I want to be informed about the decommissioning of nuclear installations even if some aspects are uncertain.





2021: *Preference for receiving uncertain information about decommissioning. (N= 1060, weighted sample)*

Source: Hoti, F., Perko T. & Turcanu C. (2021): SCK CEN Barometer

Emotions evoked by decommissioning

Research problem: communicating uncertainty

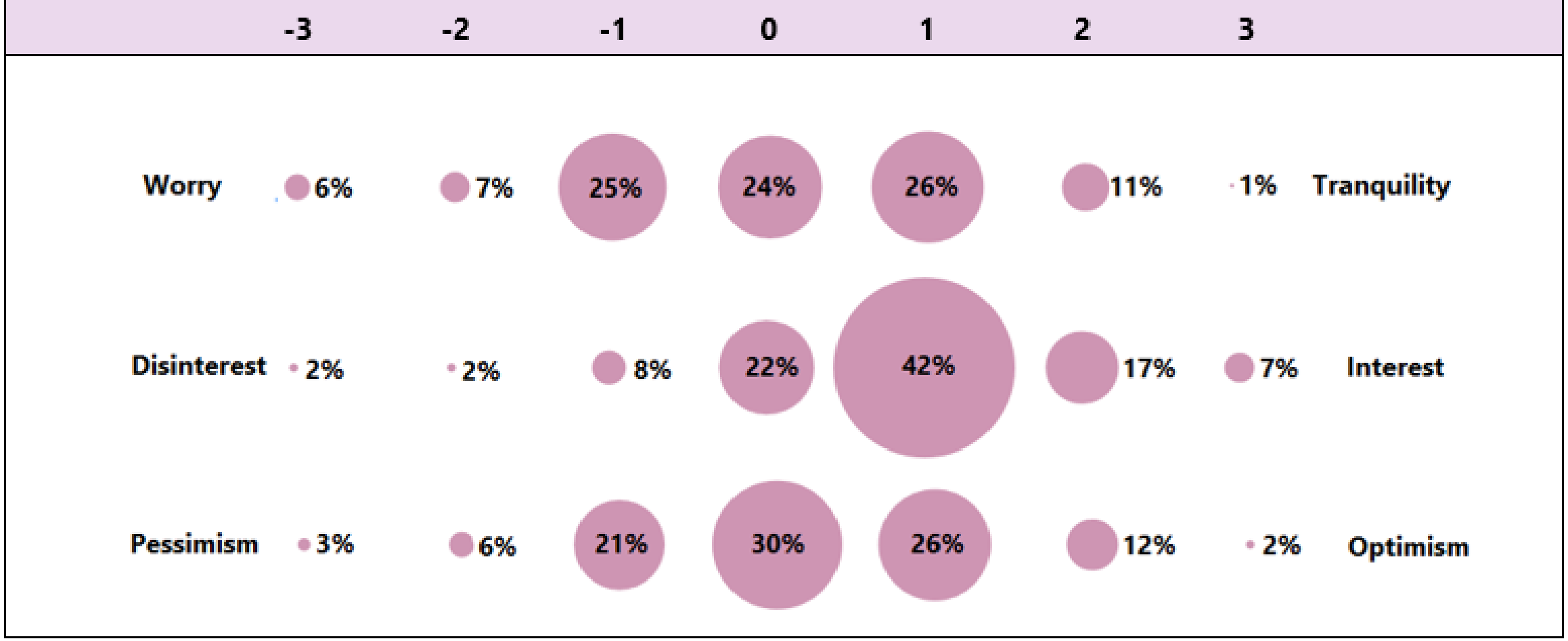
Emotions:

Increases concern: **(Visschers, 2018)**

Less fatalism and lower proneness to backlash **(Jensen et al., 2011)**

Feelings evoked by decommissioning

To what extent does decommissioning of nuclear power plants evoke the following feelings in you, if at all?



2021: *Feelings that decommissioning evokes amongst participants (N= 1060, weighted sample)*

More in-depth analysis of emotional reaction:

Psychophysiological experiment: Communication about uncertainty

Psychophysiological experiment: Uncertainty communication and participation intention

After they have permanently stopped producing nuclear energy, nuclear power plants must be decommissioned. This entails four steps: dismantling of the (1) installation and the (2) infrastructure, the (3) remediation and clearance of the buildings, and (4) the demolition of these buildings. After these steps, the radioactivity is only present in the form of traces.

