RadoNorm pilot study report
from public opinion survey, Belgium 2020-2021

Development of a modular questionnaire for investigating societal aspects of radon and NORM

Work Package 6, task 6.1

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Document information

Project Acronym	**RadoNorm**
Project Title	**Towards effective radiation protection based on improved scientific evidence and social considerations - focus on radon and NORM**
Project Type	**RIA**
EC grant agreement No.	**900009**
Project starting / end date	**1st September 2020 – 31 August 2025**
Work Package No.	**WP6**
Work Package Title	**Societal aspects**
Subtask	**task 6.1**
Lead Beneficiary	**SCK CEN and UA**
Actual Delivery Date	**11. 11. 2021**

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Acknowledgement

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 2

Executive Summary

The most widespread quantitative tool for social scientific data gathering is a survey. Surveys –if designed and executed properly- allow for the projection of information gathered among a sample of respondents to the broader population to which this sample belongs. The focus is on gathering data which is generalizable to a larger population, through standardized procedures and questions. However, there are important variations in how surveys can be set up and applied, ranging from the sampling method to the content of the questions and the ways in which they will be presented to respondents.

The development of quantitative tools in RadoNorm WP6 therefore aims to design and test surveys which provide implementable and valid means for assessing populations' perceptions, opinions, awareness, motivations, attitudes and behaviours with regard to radon and NORM. Surveys will be applied and tested in eight different European countries. A first test, the pilot study, took place at the end of 2020 in Belgium.

This working document reports results from this pilot study on public opinion survey(s) conducted in Belgium. The document provides information of a technical / statistical nature in order to evaluate and improve radon measurement scales, in general, and RadoNorm questionnaires, in particular.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 3

Table of content

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 4

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 5

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 6

RadoNorm questionnaire for investigating societal aspects of radon and NORM

1. Introduction

The development of quantitative tools in RadoNorm WP6 aims to design and test surveys which provide implementable and valid means for assessing populations' perceptions, opinions, awareness, motivations, attitudes and behaviours with regard to radon and selected aspects of NORM. Surveys will be applied and tested in eight different European countries. A first test, the pilot study, took place at the end of 2020 in Belgium. This document report on scale development, validity and indicates future improvements.

2. Methodology

There were two surveys conducted for RadoNorm in Belgium. In the first one, a complete survey was dedicated to radon and measured different concepts potentially influencing radon related behaviours (test and mitigate). In the second survey, particular items related to radon and NORM were included as a dedicated part or separate items in a broader research project, the SCK CEN Barometer 2020-2021. SCK CEN Barometer is a large-scale public opinion survey involving topics such as perception of various radiation related risks, confidence in risk regulators, as well as detailed research sections on specific topics, such as radon.

In both surveys, the data were collected using mail-to-web data collection. This method entails inviting people by mail to participate on our online survey whose link they could find in the invitation letter. The reason why the data collection method has been changed from the previous intentions is that due to the COVID-19 situation and its related measures, it was not possible to conduct face-to-face interviews.

Survey 1: Mail to Computer-Assisted Web Interviewing (CAWI) from **stratified random sample**, representative with stratification in terms of the total number of inhabitants in Wallonia's municipalities with a high radon concentration (class 1b, 2a and 2b). The final sample of this survey consists of **N=300** respondents and is representative for the (18+) Belgian population living in Wallonia's municipalities in high radon prone area, with respect to gender and age. Response rate was 7.6%. The interviews had an average duration of 15 minutes and were conducted in the period of December 2020 and January 2021 in French language.

Survey 2: Mail to Computer-Assisted Web Interviewing (CAWI) was conducted with **N = 1060** respondents selected from **stratified random sample**, representative with stratification in terms of the total number of inhabitants in the Belgian municipalities. Response rate was 6.6 %. The final sample is representative for the (18+) Belgian population with respect to gender, age, level of urbanisation of the living habitat and province. The interviews had an average duration of 25 minutes and were conducted in the period of December 2020 and January 2021 in Dutch and French languages.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 7

2.1 Ethical approval and scientific supervision of the study

2.1.1 Ethical approval

The ethical approval for this study was issued by the ethical committee of the University of Antwerp in Belgium on 16th of December, 2020 (dossier number: SHW_20_77). This ethical committee reviewed and approved the following documents: the methodology of the study; invitation letter; consent form; the full questionnaire as well as the handling and processing of the contact information of the participants. (See the RadoNorm deliverables D9.1 and D9.3 [1][2]). The European Code of Conduct for Research Integrity[3] and Research Ethics in Ethnography/Anthropology[4] was applied to this research.

2.1.2 Steering committee

A meeting with the scientific steering committee of the SCK CEN Barometer was held online due to COVID-19 measures on 8th and 9th of May, 2020. The main purpose was to improve the scientific quality of the questionnaire by collecting general feedback and advise on the (preliminary) questionnaire as well as have a quality check for each of the items in the survey. The steering committee consisted of 5 members, each of them expert on specific aspects such as public opinion survey methodology, social behavior, risk perception and nuclear waste policy and research. These members where: Prof. Dr. Britt-Marie Drottz Sjøberg (Norwegian University of Science and Technology, Norway), Prof. Dr. Ortwin Renn (University of Stuttgart, Germany), Prof. Dr. Peter Thijssen (University of Antwerp, Belgium), Dr. Frank Hardeman (Federal Agency for Nuclear Control, Belgium), and Mr. Geert Volckaert (Federal Agency for Nuclear Control, Belgium). In this meeting participated also the three principal investigators from SCK CEN and RadoNorm, Dr. Catrinel Turcanu, Dr. Tanja Perko and PhD. Candidate Ferdiana Hoti.

2.1.3 Consultations with RadoNorm members

There were two on-line consultations with WP6 members, task 6.1 related to the questionnaires. The following topics were discussed: objectives of the questionnaires, content, concepts, introduction text, items wording, answering categories and sequence of items. The questionnaires discussed were in English language and translated in a later stage for a pilot study. Two members of the RadoNorm ethical committee participated to the final questionnaire consultation as well.

2.2 Pilot Study

A pilot study with 20 respondents was carried out as a pre-test of the survey in the period of June - July, 2020 with an online version of the questionnaire. The pilot study was conducted with new employees of the Belgian Nuclear Research Centre (SCK CEN) as well as with doctoral and postdoctoral researchers from University of Antwerp. It tested the radon related questions for both survey 1 and survey 2. Prior to respondents starting to fill in the questionnaire, the interviewers made an introduction that briefly explained the purpose of the study and also included messages that are known to encourage people to respond: (a) assure the respondents that data will remain anonymous; (b) explain the purpose of the pilot study; (c) explain the selection of the respondents (if requested); (d) communicate the estimated

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[1] Perko T., Geysmans R. et al (2020): Requirement No. 1 - Copies of opinions/approvals by ethics committees and/or competent authorities, D9.1, RadoNorm

[2] Perko T., Geysmans R. et al (2020): Templates of the informed consent forms and information sheets, D9.3, RadoNorm

[3] ALLEA - All European Academies, "The European code of conduct for research integrity (revised edition)," Promot. Res. Integr. a Glob. Environ., 2017.

[4] R. Iphofen, "Research ethics in ethnography/anthropology," 2011.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 8

time needed to fill in the questionnaire (initial estimation: 35 min); (e) emphasize that all the respondents' comments will be analysed together with the interviewer in individual discussions.

The questionnaire of the pilot study was offered in 3 languages (i.e. English, Dutch and French). 12 of the respondents chose for the Dutch version, 8 of them chose the English version, and 2 of them chose the French version of the questionnaire.

When filling-in the questionnaire, respondents were also asked to write comments next to the questions, if necessary. Online individual discussions with the interviewers were held with each respondent and this helped identifying any problems, e.g. terms or phrases that were confusing or questions that were deemed too difficult to answer. In addition, this allowed verifying that the questions were interpreted in the same way by different respondents.

A qualitative analysis of the comments obtained was used to produce improved version of the questionnaires. Every comment of the pilot study respondents was discussed and considered by the principal investigators for the final version of the improved questionnaire.

2.3   Questionnaires

Survey 1: The sequence of the topics included in the radon questionnaire is: 1) Socio-demographic items (9 items); 2) Risk perception and confidence in authorities (12 items); 3) Uncertainty preference (8 items); 4) Items measuring determinants for radon related behaviour (41 items); 5) Actors in the nuclear field (18 items); 6) Knowledge about the nuclear domain and perception of radiation risks (8 items);

The figure below visually presents the sequence of the topics included in the RadoNorm questionnaire.
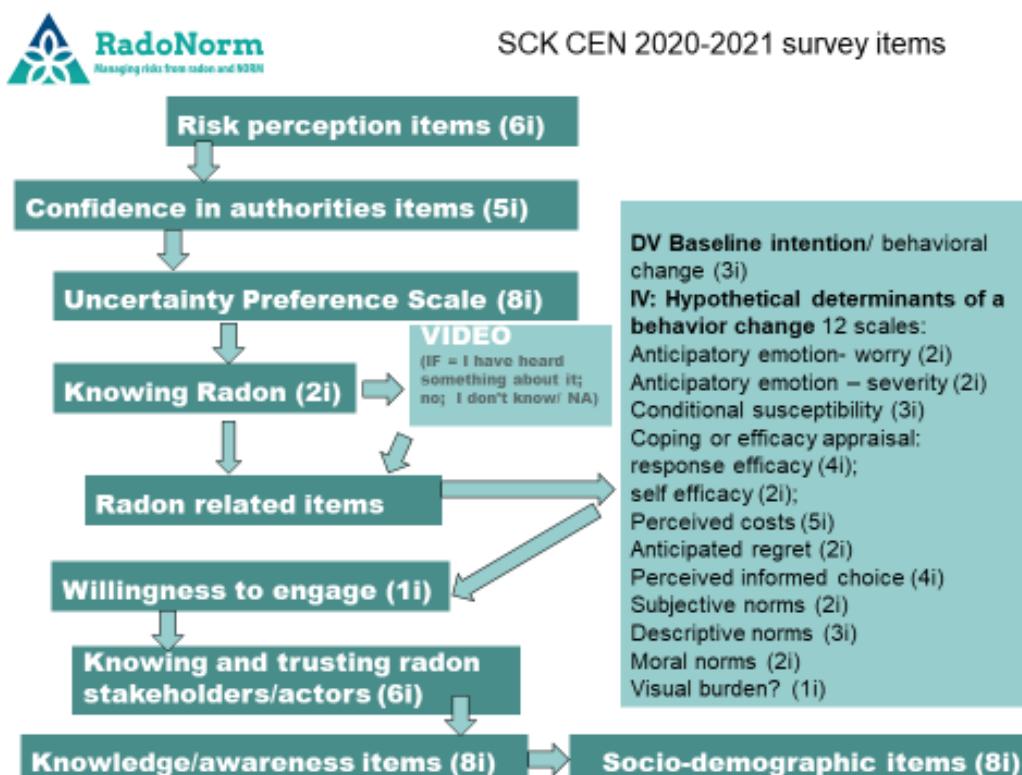
Figure 1. The sequence of sections in the questionnaire applied in high radon prone area.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 9

Survey 2: The complete sequence of sections in the Barometer 2021 questionnaire is: 1) **Socio-demographic items** (10 items); 2) **Risk perception and confidence in authorities** (30 items); 3) **Uncertainty preference** (8 items); 4) **Attitude towards science and technology** (5 items); 5) Attitude towards nuclear energy (8 items); 6) Confidence in the management of nuclear technologies (5 items); 7) **Knowing actors in the nuclear field and their trustworthiness and competences** (18 items); 8) Decommissioning of nuclear installations (26 items); 9) Radioactive waste (18 items); 10) Emergency situations (9 items); 11) **Knowledge about the nuclear domain** (10 items); and 12) **Intolerance for uncertainty** (6 items). Sections indicated in bold included items relevant to the RadoNorm project.

The figure below visually presents the sequence of the topics included in the Barometer 2020-2021 survey.
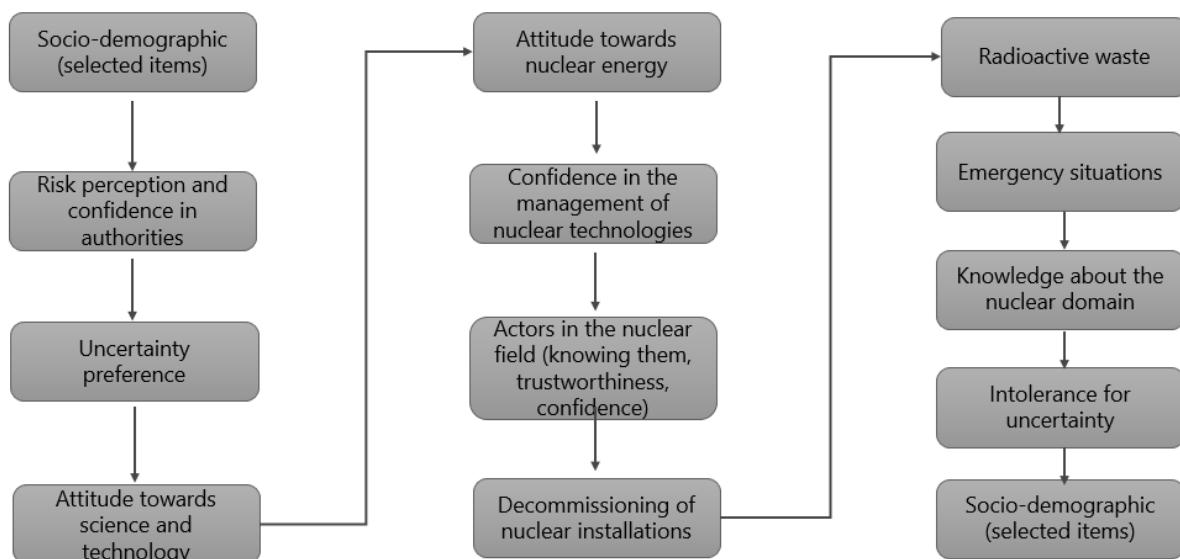
Figure 2: **The sequence of sections in the questionnaire applied in the whole Belgian territory.**

2.3.1   Formulation of survey items

Most items in the survey are formulated as questions or statements, with answering categories expressed by means of Likert-scales and/or adjusted to the context of the statement or question. Agreement with a statement is typically measured on a scale ranging from "strongly disagree", through to "disagree", "neither agree, nor disagree", "agree", to "strongly agree". The answering category "Other" was included for all closed questions with predefined answering options in order to ensure completeness. The option of "no answer" or "I don't know" was also available.

In addition, great attention was given to the translation of the questionnaire in French language for Survey no.1 and in French and Dutch for survey no.2, in order to assure the equal understanding of statements and questions investigated. For this purpose, official translation has been done by a Belgian translation company (M&M translations- Belgium). In addition, native speakers were also asked to verify the translations to the French and Dutch language. The English version of the survey, reported here, was proof-read by the RadoNorm partner EPA, Ireland. Selection of the opinion research company for the field work.

Selection of the public opinion research company to carry out the field work followed the standard procedure for tendering, with technical specifications drafted by the SCK CEN team. The criteria for the evaluation of offers included the following: 1) cost (weight 0.5); 2) methodological approach including

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 10

clarity of the offer, sampling adequacy, information about the sampling provide, possibility to randomize the order of questions in certain sections, data collection for open questions, software utilized and possibility for the SCK CEN team to test the software used for the field work, recruitment of respondents, planning and preparation of field work, reporting of results (weight 0.25); 3) professionalism of the company with similar research (weight 0.1); and 4) quality control, e.g. quality control of field work, possibility for SCK CEN for control during field work, control of data collection, and control of sampling (weight 0.15).

Based on the evaluation of two offers received, KANTAR – Belgium was selected for the field work.

2.3.2 Sampling of households and representativeness of respondents

Survey 1 : Sampling of households in the radon prone area

The (gross) sample of households was randomly drawn by Kantar from the central reference address files in Wallonia (ICAR). A sample of n = 300 inhabitants 18+ from municipalities in Wallonia with a high radon concentration (class 1b, 2a and 2b) has been realized. The respondents were contacted by invitation letters sent by mail. The letters included a link and a special code to participate on the RadoNorm online survey. Within each randomly selected household that received the invitation letters, the last birthday person in the household (+18) was asked to participate in a study using the link to the online survey and a unique code to log in to the questionnaire.
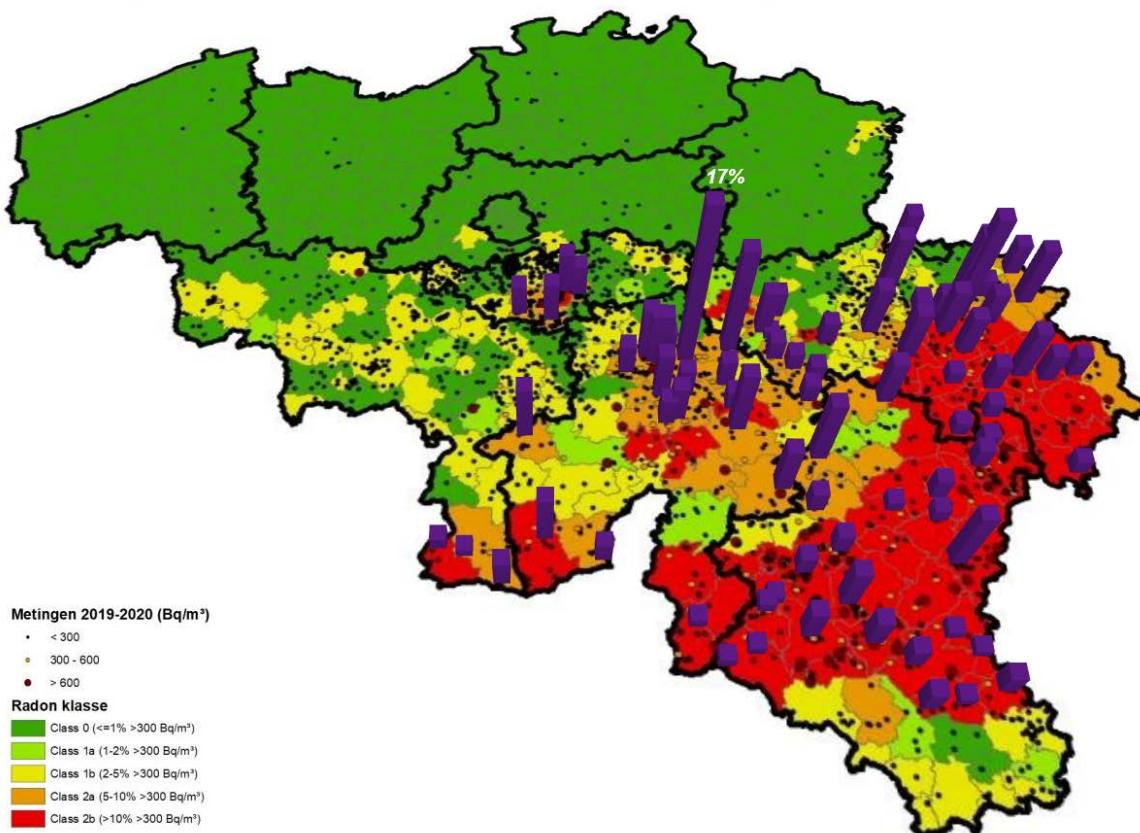
Figure 3 Sampling of respondents in radon prone areas in Belgium (blue pillars)

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 11

Survey 2: Sampling of households from the whole Belgian territory

The (gross) sample of households was randomly drawn by Kantar from the central reference address files in Flanders (CRAB), Brussels (Urbis) and Wallonia (ICAR). All Belgian municipalities have been selected where 1 address has been drawn per 1,715 inhabitants for each municipality. For instance, Mol has 37,022 inhabitants, so 22 addresses were drawn for Mol. Company addresses have been removed from the address list.

Within each randomly selected household that received the invitation letters the last birthday person in the household (+18) was asked to participate in the study by using a link to the online survey and a unique code to log in to the questionnaire.

2.3.3   Survey 1: Timing, reminders and response rate from radon prone areas

Two waves of participant recruitment were applied for the RadoNorm research. For Survey no. 1, during the first wave, 2.000 letters were sent to the households that were randomly selected. Based on the response to the first wave, Kantar sent 1,343 reminders together with 2.000 additional letters to a fresh sample in the second wave.

The letters of the first wave have been sent on 7th of December and the online survey was available on 8th of December (= Day +1), considering the delay of 2 days that it takes for the letters to arrive by post. The reminders and the additional 2.000 letters for the second wave were sent out on 4th of January, 2021. The fieldwork was closed on 18th of January, 2021 with a sample of N=304 respondents. Out of these, 300 valid interviews were retained after quality control. Response rate for this study was 7.6%.

2.3.4   Survey 1: Representativeness of respondents from radon prone areas

The final sample of this survey consists of N=300 Belgian adults and is representative for the (18+) Belgian population living in Wallonia with respect to gender and age. The weighting for these categories is explained in table below.

Table 1. Socio-demographics of the sample, weighted and unweighted.

Variable		Belgian population 18+ (N= 9,180,601) %	Unweighted survey sample (N= 300) %	Weighted survey sample (N= 300) %
Sex	Male	49.1	50	49.1
	Female	50.6	49.7	50.6
	Other	0.3	0.3	0.3
Age	18-34	26.5	20.3	26.5
	35-54	32.5	36	32.5
	55+	41	43.7	41

2.3.5   Survey 1: Other socio-demographics characteristics of the sample

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 12

S7. How many family members are currently living in your household (including yourself)? Children living in student accommodation who come home during the weekend also count as a household member.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	60	20.0	20.0	20.0
	2	100	33.3	33.3	53.3
	3	61	20.3	20.3	73.7
	4	53	17.7	17.7	91.3
	5	16	5.3	5.3	96.7
	6	9	3.0	3.0	99.7
	8	1	.3	.3	100.0
	Total	300	100.0	100.0	

S8. And how many of those are children younger than 18?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	198	66.0	66.0	66.0
	1	36	12.0	12.0	78.0
	2	48	16.0	16.0	94.0
	3	10	3.3	3.3	97.3
	4	8	2.7	2.7	100.0
	Total	300	100.0	100.0	

S10. Is the dwelling that you spend most of your time a property of yours or your family, or does it belong to someone else?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I am owner or co-owner	213	71.0	71.0	71.0
	It is the property of another family member	34	11.3	11.3	82.3
	It is the property of someone else	49	16.3	16.3	98.7
	Dk - na	4	1.3	1.3	100.0
	Total	300	100.0	100,0	

S11. For how long have you been living in this dwelling?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	16	5.3	5.3	5.3
	More than one year	284	94.7	94.7	100.0
	Total	300	100.0	100.0	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 13

2.3.6 Survey 2: Timing, reminders and response rate for the survey applied in the whole Belgian territory

Two waves of participant recruitment were applied for this survey. In wave one 8000 letters were sent to the households that were randomly selected. Based on the response on the first wave, Kantar sent 6657 reminders together with 8000 additional letters to a fresh sample in the second wave.

The letters of the first wave have been sent on 7th of December and the online survey was available on 8th of December (= Day +1), considering the delay of 2 days that it takes for the letters to arrive by post. The reminders and the additional 8000 letters for the second wave were sent out on 4th of January, 2021. The fieldwork was closed on 18th of January, 2021 with a sample of N=1077 respondents. Out of these, 1060 valid interviews were retained after quality control.

Response rate for this study was 6.6% which is similar to the previous SCK CEN Barometer studies.

2.3.7 Survey 2: Representativeness of respondents from the whole Belgian territory

The final sample of this survey consists of N=1060 Belgian adults and is representative for the (18+) Belgian population with respect to gender, age, level of urbanisation of the living habitat and province. The weighting for each of these categories as well as for the education level is explained in table below.

Table 1. *Socio-demographics of the sample, weighted and unweighted.*

Variable		Belgian population 18+ (N= 9,180,601) %	Unweighted survey sample (N= 1060) %	Weighted survey sample (N= 1060) %
Sex	Male	48.7	53.4	48.7
	Female	51.3	46.5	51.2
	Other	0.1	0.1	0.1
Age	18-34	26.3	26.5	26.2
	35-54	33.5	33.5	33.5
	55+	40.2	40	40.3
Education	Primary	20.9	9.9	20.7
	Secondary	43.2	29.8	43.1
	High	36	60.3	36.2
Habitat	Big cities	29.1	30	29.1
	Urban towns	21.9	22.8	21.9
	Municipalities	23.6	22.5	23.6
	Other	25.4	24.7	25.4
Province	Antwerp	16.1	16.9	16.1
	Brussels	10.2	11.1	10.3
	Henegouwen	11.6	10.1	11.6
	Limburg	7.8	8.7	7.8
	Luik	9.7	10.1	9.7
	Luxemburg	2.5	1.9	2.5
	Namen	4.4	3.9	4.4
	East-Flanders	13.5	13.5	13.5
	Vlaams-Brabant	10.2	9.5	10
	Waals-Brabant	3.4	4.3	3.4
	West-Flanders	10.7	10	10.7

RadoNorm

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 14

2.4   Data collection

2.4.1   Applied method

The method used for the data collection of this survey was Computer-Assisted Web Interviewing (CAWI). CAWI is an internet surveying technique where the respondent fills-in a survey provided online. The questionnaires are made in a program for creating web interviews. The program used for our survey is called Nfield NIPO and it allows for the questionnaire to contain text, pictures, audio and video clips, links to different web pages, etc. The advantage of CAWI and using the Nfield NIPO program is that the survey can be used on different devices (e.g. computer, mobile phone), at different preferred times, is user-friendly, allows for flexible data management and ensures unrivalled data security.

Respondents filled-in the survey in the chosen language. The average interview duration for Survey 1 was 15.5 minutes and for Survey 2 was 25 minutes.

2.4.2   Change in the data collection method due to the Covid-19 pandemic

Initially, the questionnaire was designed for Computer-Assisted Personal Interviewing (CAPI) which was reviewed during the steering committee meeting, consultations with radon experts and pilot study. However, during the preparations for the field work it was clear that the government measures concerning face-to-face meetings were still very strict due to the COVID-19 situation. Therefore, we switched to CAWI as a data collection method. The response rate of this survey is very similar to the previous Barometer surveys which were conducted face-to-face, which shows that the change of the method did not have any impact on the quality of the survey concerning the response of the participants.

2.4.3   Informed consent

Before participants started to fill-in the survey, they were first introduced to a consent form. This consent form explained the main goals of the study, explained who is conducting the research and who is collecting the data, and ensured the participants that their answers will be used for scientific research purposes and will be held anonymously and confidentially in keeping with the General Data Protection Regulation (GDPR). After reading the information in the consent form, the participants could choose whether or not they wanted to continue to participate in the study.

3. Theoretical background and results: Survey 1 conducted in radon prone areas

3.1   Radon awareness

There are many different approaches to investigate awareness and knowledge in surveys related to radon and NORM. Scales used measure for instance awareness of radon, radon risk area awareness, radon knowledge, confidence in own knowledge, awareness, awareness of produced water handling and content – societal and salience of radon.
Tomkiv Y. et all (2021:42 - 46) collected all existing measurement scales as follows.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 15

Awareness of radon

Most studies *(e.g. Cronin et al. 2020, Poortinga et al. 2011)* use the question asking whether respondents had ever heard of radon.

Point of attention: It remains to be seen if the answers to this question are meaningful because 'having heard of' is a very broad category.

Poortinga et al. (2011):

Q: "Had you heard of radon before this interview?": Yes; No; Don't know

Larsson et al. (2009) added to the "I don't know" category the refused option: "I don't know/refused".

Neri et al. (2018) and Denu et al. (2019) enquired about awareness of "radon related health issues":

Q: "Are you aware of the health risks associated with exposure to radon?"

Radon risk area awareness

Poortinga et al. (2008) assessed awareness of exposure to indoor radon as follows:

Q: "Do you believe that your home is in a radon area?" (yes/no)

Poortinga et al. (2011) reformulated the question and added "Don't know" as answering category:

Q: "As far as you know, do you think you live in an area affected by radon?": yes; no; don't know

Radon knowledge

Radon knowledge is typically assessed with exam style questions, whereby a knowledge variable is constructed as the sum of correct answers given to a number of true/false questions.

Nwako and Cahill (2020) use the following radon knowledge items, with possible answers True/False:

- Radon has a strong odor
- Radon exposure is linked to lung cancer
- Radon is a radioactive gas
- Radon is invisible
- Radon is a solid at room temperature
- Radon is a gas at room temperature;
- Radon occurs naturally in rocks and soils
- Radon levels are usually higher in the attic than the basement
- About 1 in 15 homes in the U.S. have elevated radon level
- Being exposed to radon increases smokers' chances of developing lung cancer
- Radon is the leading cause of lung cancer in the U.S. among non-smokers
- Testing for radon is the only way to determine if a home has an elevated radon level

Cronin et al. (2020) use the following True/False statements concerning radon:

- Radon is an invisible gas that can become trapped in your home
- You live in an area with typically high indoor radon
- Breathing in radon gas can cause lung cancer
- There is nothing that can be done to rid your home of radon

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 16

Desvousges, Smith, and Rink (1992) used multiple-choice questions covering general knowledge about testing, health risks, and mitigation in the follow-up surveys. These questions referred to:

Q: "Where does radon in homes come from?"

Q: "Which of the following best describes radon?" (e.g. radon occur naturally and has no odor)

Q: "When radon is measured in a home, which of the following will affect the most?"

Q: "How can one test for radon?"

Q: "When do health problems from radon usually occur?"

Q: "What kind of health problems are high levels of exposure likely to cause?"

Q: "What can homeowners do to reduce high radon levels in their home?"

Hahn et al. (2014) used 6 items:

- Radon exposure is unhealthy
- Radon can cause Lung cancer: true
- Radon can cause Other cancers: true
- Radon can cause Arthritis: false
- Radon can cause Asthma: false
- Radon can cause Headaches: false

Ryan and Kelleher (1998) used 12 true/false items (the statements listed below are correct, in the questions some were formulated as not correct):

- Radon is a gas
- Radon does not have a distinct odour
- Radon levels can vary in nearby houses
- Radon levels vary with the season
- Sealed windows increase the amount of radon
- Radon is not from Industrial pollution
- Radon moves from soil to air
- Radon enters through cracks in walls and floors
- High radon levels do not raise skin cancer risk
- Health effects of radon do not show for years
- Radon does not irritate eyes or throat
- High radon levels raise lung cancer risk

In the study by *Golding, Krimsky, and Plough (1991)* the statements were:

- radon is a colorless, odorless, tasteless gas
- radon comes from the natural breakdown of uranium
- exposure to radon can cause lung cancer
- radon levels are generally higher indoors
- the amount of radon depends largely on soil
- position of ventilation and techniques
- radon levels tend to be higher in basements
- elevated levels can be reduced by various forms
- radon can be measured by inexpensive screening
- how smoking affects the risk of radon exposure
- variations in radon levels over the year
- the effects of operating furnaces and appliances on indoor radon levels

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 17

Kennedy, Probart, and Dorman (1991) measured radon knowledge with the following index (highest score = 9):

- heard of radon
- knew radon did not increase risk of skin cancer
- knew it increased risks of lung cancer
- knew the health risks were cumulative
- knew radon was a gas
- realized radon has no distinctive odor
- knew could enter through cracks in foundations
- knew it was caused by decay of a radioactive element

Peterson and Howland (1996) used the following items (treated independently in analyses):

Q: Most radon in homes comes from: Industrial pollution; Uranium in soil; Home appliances; Don't know

Q: Which best describes radon?: No odor; Slight odor; Do not know

Q: First aware radon could cause health problems: Today; Less than a month ago; Between one and six months ago; More than six months ago

Q: Can exposure to high levels of radon cause lung cancer?: Yes; No; Do not know

Q: When radon is measured in a home, the level will: Depend on time of year it's measured; Not depend on time of year it's measured; Don't know

Q: People's risk from radon exposure: Increases if they smoke; Stays about the same if they smoke; Don't know

Q: Radon levels are usually higher in the: Basement or lowest floor/Don't know

Q: To determine whether there is a high level of radon in your home requires: An inexpensive screen test administered by homeowners; Expensive radiation equipment administered by trained professionals; Don't know

Point of attention: It can be noticed that one of the questions above uses the attribute "expensive/inexpensive" in knowledge questions, although respondents may have different perceptions of what can be considered as expensive.

In the longitudinal study by *Smith, Desvousges, Fisher, and Johnson (1988)* the following items were used in the Baseline Survey and Follow-up survey*:

1) Is radon a
   a) Colorless, odorless gas
   b) Or a chemical given off by radar equipment
   c) Don't know
2) Is radon caused by
   a) Industrial pollution
   b) Or the natural breakdown of uranium
   c) Don't know
3) Are high levels of radon likely to cause
   a) Minor skin problems
   b) Lung cancer
   c) Don't know
4) Does the amount of radon in a building depend mainly on the
   a) Type of machines or appliances in it
   b) Or the amount of radon in the underlying soil
   c) Don't know

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu
Page 18

5) Do the risks from radon exposure
   a) Increase the longer you are exposed
   b) Or stay the same no matter how long you are exposed
   c) Don't know

6) When radon is measured in a building, the level will
   a) Depend on the time of year it is measured
   b) Not depend on the time of year it is measured
   c) Don't know

7) Are radon levels usually higher in the
   a) Basement or lowest floor
   b) Or the highest floor
   c) Don't know

8) Will people's risk from radon exposure
   a) Increase if they smoke
   b) Or stay about the same if they smoke
   c) Don't know

9) Can the level of radon in a home or building be reduced by
   a) Increasing the amount of air ventilation
   b) Or by adding attic insulation
   c) Don't know

10) Are household appliances such as furnaces or clothes dryers likely to
    a) Increase the amount of radon by lowering inside air pressure
    b) Or decrease the amount of radon by venting it outside
    c) Don't know

11) Would the effectiveness of ways to reduce radon in homes or buildings
    a) the same for all housing or building types
    b) Or depend on the features of each home or building
    c) Don't know

12) Will drawing radon away from the home or building before it enters
    a) Usually involve several thousand dollars and an experienced contractor
    b) Or depend on the features of each home or building
    c) Don't know

Follow-up Survey only (all items marked with * were included in the follow-up survey):

- High levels of radon exposure: a) Will irritate the throat and eyes; b) Or will not irritate the throat and eyes; c) Don't know
- When radon is measured indoors, the level; a) Will depend on whether the house is closed up; b) Or will not depend on whether the house is closed up; c) Don't know
- Are people's risk from one year of radon exposure: a) Much lower than their risk from a lifetime exposure; b) Or about the same as their risk from a lifetime exposure; c) Don't know

Evans et al. (2015) asked people how confident they were in their knowledge of ionising radiation: 1 = not at all confident; … ; 5 = highly confident

Smith et al. (1988) tested namely respondents' ability to correctly use the risk charts provided in information brochures to:

- Correctly locate (in the follow-up survey) his reading on the risk charts provided in the brochures designed by the project or in the EPA Citizen's Guide.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 19

- Correct advice to a hypothetical neighbour with a specified radon reading on the timing of recommendations for mitigation activities.

Confidence in own knowledge

Evans et al. (2015) measured confidence in their own knowledge of ionizing radiation using a Likert-style scale ranging from 1 (not at all confident) to 5 (highly confident).

In their study among family medicine residents, *Sanborn et al. (2019)* included a question regarding their confidence level in answering patients' questions about radon, using the answering categories:

Not at all confident; Somewhat confident; Moderately confident; Quite confident; Very confident

Awareness of produced water handling and content - personal

Torres et al. (2017) included four questions about awareness to NORM in water:

Q: "How familiar are you with the processes of storage and transportation of produced water?":

Not at all familiar; Slightly familiar; Moderately familiar; Very familiar; Extremely familiar

Q: "How aware are you with the content of produced water? (e.g. chemicals additives and contaminants)": Not at all aware; Slightly aware; Somewhat aware; Moderately aware; Extremely aware

Q: "How familiar are you with natural radioactive material and its effects on human health?":

Not at all familiar ; Slightly familiar ; Moderately familiar ; Very familiar ; Extremely familiar

Q: "Did you know that produced water might contain levels of natural radiative material?" (yes/no)

Awareness of produced water handling and content – societal

Torres et al. (2017) also included three questions, with the same answering categories, to measure whether the participant who work in the oil field perceives others to be aware:

Q: "Based on your experience, how aware do you think the general public is about produced water risks in North Dakota?"

Q: "Based on your experience, how aware do you think the operators in the oil field are about produced water risks in North Dakota?"

Q: "Based on your experience, how aware do you think the hauling truck operators are about produced water risks in North Dakota?":

Not at all aware; Slightly aware; Somewhat aware; Moderately aware; Extremely aware

Salience of radon

Smith et al. (1995) investigated to what extent was radon a priority:

Q: "Radon may be a problem, but I haven't paid much attention to it because there are more important things to deal with"

Answers were measured on 5 Point Likert agreement scale, subsequently dichotomised as 1 for strongly agree or agree, 0 else.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 20

Weinstein and Sandman (1987) enquired respondents' frequency of thinking about radon.

In our study (Survey 1), radon awareness was measured by closed and open questions.
- Do you know anything about radon? With response categories "yes, I have heard something about it and No".
- Can you describe in a few words what you have heard about radon? (open question for those responding "Yes" and "I have heard something about it".

Knowing radon:

Do you know anything about radon?
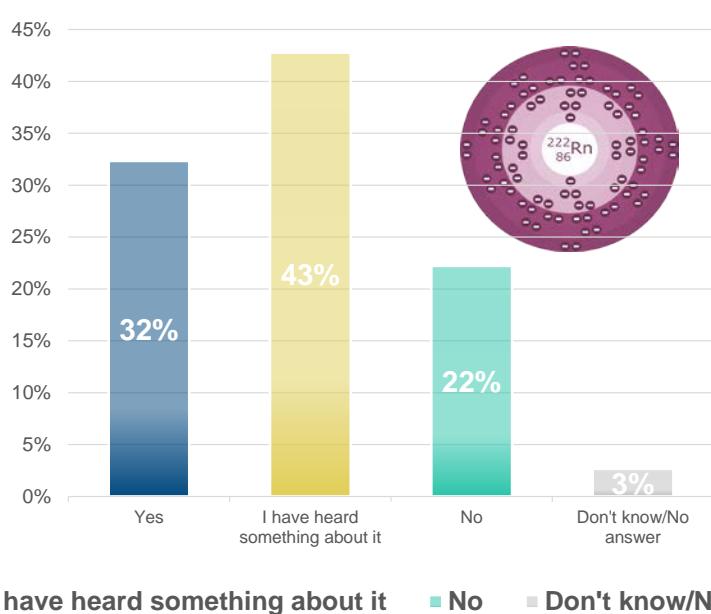
Figure 4 Awareness of radon

Answers given to the open question have been grouped per categories as illustrated in the table below.

Categories:	Exact wording
'I heard from my doctor'	1. "My doctor friend informed me about the presence of radon in the soil in the Ardennes and asked us to air the rooms as often as possible."
'The Municipality/Region intervened'	2. "Municipality installed a recorder in my cellar for 6 months, my house is built on shale: negative results ...." 99."Is a gas that is in the ground in some regions. I received a detector from the region of Wallonia for my house and it was negative!"
'Used by space companies'	38."Know that it's a noble gas that among other things used by space companies."
'Information learned in school'	45."Already did some exams at school. Radon is a radioactive gas."

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 21

As 'a Neutral explanation'	71."What Marie Curie discovered and used for the radiographs." 74."Is a liquid that allows the cooling of the fridge. It is present in the ground but in a small amount." 125."Compound derived from or related to radium." 129."Particle, molecule." 142."Radius that exists naturally."
As 'Pollution'	60."Hardly detectable filth." 76."Is a chemical compound present in the air I think 123."Air pollution. " 124."Pollution by rocky soil."
As 'found in the ground'	3."Release from the rocks (Shale) (Ardennes)." 41."Found in the ground." 72."Is like a kind of stone I think that releases radon." 121."Comes from the under-grounds."
As '(Rare) Gas'	5."Gas" 6."Harmful gas" 7."Gas originating from the ground" 8."Colorless and odorless gas, that originate from the ground in the houses and that can be harmful to health. Very present in the province of Luxembourg." 9."Odorless and transparent gas that is released inside without the inhabitants noticing it and intoxicate them, a little bit like CO2." 10." Odorless gas that can build up in the houses and is dangerous." 11."Natural gas that comes from the ground, especially Shale, in low quantities and that can be harmful to the health if exposed for a longer period." 12."Gas or a toxic substance that can be found in houses, especially in some geographical areas I think." 13."Gas that is released from the ground in shale areas." 14."Gas that is released from the ground and invades homes through the cracks, hence the importance of airing these living quarters." 15."Gas released from the ground." 18."Rare gas, radioactive, present in the rocky soil of Wallonia." 19."I think that it is a rare gas, slightly radioactive maybe but I don't know the subject in depth." 24."few things… Rare gas." 25."Radon is a naturel gas, without sent that can cause cancer." 44."Is a gas." 62."Gaseous chemical element." 78."Is a gas." 81."Is a gas released by shale rocks. It would be present in the basement of some houses located at the bottom of my city near a water bear." 84."Bad gas."

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu — Page 22

87."Is a natural gas that can sometimes escape according to the nature of soil (in a basement for example) There is a cartography for Belgium."

88."Is a natural gas that escapes from certain soils."

94."Is a gas present at very low percentage in the earth's atmosphere."

96."Is a gas coming from the ground."

102."Is a gas that goes up in the ground."

103."Is a gas that escapes from certain soils and intoxicates."

104."Is a gas that can be found in houses. I tried it for our house it rate is totally normal."

122."Gas pollution Inside homes."

148."Gas"

150."Gas in the natural state which enters in a volatile way in the houses of certain areas of the world and in particular the Belgian Ardennes."

151."Gas inside homes."

153."Chemical gas."

154."Of mainly natural gas origin."

156."Gas in the basement."

157."Decomposition of radium gas coming from the ground that is filtered through of rocky soils, shale etc. and reaches the houses from the cellars."

163."Rare inert gas of the same family as helium, Xenon,... having a natural radioactive isotope with a "medium" hal1f-life."

165."Odorless and colorless gas present in certain undergrounds and that can sometimes enter houses."

168."Odorless gas coming from the ground."

170."Invisible and odorless gas coming from certain rocks from undergrounds of the planet."

171."Gas coming from the disintegration of radium."

172."Gas linked with uranium."

174."Natural gas that can be usually found in basement of houses."

181."Gas present in certain shale soils."

182."Gas present in the ground and present in certain habitations."

184."Gas coming from certain rocky undergrounds."

185."Gas coming from degradation of rocks."

186."Gas coming from shale."

187."Gas coming from soils."

189."Gas that comes from the undergrounds and goes into the house."

207."Rare gas present in the ground."

208."Rare gas coming from the ground and rises to the buildings."

209."Gas rises into the houses in certain regions."

210."Gas spread into the shale soils."

212."Underground gas."

217."Gas coming from the ground particularly in schistose and calcareous zone especially in Ardennes,Ardennes liégeoises."

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 23

	218."Gas coming from the radioactive soil, degenerated becomes a radioactive dust which can be inhaled."
	219."Gas."
As '(Naturally) Radiative'	16."Radioactive gas."
	17."Radioactive gas that can be found in the ground."
	26."Radon is a radioactive gas produced by rock deterioration, such as shale, the solution is a good ventilation of the basement (cellars)."
	27."Radon is a radioactive gas issued by the terrestrial structure. The matter is about natural radioactivity."
	28."Radon is a natural radioactive more present near the railroads."
	29."Radon is a radioactive gas originating from uranium present in the ground and the rocks."
	31."Radiation that comes from outer layer of the earth focused on certain points particularly."
	33."About a radioactive gas that can be naturally found in some grounds and that propagate in the buildings, through basements. I think it's presence is more important in Wallonia than in Flanders and Brussels."
	35."About a natural radiation, especially in shale regions. It's important to implement measures before building your house. And take required measures in case of significant amount of radiation."
	39."Know that it's a radioactive gas present in the ground."
	48."Radioactive substance."
	49."Radioactive substance."
	55."Radiation in the environment, measurable, airing rooms can decrease the radiation."
	56."Radiation that comes from the ground."
	57."Ground radiation."
	58."Natural radioactivity."
	61."Chemical element in the period table with radioactive properties."
	67."Natural radioactive element."
	68."Element naturally radioactive."
	77."Is a natural radioactive element or a gas."
	86."Is a natural and radioactive gas."
	90."Is a natural radioactive gas."
	91."It's a natural radioactive gas that comes from the ground, mainly in the basements in the ardennaise regions and that because of the type of the soil. A good ventilation of the premises in the basement is advised to ventilate this gas towards the outside. I have personally already made a survey in my basement and the rate found a few years ago was within the norm for the region."
	92."Is a noble radioactive gas."
	97."Is a gas coming from earth and is radioactive. You need to ventilate so that the concentration is not too high."
	105."Is a radioactive gas."
	106."Is a natural radioactive gas coming from the ground that can enter in the buildings in some places and poison the indoor air."
	107."Is a radioactive gas present in the soil in some regions of the country."

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 24

108. "Is a radioactive gas originating from uranium, present in the soil and in rocks, odorless and colorless."

109. "Is a radioactive gas coming from uranium in rocks, heavy gas, odorless and colorless that can easily accumulate in the basement of certain habilitations."

110. "Is a radioactive gas coming from subterranean rocks."

111. "Is a radioactive gas that we find under-ground as well as in our homes."

113. "Is a rare radioactive gas."

114. "Is a very persistent radioactive gas."

118. "Is a radiation coming from under-ground that we can decrease with a ventilated space."

119. "Is a radioactive gas coming from the uranium present in the soil."

133. "Radiation in the ground."

137. "Radioactive matter present in certain places on earth."

138. "Radioactive gas which is in the ground and especially at the level of the railroads, air your house every day."

139. "Radioactive fuel from Namur."

143. "Ionizing radiation provoked by lightning rods."

144. "Natural Radiation coming from certain soils and, which concentrated inside a house, causes cancers mainly of the respiratory system. Radon is a natural gas, odorless and invisible."

145. "Natural radiation coming from the ground."

146. "Natural radiation coming from soils. More or less important depending on the region. Important if subsoil is shale."

147. "Radiation coming from the ground."

161. "Colorless, odorless gas but radioactive."

162. "Colorless, odorless gas radioactive naturally released by various types of soil."

166. "Radioactive odorless and colorless gas nr 86."

169. "Odorless, radioactive gas that can be dangerous."

175. "Natural radioactive gas, coming from undergrounds that can pollute inside a house with carcinogenic risks."

176. "Natural radioactive gas from underground. Dangerous emission in the houses of some regions in Belgium. My dose in my house is 116Bq/m3. => low risk, no preventive action."

178. "Naturally radioactive gas, very present in some regions of the country, especially in the presence of shale. Responsible for lung cancers (2nd behind smoking if I'm not mistaken)."

179. "Noble gas only present under a radioactive form and present everywhere in the atmosphere."

180. "Radioactive noble gas coming from cement."

183. "Gas coming from rocky subsoil and containing a radioactive isotope."

200. "Radioactive gas coming from certain undergrounds and undetectable by the population.no local measurement is made by the authorities nor practically no information."

201. "Radioactive gas coming from the undergrounds (rocks)."

202. "Radioactive gas coming from the undergrounds tending to stagnate in poorly ventilated apartment buildings in some parts of the country."

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 25

	203.“Radioactive gas in the soil.” 204.“Radioactive gas which is naturally found in the ground, in particular in the shale soils in the Ardennes for example.” 205.“Radiative gas coming from shale rocks. 214.“Underground radioactive gas.”
As 'Toxic and/or Dangerous'	4.“Is a toxic substance that can be find in ancient buildings” 22.“Think it's a potentially dangerous gas.” 32.“About a toxic gas.” 42.“Would be present inside houses and would be toxic for the humans.” 43.“Would be a toxic matter that we discover in certain soils.” 46.“Toxic substance in the ground.” 47.“Polluting substance found in certain houses toxic for your health.” 50.“Toxic.” 59.“it's dangerous.” 63.“Chemical element that can be dangerous in excessive amounts inside.” 70.“Very toxic.” 79.“Is a dangerous gas that enter homes through cracks in the ground. It can cause cancer.” 80.“Is a dangerous gas that can sometimes be found in houses and you have to install detectors.” 93.“Is a toxic gas that escapes from the ground and can be present in the habitations.” 98.“Is a dangerous gas.” 117.“Is a toxic radiation in certain homes.” 149.“Gas- Harmful if high exposure.” 155.“Dangerous gas that comes from the ground.” 167.“Harmful odorless gas.” 177.“Natural Harmful gas.” 190.“Dangerous radioactive gas for the lungs.” 196.“Radioactive gas rising from the ground and stagnating in the subsoil.” 197.“Radioactive gas in the soil.” 198.“Radioactive gas present in the soil in some regions of Wallonia. Screenings" can be requested.” 213.“Harmful gas.” 215.“Harmful gas.” 216.“Harmful gas in the ground, mine explosions.”
As 'Causing Health problems'	30.“Radon is found in the basement, more concentrated in some places, like Gerpinnes, cancers are multiplied in the case of higher radiation.” 34.“About a gas that can cause health problems.” 36.“Escapes from certain grounds, contains it (mainly in shale rocks). I know that there is a great presents in my municipality Jalhay and can cause cancers.” 37.“Only know that has harmful effect on heath.” 51.“Toxic for your health.”

52. "Toxic for your health, it's in the ground."

64. "Chemical element present in certain places in the country. Measurement campaigns are organized regularly. The level may be too high in some homes and therefore a health hazard."

65. "Chemical element toxic for the respiratory tract."

66. "Chemical element odorless, colorless, questioned in lung cancer."

75. "Is something harmful that can be found inside walls in ancient buildings."

83. "Is an odorless gas that is often found in the basement of some houses, only recognizable with specific materials and very dangerous for your health."

85. "Is a carcinogenic, natural gas that spreads from certain types of soils."

89. "Is a natural gas that comes from the ground. We can find it in houses (often in basements). There are multiples way to measure it. If it's present in an excessive quantity, it is harmful to health."

95. "Is a gas coming from the ground and can cause lung cancers."

100. "Is a gas present in the ground harmful for your health. It is particularly present in the province of Liège. After doing the test at my house, I am reassured for my habitation."

101. "Is a gas coming from the ground and that can be found in houses. It's harmful your health."

112. "Is a radioactive gas that naturally present in the ground. We can find some in the basement of ancient homes if they aren't ventilated correctly. This gas can cause cancers."

115. "Is a rare gas present in soil that can cause severe diseases."

116. "Is a gas, that we can find in houses and is not good for health."

120. "Radioactivity present in the ground and the rocks gives lung cancer."

131. "Don't know much, that it's dangerous and undetectable without measuring instruments, therefore an individual can be intoxicated without realizing it until it is too late."

132. "Not much. Can release radiation that is harmful to the body."

135. "Materials existing in the ground that can have harmful effects."

136. "Carcinogenic material (ex: the roof)."

140. "Rather harmful for health but I don't know."

141. "Bad, possibility to do tests at home."

152. "Gas carcinogen coming from the ground."

158. "Gas from the underground that infiltrate certain houses and can cause lung cancer."

159. "Gas coming from certain soils and may be of little or great harm, and sometimes need the intervention of firms specialized in insulation."

160. "Gas coming from the ground (rocks, shale in particular) and is responsible of lung cancer."

164. "Odorless gas in the undergrounds of certain regions, mainly in the south of the country and infiltrates houses by cracks in the ground for example. Dangerous for health (cancer) when exposed for a long period. There are detectors. When the rate is low, a good ventilation of the houses is sufficient, otherwise it is necessary to intervene by a better insulation."

173. "Gas bad for health."

188. "Gas coming from the ground and is harmful for health. I think for the lungs."

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 27

	194."Radioactive gas in the undergrounds attacking lungs and giving provoking cancer."
	195."Radioactive gas from shale stone, it tends to stagnate on the ground of the cellars. It is very present in the region of Vielsalm and can cause cancers."
	199."Radioactive gas in the soil. I think it comes from uranium. It is colorless, odorless and very dangerous to health."
	206."Radiative gas coming from shale rocks, coming from the ground and can be dangerous for the health."
	211."Gas found in the soil (shale) which can be dangerous for humans in large doses. It is also found in certain materials used in construction (gypsum)."
As 'Deadly'	82."Is an odorless gas but deadly, the only way to get rid of it is to air. It destroys everything if he stagnates."
'No knowledge'	20."Only knows it by name."
	21."Don't know what it is."
	40."Don't know much."
	53."None."
	54."No idea."
	69."no."
	73."Is in houses, but don't know it."
	126."No."
	127."No, I don't know enough on the subject."
	128."No, not at all."
	130."Don't know much."
	134."Not really."

3.2   Behavioral change applied/ testing, mitigation done

The behavioral changes are the specific practice changes that occur in the target population. These are usually easy to identify and indeed, to measure. (Gleason, Taggert, & Goun, 2020) investigated testing with the following question: "Have you or someone else ever tested your current residence for radon?" (Yes; No; I don't know) and "Has your household air been tested for the presence of radon gas?" . *Weinstein et al. (1991)* used the following categories to describe the testing behaviour*: never thought about it ; do not plan to test ; thinking about it but haven't decided ; plan to have it done but haven't yet; test ordered or in progress ; have already received test results.* Earlier studies used response mixing behavioural change and intention to behavioural change. For instance (Halpern & Warner, 1994) used the following categories: *Have tested for radon; Plan to test for radon; Neither have tested nor plan to test* and Weinstein et al. (1991) used the categories: *not needed; undecided; plan to test*.

In our study the respondents first received an explanation (introduction) after which they were asked to respond to the following questions:

> *Introduction: "To summarize, a building can be tested for radon; it can be remediated if there is radon detected; or there can be preliminary protective measures installed when the building is built. For instance, the new building has a special ventilation system from the beginning."*

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 28

- *Are there any of these actions related to radon indoors being applied in your household?*
  Answering categories: *Yes, No, I don't know, NA*

- Those that responded as "Yes" were asked to respond *"What kind?"* with the following answering categories*: "Test, Remediation, Preliminary protective measures in new building, Other (open)"*

Any mitigation actions applied in the respondent's houshold

Are there any of these actions related to radon indoors being applied in your household?

N=300

Yes — No — Don't know/No answer
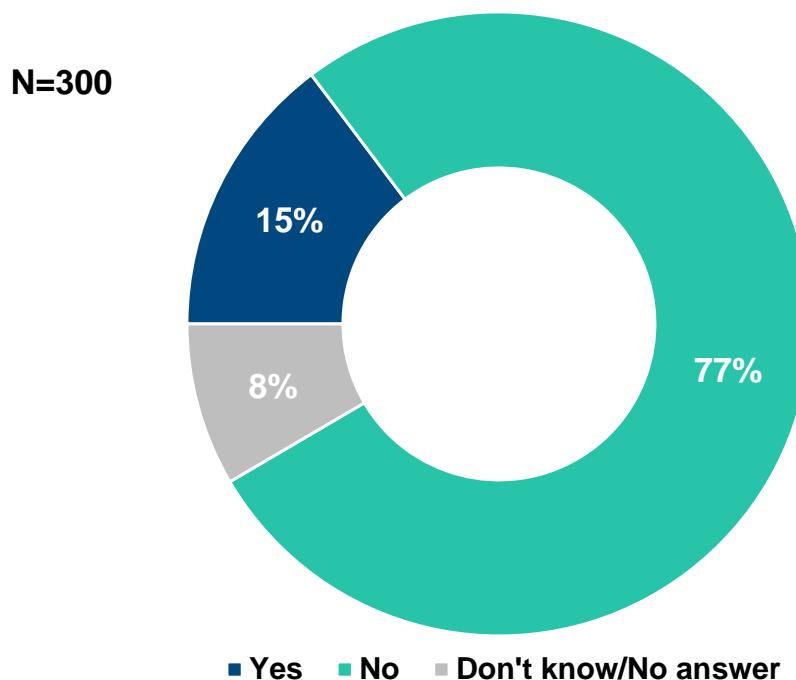
Figure 5 Application of mitigation actions

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 29

N=44 **Mitigation actions applied in the respondent's houshold**
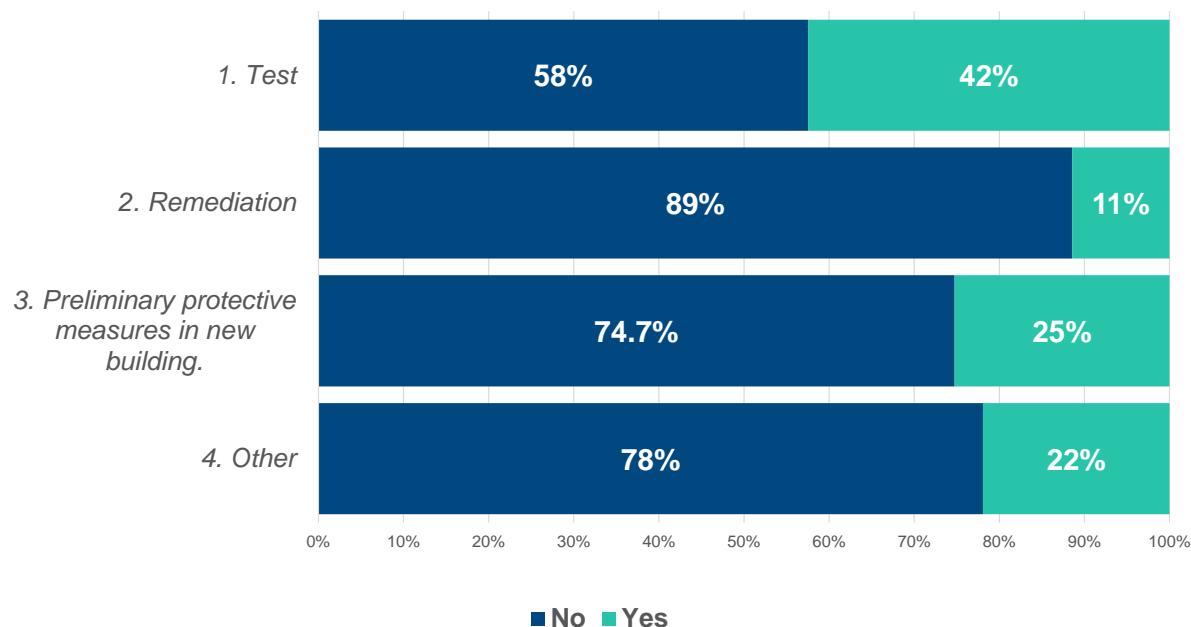
Figure 6 Mitigation actions

The specific actions referred to as "Other" are presented in the table below.

French- original	English-Translation
Aération des caves.	Aeration of cellars.
Aérer les pièces 5 à 10 min par jour.	Air the rooms 5 to 10 minutes per day.
Ventilation de ma cave, c'est un très vieux bâtiment.	Ventilation in my basement, it's a very old building.
Système d'extraction d'air au sous-sol, ventilation simple flux pour le reste du bâtiment.	Air extraction system in the basement, simple flow ventilation for the rest of the building.
Un système d'extraction d'air a été installé lors de travaux de rénovation	Air extraction system was installed during renovation work.
Ventilation régulière.	Regular ventilation.
Ventilation des caves par courants d'air. caves carrelées.	Ventilation of the basements by air circulation. Tiled (Paved) Basements.
Membrane en plastique installée sous la chape des caves.	Plastic membrane installed under the screed of the basements.
Ventilation des caves.	Ventilation in the Basements.
Ventilation de la cave depuis des dizaines d'années.	Ventilation of the Basement for approximately ten years.
Ventilation dans la cave (maison ancienne).	Ventilation in the Basement (old house).

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu Page 30

Categories of "Other" actions:
Ventilation (6)
Air extraction system (2)
Plastic membrane (1)

3.3   Behavioral change/ intention

Intention to test and intention to mitigate are often measured since intention is an important predictor of actual behavior and therefore a determinant (Ajzen, 1988).   (Rinker, Hahn, & Rayens, 2013) dichotomized the scale into those with testing intentions and those without. (Weinstein & man, 1992a, 1992b) used only a part of categories to capture the testing stage: *Never thought about it; Not needed; Undecided; Plan to test.* (Weinstein & Lyon, 1999) adapted the categories to better capture the respondent's decision: "*I have already completed a test, have a test in progress, or have purchased a test; I have never thought about testing my home; I am undecided about testing; I've decided I don't want to test ; I've decided I do want to test".* (Sanborn et al., 2019) adapted these categories as follows: *Completed or in progress; Plan to monitor; Haven't decided; Not needed; Never thought about it; Never heard of radon.* (Poortinga, Bronstering, & Lannon, 2011) further elaborated the scale of Weinstein et al. (1991) to better describe the options: "*Select a statement that "best describes your thoughts before this interview about testing your home for radon." : I have never thought about testing my home for radon ; I am undecided whether or not to test my home for radon ; I have decided I don't want my home tested for radon ; I have decided I do want my home tested for radon' ; 'I have already completed a test for radon ; I have a test for radon in progress ; I have bought a test for radon ; Don't know.*" The above study then combined the options *"I have already completed a radon test," "I have a test for radon in progress,"* and *"I have bought a test for radon"* to reflect participants who had taken the decision to test their home for radon, and compared this to all other answering options. Weinstein et al. (1991) inquired about the Likelihood of their testing in the next year: "*1 = definitely will not test; … ; 5 = definitely will test.*"

Baseline intention / behavioral change related to radon protection was measured in our study by the following three items adopted from (LaTour & Tanner, 2003) and (D'Antoni et al., 2019):
- "*I intend to test radon concentration in my home if advised by experts.*";
- "*I intend to start the remediation of the home straight after I've obtained the results if advised by experts.*";
- "*I would agree to install a radon removal system if advised by experts.*"

The answering categories consisted of a 5-point Likert scale ranging from "*Strongly disagree*" (1), "*Disagree*" (2), "*Neither agree, nor disagree*" (3), "*Agree*" (4) to "*Strongly agree*" (5) and "*I don't know*" (9) answers.

The three items resulted as one factor in a reliable scale with Cronbach's Alpha 0.916 and 86% of explained variance. (N = 259 out of 300)

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 31

RadoNorm
Managing risks from radon and NORM

✅ **Baseline intention/ behavioral change**

Baseline intention/behavioral change: Factor Matrix[a]:

	Factor
	1
RA6. I intend to **start the remediation** of the home straight after I've obtained the results if advised by experts.	,928
RA8. I would agree to **install a radon removal system** if advised by experts.	,907
RA5. I intend to **test** radon concentration in my home if advised by experts.	,833

Extraction Method: Principal Axis Factoring.
a.   1 factors extracted. 8 iterations required.

Reliability Statistics: Cronbach's Alpha 3 items: ,916

N out of 300= 259

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,580	86,008	86,008	2,377	79,226	79,226
2	,263	8,757	94,764			
3	,157	5,236	100,000			

Extraction Method: Principal Axis Factoring.

27

Figure 7: Factor for baseline intention/behavioral change

Behavioral intention/change	All	Not seen video (n=107)	Seen video (n=183)
N	259	104	147
Reliability	.916	.884	.922
Dimensionality	1	1	1
Factor Loading	High: .93 – Low: .83	High: .90 – Low: .81	High: .94 – Low: .83

3.4   Willingness to engage

Experience in different countries shows that stakeholder engagement should be recognized as an essential component of long-term radiological risk management. This allows stakeholders to build more familiarity with and control of the issue at hand and raises public confidence (NEA, 2013). Involvement may take the form of sharing information, consulting, conducting dialogues or deliberating on decisions. Through stakeholder involvement, public concerns can be addressed in an open and transparent manner and trust can be built between the different parties. Furthermore, stakeholders may end up developing a certain level of ownership of the solutions to be implemented. There are various techniques and instruments explicitly designed to enhance public involvement such as the organization and implementation of focus groups, expert panels or hearings, roundtables, interest groups, in-depth groups, citizen juries or panels, citizen advisory committees, consensus conferences, coercive

RadoNorm

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 32

dialogues and other public meetings (De Marchi & Ravetz, 2001; Di Nucci, Brunnengräber, & Isidoro Losada, 2017; Krütli, Stauffacher, Flüeler, & Scholz, 2010; Renn, 2008). Arnstein (1969) developed for this purpose a "ladder of citizen participation" which consists of an escalating series of engagement including manipulation, therapy, informing, consultation, placation, partnership, delegation and citizen control. The influence of citizens on decisions is lowest in the first two rungs of the ladder (labelled as 'non-participation') where the main goal of decision-makers is to "educate" and "cure" citizens. Rungs 3, 4, and 5 are labelled as 'degrees of tokenism' and are levels in which citizens are in dialogue with public authorities but they have no influence on their decision. The last three rungs of the ladder are labelled as 'citizen power' and these are the levels in which citizens have appointed seats in decision-making committees and/or deal themselves with the policy-making process and as such they influence decisions to a greatest level (Arnstein, 1969).

In this study we adopted an item from (Turcanu, Perko, & Laes, 2014) and (Hoti, Perko, Thijssen, & Renn, 2021).

- *If there would be an activity asking for input from the general public related to radon concentrations near your home, to what extent would you like to participate?*

The following answering categories, presented on a graphical card, were offered and participants could only choose one option: *I don't want to be involved, I want to receive information; I want to receive information and express my opinion; I want to participate in a dialog towards decision; I want to be a partner in the decision-making process and I don't know/no answer.*
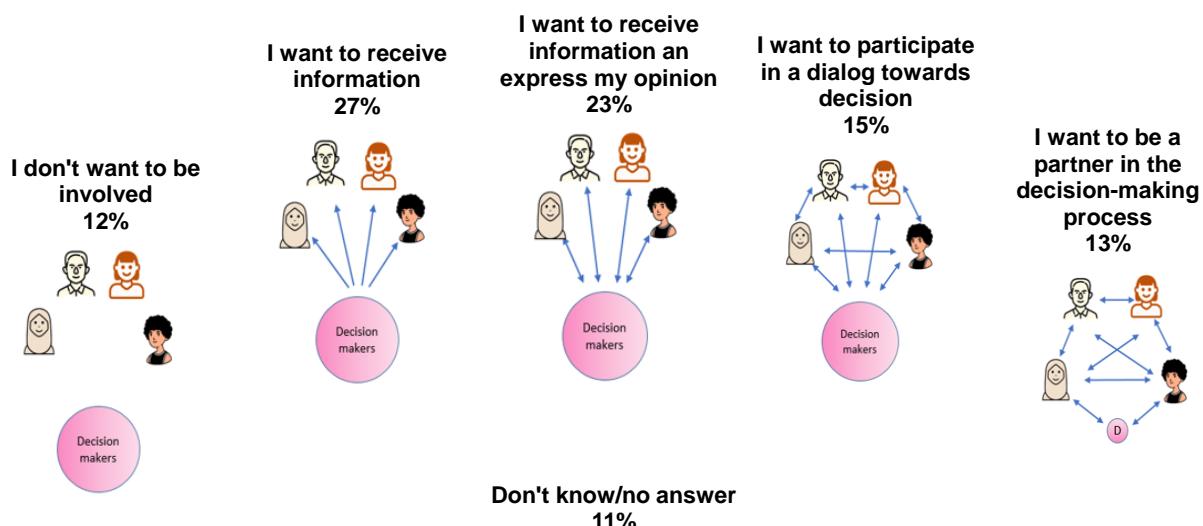
Figure 8 Participation intention

3.5 Knowing radon actors, their technical competences and trustworthiness

The perception of trust and credibility of a communicator is dependent on the perceptions of his/her knowledge and expertise, honesty and care (Peters et al., 1997). Effective communication requires respected and trustworthy sources (Fischhoff, 1991; Morgan et al., 1992). Conversely, not knowing whom or what to believe can make risk decisions intractable, and a lack of credibility and trust can erode relations between experts (the communicator) and the public. In general, people will be more tolerant of risks that are perceived to be generated by a trusted source, compared to a questionable one (Fischhoff, 1991). However, trust is not created by knowledge in itself. Rather, trusted sources are seemingly characterized by multiple positive attributes, since sources with moderate accountability are seen as the most trusted ones (Frewer et al., 1996). Trust and credibility in organizations involved in radiation risk management or experts depend on the perception of knowledge, expertise, honesty and cooperation between experts, radiation risk management organizations and (local) communities and residents.

Trust is defined and measured differently across studies. Torres et al. (Torres, Yadav, & Khan, 2017b) asked people to indicate the degree of trust in the following organizations either directly or indirectly involved in produced water management: Oil operators, Truck companies, State/local, Federal government, Environmental Protection Agency. For each organization they had to indicate how much trust they have: no trust at all; little trust; quite a bit of trust; a lot of trust. Torres et al. (2017a) included a question to measure the perceived competence and trustworthiness of state agencies: "How confident are you that the state agencies (e.g. Department of Health and Department of Mineral Resources) will provide honest and accurate information about the safety of produced water handling and disposal?": Not at all confident; Not too confident; Somewhat confident; Very confident; Other. (Torres, Yadav, & Khan, 2017a)

In this study the items measuring knowledge of radon actors, their technical competences and trustworthiness were adopted form SCK CEN barometer (Turcanu & Perko, 2014) and (Perko, Zeleznik, Turcanu, & Thijssen, 2012a).

- *When we look at radon, can you tell us: Whether you know the following actors If so, can you tell us if you think they are: telling the truth about radon risks technically competent with regard to radon mitigation. Not knowing an actor is a filter for "telling the truth" and "being technically competent"*

The answering categories consisted of a 5-point Likert scale ranging from "*Strongly disagree*" (1), "*Disagree*" (2), "*Neither agree, nor disagree*" (3), "*Agree*" (4) to "*Strongly agree*" (5) and "*I don't know*" answers (9).