However, experts are uncertain ...

... if the remaining radioactivity will be accepted by the public

... about the amount of radioactive waste that will be generated by decommissioning.

... about the financial costs of decommissioning a nuclear installation .

Psychophysiological experiment: Uncertainty communication and participation intention

Data collection
Combination of a short survey with psychophysiological measurement of arousal (approx. 10 min per respondent)

Equipment
shimmer 3-GSR, iMotions software

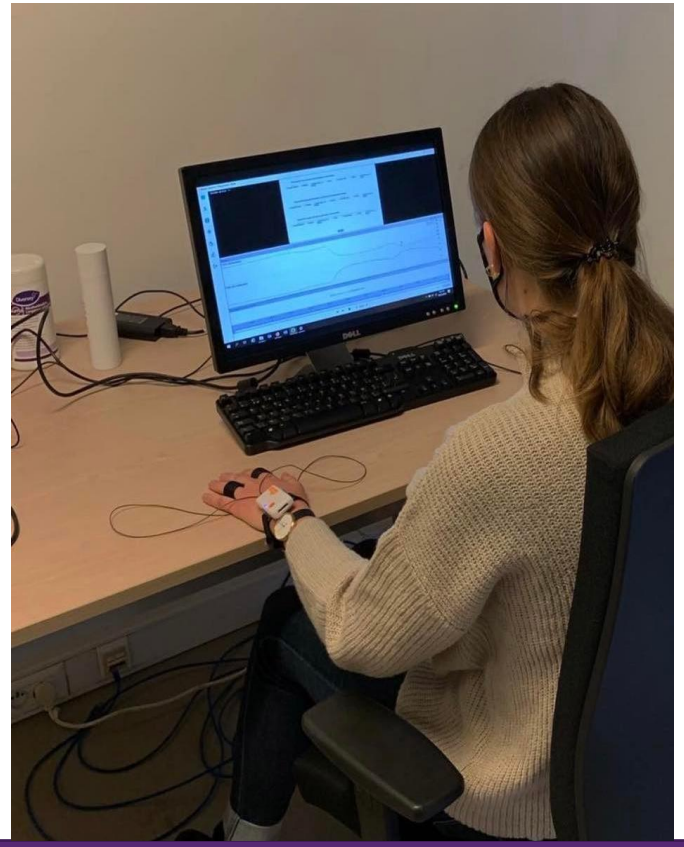
Measurement
Phasic skin conductance measurements
Questionnaire items (25 items)

Respondents
Employees of the Belgian Nuclear Research Centre (SCK CEN); VITO & Belgoprocess N=134

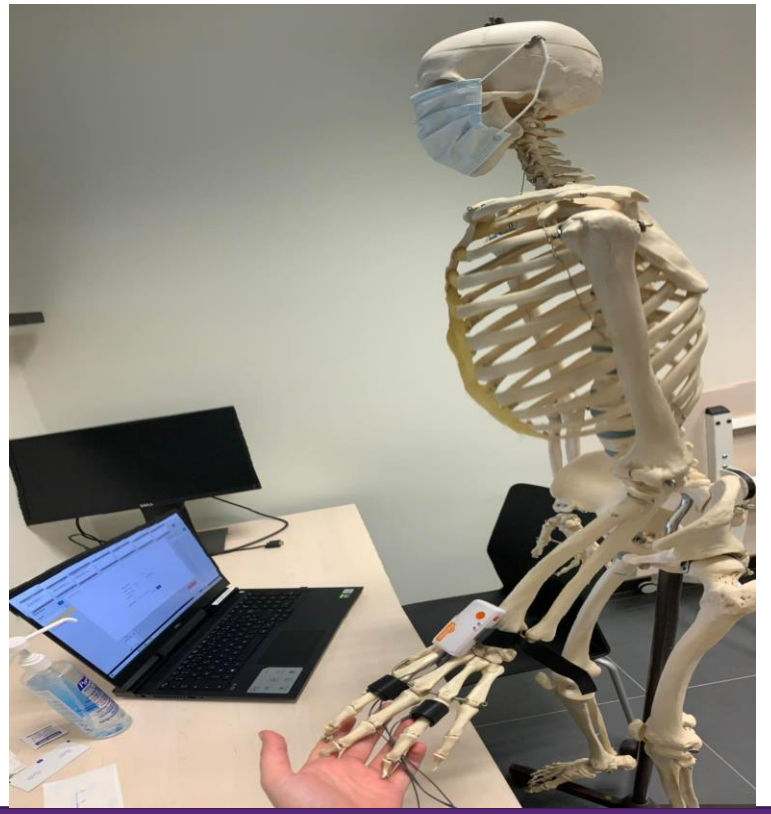
Sample:
Group 1. Employees that are not familiar with decommissioning
Group 2. Employees that are involved with at least one of the decommissioning procedures and/or are knowledgeable about it