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 34

Do you know ... ?
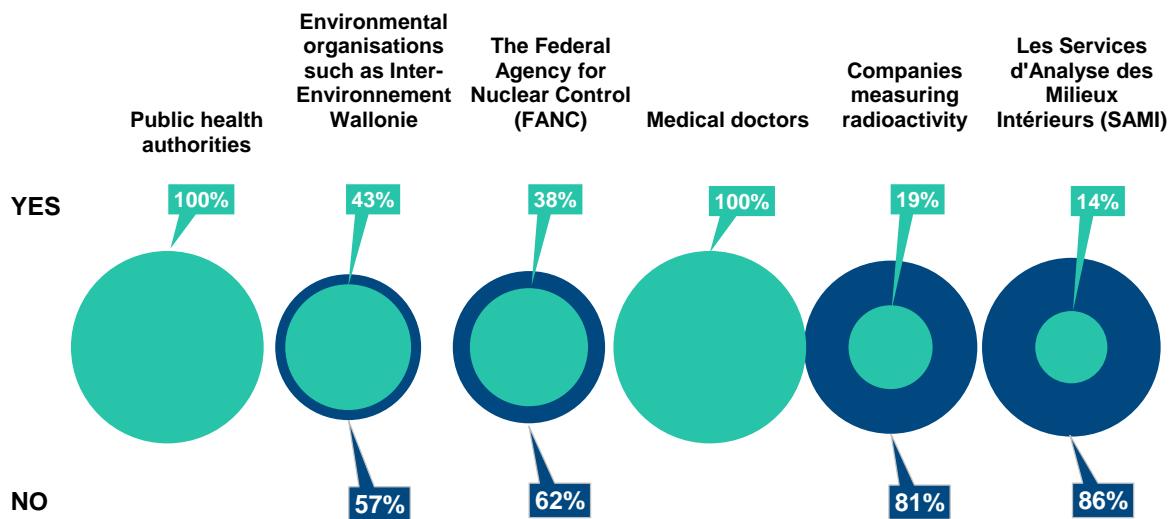
Figure 9 Knowledge of actors

Credibility

Can you tell us if you think they are telling the truth about radon risks?
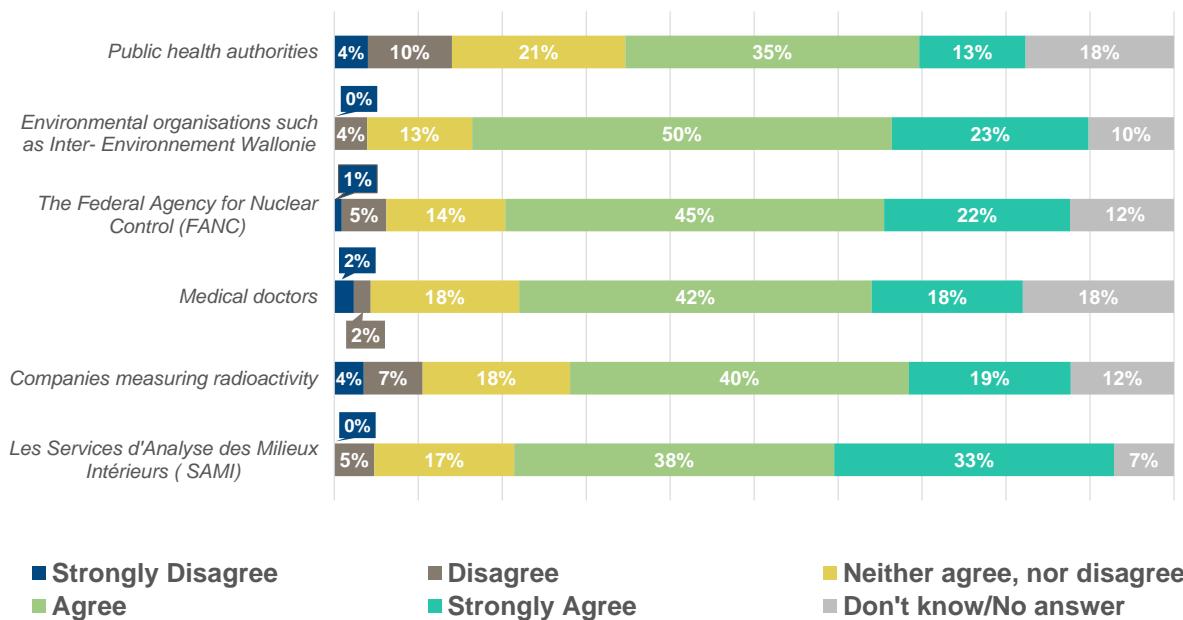
Figure 10 Trustworthiness
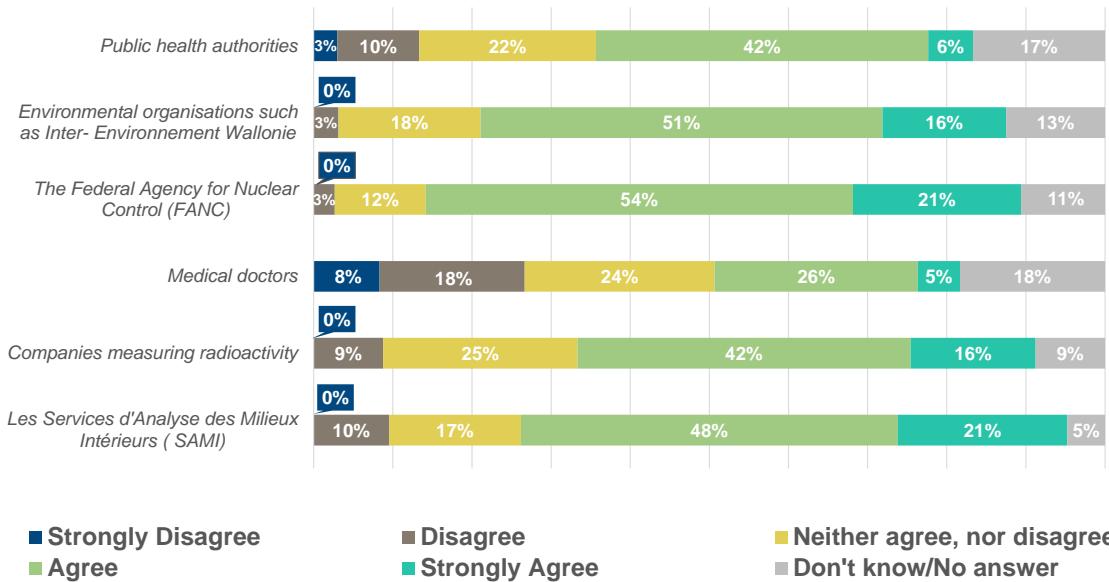
Figure 11 Technical competence
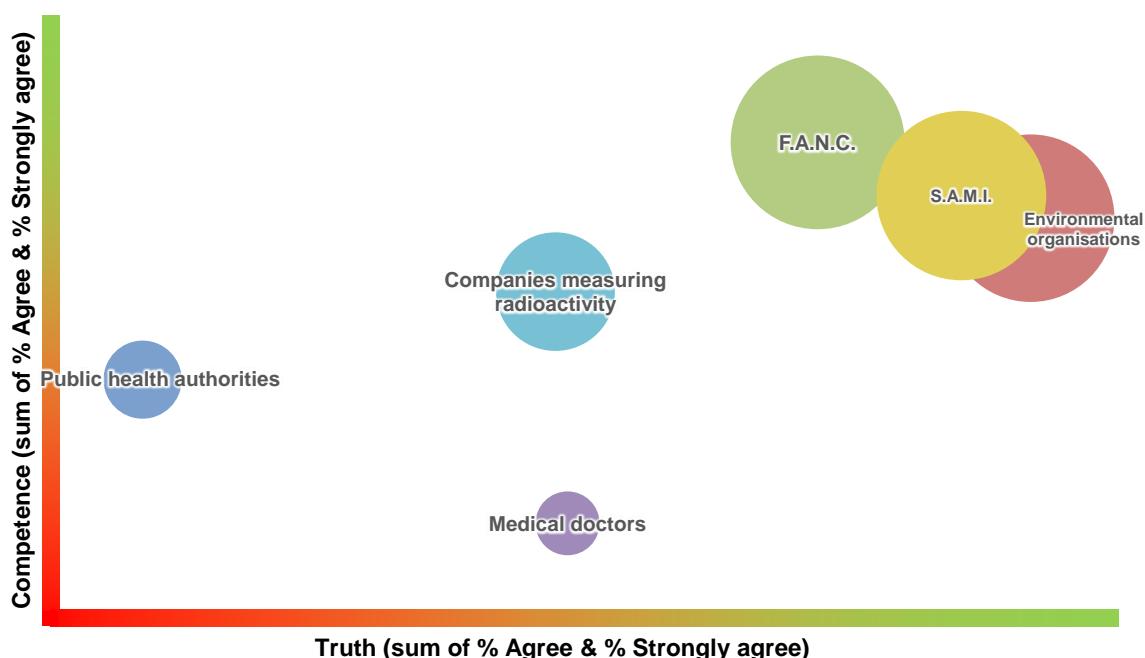
Figure 12 Trustworthiness vs. technical competence

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu — Page 36

Telling the truth & Technically competent	Truth (sum of Agree & Strongly agree)	Competence (sum of Agree & Strongly agree)	Know the actor
Public health authorities	48%	48%	23%
Environmental organisations	73%	66%	49%
FANC-AFCN	67%	75%	51%
Medical doctors	60%	31%	19%
Companies measuring radioactivity	60%	58%	35%
SAMI	71%	69%	49%

Results of factor analysis conducted on items measuring trust and confidence for all actors are presented below.

	All	**Not seen video (n=107)**	**Seen video (n=183)**
N	210	92	115
Reliability	.848	.825	.863
Dimensionality	1	1	1
Factor Loading	High: .79 – Low: .60	High: .77 – Low: .51	High: .84 – Low: .67

3.6   Potential radon protection behavioral determinants

In order to identify determinants for behavioral change (test and mitigate) different concepts from health protection theories, risk perception theory and risk communication theories were integrated in the questionnaire. Different elements (central determinants) from socio-psychological models were used and thirteen validated scales were adopted and modified for the radon topic.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 37

Figure 13: Survey items for hypothetical behavioral determinants used in the questionnaire

3.6.1 Perception of radiological risks

Risk perception as a term has been extensively used within social sciences (Slovic 1987; Sjöberg 2000), and it mainly denotes the way individuals think and feel about the risks they face (Lemyre 2017; Scholz 2011, p. 179; Renn 2008, pp. 93ff.; Slovic 1987; Renner, and al., 2015).

Risk perception of radon was measured in the study of (Weinstein, Lyon, man, & Cuite, 1998) with the following items: *perceived likelihood in own home; percentage chance in own home; and percentage prevalence in community*.

The SCK CEN Barometer developed the risk perception measurement since 2002 onwards (Carlé & Hardeman, 2003); (Van Aeken, Turcanu, Bombaerts, Carlé, & Hardeman, 2007); (Turcanu, Perko, & Schröder, 2011); (Perko, Turcanu, Schröder, & B., 2010). From 2015 it focuses on personal, rather than general risk perception In 2015, the list included industrial risks (nuclear and chemical), various radiological risks and environmental pollution. Following the recurrent comments received from participants in the pilot studies, general risk perception was replaced by personal risk perception. The measurement methodology for personal risk perception followed that introduced in 2013 (Turcanu & Perko, 2014) the type of risk ("health risks") and the time scale ("next 20 years") were specified.

Risk perception of radon, measured with those items, is reported in the following studies: (Perko, 2014); (Perko, Thijssen, C., & Van Gorp, 2014); (Perko, Zeleznik, Turcanu, & Thijssen, 2012b)

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 38

Some SCK CEN Barometer items were used in the RadoNorm study in order to assess risk perception of radon, NORM in buildings and other related or associated risks among residents of the radon prone areas in Belgium:

- *"How do you perceive the potential risk to your health within the next 20 years from each of the following sources?"*: Environmental pollution; Natural radiation (from the soil or from space); Indoor air pollution due to radon; The use of ionizing radiation for medical tests or treatments; The use of recycled material with low levels of radioactivity for buildings; and Climate crisis.

The answering categories consisted of a 6-point Likert scale ranging from "no risk at all" (0), "very low" (1), Low (2), Moderate (3), High (4), "very high risk" (5), and "I don't know" . (results are weighted)

Risk perception: Environmental pollution

How do you perceive the potential risk to your health within the next 20 years from ...?

N=300

23% | 7% | 2% | 1% | 5% | 45% | 16%

■ No risk ■ Very low ■ Low ■ Moderate ■ High ■ Very high ■ Don't know/No answer
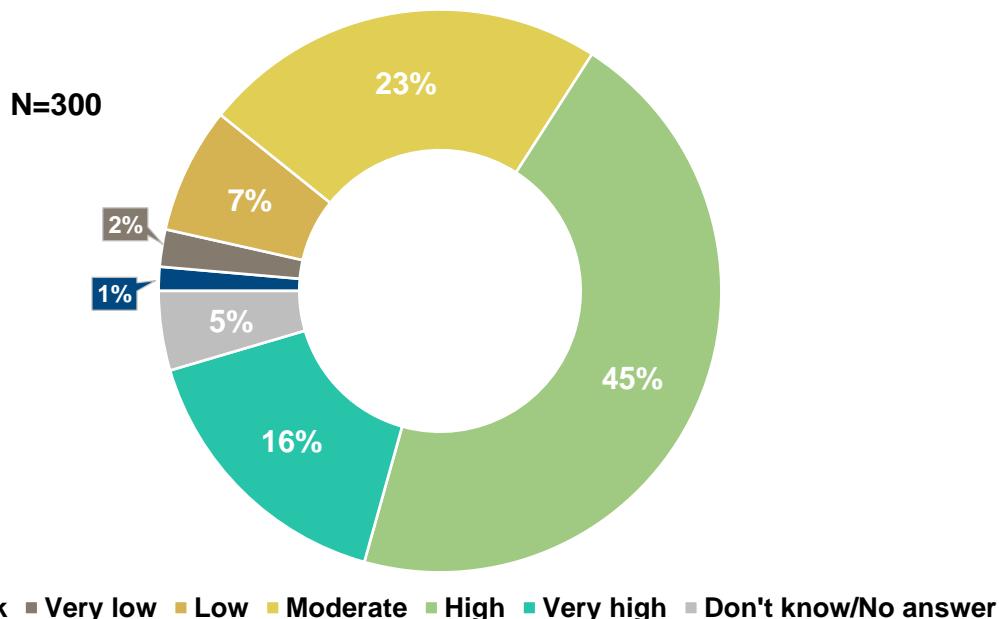
Figure 14 Perception of risk from environmental pollution

www.radonorm.eu   Page 39

Risk perception: Natural radiation (from the soil or from space)

How do you perceive the potential risk to your health within the next 20 years from ...?

N=300

27%

26%

17%

4%

11%

3%

12%

■ No risk ■ Very low ■ Low ■ Moderate ■ High ■ Very high ■ Don't know/No answer
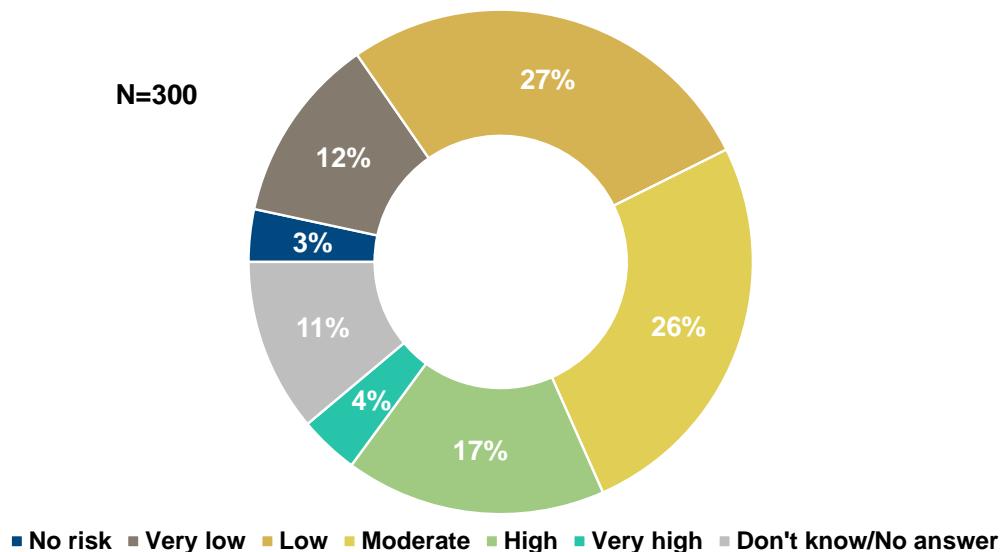
Figure 15 Perception of risk from natural radiation

**Risk perception:
The use of ionising radiation for medical tests or treatments**

How do you perceive the potential risk to your health within the next 20 years from ...?

N=300

19%

25%

22%

5%

18%

2%

7%

■ No risk ■ Very low ■ Low ■ Moderate ■ High ■ Very high ■ Don't know/No answer
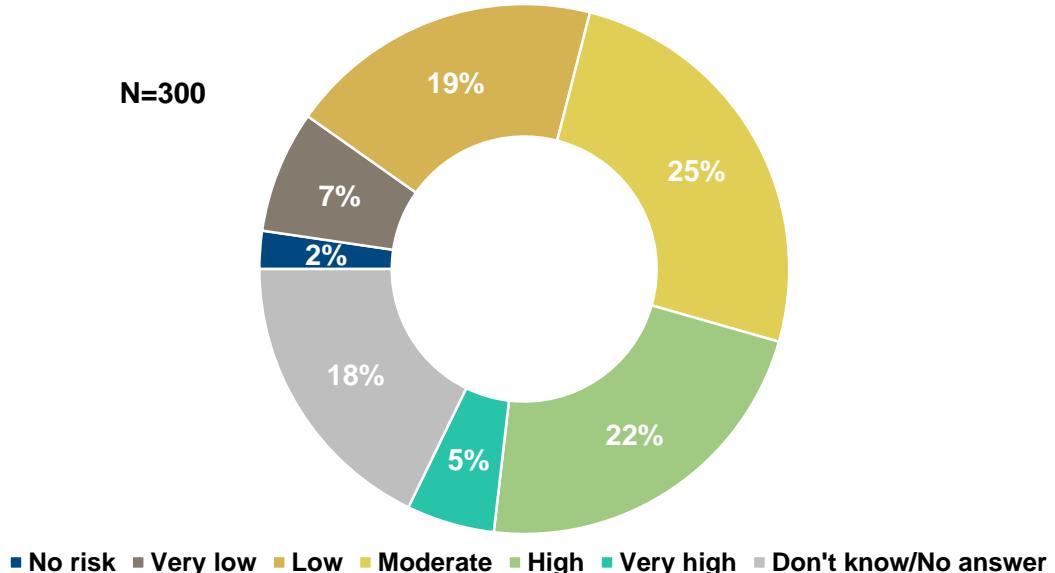
Figure 16 Perception of risk from use of ionising radiation in medicine

RadoNorm

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 40

Risk perception: The use of recycled material with low levels of radioactivity for buildings

How do you perceive the potential risk to your health within the next 20 years from ...?

N=300

■ **No risk** ■ **Very low** ■ **Low** ■ **Moderate** ■ **High** ■ **Very high** ■ **Don't know/No answer**
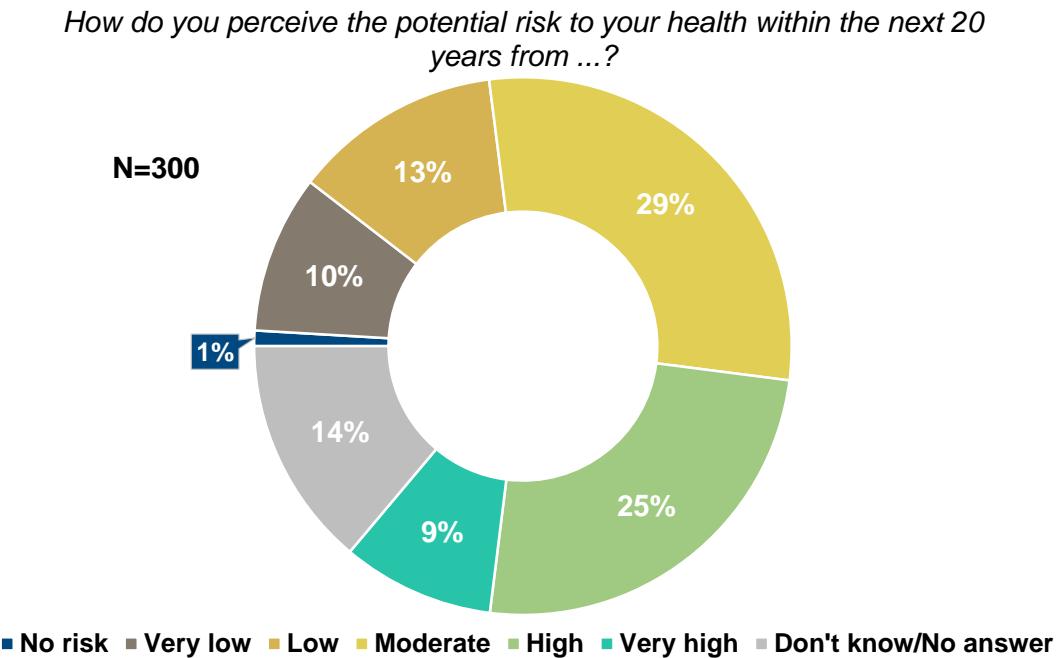
Figure 17 Perception of risk from NORM in building

Risk perception: Climate Crisis

How do you perceive the potential risk to your health within the next 20 years from ...?

N=300

■ **No risk** ■ **Very low** ■ **Low** ■ **Moderate** ■ **High** ■ **Very high** ■ **Don't know/No answer**
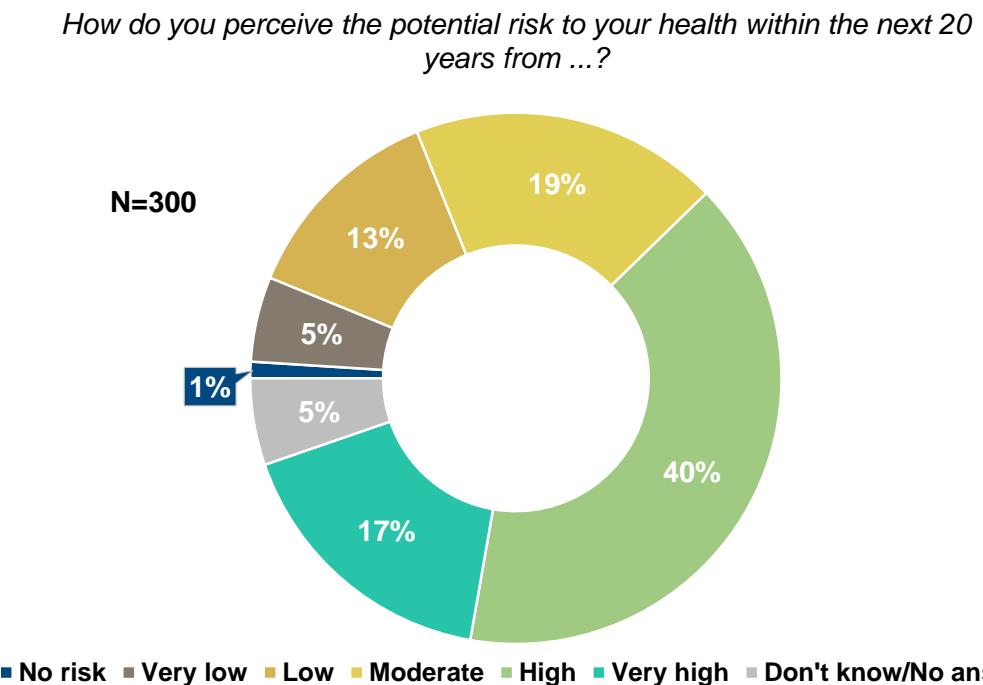
Figure 18 Perception of risk from climate crisis

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 41

Risk perception: Indoor air pollution due to radon

How do you perceive the potential risk to your health within the next 20 years from ...?
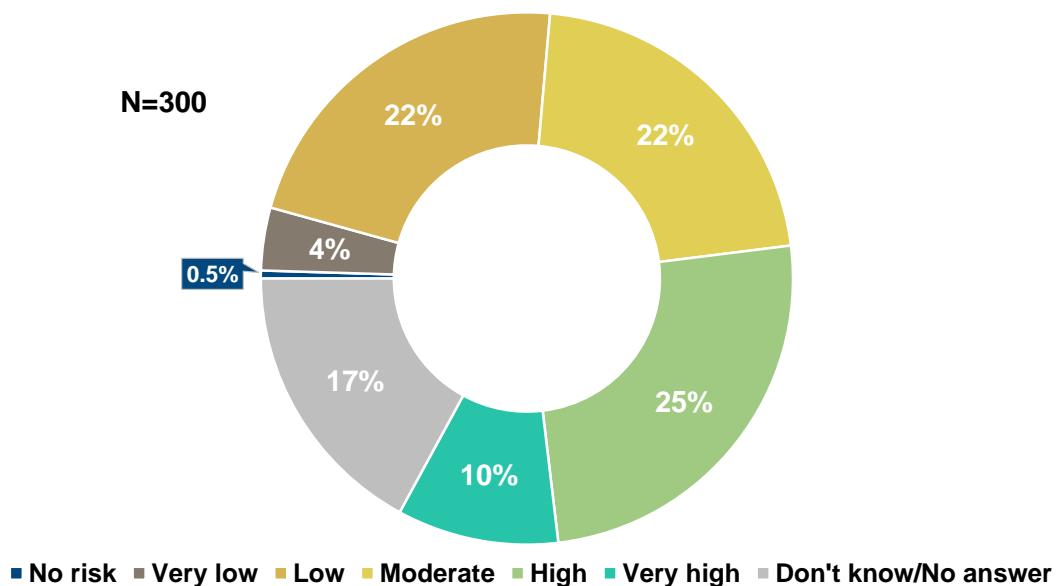
Figure 19 Perception of risk from indoor air pollution due to radon

3.6.2 Risk perception of radon and NORM in comparison with other radiological risks

(Evans et al., 2015) also measured perception of radon risk relative to other sources of ionising radiation: *"Select which of the following posed the greatest and least health risk to the respondent"*: *medical imaging tests that use ionizing radiation; radon; other natural sources of ionizing radiation; nuclear power plants; airplane travel* .

Results show, that residents of the radon prone areas in Belgium perceive the risk from *environmental pollution* as the highest potential risk to their health within the next 20 years (mean=4.63, std.= 1.012), followed by risk of a *climate crisis* (mean=3,47 on a scale from 0=no risk at all,…, to 5=very high risk, std.= 1.164). Among radon and NORM related risks, the risk of the *indoor air pollution due to radon* is perceived as the highest potential risk to their health within the next 20 years (mean=3.12, std.= 1.148), followed by the *use of recycled material with low levels of radioactivity for buildings* (mean=3.03, std. = 1.177). The lowest risk for a health within the next 20 years is perceived for *natural radiation (from the soil or from space)* (mean=2.5, std. 1.177). It is interesting, that the risk of *natural radiation (from the soil or from space)* is perceived as a potential lower risk than *the use of ionising radiation for medical tests or treatments.* However, the risk of medical application of ionizing radiation is perceived as one of the lowest radiological risks by residents of radon prone areas in Belgium (mean=2.85, std. = 1.109).

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu　　　Page 42

Descriptive Statistics of Risk Perceptions

How do you perceive the potential risk to your health within the next 20 years from each of the following sources?	N (out of 300)	Minimum	Maximum	Mean	Std. Deviation
RP6. Natural radiation (from the soil or from space)	264	1	6	2,50	1,157
RP7. The use of ionising radiation for medical tests or treatments	243	1	6	2,85	1,109
RP20. The use of recycled material with low levels of radioactivity for buildings	263	1	6	3,03	1,177
RP12a. Indoor air pollution due to radon	254	1	6	3,12	1,148
RP11. Climate Crisis	287	1	6	3,47	1,164
RP1. Environmental pollution	289	1	6	3,63	1,012

It is worth to mention, that 15,3% residents leaving in a high radon prone area selected "I don't know" answer on the following question: *"How do you perceive the potential risk to your health within the next 20 years from indoor air pollution due to radon."* This is rather a high percentage of the population, indicating, that radon may not be associated to indoor air pollution by respondents. As expected, also *natural radiation (from soil or from space)* and the *use of recycled material with low levels of radioactivity for buildings* often triggered "I don't know" response (12% for natural radiation and 12,3 % the reuse of NORM). For instance, only 3,7%, respectively 4,3%, of respondents indicated that they don't know what is the potential risk to their health due to *environmental pollution* or *climate crisis*. This signifies that radon and NORM receive rather minor attention from the population living in an area with high radon exposure in Belgium.

RadoNorm

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 43
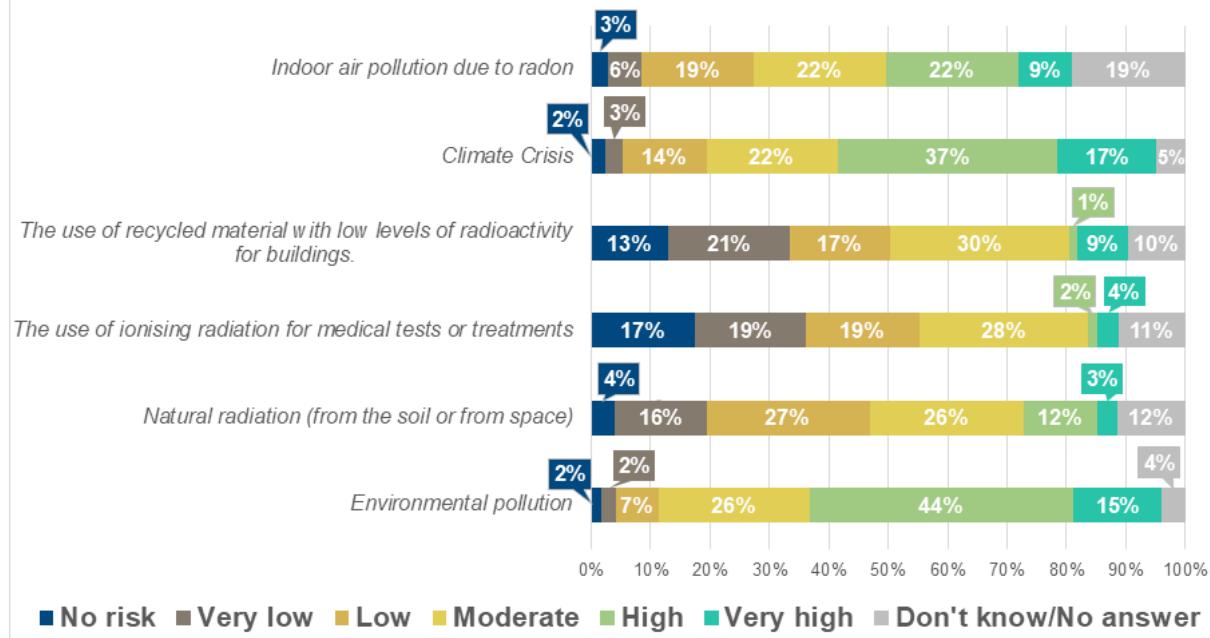
Figure 20: Risk perception: all items

A chi-square test (χ2) for evaluating the statistical significance of an association among the radiological risks perceptions and gender, education, number of family members, ownership and duration of residence in the dwelling and municipality of the respondent showed that we can confirm with 95% confidence an association between risk perception of natural radiation (from the soil or from space) and ownership of a dwelling ($\chi2(15)=28,769$, $p=0.017$), a significant association was confirmed between risk perception of the indoor air pollution due to radon and local community of the respondent (postal code) ($\chi2(400)=550,722$, $p=0.000$). Moreover, the following associations were observed: between risk perception of environmental pollution and level of education ($\chi2(40)=64,113$, $p=0.009$), between risk perception of natural radiation and gender/sex ($\chi2(10)=19,259$, $p=0.037$), between the risk perception of the use of ionizing radiation for medical tests or treatments and gender/sex ($\chi2(10)=21,222$, $p=0.020$) and risk perception of the use of ionizing radiation for medical tests or treatments and level of education ($\chi2(35)=57,754$, $p=0.009$), between risk perception of environmental pollution and local community of the respondent.

It is worth to mention, that association between perception of risk from *indoor air pollution due to radon* and gender/sex, level of education, number of family members, ownership of the dwelling, and duration of residence in the dwelling resulted as not significant.

Also no association was observed between perception of risks from *the use of recycled material with low levels of radioactivity for buildings* and the socio-demographic variables gender, education, number of family members, ownership of the dwelling, time in the dwelling, or local community.

RadoNorm

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 44

Risk perception	Gender/Sex	Level of education	No. of family members
Environmental pollution	Not sig.	χ2(40)=64,113, p=0.009	Not sig.
Natural radiation (from the soil or from space)	χ2(10)=19,259, p=0.037	Not sig.	Not sig.
Indoor air pollution due to radon	Not sig.	Not sig.	Not sig.
The use of ionizing radiation for medical tests or treatments	χ2(10)=21,222, p=0.020	χ2(35)=57,754, p=0.009	Not sig.
The use of recycled material with low levels of radioactivity for buildings	Not sig.	Not sig.	Not sig.
Climate crisis	Not sig.	Not sig.	Not sig.

Risk perception	Ownership of the dwelling	For how long in this dwelling	Local community (poste code)
Environmental pollution	Not sig.	Not sig.	χ2(420)=506,655, p=0.002
Natural radiation (from the soil or from space)	χ2(15)=28,769, p=0.017	Not sig.	Not sig.
Indoor air pollution due to radon	Not sig.	Not sig.	χ2(400)=550,722, p=0.000
The use of ionizing radiation for medical tests or treatments	χ2(15)=35,736, p=0.002	Not sig.	Not sig.
The use of recycled material with low levels of radioactivity for buildings	Not sig.	Not sig.	Not sig.
Climate crisis	χ2(15)=27,435, p=0.025	Not sig.	Not sig.

Correlations were also evaluated between the different risk perceptions variables, as shown in the table below.
Correlation between the two variables (name the variables) is significant as p < .001"
Correlation between the risk perception of environmental pollution and natural radiation (from the soil or from space) space is significant as p < .001.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 45

Correlations between risk perception variables

Spearman's rho		RP1. Environmental pollution	RP6. Natural radiation (from the soil or from space)	RP7. The use of ionising radiation for medical tests or treatments	RP20. The use of recycled material with low levels of radioactivity for buildings	RP11. Climate Crisis	RP12a. Indoor air pollution due to radon
RP1. Environmental pollution	Correlation Coefficient	1,000	,372**	,467**	,352**	,613**	,517**
	Sig. (2-tailed)	.	,000	,000	,000	,000	,000
	N	289	263	241	261	286	253
RP6. Natural radiation (from the soil or from space)	Correlation Coefficient		1,000	,612**	,446**	,446**	,498**
	Sig. (2-tailed)		.	,000	,000	,000	,000
	N		264	233	243	263	241
RP7. The use of ionising radiation for medical tests or treatments	Correlation Coefficient			1,000	,536**	,386**	,605**
	Sig. (2-tailed)			.	,000	,000	,000
	N			243	230	242	224
RP20. The use of recycled material with low levels of radioactivity for buildings	Correlation Coefficient				1,000	,303**	,519**
	Sig. (2-tailed)				.	,000	,000
	N				263	260	239
RP11. Climate Crisis	Correlation Coefficient					1,000	,352**
	Sig. (2-tailed)					.	,000
	N					287	252
RP12a. Indoor air pollution due to radon	Correlation Coefficient						1,000
	Sig. (2-tailed)						.
	N						254

**. Correlation is significant at the 0.01 level (2-tailed).

3.6.3 Confidence in authorities for the actions they undertake to protect the population against radon, NORM in buildings and other radiological risks

To measure confidence in authorities, the residents of the high radon prone areas in Belgium were asked to respond to the following question:

- "*How much confidence do you have in the authorities for the actions they undertake to protect the population against risks from each of the following sources"*: natural radiation, indoor air pollution due to radon, the use of recycled material with low levels of radioactivity for buildings , environmental pollution and the use of ionising radiation for medical tests or treatments.

The answering categories consisted of a 6-point Likert scale ranging from *"none" (0), "very little" (1), "little" (2), "moderate" (3), "quite a lot" (4), "very much" (5) and "don't know")*.

The survey shows that confidence in the authorities for the actions they undertake to protect the population against the evaluated risks is moderate for all investigated risks. However, results show that residents of high radon prone areas in Belgium have the lowest confidence in authorities for the actions they undertake to protect the population against risks from *natural radiation* (mean=2.36, std.=1,150), followed by risks from *indoor air pollution due to radon* (mean=2.39, std.=1,214) and *the use of recycled*

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 46

material with low levels of radioactivity for buildings (mean=2.42, std.=1,180). The highest confidence in authorities among the evaluated radiological risks was expressed for actions undertaken to protect the population against *the use of ionising radiation for medical tests or treatments* (mean=2.74, std.=1,242) and *environmental pollution* (mean=2.44, std.=1,233).

Descriptive Statistics for confidence in authorities

	N (out of 300)	Minimum	Maximum	Mean	Std. Deviation
RC6. Natural radiation	257	1	6	2,35	1,150
RC12a. Indoor air pollution due to radon	247	1	6	2,39	1,214
RC20. The use of recycled material with low levels of radioactivity for buildings	257	1	6	2,42	1,180
RC1. Environmental pollution	287	1	6	2,44	1,233
RC7. The use of ionising radiation for medical tests or treatments	243	1	6	2,74	1,242
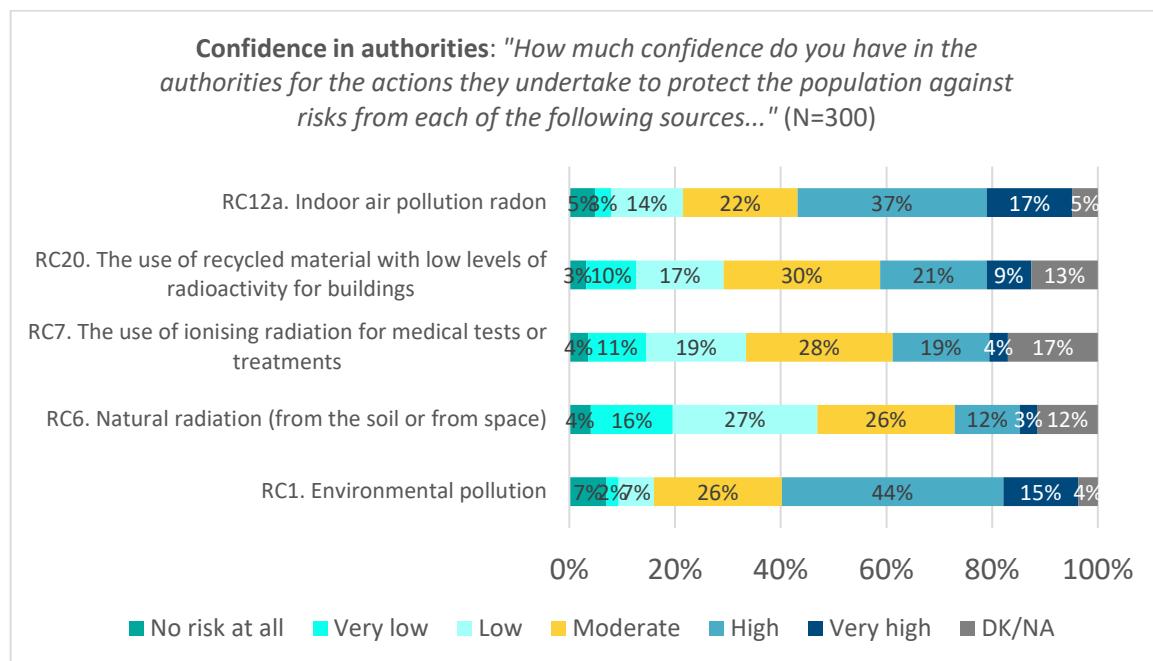
Figure 21: Confidence in authorities

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 47
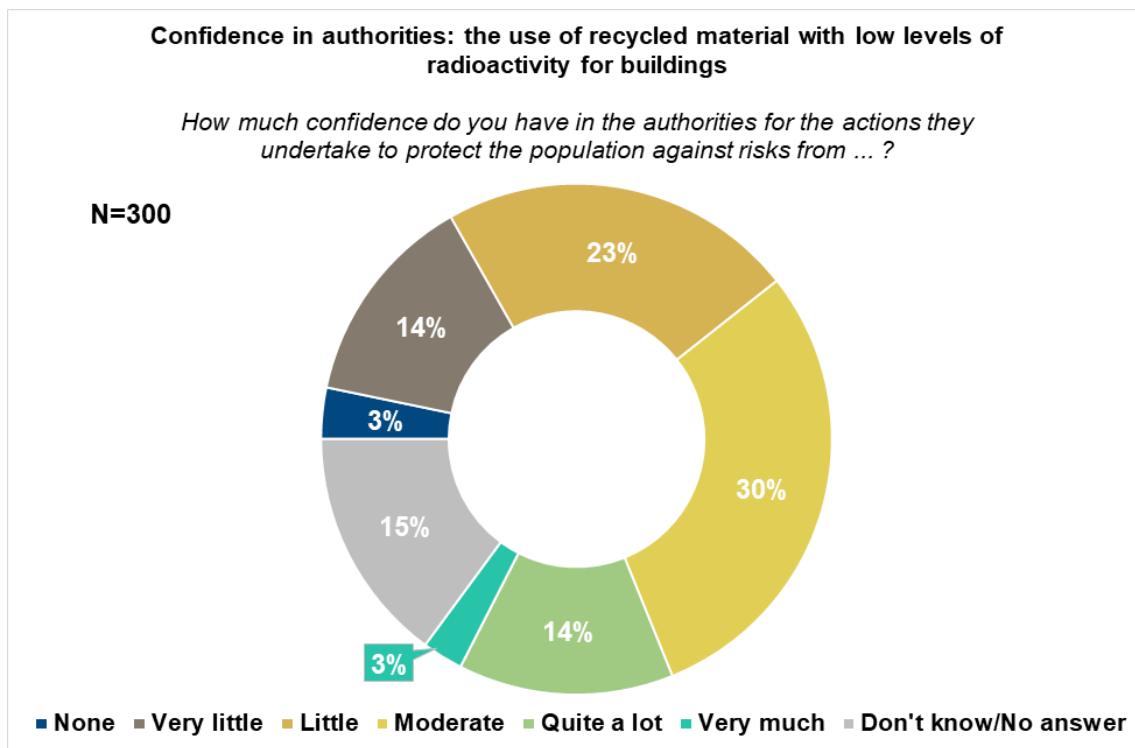
Figure 22: Confidence in authorities: The use of recycled material with low levels of radioactivity for buildings

A chi-square test (χ2) for evaluating the statistical significance of an association among the confidence in the authorities for the actions they undertake to protect the population against risks from different sources of radiological risks and gender, education, number of family members, ownership of the dwelling, time in the dwelling and local community was calculated. The following associations were observed: between the confidence in the authorities for the actions they undertake to protect the population against risks from *indoor air pollution due to radon* and level of *education* (χ2(35)=52,661, p=0.028), between the confidence in the authorities for the actions they undertake to protect the population against risks from *natural radiation (from the soil or from space) and local community (postal code) (*χ2(410)=492,227, p=0.003) and between the confidence in the authorities for the actions they undertake to protect the population against risks from *indoor air pollution due to radon* and *local community* (χ2(400)=451,219, p=0.039). All other associations revealed as statistically not significant.

Confidence in the authorities for the actions they undertake to protect the population against risks from	Gender/Sex	Level of education	No. of family members
Environmental pollution	Not sig.	Not sig.	Not sig.
Natural radiation (from the soil or from space)	Not sig.	Not sig.	Not sig.
Indoor air pollution due to radon	Not sig.	χ2(35)=52,661, p=0.028	Not sig.
The use of ionizing radiation for medical tests or treatments	Not sig.	Not sig.	Not sig.
The use of recycled material with low levels of radioactivity for buildings	Not sig.	Not sig.	Not sig.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 48

Confidence in the authorities for the actions they undertake to protect the population against risks from	Ownership of the dwelling	For how long in this dwelling	Local community (poste code)
Environmental pollution	Not sig.	Not sig.	Not sig.
Natural radiation (from the soil or from space)	Not sig.	Not sig.	χ2(410)=492,227, p=0.003
Indoor air pollution due to radon	Not sig.	Not sig.	χ2(400)=451,219, p=0.039
The use of ionizing radiation for medical tests or treatments	Not sig.	Not sig.	Not sig.
The use of recycled material with low levels of radioactivity for buildings	Not sig.	Not sig.	Not sig.

3.6.4   Anticipatory emotion- worry

The anticipatory emotion – worry is an emotion where a person experiences increased levels of anxiety by thinking about an event or situation in the future. The scale was adapted from (McGlone, Bell, Zaitchik, & McGlynn, 2013; Witte, Meyer, & Martell, 2012). Also in their studies the used two items and Spearman-Brown statistics (0.94) to measure the reliability. In our study the anticipatory emotion – worry was measured with the following two items:

- *"Information about radon makes me nervous and tense about my health.";*
- *"Information about radon makes me worry about the possibility of getting lung cancer."*

The answering categories consisted of a 5-point likert scale ranging from "*Strongly disagree*" (1), "*Disagree*" (2), "*Neither agree, nor disagree*" (3), "*Agree*" (4) to "*Strongly agree*" (5) and "*I don't know*" answers (9).

Table: Descriptive statistics for anticipatory emotion- worry

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
RA10. Information about radon makes me worry about the possibility of getting lung cancer: To what extent do you agree or disagree with the following statements?	280	1	5	3,21	1,106
RA11. Information about radon makes me nervous and tense about my health: To what extent do you agree or disagree with the following statements?	286	1	5	2,27	1,001
Valid N (listwise)	279				

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 49

Anticipatory emotion - worry

Information about radon makes me worry about the possibility of getting lung cancer

N=300

- ■ **Strongly Disagree**
- ■ **Agree**
- ■ **Disagree**
- ■ **Strongly Agree**
- ■ **Neither agree, nor disagree**
- ■ **Don't know/No answer**
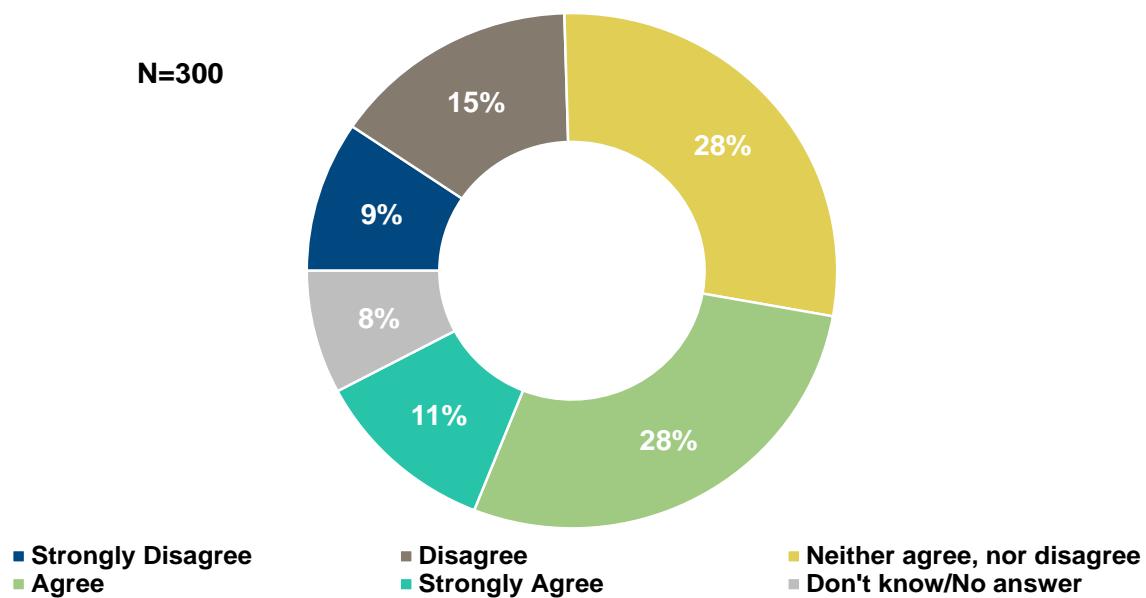
Figure 23 Anticipatory emotion-worry: lung cancer

Anticipatory emotion - worry

Information about radon makes me nervous and tense about my health

N=300

- ■ **Strongly Disagree**
- ■ **Agree**
- ■ **Disagree**
- ■ **Strongly Agree**
- ■ **Neither agree, nor disagree**
- ■ **Don't know/No answer**
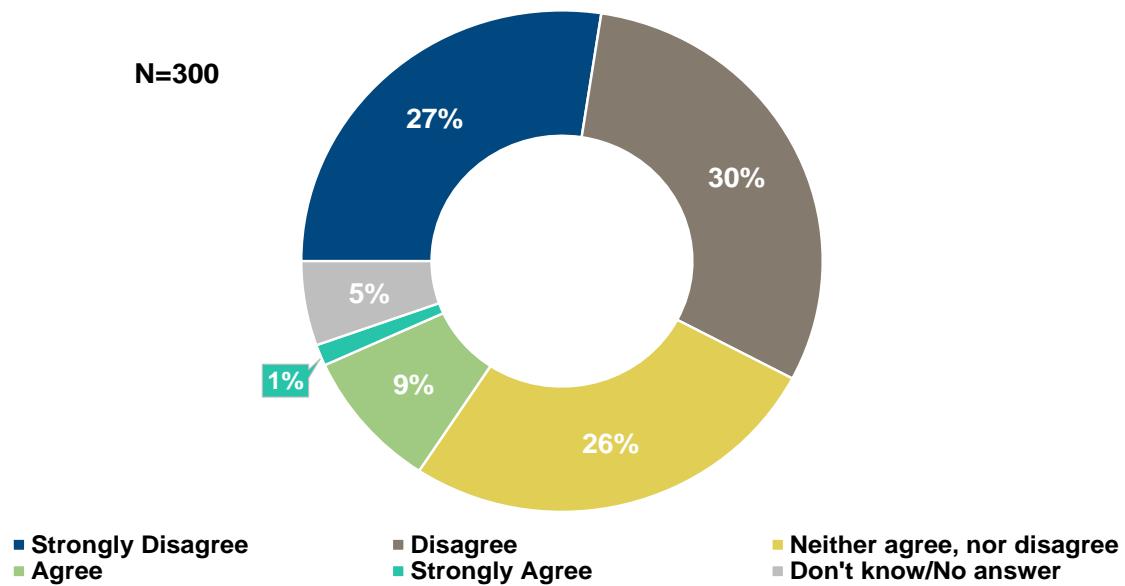
Figure 24 Anticipatory emotion-worry: health

The two items resulted as one factor in a reliable scale with Spearman-Brown statistics (0,743) and 79% of explained variance. (N = 279 out of 300)

Anticipatory emotion- worry (2i)

Anticipatory emotion – Worry Factor Matrix[a]

	Factor
RA11. Information about radon makes me **nervous and tense** about my health:	,768
RA10. Information about radon makes me **worry** about the possibility of getting lung cancer:	,768

Extraction Method: Principal Axis Factoring.
a. 1 factors extracted. 8 iterations required.

Reliability Statistics: Cronbach's Alpha 2 items: ,741;

Spearman-Brown Coefficient: ,743

N out of 300= 279

Reliability Statistics

Cronbach's Alpha	Part 1	Value	1,000
		N of Items	1[a]
	Part 2	Value	1,000
		N of Items	1[b]
	Total N of Items		2
Correlation Between Forms			,591
Spearman-Brown Coefficient	Equal Length		,743
	Unequal Length		,743
Guttman Split-Half Coefficient			,741

a. The items are: RA11. Information about radon makes me nervous and tense about my health: To what extent do you agree or disagree with the following statements?

b. The items are: RA10. Information about radon makes me worry about the possibility of getting lung cancer: To what extent do you agree or disagree with the following statements?

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,591	79,538	79,538	1,180	58,982	58,982
2	,409	20,462	100,000			

Extraction Method: Principal Axis Factoring.

This project has received funding from the Euratom research and training programme 20

Figure 25: Factor analysis for anticipatory emotion – Worry

	All	**Not seen video (n=107)**	**Seen video (n=183)**
N	279	103	168
Reliability	.743	.727	.774
Dimensionality	1	1	1
Factor Loading	High: .77 – Low: .77	High: .76 – Low: .76	High: .79 – Low: .79

3.6.5   Anticipatory emotion – severity

Anticipatory emotion - severity refers to people's beliefs about how serious are the negative consequences of a hazard. In radon exposure situations, the threat involves cancer, which is severe. (Mazur & Hall, 1990) measured severity with the following items: *"How much of a problem is the radon level in your home?"* And *"If you don't take any action, do you think the radon in your home will eventually make you sick?". (Sandman, Weinstein, & Miller, 1994)* measured perceived threat with the following estimations: *perceived likelihood of developing some illness from this level of exposure; perceived danger of this level; expected concern from finding such a level in one's home; and expected fear? (Marko Dragojevic, Bell, & McGlone, 2014)* measured severity with items such as *e.g. "Radon gas is a serious threat to health".*

The scale in our study was adapted from (LaTour & Tanner, 2003) and (Witte et al., 1998). In our study the anticipatory emotion – severity was measured with the following two items:

To what extent do you agree or disagree with the following statements?

- *"Having high radon concentration in my house would NOT be a severe threat to my health."*
- *"I believe that I can develop cancer if there is a high radon concentration in my home."*

The answering categories consisted of a 5-point Likert scale ranging from "*Strongly disagree*" (1), "*Disagree*" (2), "*Neither agree, nor disagree*" (3), "*Agree*" (4) to "*Strongly agree*" (5) and "*I don't know*" answers (9).

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
RA12. Having high radon concentration in my house would NOT be a severe threat to my health.	265	1	5	2,14	1,066
RA13. I believe that I can develop cancer if there is a high radon concentration in my home.	262	1	5	3,52	,982
Valid N (listwise)	251				

Table: Descriptive statistics for anticipatory emotion- severity

Anticipatory emotion – severity

Having high radon concentration in my house would NOT be a severe threat to my health
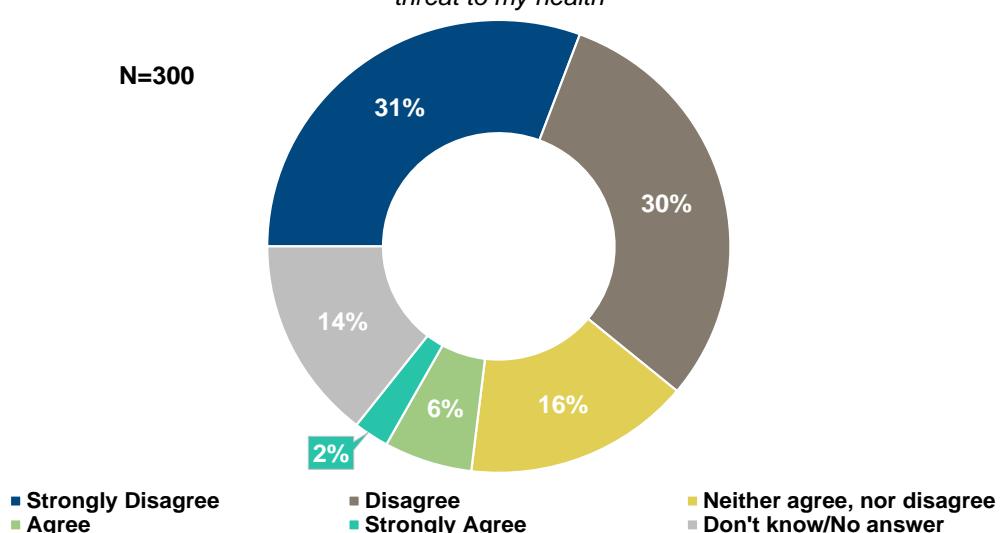
Figure 26 Anticipatory emotion-severity: health

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 52

Anticipatory emotion – severity

I believe that I can develop cancer if there is a high radon concentration in my home

N=300

- Strongly Disagree
- Disagree
- Neither agree, nor disagree
- Agree
- Strongly Agree
- Don't know/No answer

Figure 27 Anticipatory emotion-severity: lung cancer

The two items didn't result in one factor and a scale since Cronbach's alpha was only 0,534 and loadings of items were below 0,5, (N = 251 out of 300).

Anticipatory emotion – severity (2i)

Anticipatory emotion – severity Factor Matrix[a]

	Factor 1
RA12. Having high radon concentration in my house would NOT be a **severe threat** to my health:	,460
RA13. I believe that **I can develop cancer** if there is a high radon concentration in my home:	-,460

Extraction Method: Principal Axis Factoring.
a. 1 factors extracted. 8 iterations required.

Reliability Statistics: Cronbach's Alpha 2 items: -0,534;

N out of 300= 251

Reliability Statistics

Cronbach's Alpha	Part 1	Value	1,000
		N of Items	1[a]
	Part 2	Value	1,000
		N of Items	1[b]
	Total N of Items		2
	Correlation Between Forms		-,212[c]
Spearman-Brown Coefficient		Equal Length	-,538[c]
		Unequal Length	-,350[c]
	Guttman Split-Half Coefficient		-,534

This project has

Figure 28 Factor analysis for anticipatory emotion – Severity

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 53

	All	Not seen video (n=107)	Seen video (n=183)
N	251	96	148
Reliability	.350	.417	.191
Dimensionality	1	1	1
Factor Loading	High: .46 – Low: .46	High: .51 – Low: .51	High: .32 – Low: .32

3.6.6 Conditional/perceived susceptibility

Perceived susceptibility is the subjective belief that a person may acquire a disease or enter a dire state due to a particular behavior. In our study, the scale was adapted from (D'Antoni et al., 2019), (Weinstein, man, & Roberts, 1991) and (Niemeyer & Keller, 1999). Anticipatory emotion – worry was thus measured with the following three items:

- *How likely do you think it is that you will get sick if there is presence of radon in your home and you don't remediate it?*
- *How likely do you think it is that people living in your region will get sick due to indoor radon concentrations if they don't remediate their homes?*
- *How likely do you think it is that your own home has such an indoor radon concentration that you should do something about it?*

The answering categories consisted of a 5-point likert scale ranging from "*Very unlikely*" (1), "*Unlikely*" (2), "*Somewhat likely*" (3), "*Likely*" (4) to "*Very likely*" (5) and "*I don't know*" answers (9).

Table: Descriptive statistics for conditional susceptibility

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
RA14. How likely do you think you will get sick if there is presence of radon in your home and you don't remediate it?:	253	1	5	3,10	1,049
RA15. How likely do you think it is that people living in your region will get sick due to indoor radon concentrations if they don't remediate their homes?:	243	1	5	3,18	1,023
RA16. How likely do you think it is that your own home has such an indoor radon concentration that you should do something about it?:	257	1	5	2,44	1,003
Valid N (listwise)	229				

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 54

N=300

Conditional susceptibility
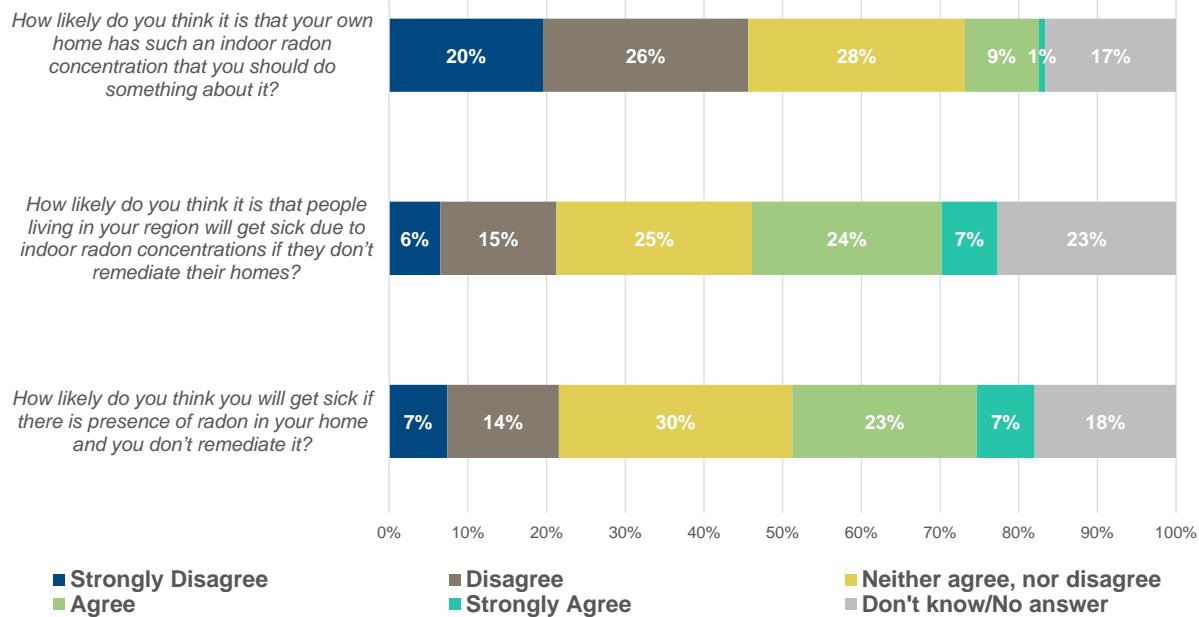
Figure 29 Conditional susceptibility: all items

Conditional susceptibility

How likely do you think you will get sick if there is presence of radon in your home and you don't remediate it?

N=300
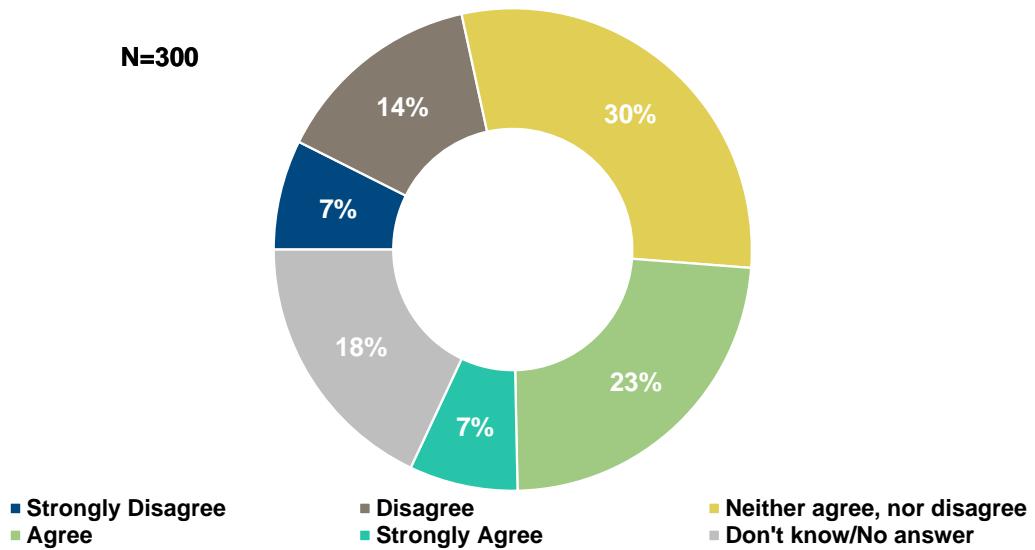
Figure 30 Conditional susceptibility: likelihood of getting sick: personal

www.radonorm.eu

Page 55

Conditional susceptibility

How likely do you think it is that people living in your region will get sick due to indoor radon concentrations if they don't remediate their homes?

N=300

- Strongly Disagree
- Disagree
- Neither agree, nor disagree
- Agree
- Strongly Agree
- Don't know/No answer
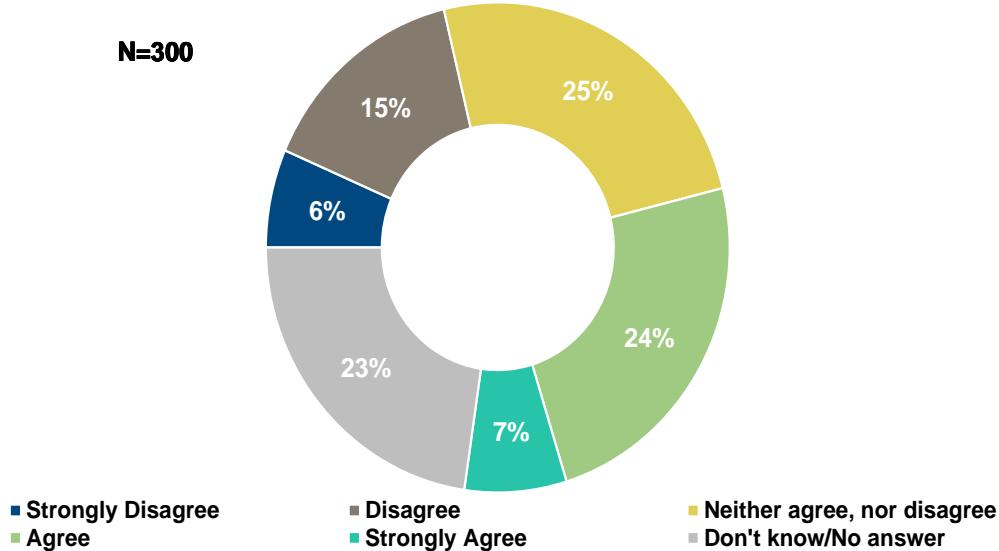
Figure 31 Conditional susceptibility: likelihood of getting sick: societal

Conditional susceptibility

How likely do you think it is that your own home has such an indoor radon concentration that you should do something about it?

N=300

- Strongly Disagree
- Disagree
- Neither agree, nor disagree
- Agree
- Strongly Agree
- Don't know/No answer
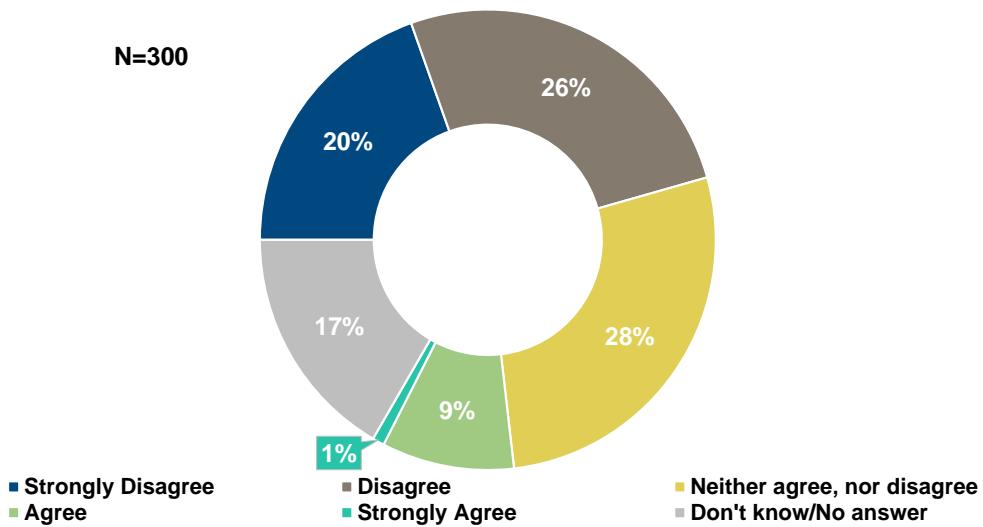
Figure 32 Conditional susceptibility: likelihood of high radon in house

The three items resulted on one scale with Cronbach's alpha 0,816 and 73% of explained variance. However, loading of the the item "*you should do something*" is on the limit of belonging to the same factor (0,488), (N = 229 out of 300).

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 56

Conditional susceptibility (3i vs. 2i))

Conditional susceptibility : Factor Matrix[a]

	Factor
	1
RA14. How likely do you think **you will get sick** if there is presence of radon in your home and you don't remediate it?	,942
RA15. How likely do you think it is that **people living in your region will get sick** due to indoor radon concentrations if they don't remediate their homes?	,922
RA16. How likely do you think it is that your own home has such an indoor radon concentration that **you should do something** about it?	,488

Extraction Method: Principal Axis Factoring.
a. 1 factors extracted. 11 iterations required.

Reliability Statistics: Cronbach's Alpha 3 items: ,816

N out of 300= 229

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,211	73,708	73,708	1,977	65,891	65,891
2	,658	21,929	95,637			
3	,131	4,363	100,000			

Extraction Method: Principal Axis Factoring.

30

Figure 33 Factor analysis for conditional susceptibility

The table below illustrates the reliability for the groups who saw, respectively did not see, the video.

	All	**Not seen video (n=107)**	**Seen video (n=183)**
N	229	93	103
Reliability	.816 (improve if RA16 out)	.781 (idem)	.834 (idem)
Dimensionality	1	1	1
Factor Loading	High: .94 – Low: .49	High: .91 – Low: .47	High: .97 – Low: .49

3.6.7 Severity+susceptibility+worry+risk perceptions

Additional analysis was carried out to explore possibilities to improve the scales by conducting factor analysis on the following items.

RP1-RP6-RP7-RP20-RP11-RP12a: Risk perception items
RA10 Information about radon makes me worry about the possibility of getting lung cancer.
RA11 Information about radon makes me nervous and tense about my health.
RA12 Having high radon concentration in my house would not be a severe threat to my health.
RA13 I believe I can develop cancer if there is a high radon concentration in my home.
RA14 How likely do you think you will get sick if there is presence of radon in your home and you don't remediate it?
RA15 How likely do you think it is that people living in your region will get sick due to indoor radon concentrations if they don't remediate their homes?
RA16 How likely do you think it is that your own home has such an indoor radon concentration that you should do something about it?

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 57

	All	Not seen video (n=107)	Seen video (n=183)
N	174	81	90
Reliability	.852 (if recoded RA12 is out alpha better)	.846 (idem)	.861 (idem)
Dimensionality	3 (almost 4)	3 (almost 4)	?
Factor Loading	1: RP1-RP6-RP7-RP20-RP11-RP12a (risk) 2: RA14-RA15 (susc) 3: RA10-RA11 (worry)	1: RP1-RP6-RP7-RP20-RP11-RP12a (risk) 2: RA14-RA15 (susc) - RA13 (sev) 3: RA10-RA11-RA16 (worry)	Did not want to extract..

When the number of 4 factors is imposed, this results indeed in risk perceptions – susceptibility – worry – severity:

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,792	36,865	36,865	4,417	33,974	33,974	3,001	23,084	23,084
2	2,064	15,877	52,742	1,724	13,258	47,232	1,774	13,645	36,730
3	1,253	9,640	62,383	,850	6,537	53,769	1,752	13,481	50,210
4	,968	7,449	69,831	,464	3,569	57,338	,927	7,128	57,338
5	,752	5,782	75,613						
6	,748	5,754	81,367						
7	,516	3,966	85,333						
8	,453	3,485	88,818						
9	,412	3,167	91,985						
10	,356	2,736	94,721						
11	,298	2,293	97,014						
12	,261	2,008	99,022						
13	,127	,978	100,000						

Extraction Method: Principal Axis Factoring.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 58

ALL

Rotated Factor Matrix[a]

|	Factor			
	1	2	3	4
RP7. The use of ionising radiation for medical tests or treatments: How do you perceive the potential risk to your health within the next 20 years from each of the following sources? (RISK PERCEPTION AND CONFIDENCE IN AUTHORITIES)	,772	,098	,167	-,080
RP1. Environmental pollution: How do you perceive the potential risk to your health within the next 20 years from each of the following sources? (RISK PERCEPTION AND CONFIDENCE IN AUTHORITIES)	,721	,076	-,025	,326
RP6. Natural radiation (from the soil or from space): How do you perceive the potential risk to your health within the next 20 years from each of the following sources? (RISK PERCEPTION AND CONFIDENCE IN AUTHORITIES)	,708	,083	,312	-,055
RP12a. Indoor air pollution due to radon: How do you perceive the potential risk to your health within the next 20 years from each of the following sources? (RISK PERCEPTION AND CONFIDENCE IN AUTHORITIES)	,667	,061	,294	,104
RP11. Climate Crisis: How do you perceive the potential risk to your health within the next 20 years from each of the following sources? (RISK PERCEPTION AND CONFIDENCE IN AUTHORITIES)	,630	,162	-,066	,202
RP20. The use of recycled material with low levels of radioactivity for buildings: How do you perceive the potential risk to your health within the next 20 years from each of the following sources? (RISK PERCEPTION AND CONFIDENCE	,628	,049	,143	,140
RA14. How likely do you think you will get sick if there is presence of radon in your home and you don't remediate it?:	,122	,908	,213	,302
RA15. How likely do you think it is that people living in your region will get sick due to indoor radon concentrations if they don't remediate their homes?:	,163	,805	,236	,205
RA11. Information about radon makes me nervous and tense about my health: To what extent do you agree or disagree with the following statements?	,163	,075	,746	,096
RA10. Information about radon makes me worry about the possibility of getting lung cancer: To what extent do you agree or disagree with the following statements?	,175	,260	,707	,401
RA16. How likely do you think it is that your own home has such an indoor radon concentration that you should do something about it?:	,163	,338	,548	-,016
RA13. I believe that I can develop cancer if there is a high radon concentration in my home: To what extent do you agree or disagree with the following statements?	,005	,225	,239	,556
ra12_recode	,151	,094	,014	,357

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations.