Results: The impact of uncertainty communication on emotions

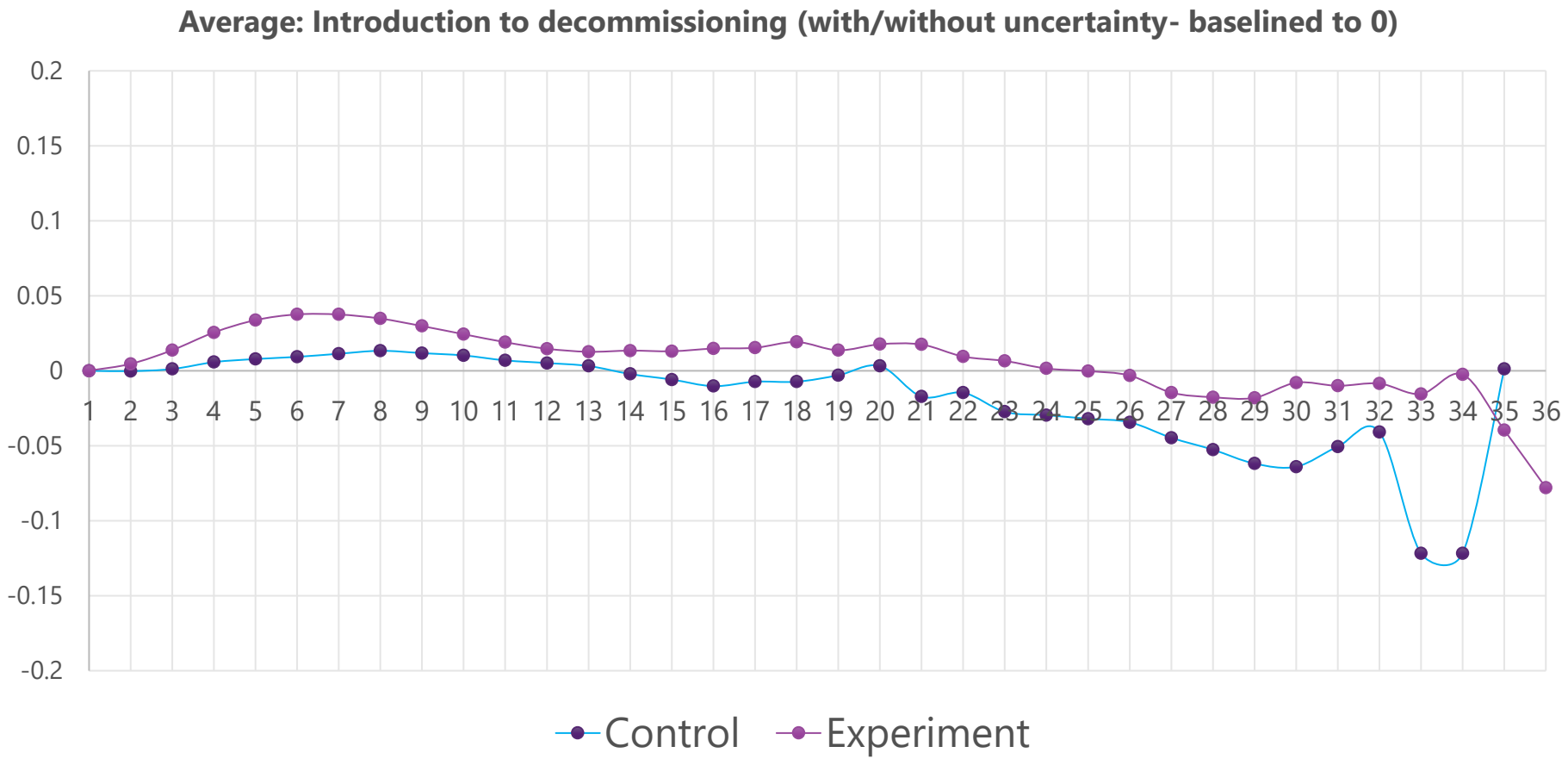
Before uncertainty communication



After uncertainty communication



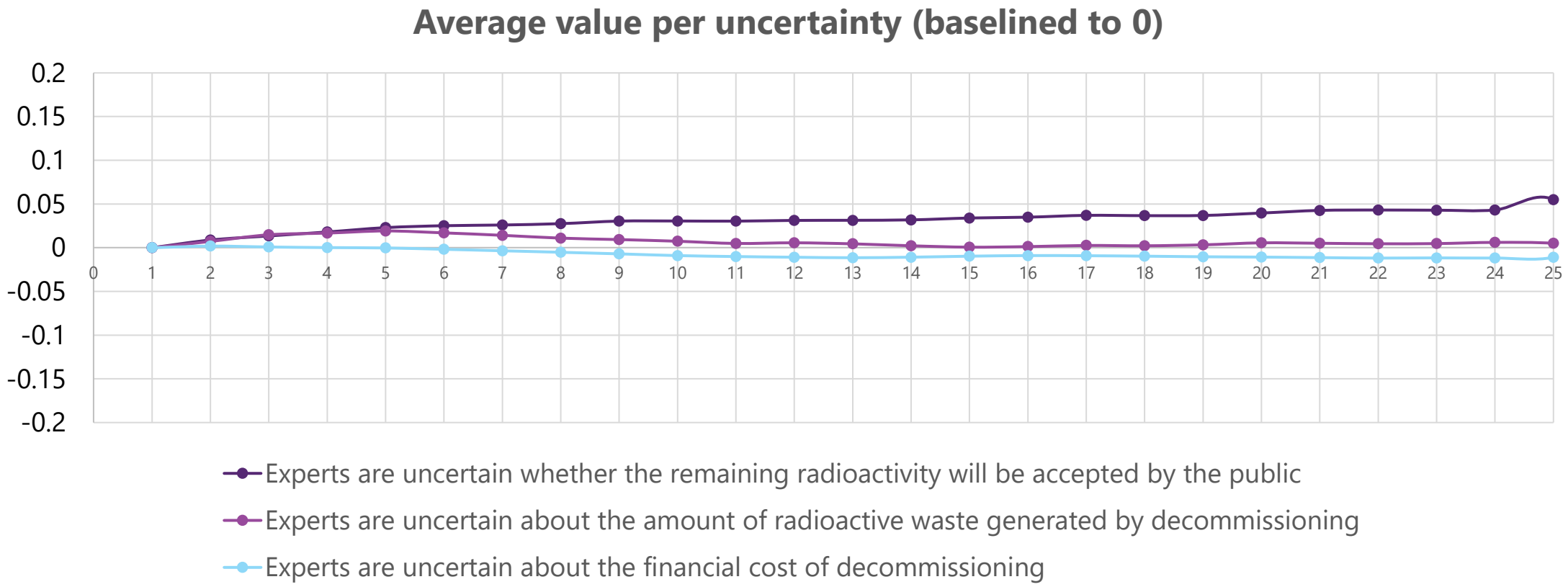
2021: Psychophysiological experiment: The impact of uncertainty communication on emotional arousal



The difference in arousal between control and experimental group (N= 134).

Source: Hoti, F. (2022). *The impact of uncertainty communication on emotional arousal and participation intention: The psychophysiological effects of uncertainties on experts.* (Under review)