NO VIDEO

Rotated Factor Matrix[a]

	Factor			
	1	2	3	4
RA14. How likely do you think you will get sick if there is presence of radon in your home and you don't remediate it?:	,877	,242	-,027	,170
RA15. How likely do you think it is that people living in your region will get sick due to indoor radon concentrations if they don't remediate their homes?:	,716	,266	,112	,184
RA13. I believe that I can develop cancer if there is a high radon concentration in my home: To what extent do you agree or disagree with the following statements?	,626	,080	,076	-,029
ra12_recode	,202	,079	,160	,075
RA11. Information about radon makes me nervous and tense about my health: To what extent do you agree or disagree with the following statements?	,224	,656	,224	-,028
RA10. Information about radon makes me worry about the possibility of getting lung cancer: To what extent do you agree or disagree with the following statements?	,523	,610	,145	,052
RP6. Natural radiation (from the soil or from space): How do you perceive the potential risk to your health within the next 20 years from each of the following sources? (RISK PERCEPTION AND CONFIDENCE IN AUTHORITIES)	,000	,591	,461	,397
RA16. How likely do you think it is that your own home has such an indoor radon concentration that you should do something about it?:	,256	,561	,064	,031
RP20. The use of recycled material with low levels of radioactivity for buildings: How do you perceive the potential risk to your health within the next 20 years from each of the following sources? (RISK PERCEPTION AND CONFIDENCE	,216	,069	,770	,103
RP12a. Indoor air pollution due to radon: How do you perceive the potential risk to your health within the next 20 years from each of the following sources? (RISK PERCEPTION AND CONFIDENCE IN AUTHORITIES)	,094	,344	,639	,304
RP7. The use of ionising radiation for medical tests or treatments: How do you perceive the potential risk to your health within the next 20 years from each of the following sources? (RISK PERCEPTION AND CONFIDENCE IN AUTHORITIES)	-,117	,288	,534	,370
RP11. Climate Crisis: How do you perceive the potential risk to your health within the next 20 years from each of the following sources? (RISK PERCEPTION AND CONFIDENCE IN AUTHORITIES)	,152	,000	,139	,826
RP1. Environmental pollution: How do you perceive the potential risk to your health within the next 20 years from each of the following sources? (RISK PERCEPTION AND CONFIDENCE IN AUTHORITIES)	,174	,066	,410	,666

3.6.8 Severity+susceptibility+worry+regret

	All	**Not seen video (n=107)**	**Seen video (n=183)**
N	212	86	212
Reliability	.782 (better if RA12rec out)	.802	.782 (if RA12 out better)
Dimensionality	3 (almost 4)	2 (almost 3)	3 (almost 4)
Factor Loading	1: RA14-RA15 (susc) 2: RA10-RA11-RA16 (worry) 3: RA28-RA29 (regret) Does not load: RA13, RA12rec (sever)	1: RA10-RA14-RA15-RA16-RA11 (susc + worry) 2: RA28-RA29 (regret) Don't load: RA13, RA12 (sever)	1: RA14-RA15 (susc) 2: RA10-RA11-RA16 (worry) 3: RA28-RA29 (regret) Does not load: RA13, RA12rec (sever)
Factors Loading (fixed 4)	Idem (4th: RA12-RA13)	1: (RA13)-RA14-RA15 2: RA28-RA29 3:RA11-RA16 4:RA10	Idem (4th: RA12-RA13)

3.6.9 Coping or efficacy appraisal: response efficacy

Coping appraisal is needed to adopt or maintain a health protection behavior and is essential for overcoming fears and mental blocks. Coping appraisal consists of three elements: response efficacy, response costs and self-efficacy. Only if the individual is convinced that a behavior (test or mitigation) leads to the desired outcome will she or he be more likely to intend to perform the behavior (test or mitigate). The response efficacy scale was adopted from (Weinstein, man, & Roberts, 1990), (Weinstein, Roberts, & Pflugh, 1992) and (Witte et al., 1998) and (M. Dragojevic, Bell, & M., 2014). In our study the coping of efficacy appraisal – response efficacy was measured with the following four items:

To what extent do you agree or disagree with the following statements?:

- *"Home remediation offers effective protection against the radon hazard.";*
- *"Home remediation will NOT protect me from lung cancer due to indoor radon.";*
- *"I feel very confident that (if needed) a special ventilation system would eliminate the radon hazard from my home.";*
- *"It is very difficult to reduce radon to a safe level in homes that have a radon problem."*

The answering categories consisted of a 5-point Likert scale ranging from "*Strongly disagree*" (1), "*Disagree*" (2), "*Neither agree, nor disagree*" (3), "*Agree*" (4) to "*Strongly agree*" (5) and "*I don't know*" answers (9).

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 60

Table: Descriptive statistics for coping of efficiency appraisal – response efficacy

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
RA17. Home remediation offers effective protection against the radon hazard.	255	1	5	3,81	,701
RA18. Home remediation will NOT protect me from lung cancer due to indoor radon.	242	1	5	2,49	,865
RA19. I feel very confident that (if needed) a special ventilation system would eliminate the radon hazard from my home.	249	1	5	3,55	,782
RA20. It is very difficult to reduce radon to a safe level in homes that have a radon problem.	209	1	5	2,78	,882
Valid N (listwise)	187				

Coping or efficacy appraisal

Home remediation offers effective protection against the radon hazard

N=300

- Strongly Disagree: 0.2%
- Disagree: 3%
- Neither agree, nor disagree: 15%
- Agree: 57%
- Strongly Agree: 10%
- Don't know/No answer: 15%
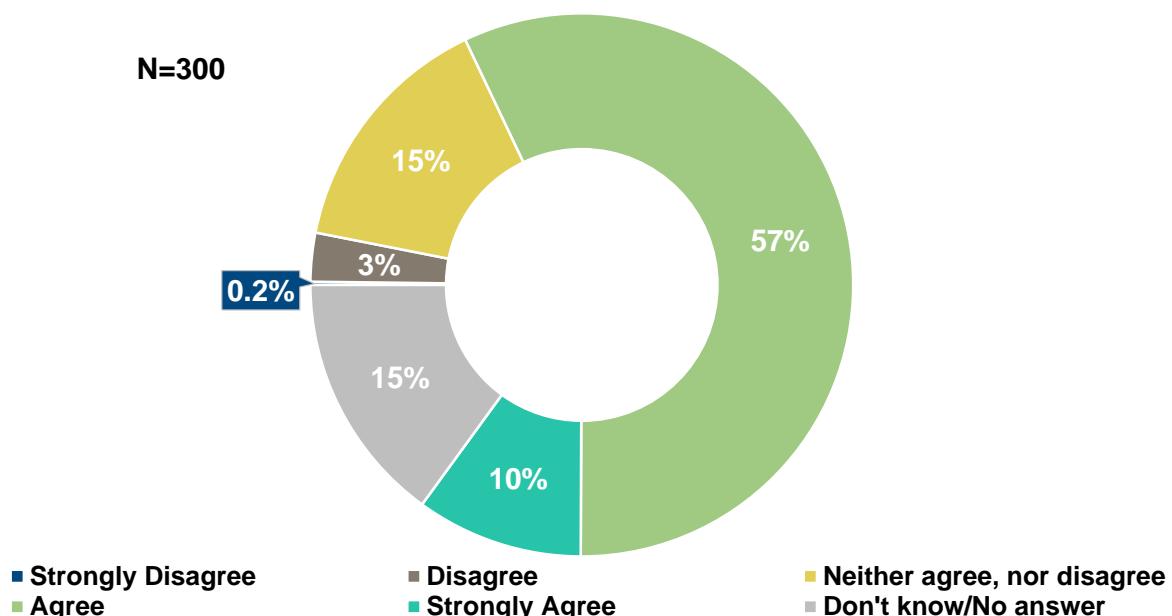
Figure 34 Coping or efficacy appraisal: remediation (radon hazard)

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 61

Coping or efficacy appraisal

Home remediation will NOT protect me from lung cancer due to indoor radon

N=300

- ■ Strongly Disagree
- ■ Agree
- ■ Disagree
- ■ Strongly Agree
- ■ Neither agree, nor disagree
- ■ Don't know/No answer
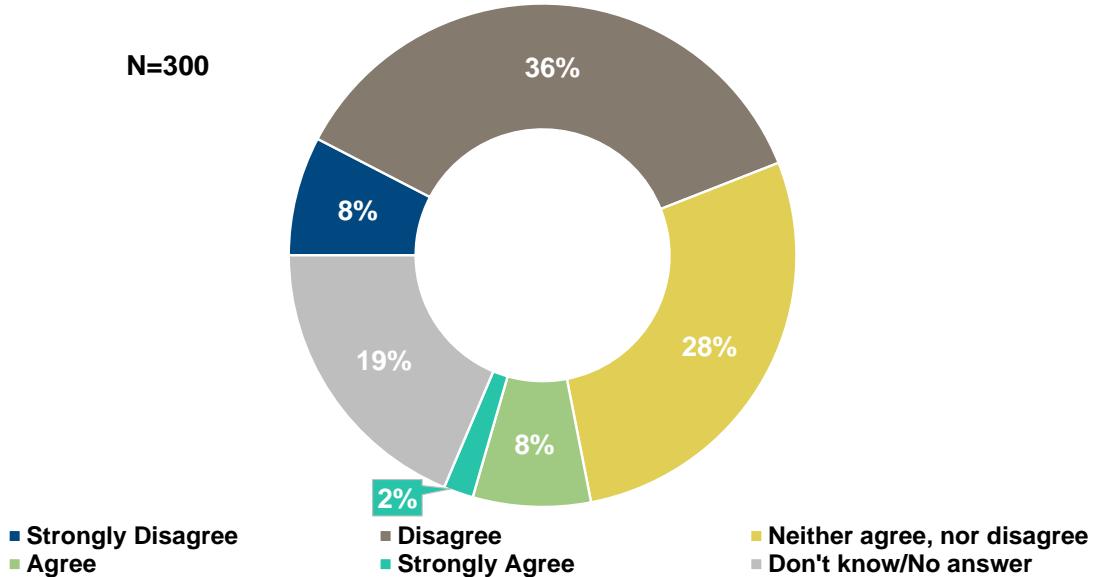
Figure 35 Coping or efficacy appraisal: remediation, (lung cancer)

Coping or efficacy appraisal

I feel very confident that (if needed) a special ventilation system would eliminate the radon hazard from my home.

N=300

- ■ Strongly Disagree
- ■ Agree
- ■ Disagree
- ■ Strongly Agree
- ■ Neither agree, nor disagree
- ■ Don't know/No answer
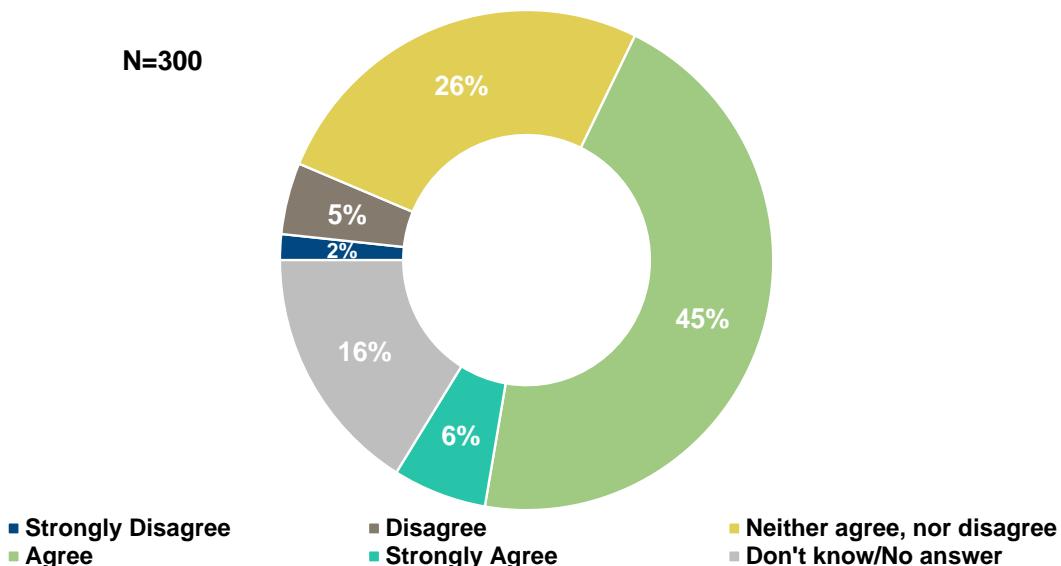
Figure 36 Coping or efficacy appraisal: ventillation

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 62

Coping or efficacy appraisal

It is very difficult to reduce radon to a safe level in homes that have a radon problem

N=300
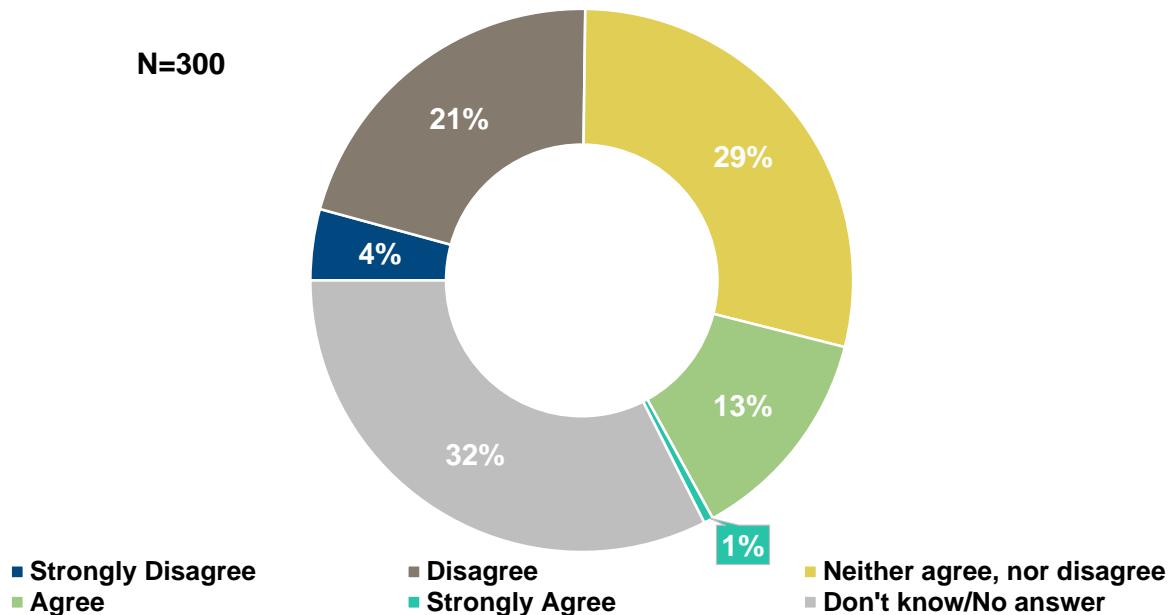
Figure 37 Coping or efficacy appraisal: difficulty

Unfortunately, the items don't correlate, so they together don't measure the latent construct response efficacy.

Table: Correlations between "response efficacy" items

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 63

Correlations

			RA17. Home remediation offers effective protection against the radon hazard	RA18. Home remediation will NOT protect me from lung cancer due to indoor radon	RA19. I feel very confident that (if needed) a special ventilation system would eliminate the radon hazard from my home	RA20. It is very difficult to reduce radon to a safe level in homes that have a radon problem
Spearman's rho	RA17. Home remediation offers effective protection against the radon hazard	Correlation Coefficient	1,000	-,267**	,482**	-,225**
		Sig. (2-tailed)	.	,000	,000	,001
		N	255	235	235	199
	RA18. Home remediation will NOT protect me from lung cancer due to indoor radon	Correlation Coefficient	-,267**	1,000	-,290**	,483**
		Sig. (2-tailed)	,000	.	,000	,000
		N	235	242	227	197
	RA19. I feel very confident that (if needed) a special ventilation system would eliminate the radon hazard from my home	Correlation Coefficient	,482**	-,290**	1,000	-,255**
		Sig. (2-tailed)	,000	,000	.	,000
		N	235	227	249	199
	RA20. It is very difficult to reduce radon to a safe level in homes that have a radon problem	Correlation Coefficient	-,225**	,483**	-,255**	1,000
		Sig. (2-tailed)	,001	,000	,000	.
		N	199	197	199	209

**. Correlation is significant at the 0.01 level (2-tailed).

Pattern Matrix[a]

	Component	
	1	2
RA17. Home remediation offers effective protection against the radon hazard: To what extent do you agree or disagree with the following statements?	,908	,043
RA18. Home remediation will NOT protect me from lung cancer due to indoor radon: To what extent do you agree or disagree with the following statements?	,058	,885
RA19. I feel very confident that (if needed) a special ventilation system would eliminate the radon hazard from my home:	,874	-,049
RA20. It is very difficult to reduce radon to a safe level in homes that have a radon problem:	-,067	,835

Extraction Method: Principal Component Analysis.

Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 4 iterations.

RadoNorm

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu
Page 64

Component Matrix[a]

	Component 1
RA17. Home remediation offers effective protection against the radon hazard.	,869
RA19. I feel very confident that (if needed) a special ventilation system would eliminate the radon hazard from my home.	,869

Extraction Method: Principal Component Analysis.

a. 1 components extracted.

The two items resulted on one scale with Cronbach's alpha 0,674 and 75% of explained variance. (N = 235 out of 300).

	All	Not seen video (n=107)	Seen video (n=183)
N	187	71	112
Reliability	.632	.644	.623
Dimensionality	2	2	
Factor Loading (PAF)	1: RA17-RA19 2: RA18-RA20	Idem	Idem BUT: negative items actually load .7 !!

3.6.10 Coping or efficacy appraisal - self-efficacy

Self-efficacy refers to the belief in one's own competence to perform a behaviour even in the face of barriers or in other words, the individual in carrying out the recommended coping response. Hahn et al (Hahn et al., 2019) measured a self-efficacy as *Ability (e.g., "I am able to test my home for radon to prevent lung cancer"), resources ("e.g., I have the time to test"), and ease of action (e.g., "I can easily test").* (Larsson, 2015) measured it with 7 items, which are not reported.

The scale in this study was adopted from (Rhodes, Blanchard, & Matheson, 2006) and (Weinstein & Lyon, 1999; Weinstein, Lyon, Sandman, & Cuite, 1998a). In our study the coping of efficacy appraisal – self efficacy was measured with the following two items:

- *"I am confident I would be able to test the indoor radon concentration in my home if I wanted to."*
- *"I am confident I would be able to remediate my home in order to decrease the indoor radon concentration if I wanted to."*

The answering categories consisted of a 5-point Likert scale ranging from "*Strongly disagree*" (1), "*Disagree*" (2), "*Neither agree, nor disagree*" (3), "*Agree*" (4) to "*Strongly agree*" (5) and "*I don't know*" answers (9).

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 65

Coping or efficacy appraisal

I am confident I would be able to test the indoor radon concentration in my home if I wanted to

N=300

- Strongly Disagree
- Agree
- Disagree
- Strongly Agree
- Neither agree, nor disagree
- Don't know/No answer
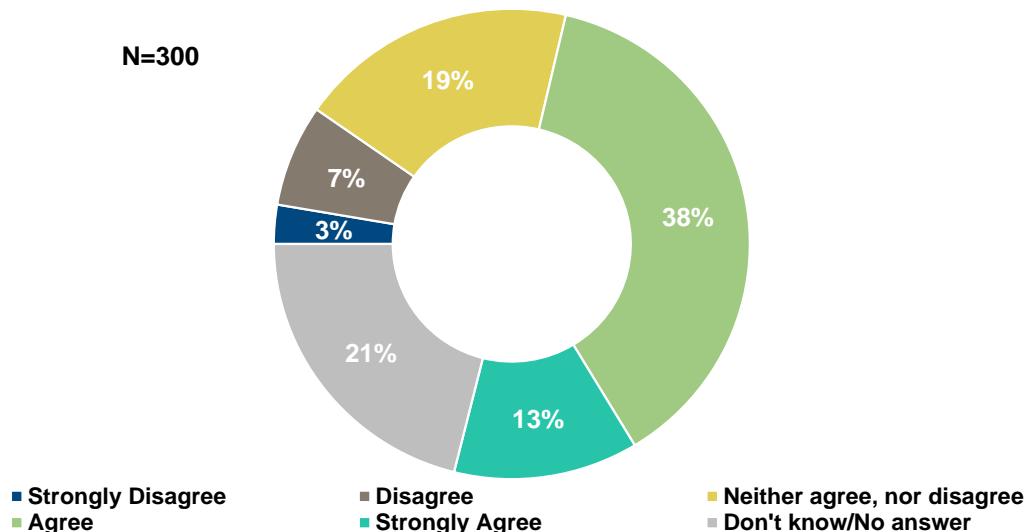
Figure 38 Coping or efficacy appraisal: able to test

Coping or efficacy appraisal

I am confident I would be able to remediate my home in order to decrease the indoor radon concentration if I wanted to

N=300

- Strongly Disagree
- Agree
- Disagree
- Strongly Agree
- Neither agree, nor disagree
- Don't know/No answer
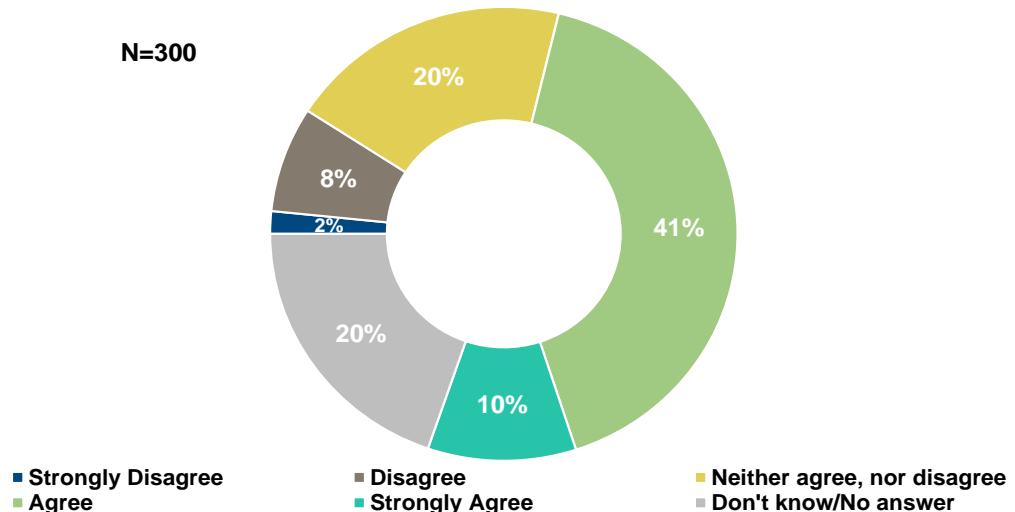
Figure 39 Coping or efficacy appraisal: able to remediate

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 66

Figure 40 Factor analysis Coping or efficacy appraisal: able to test

The two items resulted on one scale with Spearman-Brown coefficient 0,761 and 80% of explained variance. (N = 224 out of 300).

	All	**Not seen video (n=107)**	**Seen video (n=183)**
N	224	88	131
Reliability	.761	.717	.790
Dimensionality	1	1	1
Factor Loading (PAF)	High: .78 – Low: .78	High: .75 – Low: .75	High: .81 – Low: .81

3.6.11 Perceived costs

The potential determinant "Perceived costs" captures the person's perceptions of the disadvantages of, or barriers to, undertaking the behaviour (test or mitigate).(Losee, Shepperd, & Webster, 2020) measured focused on financial burden, for which they used two items: "*Reducing radon would be burdensome for me*" and *"Reducing radon in my house would require more resources than I have."* Perceived ease of testing, was measured by (Weinstein, Lyon, Sandman, & Cuite, 1998b) with the following two items: *Ease of finding a test kit*; and *Ease of using a test kit.*

In this study, the scale was adopted from (Hampson, Andrews, Barckley, Lichtenstein, & Lee, 2006; Sheeran, 2014). In our study, the construct "Perceived costs" is measured by fife items:

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 67

- *I believe that the cost for remediation of my home to reduce the indoor radon concentration is …(on a 7-piont scale ranging from Free of costs to Very high)*
- *The procedure for testing the radon concentration at home is …*
- *The procedure for remediating my home is …*
- *Obtaining personal advice from a local expert on how to control the radon concentration in my home is …*
- *Obtaining personal advice from responsible authorities on how to control the radon concentration in my home is … …(on a 7-pont scale ranging from Very easy to Very complicated)*

Perceived costs

I believe that the cost for remediation of my home to reduce the indoor radon concentration is …
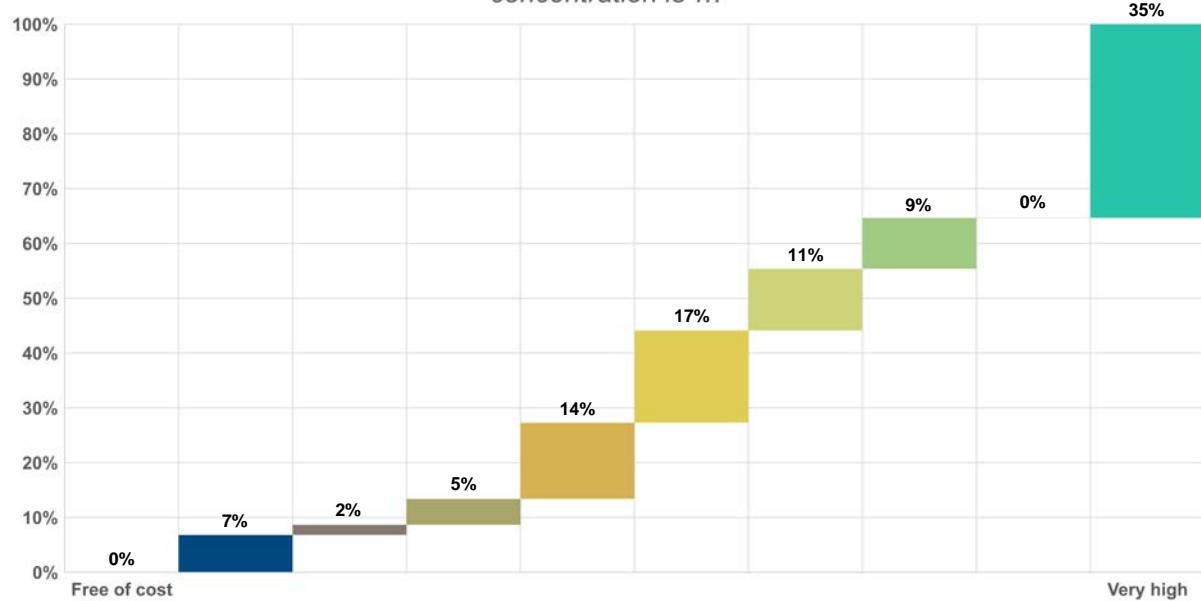
Figure 41: Perceved costs – How much is the cost of remediation

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 68

The procedure for testing the radon concentration at home is …
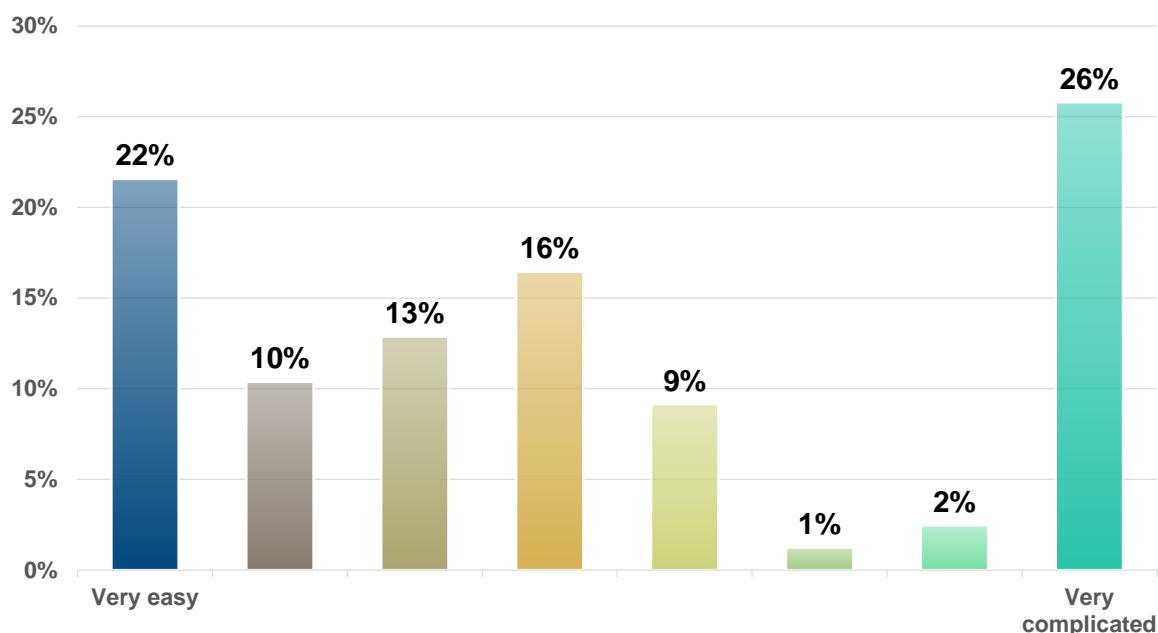
N=300

Figure 42: Perceived costs – How easy or complicated is procedure for testing

The procedure for remediating my home is …
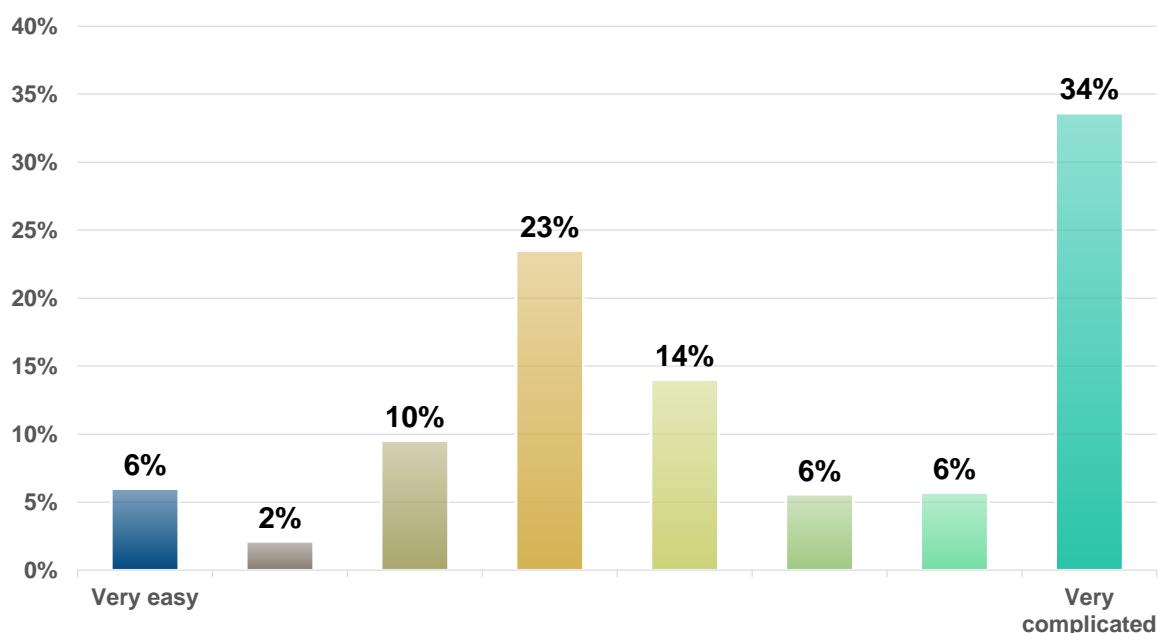
N=300

Figure 43 Perceived costs – How easy or complicated is procedure for remediating

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 69

N=300

Obtaining personal advice from a local expert on how to control the radon concentration in my home is …
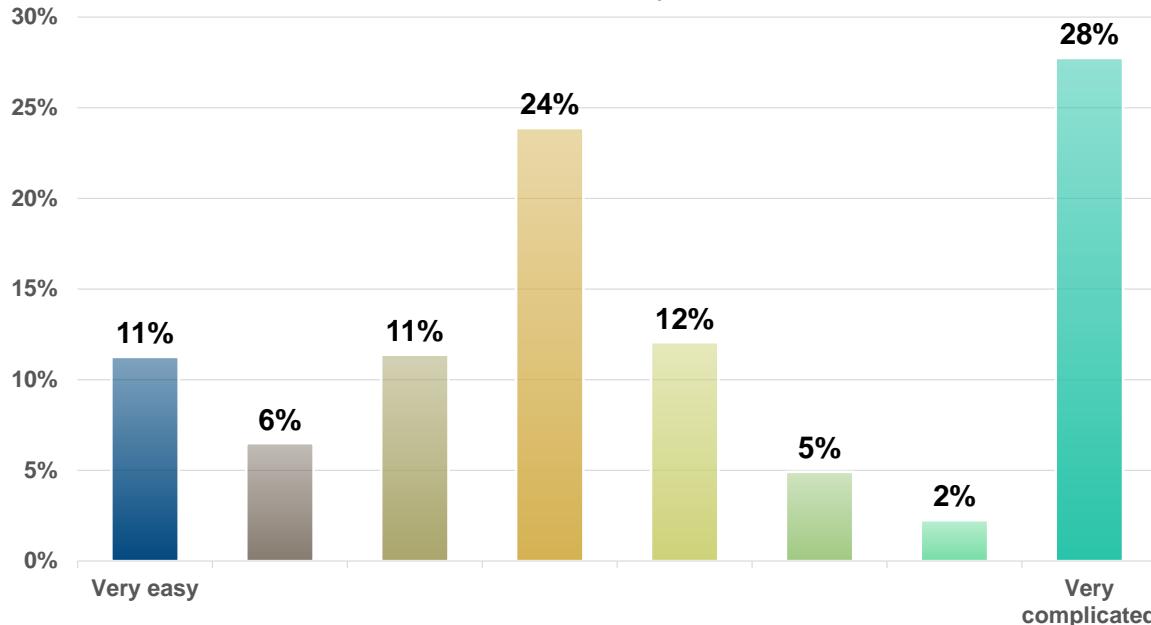
Figure 44: Perceived costs – How easy or complicated is obtaining personal advice from a local expert

N=300 *Obtaining personal advice from responsible authorities on how to control the radon concentration in my home is …*
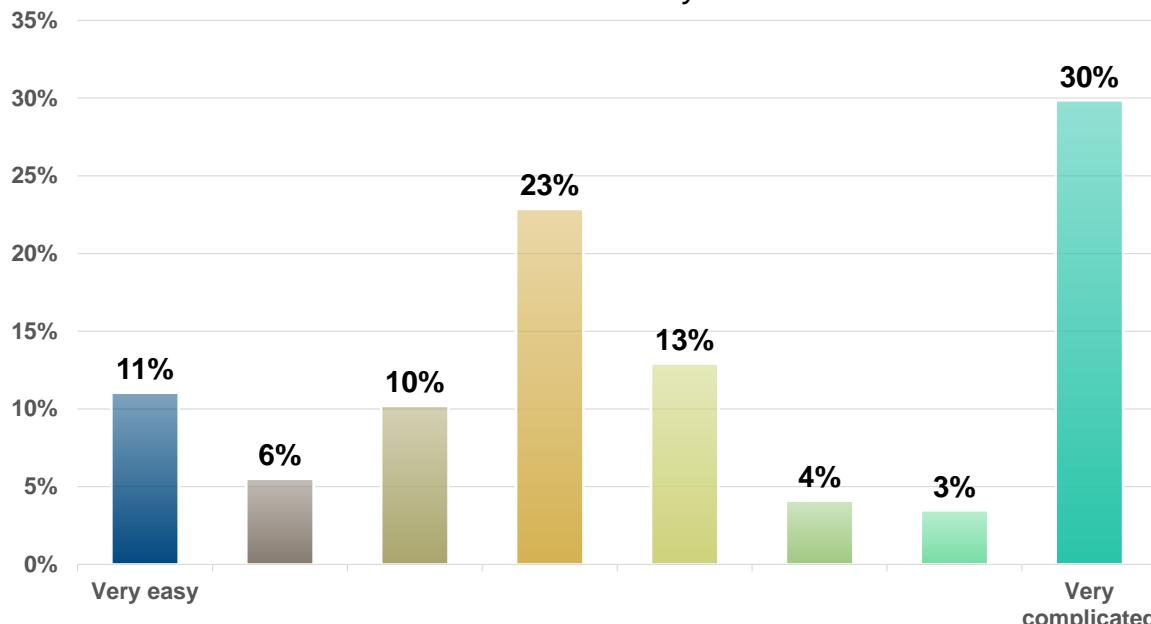
Figure 45: Perceived costs – How easy or complicated is obtaining personal advice from responsible authorities

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 70
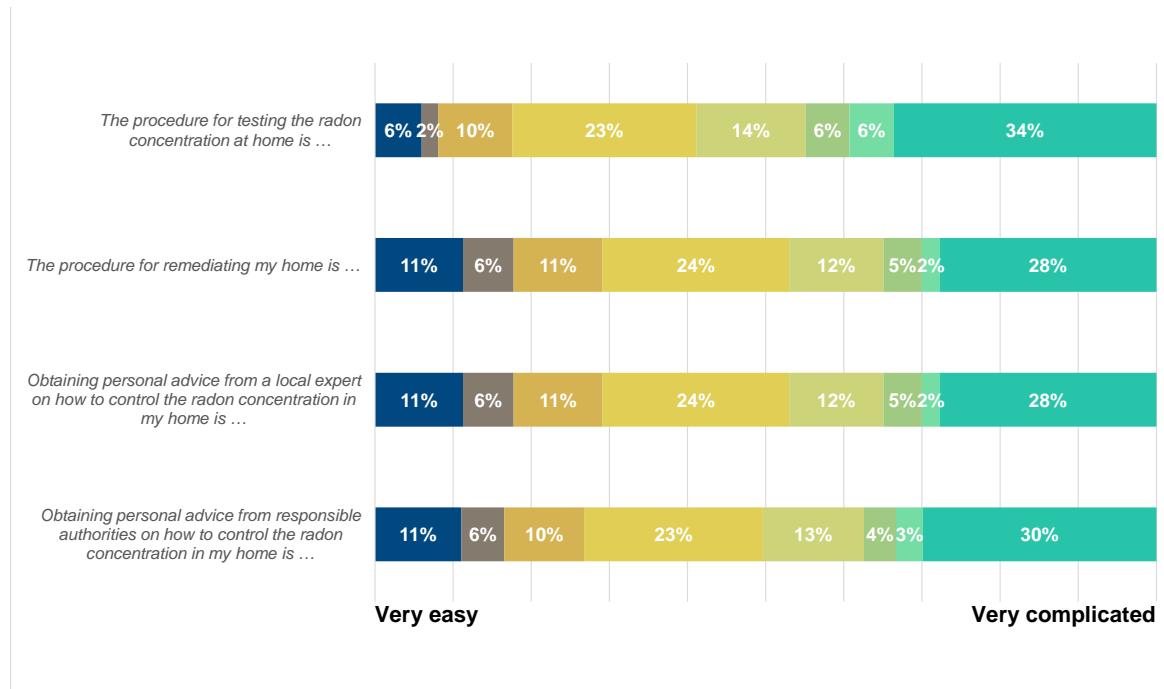
Figure 46: Perceived costs (4 items)
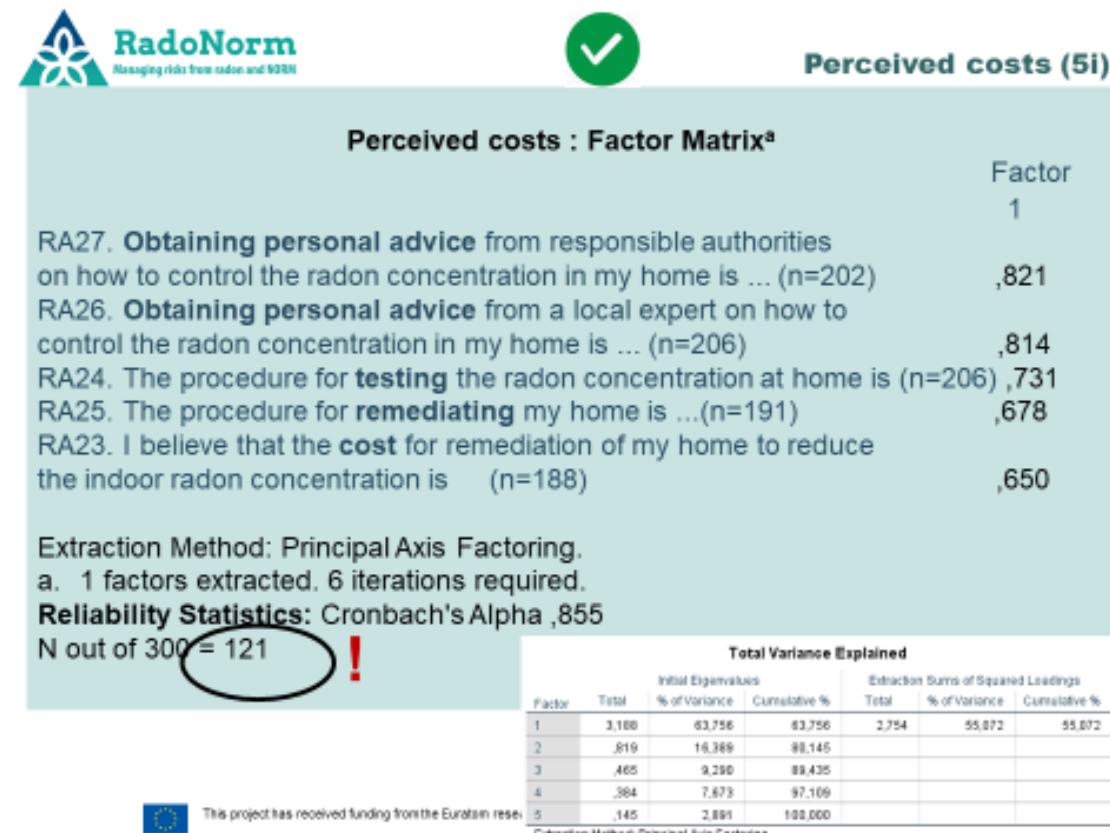
Figure 47 Factor analysis for perceived costs

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 71

The five items resulted on one scale with Cronbach's alpha 0,855 and 64% of explained variance. (N = 121 out of 300).

	All	**Not seen video (n=107)**	**Seen video (n=183)**
N	121	47	70
Reliability	.855	.870	.811
Dimensionality	1	1	2
Factor Loading (PAF)	High: .82 – Low: .65	High: .91 – Low: .59 (RA25)	1: RA26-RA27 2: RA23-RA24-RA25

3.6.12 Anticipated emotions / regret

Anticipated emotions are a component of the immediate consequences of the decision; they are emotions that are expected to occur when outcomes are experienced. The most extensively researched anticipated emotions are regret, guilt, and shame. The scale was adopted from (Hampson et al., 2006; Sheeran, 2014). In our study, the construct "Anticipated regret" is measured by two items:

- *I would feel regret if I had not remediated my home against radon and ended up getting lung cancer.*
- *I would be ashamed not to remediate my home if indoor radon levels exceeded the limits.*

The answering categories consisted of a 5-point Likert scale ranging from "*Strongly disagree*" (1), "*Disagree*" (2), "*Neither agree, nor disagree*" (3), "*Agree*" (4) to "*Strongly agree*" (5) and "*I don't know*" answers (9).
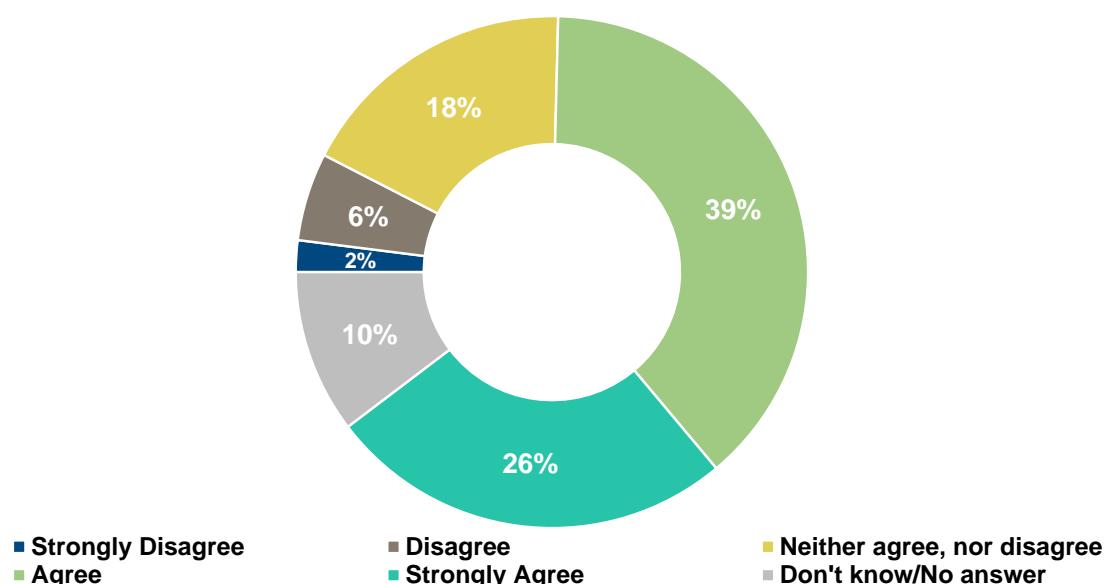
Figure 48: Anticipated emotion - regret

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 72

N=300

I would be ashamed not to remediate my home if indoor radon levels exceeded the limits

- ■ Strongly Disagree
- ■ Disagree
- ■ Neither agree, nor disagree
- ■ Agree
- ■ Strongly Agree
- ■ Don't know/No answer
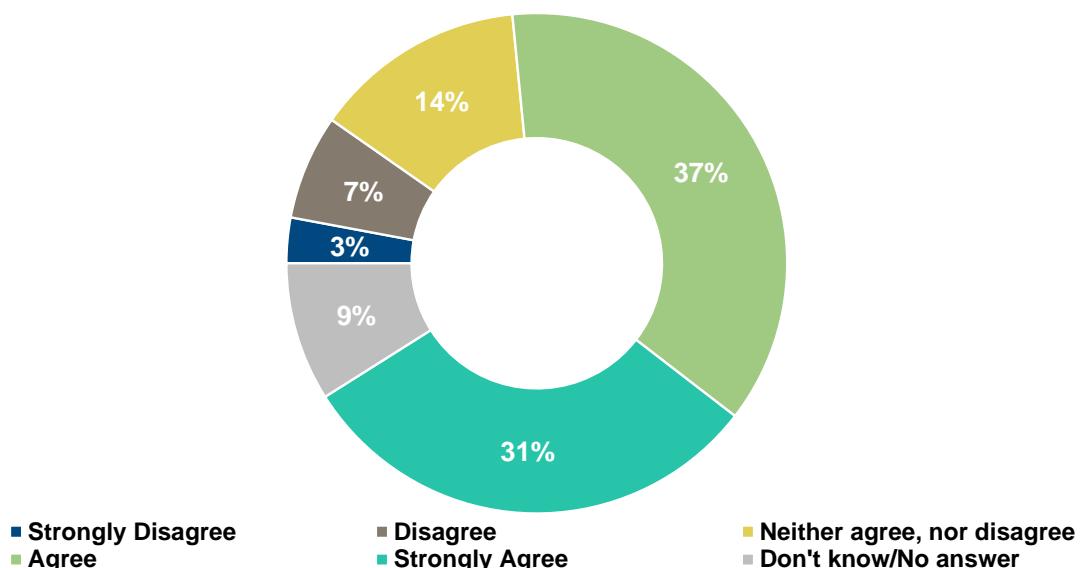
Figure 49: Anticipated emotion - shame
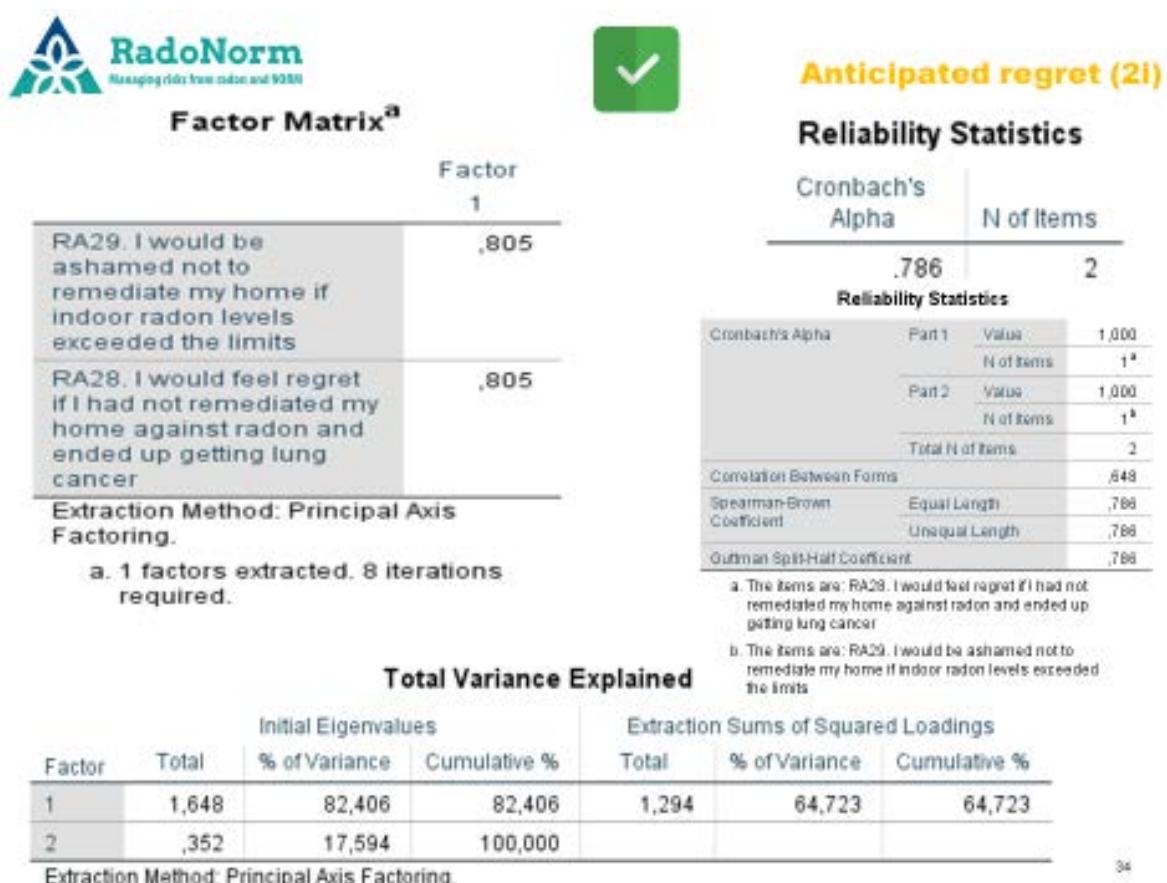
Figure 50: Factor analysis Anticipated emotion

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 73

The two items resulted on one scale with Cronbach's alpha 0,786 and 82% of explained variance. (N = 260 out of 300).

	All	**Not seen video (n=107)**	**Seen video (n=183)**
N	300	107	183
Reliability	.769	.734	.790
Dimensionality	1	1	1
Factor Loading (PAF)	High: .79 – Low: .79	High: .76 – Low: .76	High: .81 – Low: .81

3.6.13 Perceived informed choice

Informed choice means that people under radon risk make decisions that are consistent with their goals and values. (Weinstein & man, 1992a) and (Weinstein & man, 1992b) measured satisfaction with information with the following items: Whether the test results had been explained clearly; Whether the action recommendation had been clear; Whether DEP (Department of environmental Protection) information is trustworthy; Whether additional information could be obtained from DEP if needed; How the DEP program should be rated .

In this study we measure perceived informed chice with four items:

- *I don't feel well informed about which actions are needed related to indoor radon levels.*
- *There is enough information for me to be able to decide whether or not I should perform a radon test at home.*
- *Information about radon and its health effects is still too uncertain to take actions based on it.*
- *I am confident that in the case of exceeded levels of indoor radon in my home, I will find the information needed to protect myself and my family.*

The answering categories consisted of a 6-point likert scale ranging from "*Strongly disagree*" (1), "*Disagree*" (2), "*Neither agree, nor disagree*" (3), "*Agree*" (4) to "*Strongly agree*" (5) and "*I don't know*" answers (9).

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu Page 74

Perceived informed choice

N=300 *I don't feel well informed about which actions are needed related to indoor radon levels*

- ■ **Strongly Disagree**
- ■ **Agree**
- ■ **Disagree**
- ■ **Strongly Agree**
- ■ **Neither agree, nor disagree**
- ■ **Don't know/No answer**
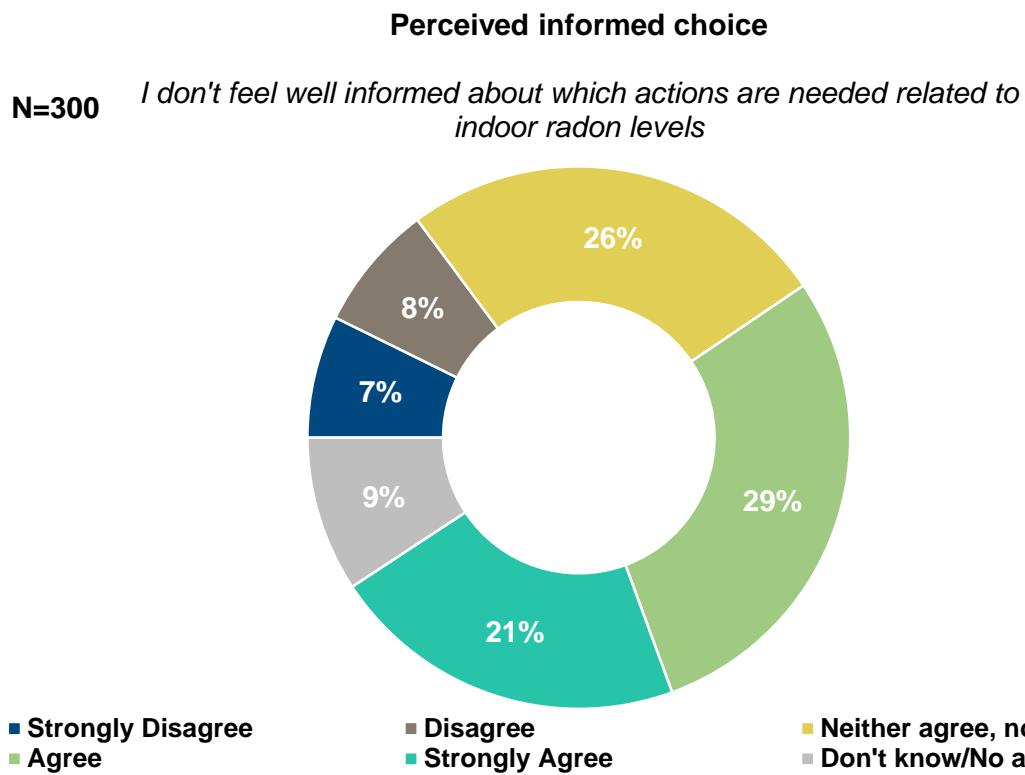
Figure 51: Perceived informed choice – feeling of being informed

Perceived informed choice

N=300 *There is enough information for me to be able to decide whether or not I should perform a radon test at home*

- ■ **Strongly Disagree**
- ■ **Agree**
- ■ **Disagree**
- ■ **Strongly Agree**
- ■ **Neither agree, nor disagree**
- ■ **Don't know/No answer**
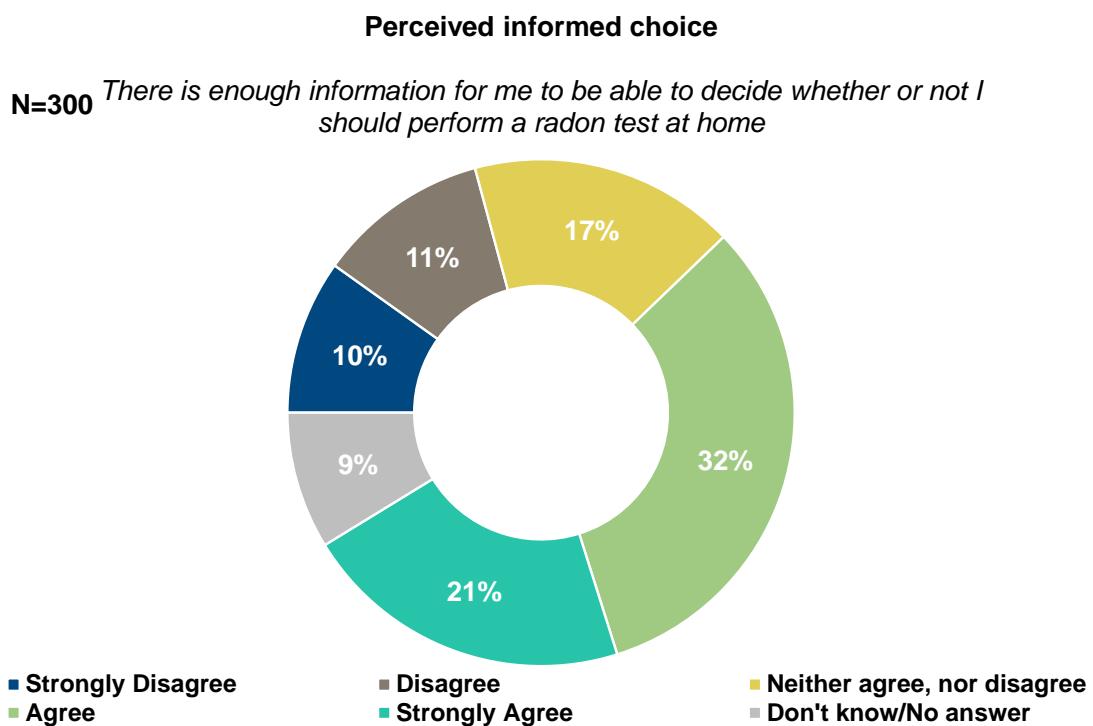
Figure 52 Perceived informed choice – enough information

RadoNorm

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 75

Perceived informed choice

Information about radon and its health effects is still too uncertain to take actions based on it

N=300

- ■ **Strongly Disagree**
- ■ **Agree**
- ■ **Disagree**
- ■ **Strongly Agree**
- ■ **Neither agree, nor disagree**
- ■ **Don't know/No answer**

Figure 53: Perceived informed choice – information is still too uncertain

Perceived informed choice

I am confident that in the case of exceeded levels of indoor radon in my home, I will find the information needed to protect myself and my family

N=300

- ■ **Strongly Disagree**
- ■ **Agree**
- ■ **Disagree**
- ■ **Strongly Agree**
- ■ **Neither agree, nor disagree**
- ■ **Don't know/No answer**
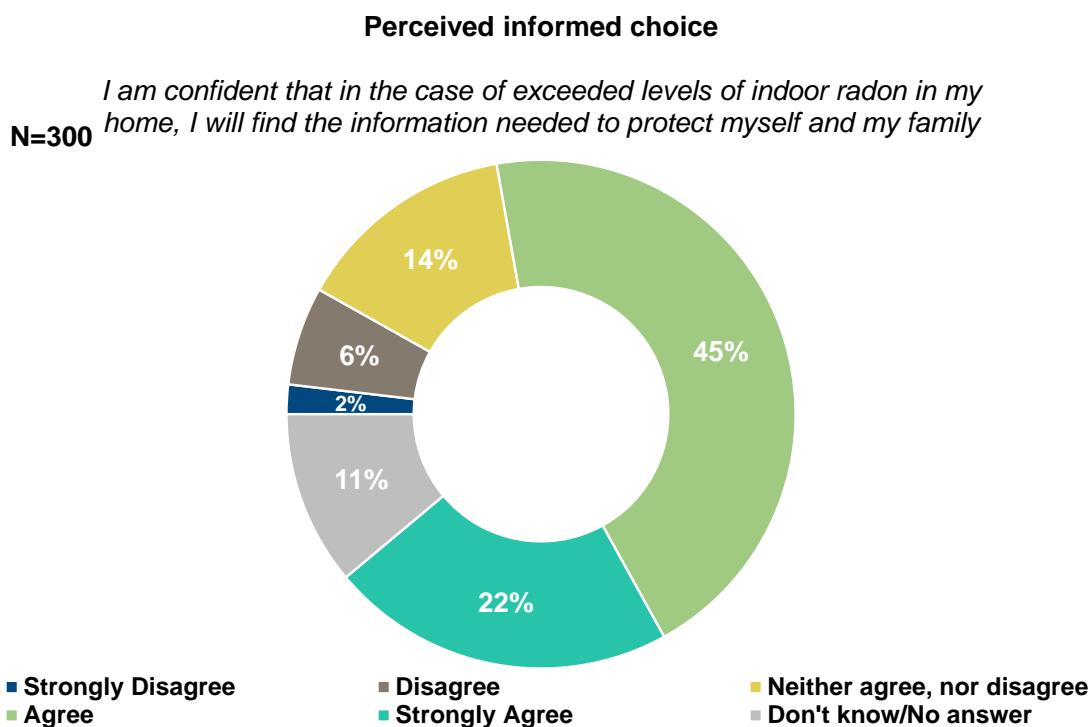
Figure 54: Perceived informed choice – confident in finding information

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 76

Figure 55: Factor Perceived informed choice

Factor analysis showed that one item (confident in finding information if necessary) doesn't load on one factor. The other three items resulted on one scale with Cronbach's alpha 0,802 and 72% of explained variance. (N = 248 out of 300).

	All	Not seen video (n=107)	Seen video (n=183)
N	237	97	135
Reliability	-.983?? Without recode: .592 (up to 7 when ra33 out)	Negative Without recode: .573 (idem)	Negative Without: .61 (idem)
Dimensionality	1 (almost 2 – second .984)	1 (almost 2 – second .98)	2
Factor Loading (PAF)	High: .896, Low: -.14 (RA33)	High: .886, Low: -.22 (RA33)	High: .880, Low: .29 BUT: RA33 is other

3.6.14 Response efficacy + self-efficacy + perceived cost + informed choice

An additional analysis was conducted on the items pertaining to response efficacy, self-efficacy, perceived costs and informed choice

Note: did not use 30 and 50 recoded

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 77

	All	**Not seen video (n=107)**	**Seen video (n=183)**
Dimensionality	4	4 (almost 5)	5 (almost 6) when restricted because normal didn't work
Factor Loading (PAF)	1: RA23-RA24-RA25-RA26-RA27 2: RA17-RA19-(RA21)-RA22-(RA33) 3: RA30-RA31 4: RA50 Don't load: RA18-RA20-RA33	See below = +-	Doesn't work
Factor Loading (when restricted to 4)	1: RA23-RA24-RA25-RA26-RA27 (perceived cost) 2: RA17-RA19-(RA21)-RA22-(RA33) (don't load: RA18recoded and RA20rec) (self- and response) 3: RA30-RA31 (informed choice) 4: RA50 (informed choice)	1: RA24-RA26-RA27 (perceived cost) 2: RA17-RA19-RA21-RA22-(RA18rec- really doesn't load) (response and self) 3: RA23-RA25-RA30-RA31-(RA50)-(RA20 recode – really doesn't load) (perceived cost and informed choice) 4: (RA33) (informed choice)	1: RA23-RA24-RA25 (perceived cost) 2: RA50-RA31-(RA30) (informed choice) 3: RA26-RA27 (perceived cost) 4: RA17-RA19-(RA33) (response efficacy) Don't load: RA21-RA22-RA18-RA20

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu Page 78

Rotated Factor Matrix[a]

	Factor			
	1	2	3	4
RA23. I believe that the cost for remediation of my home to reduce the indoor radon concentration is ...: Please use the following scale to indicate your answer to the following question.	,759	-,056	,106	-,076
RA24. The procedure for testing the radon concentration at home is ...: Please use the following scale to indicate your answer to the following question.	,710	-,220	,071	,209
RA25. The procedure for remediating my home is ...: Please use the following scale to indicate your answer to the following question.	,701	-,030	,195	,029
RA26. Obtaining personal advice from a local expert on how to control the radon concentration in my home is ...: Please use the following scale to indicate your answer to the following question.	,692	-,085	,116	,408
RA27. Obtaining personal advice from responsible authorities on how to control the radon concentration in my home is ...: Please use the following scale to indicate your answer to the following question.	,677	-,117	,186	,344
RA22. I am confident I would be able to remediate my home in order to decrease the indoor radon concentration if I wanted to: To what extent do you agree or disagree with the following statements?	,035	,709	-,119	-,125
RA19. I feel very confident that (if needed) a special ventilation system would eliminate the radon hazard from my home: To what extent do you agree or disagree with the following statements?	-,083	,697	,199	-,258
RA17. Home remediation offers effective protection against the radon hazard: To what extent do you agree or disagree with the following statements?	-,070	,636	,252	-,107
RA21. I am confident I would be able to test the indoor radon concentration in my home if I wanted to: To what extent do you agree or disagree with the following statements?	-,146	,581	-,431	,041
RA33. I am confident that in the case of exceeded levels of indoor radon in my home, I will find the information needed to protect myself and my family: To what extent do you agree or disagree with the following statements?	-,287	,472	-,041	,043
RA31. There is enough information for me to be able to decide whether or not I should perform a radon test at home: To what extent do you agree or disagree with the following statements?	,339	-,036	,784	,204
RA30. I don't feel well informed about which actions are needed related to indoor radon levels: To what extent do you agree or disagree with the following statements?	,181	,166	,736	,239
RA20_recode	-,182	,130	-,021	-,713
RA18_recode	-,063	,100	-,131	-,560
RA50. Information about radon and its health effects is still too uncertain to take actions based on it: To what extent do you agree or disagree with the following statements?	,095	-,042	,356	,497

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

3.6.15 Subjective norms

Subjective norms refer to the belief that an important person or group of people will approve and support a particular behaviour, for instance protection against radon (test and/or mitigate). Although subjective norms are potential behavioural change determinant, in radon related studies they have not been studied extensively. (Clifford, Hevey, & Menezes, 2012) and (Park, Scherer, & Glynn, 2001) have measured subjective norms relative to radon testing with items such as "*People who are important to me would like me to get my house tested for radon*" And (Clifford et al., 2012) have measured subjective norms relative to radon testing with items such as: "*People who are important to me would like me to get my house tested for radon*".

In this study we adopted items to measure subjective norms from (Turcanu et al., 2014). Subjective norms are measured with the following two items:

- *Most people who are important to me (family, friends) are in favour of me testing the indoor radon levels in my home.*
- *Most people who are important to me (family, friends) are in favour of me remediating my home if the indoor radon levels would exceed the limits.*

The answering categories consisted of a 5-point Likert scale ranging from "*Strongly disagree*" (1), "*Disagree*" (2), "*Neither agree, nor disagree*" (3), "*Agree*" (4) to "*Strongly agree*" (5) and "*I don't know*" answers (9).

Subjective norms

Most people who are important to me (family, friends) are in favour of me testing the indoor radon levels in my home

N=300

- Strongly Disagree
- Disagree
- Neither agree, nor disagree
- Agree
- Strongly Agree
- Don't know/No answer

Figure: Subjective norms – important people to me are in favour of me testing

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu
Page 80

Subjective norms

Most people who are important to me (family, friends) are in favour of me remediating my home if the indoor radon levels would exceed the limits

N=300

- ■ **Strongly Disagree**
- ■ **Disagree**
- ■ **Neither agree, nor disagree**
- ■ **Agree**
- ■ **Strongly Agree**
- ■ **Don't know/No answer**
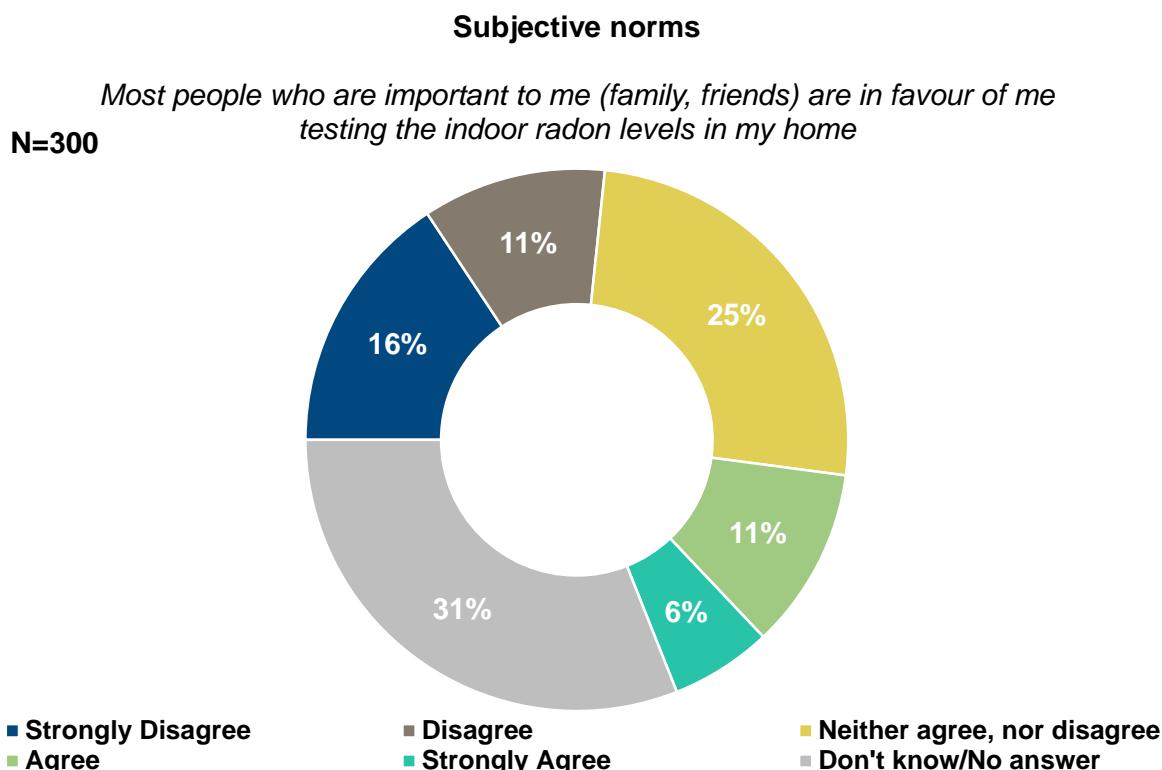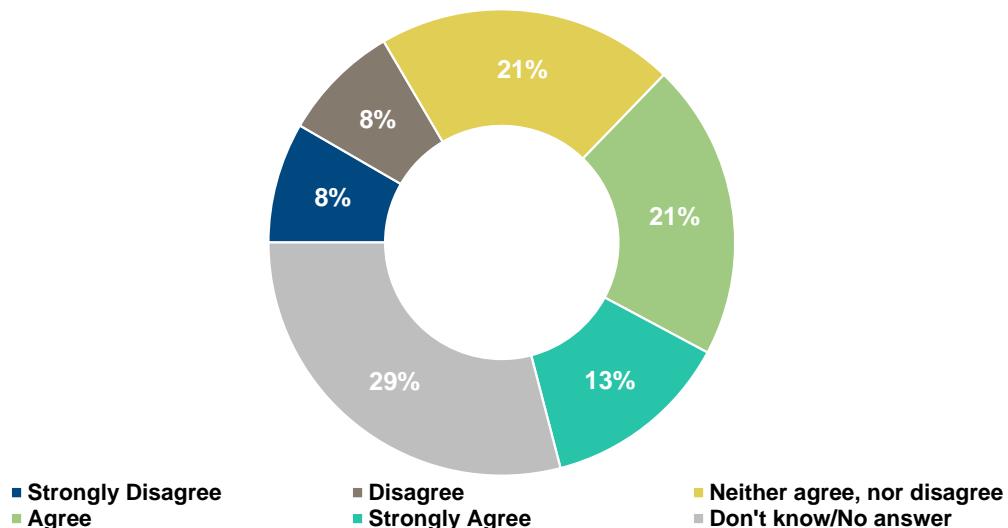
Figure 56: Subjective norms – important people to me are in favour of me remediating

Subjective norms (2i)

Subjective norms: Factor Matrix

	Factor 1
RA34b. Most people who are important to me (family, friends) are in favour of me remediating my home if the indoor radon levels would exceed the limits:	,680
RA34. Most people who are important to me (family, friends) are in favour of me testing the indoor radon levels in my home	,680

Extraction Method: Principal Axis Factoring.
a 1 factors extracted. 8 iterations required.
Reliability Statistics: Cronbach's Alpha - Spearman-Brown Coefficient 0,634; N out of 300=202

Total Variance Explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,464	73,189	73,189	,926	46,281	46,281
2	,536	26,811	100,000			

Extraction Method: Principal Axis Factoring.