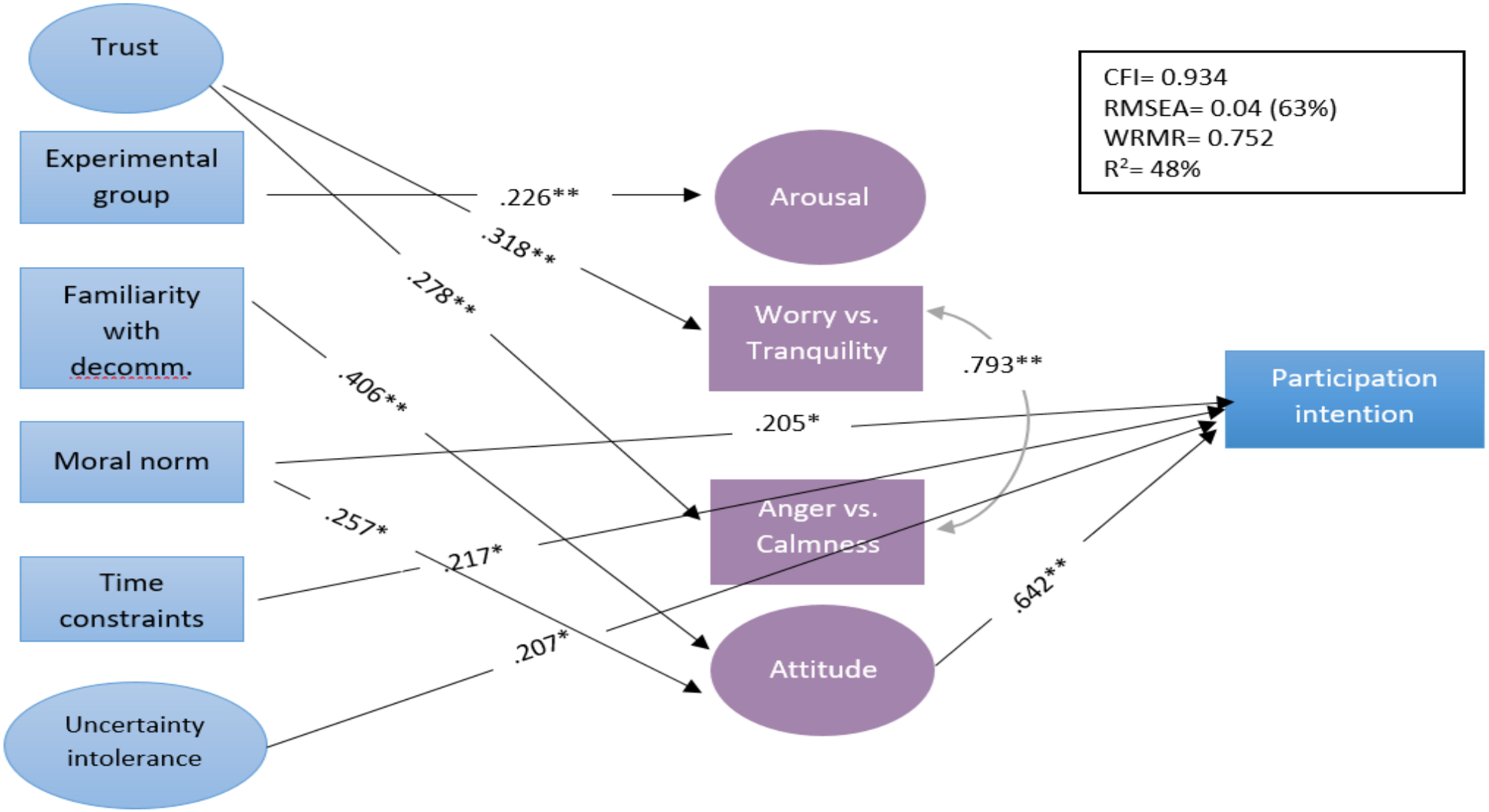
2021: The impact of uncertainty communication on emotional arousal



The difference in arousal across different types of uncertainties (N=134)

Source: Hoti, F. (2022). *The impact of uncertainty communication on emotional arousal and participation intention: The psychophysiological effects of uncertainties on experts.* (Under review)

What influences participation among SCK, VITO and Belgoprocess employees??



*SEM results including model statistics and only significant standardized pathways. *p < 0.05; **p < 0.01.; ***p < 0.001.*

Source: Hoti, F. (2022). *The impact of uncertainty communication on emotional arousal and participation intention: The psychophysiological effects of uncertainties on experts.* (Under review)

Conclusions

- Societal aspects of decommissioning are equally important to the technical ones.

- The public needs to be involved in the decision-making about decommissioning.
  - *Instrumental rationale: decrease conflict and increase acceptance of or trust*
  - *Normative rationale: Legitimacy*
  - *Substantive rationale: which argues that relevant wisdom is not limited to scientific specialists and public officials but mutual learning with laypeople is needed*

- The majority of citizens are willing to spend time to get informed but not to be engaged at a higher level.

- Scientific approach to societal aspects

- Open and transparent communication
  - Also about uncertainties.

Thank you very much for your attention!

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