Figure 57: Factor Subjective norms

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 81

The two items resulted on one scale with Cronbach's alpha 0,634 and 73% of explained variance. (N = 202 out of 300).

	All	**Not seen video (n=107)**	**Seen video (n=183)**
N	202	86	110
Reliability	.634	.70	.557
Dimensionality	1	1	1
Factor Loading (PAF)	High: .68 – Low: .68	High: .73 – Low: .73	High: .62 – Low .62

3.6.16 Descriptive norms

Descriptive norms refer to what most people in a group think, feel, or do. Descriptive norms are a reflection on "*What is typical or normal … what most people do*", including "*evidence as to what will likely be effective and adaptive action*" (Cialdini, 1990). Descriptive norms normally refer to the perception of others' behaviour in this case, respondent's perception of others' testing and/or mitigating.

(Peterson & Howland, 1996) asked respondents whether they "*knew another person who tested*" for radon. (Weinstein et al., 1991) and (Rinker et al., 2013) asked about the number of people respondents knew, who tested for radon: "*How many people do you know who have tested for radon?* with answering categories: *None; one or two people; more than two people*".

In our study we capture descriptive norms with three items:

- *Most people in my neighbourhood would test indoor radon and remediate their houses if indoor radon levels exceeded the limits.*
- *Most of my friends living in the same region as I do would test the indoor radon concentration and remediate their houses if indoor radon levels exceeded the limits.*
- *Of the people I know, nobody would test the indoor radon concentration or remediate their house if indoor radon levels exceeded the limits.*

The answering categories consisted of a 5-point lLkert scale ranging from "*Strongly disagree*" (1), "*Disagree*" (2), "*Neither agree, nor disagree*" (3), "*Agree*" (4) to "*Strongly agree*" (5) and "*I don't know*" answers (9).

RadoNorm

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 82

Descriptive norms

Most people in my neighbourhood would test indoor radon and remediate their houses if indoor radon levels exceeded the limits

N=300

- ■ **Strongly Disagree**
- ■ **Disagree**
- ■ **Neither agree, nor disagree**
- ■ **Agree**
- ■ **Strongly Agree**
- ■ **Don't know/No answer**
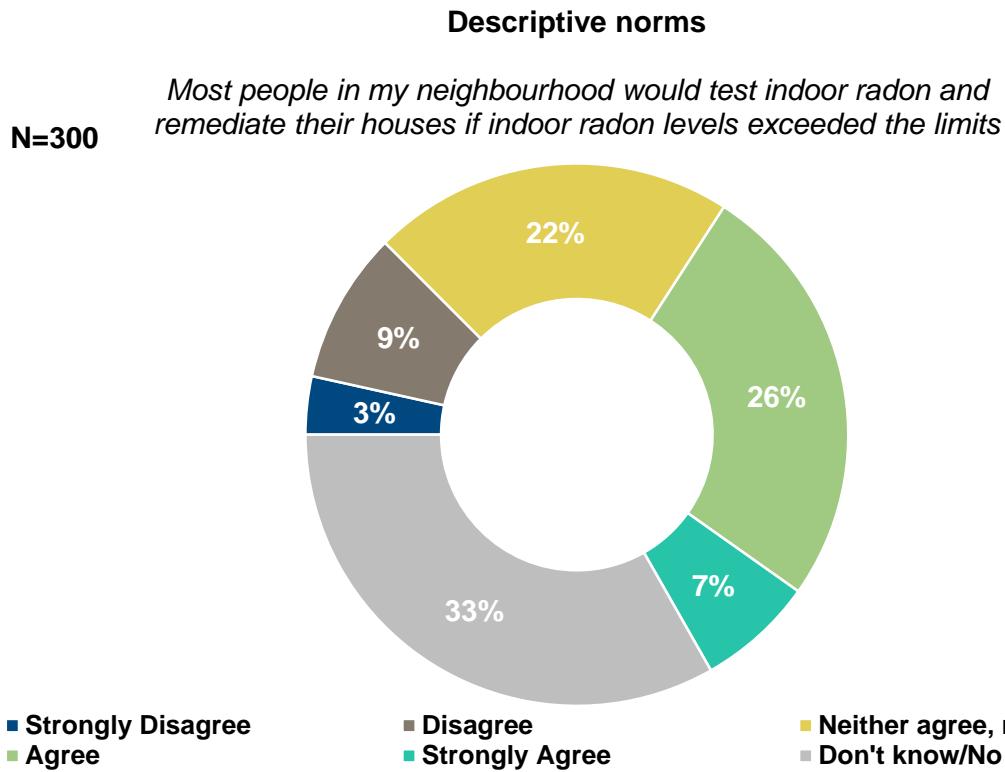
Figure 58: Descriptive norms – people in my neighbourhood

Descriptive norms

Most of my friends living in the same region as I do would test the indoor radon concentration and remediate their houses if indoor radon levels exceeded the limits

N=300

- ■ **Strongly Disagree**
- ■ **Disagree**
- ■ **Neither agree, nor disagree**
- ■ **Agree**
- ■ **Strongly Agree**
- ■ **Don't know/No answer**
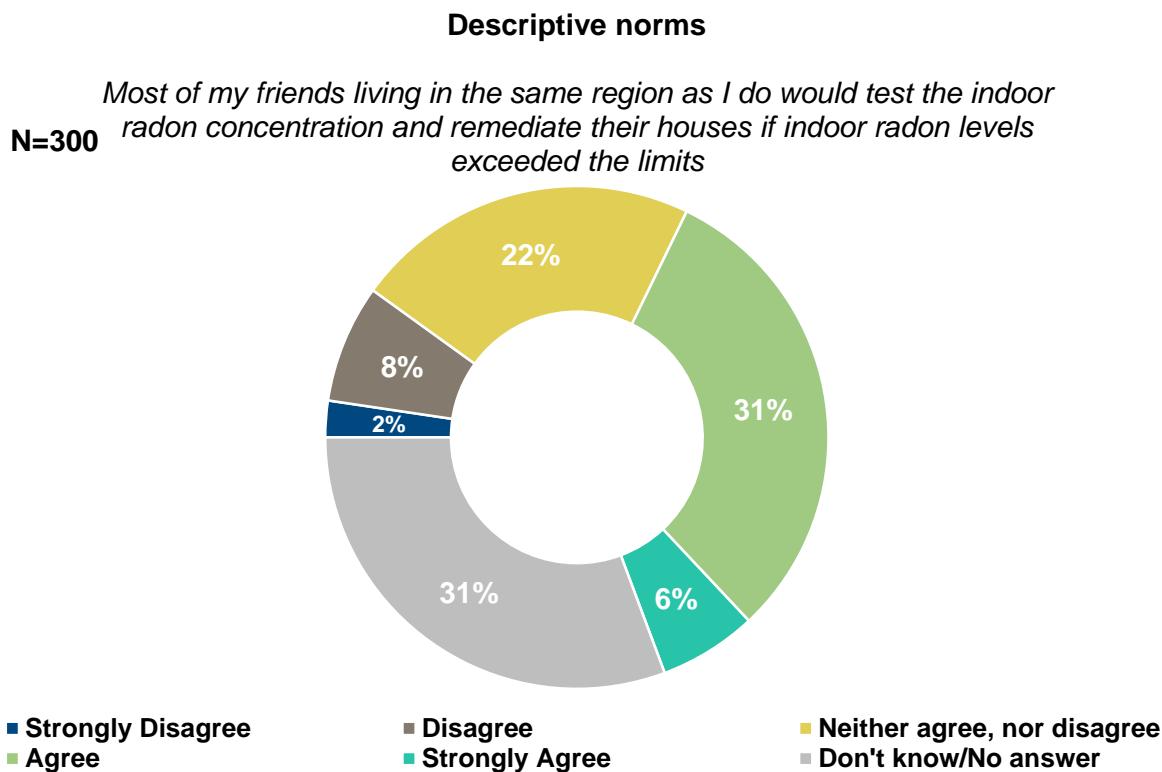
Figure 59: Descriptive norms – friends in the same region

Descriptive norms

*Of the people I know, nobody would test the indoor radon concentration
or remediate their house if indoor radon levels exceeded the limits*

N=300

- ■ **Strongly Disagree**
- ■ **Agree**
- ■ **Disagree**
- ■ **Strongly Agree**
- ■ **Neither agree, nor disagree**
- ■ **Don't know/No answer**
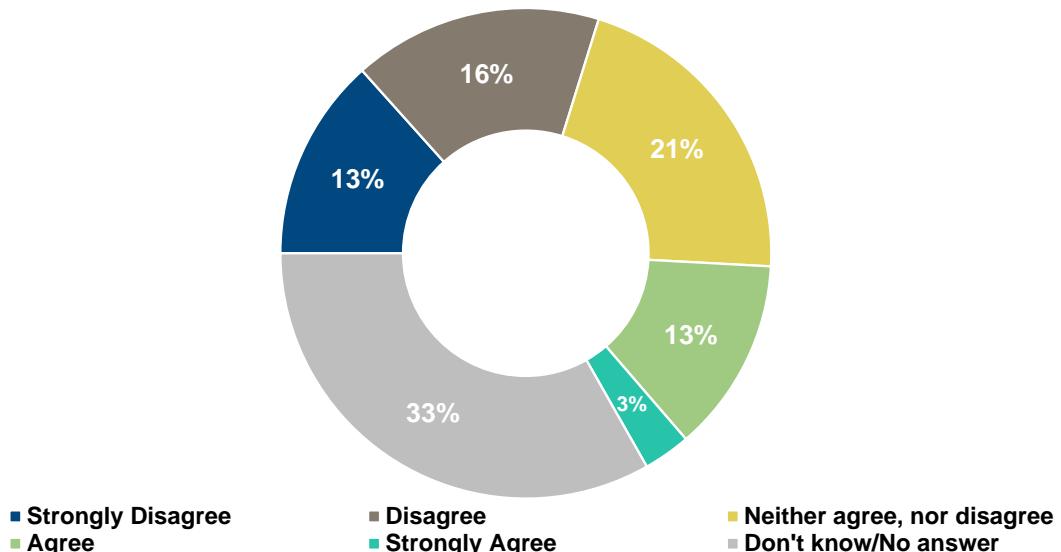
Figure 60: Descriptive norms – people I know
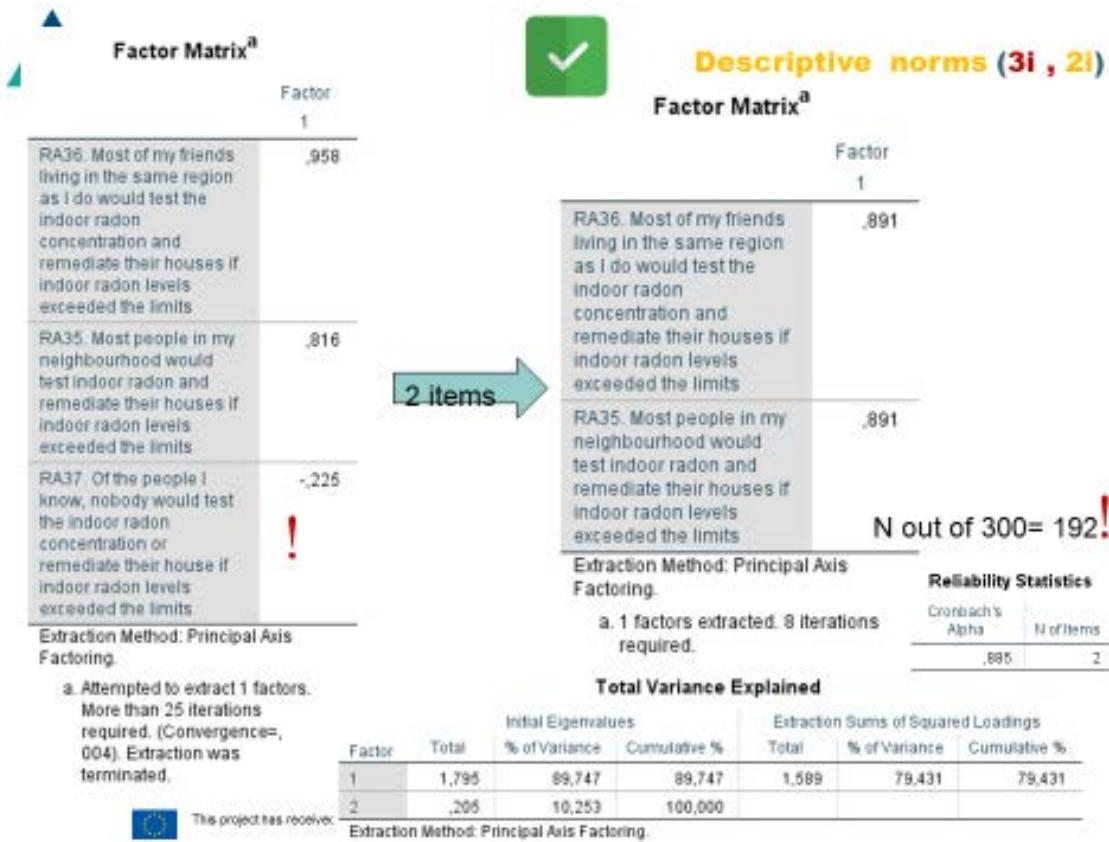
Figure 61: Factor – Descriptive norms

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 84

The three items didn't load significantly on one factor, thus one item has been removed. The two items resulted on one scale with Cronbach's alpha 0,895 and 79% of explained variance. (N = 192 out of 300).

	All	**Not seen video (n=107)**	**Seen video (n=183)**
N	179	69	105
Reliability	.633 (goes to 8 if RA37 goes out)	.653 (idem)	.627
Dimensionality	1 (almost 2)	1	1
Factor Loading (PAF)	High: .96 – Low: .23 (RA37)	/ (RA37 has low communality)	/

3.6.17 Moral norms

Moral norms are internalised, unconditional and emotional internalised and enforced through self-generated emotions such as guilt (Bicchieri, 2006). Moral norms are in this study adopted from (Turcanu et al., 2014).

We measured moral norms with the following two items.

- *It is my responsibility as a household member to protect the health of my family by making sure that the radon concentration in my home has been tested and remediated if necessary.*
- *It is morally right to test and remediate against indoor radon if advised.*

The answering categories consisted of a 6-point likert scale ranging from "*Strongly disagree*" (1), "*Disagree*" (2), "*Neither agree, nor disagree*" (3), "*Agree*" (4) to "*Strongly agree*" (5) and "*I don't know*" answers (9).

Moral norms

It is my responsibility as a household member to protect the health of my family by making sure that the radon concentration in my home has been tested and remediated if necessary

N=238

Household members > 1

- ■ **Strongly Disagree**
- ■ **Disagree**
- ■ **Neither agree, nor disagree**
- ■ **Agree**
- ■ **Strongly Agree**
- ■ **Don't know/No answer**
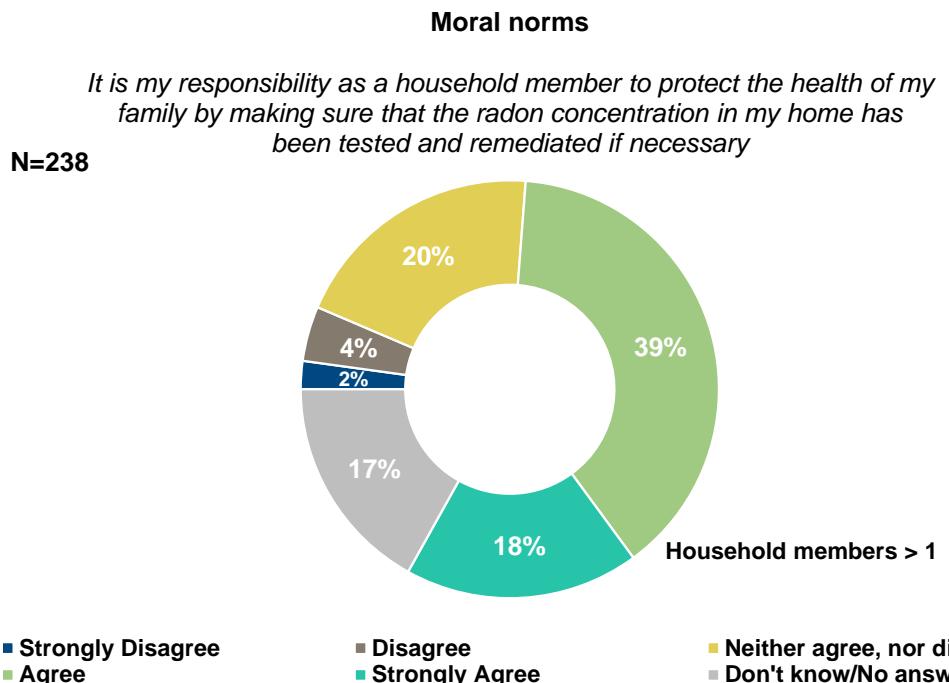
Figure 62: Moral norms - responsibility to protect family members

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 85

Moral norms

It is my responsibility as a household member to protect the health of my family by making sure that the radon concentration in my home has been tested and remediated if necessary

N=238

- **Strongly Disagree**
- **Disagree**
- **Neither agree, nor disagree**
- **Agree**
- **Strongly Agree**
- **Don't know/No answer**

Figure 63: Moral norms - responsibility to protect family members for households with more than one member

Moral norms

It is morally right to test and remediate against indoor radon if advised

N=300

- **Strongly Disagree**
- **Disagree**
- **Neither agree, nor disagree**
- **Agree**
- **Strongly Agree**
- **Don't know/No answer**

Figure 64: Moral norms - it is morally right

Figure 65: Factor – Moral norms

The two items resulted on one scale with Cronbach's alpha 0,799 and 83% of explained variance. (N = 199 out of 300).

	All	**Not seen video (n=107)**	**Seen video (n=183)**
N	199	78	115
Reliability	.799	.832	.736
Dimensionality	1	1	1
Factor Loading (PAF)	High: .82 – Low: .82	High: .84 – Low: .84	High: .76 – Low: .76

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 87

3.6.18 ALL norms

Additional factor analysis was carried out on all items pertaining to norms

	All	**Not seen video (n=107)**	**Seen video (n=183)**
N	119	52	62
Reliability	.745 (better if RA34 and RA37 are removed)	.774 (better if only RA37 goes)	.669 (to 7 if RA34 and RA37 go)
Dimensionality	3	2 (almost 3)	3
Factor Loading (PAF)	1: RA34b-RA35-RA36-RA38-RA39 2: ? 3: RA37recoded	?	1: RA34b-RA35-RA36 (sub and desc) 2: RA38-RA39 (moral) 3: RA37 (high value!) (desc) (RA34 doesn't load)
Factor Loading (if fixed at 3)	1: RA34B-RA35-RA36-(RA38)-RA39 (all norm types) 2: ? 3: RA37 (desc norm) (RA34 doesn't load well)	Actually 2 here but still fixed..	1: RA34b-RA35-RA36 (sub and desc) 2: RA38-RA39 (moral) 3: RA37 (desc) (RA34 doesn't load but best with 1)

All with 3 factors set:

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 88

Factor Matrix[a]

	Factor		
	1	2	3
RA36. Most of my friends living in the same region as I do would test the indoor radon concentration and remediate their houses if indoor radon levels exceeded the limits: To what extent do you agree or disagree with the following	,808	-,163	,167
RA35. Most people in my neighbourhood would test indoor radon and remediate their houses if indoor radon levels exceeded the limits: To what extent do you agree or disagree with the following statements?	,800	-,426	,111
RA39. It is morally right to test and remediate against indoor radon if advised.: To what extent do you agree or disagree with the following statements?	,742	,626	-,205
RA34b. Most people who are important to me (family, friends) are in favour of me remediating my home if the indoor radon levels would exceed the limits: To what extent do you agree or disagree with the following statements?	,718	-,143	,133
RA38. It is my responsibility as a household member to protect the health of my family by making sure that the radon concentration in my home has been tested and remediated if necessary: To what extent do you agree or disagree wit	,561	,416	-,047
RA34. Most people who are important to me (family, friends) are in favour of me testing the indoor radon levels in my home: To what extent do you agree or disagree with the following statements?	,415	-,339	-,522
RA37_recode	,147	,126	,512

Extraction Method: Principal Axis Factoring.

a. Attempted to extract 3 factors. More than 25 iterations required. (Convergence=,008). Extraction was terminated.

3.6.19 Moral NORM and behavior

Further factor analysis was conducted o moral norms and behaviour items.

RA5 I intend to test radon concentration in my home if advised by experts.
RA6 I intend to start the remediation of the home straight after I've obtained the results if advised by experts.
RA8 I would agree to install a radon removal system if advised by experts.
RA38 It is my responsibility as a household member to protect the health of my family by making sure that the radon concentration in my home has been tested and remediated if necessary.
RA39 It is morally right to test and remediate against indoor radon if advised.

	All	**Not seen video (n=107)**	**Seen video (n=183)**
N	182	76	100
Reliability	.872 (little better if RA38 out)	.868	.848 (better if RA38 out)
Dimensionality	1	1	2
Factor Loading (PAF)	High: .833 – Low: .599 (RA38 only this isn't great)	High: .816 – Low: .664	1: RA5-RA6-RA8 (behavior) 2: RA38-RA39 (moral norm)

3.6.20 Visual burden

Perceived visual burden of home remediation was measured with one direct item:
* *Remediation due to exceed levels of radon would visually destroy my home*

The answering categories consisted of a 5-point Likert scale ranging from "*Strongly disagree*" (1), "*Disagree*" (2), "*Neither agree, nor disagree*" (3), "*Agree*" (4) to "*Strongly agree*" (5) and "*I don't know*" answers (9).

Visual burden

Remediation due to exceeded levels of radon would visually destroy my home
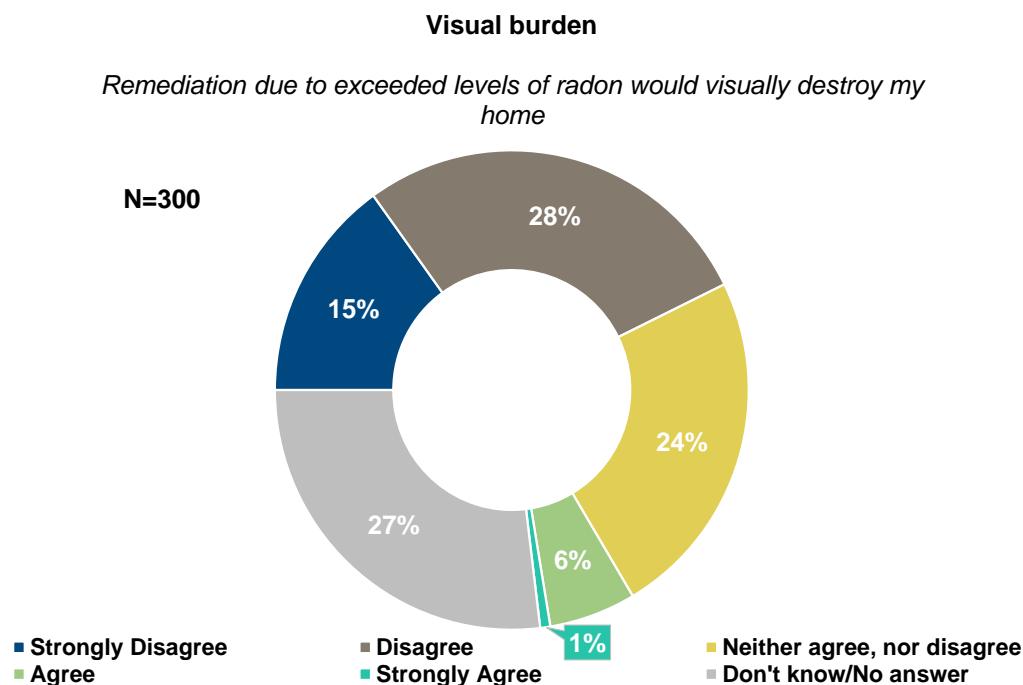
Figure 66: Visual burden for my home due to remediation

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 90

3.7   Response Bias

Response style can have implications for scientific results. Response style or response bias is the respondent's systematic tendency to respond to a range of survey items on a different basis from what the items are designed to measure (Paulhus, 1991 in Van Vaerenbergh & Thomas, 2012). This means that respondents do not fill in the survey according to their preferences about the survey questions, but that another factor plays a role. In this case: a style factor that indicates that respondents answer all questions in the same style. Their answers are thus independent of the content, but are nevertheless systematic. For example, answers can be very moderate or very extreme. There are many types of response styles. The response style (RS) can influence the outcome of an investigation in several ways. First, the presence of an RS can affect the distribution of a variable. Both the mean and the variance (= spread) can be distorted by the presence of RS, causing the researcher to misinterpret his result. RS can also influence the correlation between different variables. Correlations can be both strengthened and weakened. Since correlations form the basis of most statistical operations, this can have major consequences (Van Vaerenbergh, Thomas, 2012, p. 2).

There are many response styles: *Midpoint Response Style* (MRS): This refers to the tendency to always choose the middle categories for survey items with a ranking scale. *Extreme Response Style (ERS):* ERS refers to the tendency to choose often the highest or the lowest categories.   *Mild Response Style* (MLRS): This RS is not to be confused with MRS, and means that the lowest and highest answer is avoided by the respondent at all times. *Noncontingent Response Style* (NRS): When this RS is determined, it means that the respondent tended to answer the questions/item randomly and without thinking (Van Vaerenbergh, Thomas, 2012, pg. 3). *Disacquiescence Response Style* (DRS): indicates a tendency to disagree with the items from the questionnaire. Regardless of the content, the respondent always chooses to agree as little as possible with the survey items presented (Van Vaerenbergh, Thomas, 2012, pg. 3). *Net Acquiescence Response Style* (NARS) is a combination of DRS and ARS in which they are compared and the assumption is made whether or not one tends to show more acquiescence than disacquiescence.

The tables bellow indicate the response styles in the Perceived informed choice and Descriptive norms scales.

Perceived informed choice

(Potential) Response Bias	All	Not seen video (n=107)	Seen video (n= 195)
Same Direction	62	22	40
Neutral	18	3	15
¾ Neutral	30	8	22
Don't know	22	1	21
Total	132	34	98

 A lot of responses are in the same direction, even though the scale is balanced: 132 out of 300 are potentially affected by response bias.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 91

Descriptive norms

(Potential) Response Bias	All	Not seen video (n=107)	Seen video (n= 195)
Same Direction	14	8	6
Neutral	33	8	25
¾ Neutral	27	6	21
Don't know	81	27	54
Total	155	49	106

Here we note especially a lot of neutral answers (46) and don't knows (54) in the group that were informed about radon through the survey. Such respondents should not get the items related to norms as they are too hypothetical for this group.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 92

4. Results: Survey 2 – entire Belgian territory

## 4.1 Risk perception of radon and NORM in building in comparison to other radiological risks

Among radiological risks the most risky for the health within the next 20 years is perceived the risk of malicious use of nuclear technologies by terrorists, followed by radioactive waste, an accident in a nuclear installation, **indoor air pollution due to radon (mean 2.91 on a scale from 0=no risk et all, to 5=very high risk , SD=1.2),** extension of the operational lifetime of nuclear reactors Doel 1 and 2, the use of recycled material with low levels of radioactivity for buildings, **the use of recycled material with low levels of radioactivity for buildings (mean 3.83, SD=1.19) and the presence of the naturally radioactive gas- Radon (mean 2.72, SD=1.31).** The use of ionizing radiation for medical tests or treatments and the use of ionizing radiation for food sterilization were perceived among the lowest radiological risks by Belgian population. **Natural radiation (from soil or from space)** is the item with the lowest risk perception among respondents (mean of 2.36, SD of 1.21) with almost half of the respondents perceiving low, very low, or no risk at all from this risk domain and only 16% perceiving it as a high or very high risk.

The question asked to the respondents was: *"How do you perceive the potential risk to your health within the next 20 years from each of the following sources?".* The answering categories consisted of a 6-point Likert scale ranging from *"no risk at all" (0)* to *"very high risk" (5).* To evaluate the perception of potential risks to respondents' own health within the next 20 years, we investigated 15 risk domains.
These risk domains were: Environmental pollution; Radioactive waste; Chemical waste; An accident in a chemical installation; An accident in a nuclear installation; Natural radiation (from the soil or from space); The use of ionizing radiation for medical tests or treatments; The use of ionizing radiation for food sterilization; The use of recycled material with low levels of radioactivity for buildings; Extension of the operational lifetime of nuclear reactors Doel 1 and 2; Malicious use of nuclear technologies by terrorists; Large scale epidemic; and Climate crisis. Two items measuring risk perception concerning radon, with different formulation of radon, were included. More particularly, respondents were divided in two groups where each of them received one item about radon, but framed in a different way than in the other group. This way, one group (N= 558) received the framing "Indoor air pollution due to radon" and the other group received the framing "The presence of the naturally radioactive gas- Radon".
Among radiological risks the most risky for the health within the next 20 years is perceived the risk of malicious use of nuclear technologies by terrorists (mean 3.54, SD of 1.23), followed by radioactive waste (mean 3.36, SD of 1.36), an accident in a nuclear installation (mean 3.3, SD= 1.41), indoor air pollution due to radon (mean 3.91 , SD=1.2), extension of the operational lifetime of nuclear reactors Doel 1 and 2 (mean 2.87, SD=1.32), the use of recycled material with low levels of radioactivity for buildings (mean 3.83, SD=1.19) and the presence of the naturally radioactive gas- Radon (mean 2.72, SD=1.31). The use of ionizing radiation for medical tests or treatments (mean= 2.64, SD=1.15) and the use of ionizing radiation for food sterilization were perceived among the lowest risks (mean 2.6 and SD=1.22) . Natural radiation (from soil or from space) constitutes the lowest risk perception among respondents (mean of 2.63, SD of 1.21) with 47% of them perceiving, very low, low, or no risk at all from this risk domain and only 16% perceiving it as a high or very high risk. It is interesting, that respondents had difficulty to express their perception related to the risks of indoor air pollution due to radon, 19% of population decided for "I don't know" answer. Similar result is for the risks of the use of ionizing radiation for food sterilization where 17% of respondents selected "I don't know" answer.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 93
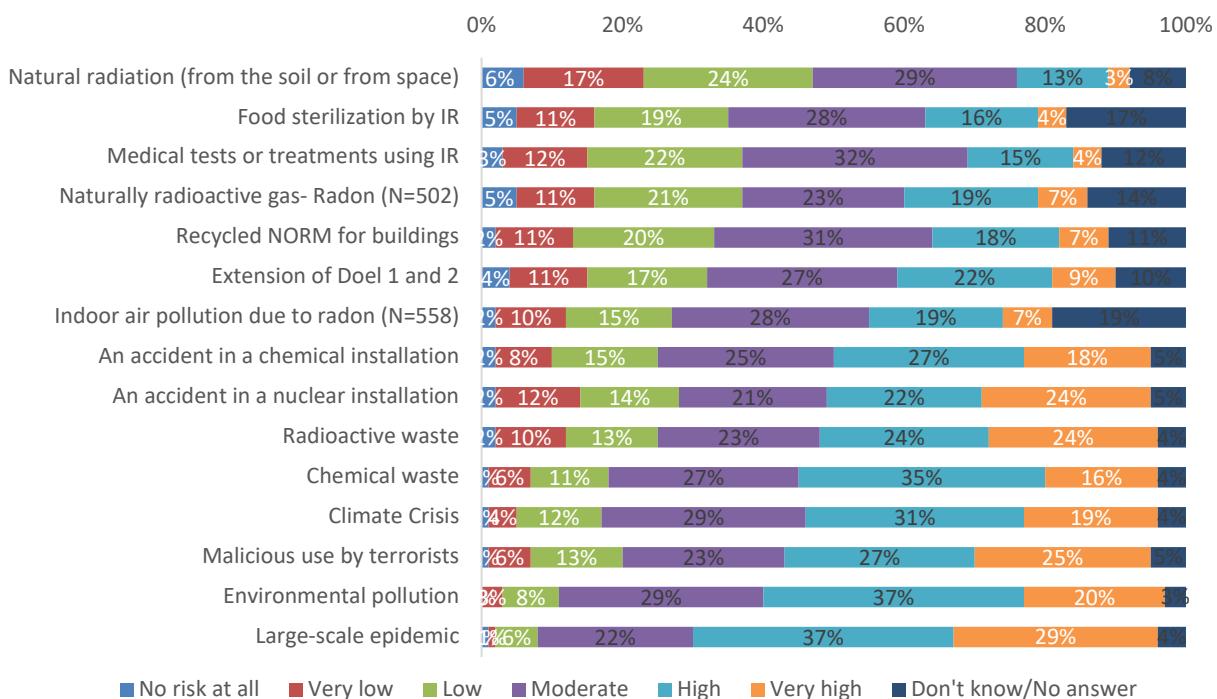
Figure 68 **Means and standard deviation of respondents' perception of risk from various domains. (N= 1060), sample weighed for gender, education, age, province, region and habitat.**

4.2 Confidence in authorities for actions they undertake to protect the population against radon, NORM and other radiological risks

The confidence in authorities for the actions they undertake to protect the population against risks from 15 various sources was measured for Environmental pollution; Radioactive waste; Chemical waste; An accident in a chemical installation; An accident in a nuclear installation; Natural radiation (from the soil or from space); The use of ionizing radiation for medical tests or treatments; The use of ionizing radiation for food sterilization; The use of recycled material with low levels of radioactivity for buildings; Extension of the operational lifetime of nuclear reactors Doel 1 and 2; Malicious use of nuclear technologies by terrorists; Large scale epidemic; and Climate crisis. For two items measuring confidence in authorities to protect the population from the risks of radon, respondents were divided in two groups where each of them received one item about radon, but framed in a different way than in the other group. This way, one group (N= 558) received the framing *"Indoor air pollution due to radon"* and the other group received the framing *"The presence of the naturally radioactive gas- Radon".* The answering categories consisted of a 6-point Likert scale ranging from *"none" (0)* to *"very much" (5).*

As the figures below show, confidence in authorities is more or less similar towards different risk domains with the lowest confidence showed when it comes to the climate crisis (14%, mean of 2.36, SD=1.18)

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 95

and the highest confidence showed when it comes to the use of ionizing radiation for medical tests or treatments (27%, with a mean of 2.95, SD= 1.09).

How much confidence do you have in the authorities for the actions they undertake to protect the population against risks from each of the following sources?

■ None ■ Very little ■ Little ■ Moderate ■ Quite a lot ■ Very much ■ Don't know/No answer
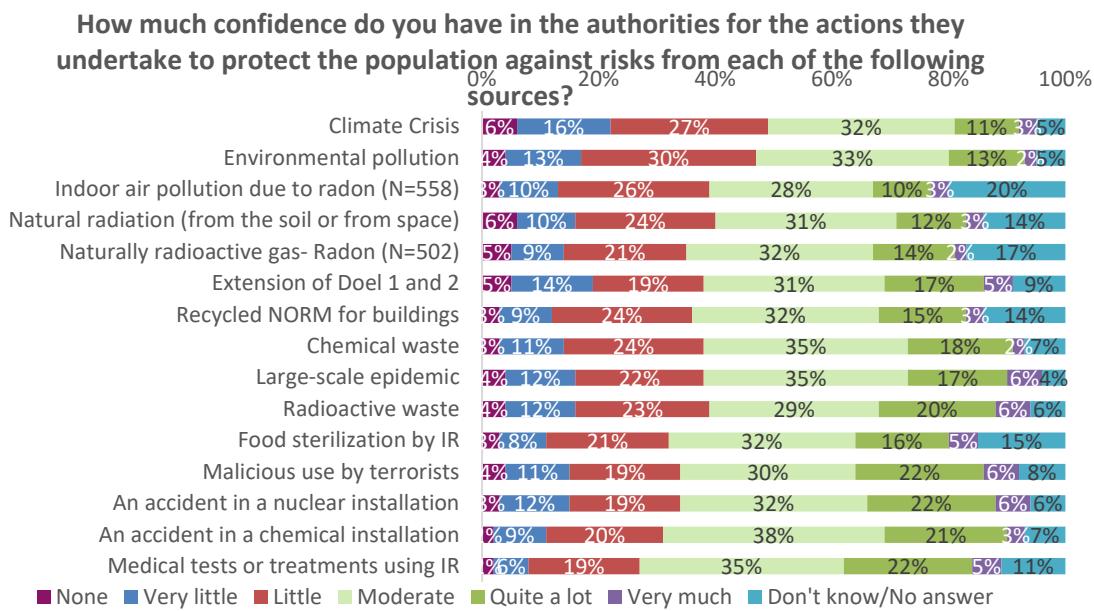
Figure 69. Respondents' confidence in the authorities for the actions they undertake to protect the population against various risk sources. (N= 1060), sample weighed for gender, education, age, province, region and habitat.
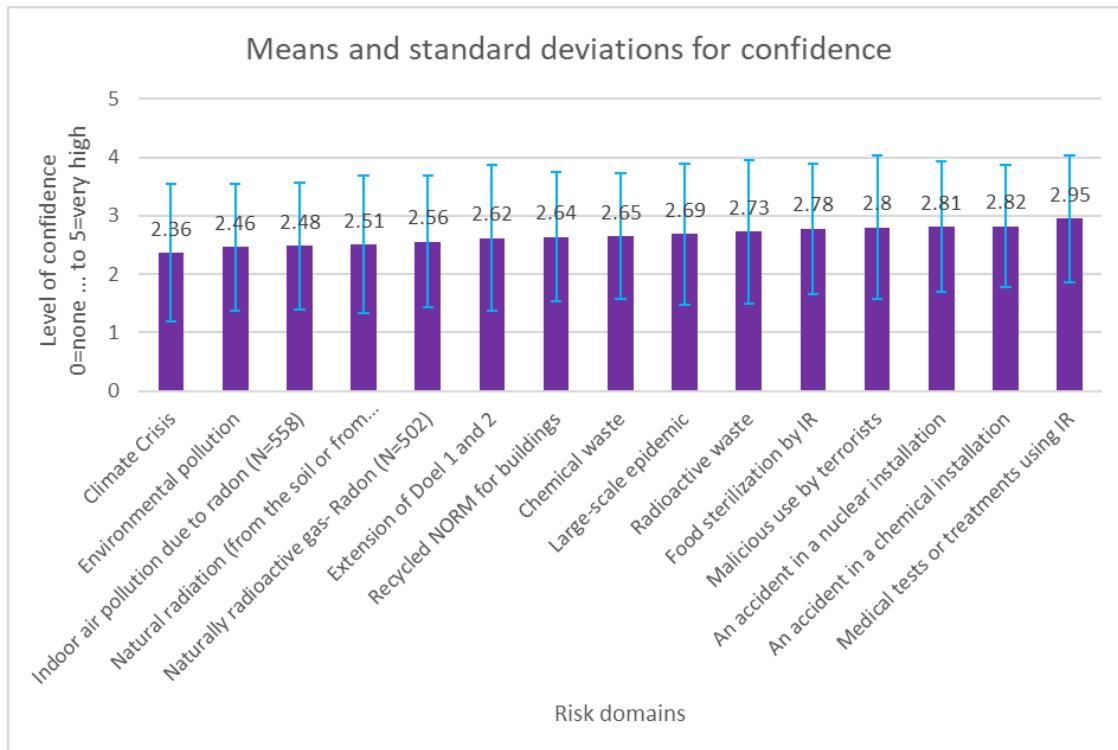
Figure 70. Mean and standard deviation values concerning respondents' confidence in the authorities for the actions they undertake to protect the population against various risk sources. (N= 1060), sample weighed for gender, education, age, province, region and habitat.

4.3 Knowledge about ionizing radiation
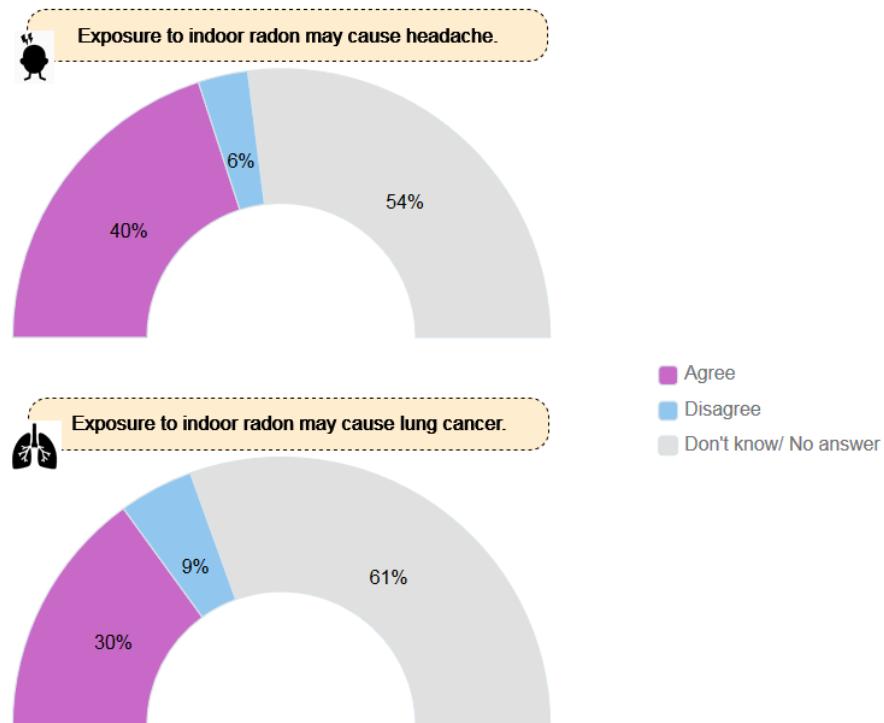
Figure 71. Public opinion about exposure to radon.
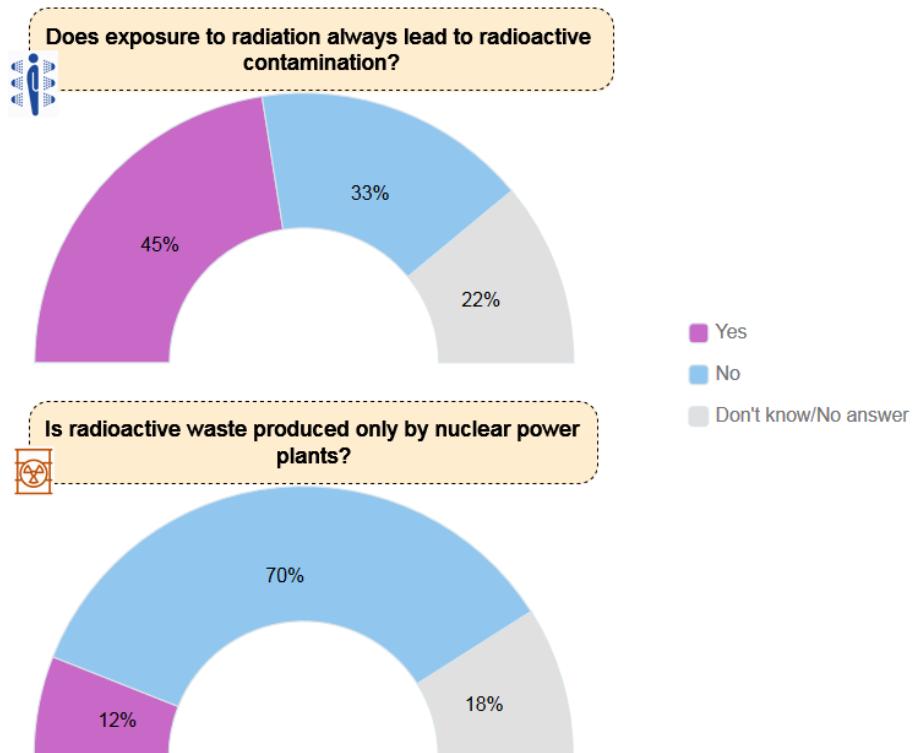
Figure 72 **Public awareness about exposure to radiation and production of radioactive waste (N=1060), weighted sample**

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 97

What is the measurement unit for radioactivity?

Watt	2%
Becquerel	67%
Metres/Second	2%
Don't know/ No answer	29%
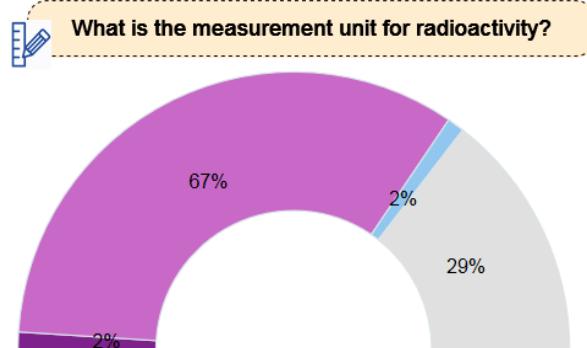
Figure 73 Public awareness concerning the measurement unit for radioactivity. (N= 1060), weighted sample

Vegetables grown near a nuclear power plant are not good for consumption because of the presence of radioactivity.

Even very low levels of radiation are harmful for human health.

The human body is naturally radioactive.

Strongly disagree   Disagree   Neither agree, nor disagree   Agree   Strongly agree   Don't know/ No answer
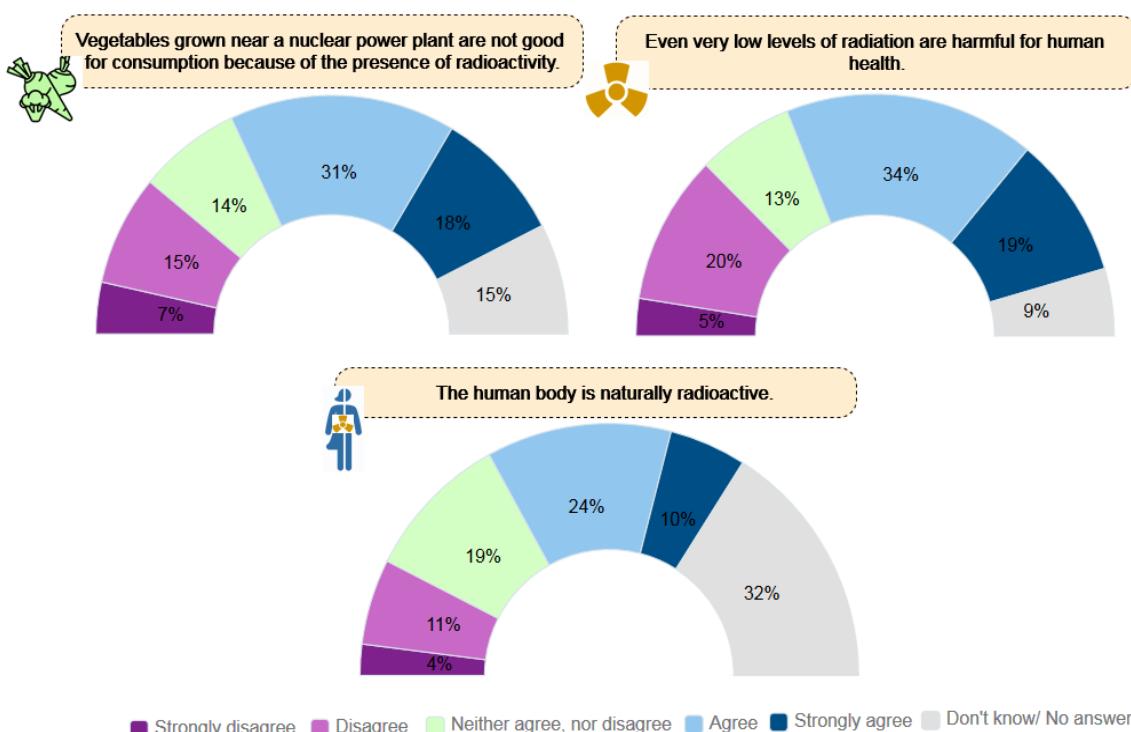
Figure 74 Public opinion about different aspects of radiation and radioactivity.

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 98
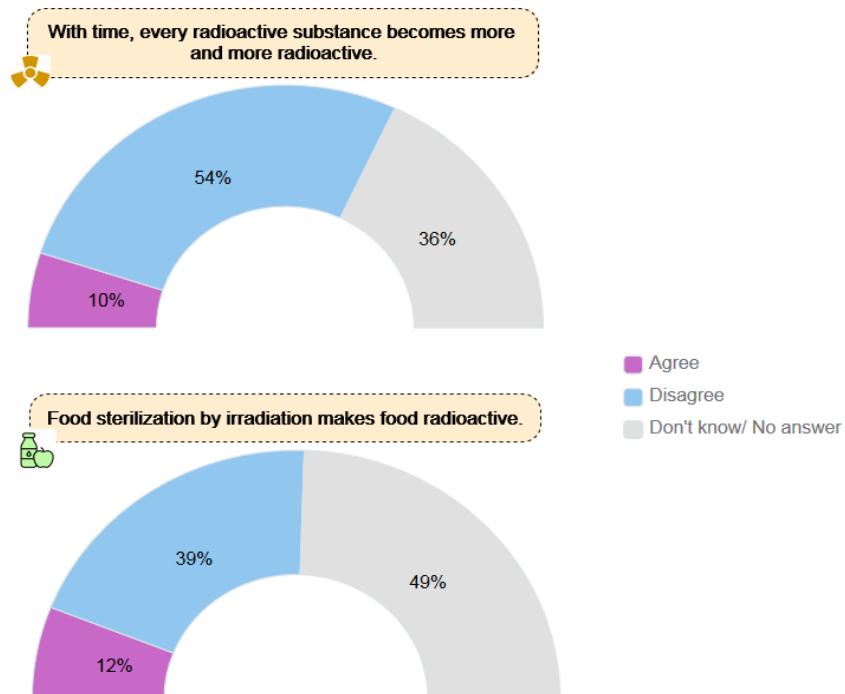
Figure 75 Public opinion about different aspects of radiation and radioactivity.

Table 2. Longitudinal analysis of knowledge items.

Knowledge questions	Answering categories	2021 (N= 1060) % correct answers	2018 (N= 1083) % correct answers	2015 (N= 1028) % correct answers	2013 (N=1002) % correct answers
Does exposure to radiation always lead to radioactive contamination?	1. Yes 2. No 9. Don't know/ No answer	33% (No)	36%	33%	26%
Is radioactive waste produced only by nuclear power plants?		70% (No)	73%	69%	65%
What is the measurement unit for radioactivity?	1. Becquerel 2. Hertz 3. Metres/second 9. I don't know/ no answer	67% (Becquerel)	NA	56%	52%
Questions	Answering categories	2021 (N= 1060) % public opinion	2018 (N= 1083) % public opinion	2015 (N= 1028) % public opinion	2013 (N=1002) % public opinion
Vegetables grown near a nuclear power plant are not good for consumption because of the presence of radioactivity.	1. Strongly disagree 2. Strongly agree 3. Neither agree/ nor disagree 4. Agree 5. Strongly agree	49% (agree or strongly agree)	NA	37%	33%

The human body is naturally radioactive.	*9. Don't know/ no answer*	34% (agree or strongly agree)	41%	39%	37%
With time, every radioactive substance becomes more and more radioactive.	*1. Agree 2. Disagree 9. Don't know/ no answer*	54% (disagree)	49%	50%	47%
Food sterilisation by irradiation makes food radioactive.		39% (disagree)	28%	NA	NA

www.radonorm.eu   Page 100

Appendix A.   Questionnaire: survey 1 (N=300)

RadoNorm – BOOST sample

Barometer 2020 Questionnaire : Translated Document

RadoNorm, Baromètre 2020 Questionnaire

PART 1. Socio-demographic variables / Variables socio-démographiques

S1	Language of the interview Langue de l'interview	1. Dutch/Néerlandais 2. French/ Français
S2	What is your gender? Que est votre sexe?	1. Male/Homme 2. Female/Femme 3. Other/Autre 4. I prefer not to say/Je préfère ne pas le préciser
S3	Place of residence Lieu de résidence de la personne interrogée	…. [zip code] Code postal
S4	Year of birth Année de naissance	…. [year] Année de naissance
S5	What is the highest diploma you have obtained? Quel est le plus haut diplôme obtenu?	1. Primary school or no education 2. Lower secondary – general 3. Higher secondary – general 4. Lower secondary – technical or arts 5. Higher secondary – technical or arts 6. Lower secondary – vocational 7. Higher secondary – vocational 8. Higher non-university 9. University 1. Primaire ou sans éducation 2. Secondaire inférieur - général 3. Secondaire supérieur - général 4. Secondaire inférieur - technique ou artistique 5. Secondaire supérieur - technique ou artistique 6. Secondaire inférieur - professionnel 7. Secondaire supérieur - professionnel 8. Supérieur - non universitaire 9. Supérieur – universitaire
S7	How many family members are currently living in your household (including yourself)? Children living in student accomodation who come home during the weekend also count as a household member. Combien de membres compte votre	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 101

	ménage, vous inclus(e) ? Les enfants en 'kot' qui reviennent le week-end à la maison comptent également comme membres du ménage.	
S8	And how many of those are children younger than 18? Combien d'enfants de 18 ans ou moins compte votre ménage ?	
S10	Is the dwelling that you spend most of your time a property of yours or your family, or does it belong to someone else? L'habitation dans laquelle vous passez la majorité de votre temps vous appartient-elle, appartient-elle à votre famille ou appartient-il à quelqu'un d'autre ?	1. I am owner or co-owner 2. It is the property of another family member 3. It is the property of someone else 99. Don't know/ NA 1. Je suis propriétaire ou copropriétaire 2. L'habitation appartient à un autre membre de ma famille 3. L'habitation appartient à une autre personne 99. Je ne sais pas / pas applicable
S11	For how long have you been living in this dwelling? Depuis combien de temps occupez-vous cette habitation ?	1. Less than 1 year 2. More than one year : (Indicate in years) 1. Moins d'un an 2. Plus d'un an : (Indiquer le nombre d'années)

PART 2. Risk perception and confidence in authorities / Perception des risques et confiance dans les autorités

Q2.1 *How do you perceive the potential risk **to your health within the next 20 years** from each of the following sources?*

Dans quelle mesure chacun de ces éléments présente, selon vous, un risque potentiel pour **votre propre santé** dans les vingt prochaines années ?

RP1	Environmental pollution La pollution environnementale	1. No risk at all 2. Very low 3. Low 4. Moderate 5. High 6. Very high 9. Don't know / no answer
RP6	Natural radiation (from the soil or from space) Les rayonnements naturels (provenant du sol ou le rayonnement atmosphérique)	
RP7	The use of ionising radiation for medical tests or treatments L'utilisation du rayonnement ionisant pour les tests et traitements médicaux.	
RP20	The use of recycled material with low levels of radioactivity for buildings. L'utilisation de matériaux recyclés faiblement radioactifs pour les bâtiments.	1. Aucun risque 2. Très faible 3. Faible 4. Moyen 5. Elevé 6. Très élevé 9. Je ne sais pas, pas de réponse
RP11	Climate Crisis La crise climatique	
RP12a	Indoor air pollution due to radon ENQUETE A 2 ECHELONS : La pollution de l'air intérieur par le radon	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu
Page 102

Q2.2 How much confidence do you have in the authorities for the actions they undertake to protect the population against risks from each of the following sources?

Quel niveau de confiance accordez-vous aux mesures que les autorités prennent pour protéger la population contre les risques liés à chacun des éléments suivants ?

RC1	Environmental pollution *La pollution environnementale*	1. None 2. Very little 3. Little 4. Moderate 5. Quite a lot 6. Very much 9. Don't know / no answer
RC6	Natural radiation (from the soil or from space)) *Les rayonnements naturels (provenant du sol ou le rayonnement atmosphérique)*	
RC7	The use of ionising radiation for medical tests or treatments *L'utilisation du rayonnement ionisant pour les tests et traitements médicaux.*	1. Pas du tout 2.Très faible 3. Faible 4. Moyen 5. Elevé 6. Très élevé 9. Je ne sais pas / pas de réponse
RC20	The use of recycled material with low levels of radioactivity for buildings. *L'utilisation de matériaux recyclés faiblement radioactifs pour les bâtiments.*	
RC12a	Indoor air pollution due to radon *La pollution de l'air intérieur par le radon*	

PART 3. Uncertainty Preference Scale/ Gérer l'incertitude

Q3.1 To what extent do you agree or disagree with the following statements? *Dans quelle mesure êtes-vous d'accord ou pas d'accord avec les déclarations suivantes ?*

UP1	I tend to avoid information about health effects of radiation *J'ai tendance à éviter les informations concernant les effets du rayonnement sur la santé*	1. Strongly Disagree 2. Disagree 3. Neither agree, nor disagree 4. Agree 5. Strongly Agree 9. Don't know / no answer
UP1a	**IF UP1= AGREE OR STRONGLY AGREE:** I tend to avoid information about health effects of radiation because I get anxious when I think about health effects of radiation **SI UP1= PLUTOT D'ACCORD OU TOUT A FAIT D'ACCORD** : *J'ai tendance à éviter les informations concernant les effets du rayonnement sur la santé parce que je deviens anxieux lorsque je réfléchis aux les effets du rayonnement sur la santé*	1. Pas du tout d'accord 2. Plutôt pas d'accord 3. Ni d'accord, ni pas d'accord 4. Plutôt d'accord 5. Tout à fait d'accord 9. Je ne sais pas / pas de réponse
UP1b	**IF UP1 = AGREE OR STRONGLY AGREE:** I tend to avoid information about health effects of radiation because the recommendations are always changing. **SI UP1= PLUTOT D'ACCORD OU TOUT A FAIT D'ACCORD :**	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu
Page 103

|		
	J'essaie d'éviter les informations concernant les effets du rayonnement sur la santé parce que les recommandations changent constamment	
UP1c	**IF UP1 = AGREE OR STRONGLY AGREE:** I tend to avoid information about health effects of radiation because the amount of information out there can be overwhelming. **SI UP1= PLUTOT D'ACCORD OU TOUT A FAIT D'ACCORD** J'essaie d'éviter les informations concernant les effets du rayonnement sur la santé parce que la quantité d'informations est colossale	
UP2	I tend to ACTIVELY SEEK OUT information about health effects of radiation Je suis plutôt enclin à RECHERCHER ACTIVEMENT des informations concernant les effets du rayonnement sur la santé	
UP2a	**IF UP2 = AGREE OR STRONGLY AGREE:** I tend to ACTIVELY SEEK OUT information about health effects of radiation because I want to get this information from different sources. **SI UP2 = PLUTOT D'ACCORD OU TOUT A FAIT D'ACCORD** Je suis plutôt enclin à RECHERCHER ACTIVEMENT des informations concernant les effets du rayonnement sur la santé parce que je souhaite avoir ces informations de différentes sources.	1. Strongly Disagree 2. Disagree 3. Neither agree, nor disagree 4. Agree 5. Strongly Agree 9. Don't know / no answer 1. Pas du tout d'accord 2. Plutôt pas d'accord 3. Ni d'accord, ni pas d'accord 4. Plutôt d'accord 5. Tout à fait d'accord 9. Je ne sais pas / pas de réponse
UP2b	**IF UP2 = AGREE OR STRONGLY AGREE:** I tend to ACTIVELY SEEK OUT information about health effects of radiation because new information can give me hope that I can protect myself from radiation **SI UP2 = PLUTOT D'ACCORD OU TOUT A FAIT D'ACCORD** Je suis plutôt enclin à RECHERCHER ACTIVEMENT des informations concernant les effets du rayonnement sur la santé parce que de nouvelles informations peuvent me donner l'espoir que je peux me protéger des rayonnements	
UP2c	**IF UP2 = AGREE OR STRONGLY AGREE:** I tend to ACTIVELY SEEK OUT information about health effects of radiation because new information can help me assess my own risks. **SI UP2 = PLUTOT D'ACCORD OU TOUT A FAIT D'ACCORD** Je suis plutôt enclin à RECHERCHER ACTIVEMENT des informations concernant les effets du rayonnement sur la santé parce que de nouvelles informations peuvent m'aider à mieux évaluer les risques pour ma santé	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 104

PART 11: Radon (UK)

Intro: The following questions are related to Radon

RA1	Do you know anything about radon?	1. Yes 2. I have heard something about it 3. No 99. I don't know/ NA
RA1bis	**FILTER: IF RA1 = 1 or 2** Can you describe in a few words what you have heard about radon? **FILTER: INDIEN RA1 = 1 or 2**	OPEN question
INTRO	**FILTER: IF RA1= 2 or 3 or 99** *Show video related to Radon:* *https://www.youtube.com/watch?v=50fX56kZiww&feature=youtu.be*	
INTRO	**To summarize, a building can be tested for radon; it can be remediated if there is radon detected; or there can be preliminary protective measures installed when the building is built. For instance, the new building has a special ventilation system from the beginning.**	
RA2	Are there any of these actions related to radon indoors being applied in your household?	1) Yes 2) No 3) I don't know, NA
RA3	**FILTER: IF RA2=1**, what kind?	**MULTIPLE OPTIONS POSSIBLE** 1. Test 2. Remediation 3. Preliminary protective measures in new building. 4. Other (open)
RP12a	*How do you perceive the potential risk to your health within the next 20 years from* Indoor air pollution due to radon?	1. No risk at all 2. Very low 3. Low 4. Moderate 5. High 6. Very high 9. Don't know / no answer

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 105

INTRO	*To what extent do you agree or disagree with the following statements?*	
RA5	I intend to test radon concentration in my home if advised by experts.	1. Strongly Disagree 2. Disagree 3. Neither agree, nor disagree 4. Agree 5. Strongly Agree 9. Don't know / no answer
RA6	I intend to start the remediation of the home straight after I've obtained the results if advised by experts.	
RA8	I would agree to install a radon removal system if advised by experts.	
RA10	Information about radon makes me worry about the possibility of getting lung cancer.	
RA11	Information about radon makes me nervous and tense about my health.	
RA12	Having high radon concentration in my house would NOT be a severe threat to my health.	
RA13	I believe that I can develop cancer if there is a high radon concentration in my home.	
RA14	How likely do you think you will get sick if there is presence of radon in your home and you don't remediate it?	1. Very unlikely 2. Unlikely 3. Somewhat likely 4. Likely 5. Very likely 9. Don't know / no answer
RA15	How likely do you think it is that people living in your region will get sick due to indoor radon concentrations if they don't remediate their homes?	
RA16	How likely do you think it is that your own home has such an indoor radon concentration that you should do something about it?	
RA17	Home remediation offers effective protection against the radon hazard.	1. Strongly Disagree 2. Disagree 3. Neither agree, nor disagree 4. Agree 5. Strongly Agree 9. Don't know / no answer
RA18	Home remediation will NOT protect me from lung cancer due to indoor radon.	
RA19	I feel very confident that (if needed) a special ventilation system would eliminate the radon hazard from my home.	
RA20	It is very difficult to reduce radon to a safe level in homes that have a radon problem	
RA21	I am confident I would be able to test the indoor radon concentration in my home if I wanted to.	
RA22	I am confident I would be able to remediate my home in order to decrease the indoor radon concentration if I wanted to.	
RA51	Remediation due to exceeded levels of radon would visually destroy my home.	
RA23	I believe that the cost for remediation of my home to reduce the indoor radon concentration is …	0 1 2 3 4 5 6 Free of cost Very high
RA24	The procedure for **testing** the radon concentration at home is …	0 1 2 3 4 5 6 Very easy Very complicated

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 106

RA25	The procedure for **remediating** my home is …	0 1 2 3 4 5 6 Very easy Very complicated
RA26	Obtaining personal advice from **a local expert** on how to control the radon concentration in my home is …	0 1 2 3 4 5 6 Very easy Very complicated
RA27	Obtaining personal advice from **responsible authorities** on how to control the radon concentration in my home is …	0 1 2 3 4 5 6 Very easy Very complicated
RA28	I would feel regret if I had not remediated my home against radon and ended up getting lung cancer.	
RA29	I would be ashamed not to remediate my home if indoor radon levels exceeded the limits.	
RA30	I don't feel well informed about which actions are needed related to indoor radon levels.	
RA31	There is enough information for me to be able to decide whether or not I should perform a radon test at home.	
RA50	Information about radon and its health effects is still too uncertain to take actions based on it.	
RA33	I am confident that in the case of exceeded levels of indoor radon in my home, I will find the information needed to protect myself and my family.	1. Strongly Disagree 2. Disagree 3. Neither agree, nor disagree 4. Agree 5. Strongly Agree 9. Don't know / no answer
RA34	Most people who are important to me (family, friends) are in favour of me testing the indoor radon levels in my home.	
RA34b	Most people who are important to me (family, friends) are in favour of me remediating my home if the indoor radon levels would exceed the limits.	
RA35	Most people in my neighborhood would test indoor radon and remediate their houses if indoor radon levels exceeded the limits.	
RA36	Most of my friends living in the same region as I do would test the indoor radon concentration and remediate their houses if indoor radon levels exceeded the limits.	
RA37	Of the people I know, nobody would test the indoor radon concentration or remediate their house if indoor radon levels exceeded the limits.	
RA38	**FILTER: IF S7= 2 or higher** It is my responsibility as a household member to protect the health of my family by making sure that the radon concentration in my home has been tested and remediated if necessary.	
RA39	It is morally right to test and remediate against indoor radon if advised.	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 107

RA41	If there would be an activity asking for input from the general public related to radon concentrations near your home, to what extent would you like to participate?	**SHOW GRAPHICAL CARD** 1 = I don't want to be involved 2 = I want to receive information 3 = I want to receive information and express my opinion 4 = I want to participate in a dialogue towards a decision 5 = I want to be a partner in the decision-making process 999. Don't know/ no answer

When we look at radon, can you tell us:

  a) Whether you know the following actors
  b) If so, can you tell us if you think they are:
  • telling the truth about radon risks
  • technically competent with regard to radon mitigation

Not knowing an actor is a filter for "telling the truth" and "being technically competent"

"x" in first column = don't ask respondents if they know them

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 108

Q7.1.

Do you know….?

RANDOMISE

	Know them	NST Telling the **truth**	NSC Technically competent	
1. Public health authorities	x			Knowledge:
2. Environmental organisations such as Inter- Environnement Wallonie (FR)				1. Yes
3. The Federal Agency for Nuclear Control (FANC)				2. No
4. Medical doctors	x			Truth & competence:
12. Companies measuring radioactivity				1. Strongly disagree
13. Les Services d'Analyse des Milieux Intérieurs (SAMI)				2. Disagree
				3. Neither agree, nor disagree
				4. Agree
				5. Strongly agree
				99. Don't know / no answer

PART 11: Radon (FR)

Intro: Les questions suivantes portent sur le radon

RA1	Connaissez-vous le radon ?	1. Oui 2. J'en ai entendu parler 3. Non 99. Je ne sais pas / non applicable
RA1bis	**FILTRE : SI RA1 = 1 ou 2.** Pouvez-vous décrire en quelques mots ce que vous savez du radon ?	
INTRO	**FILTRE : SI RA1 = 1 ou 3.** *Montrer la vidéo sur le radon :* *https://www.youtube.com/watch?v=50fX56kZiww&feature=youtu.be*	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

**www.radonorm.eu**

Page 109

INTRO	**En résumé, un bâtiment peut être testé pour la présence de radon. Il peut être assaini en cas de détection de radon ou des mesures préventives peuvent être prises à la construction du bâtiment. Par exemple, le nouveau bâtiment peut être équipé d'un système de ventilation adapté dès le début.**	
RA2	Chez vous, est-ce que des actions sont entreprises contre le radon à l'intérieur de votre domicile ?	1 Oui 2 Non 3 Je ne sais pas / pas applicable
RA3	**FILTRE : Si oui, lesquelles** :	Question à choix multiples 1. Test 2. Assainissement 3.Mesures de protection préventives dans un nouveau bâtiment 4. Autres (open)
RP12a	Comment percevez-vous le risque potentiel pour votre santé de la pollution de l'air intérieur due au radon au cours des 20 prochaines années ?	1. Aucun risque 2. Très faible 3. Faible 4. Moyen 5. Elevé 6. Très élevé 9. Je ne sais pas, pas de réponse

INTRO	*Dans quelle mesure êtes-vous d'accord ou pas d'accord avec les affirmations suivantes ?*	
RA5	J'ai l'intention de mesurer la concentration de radon dans mon habitation si les experts me le recommandent.	1. Pas du tout d'accord 2. Plutôt pas d'accord 3. Ni d'accord, ni pas d'accord 4. Plutôt d'accord 5. Tout à fait d'accord 9. Je ne sais pas / pas de réponse
RA6	Dès que j'aurai reçu les résultats, j'ai l'intention d'assainir directement ma maison si les experts le recommandent.	
RA8	Je pourrais accepter l'installation d'un système de neutralisation du radon si les experts le recommandent.	
RA10	Les informations à propos du radon m'inquiètent quant au risque d'être atteint(e) d'un cancer des poumons.	
RA11	Les informations à propos du radon me rendent nerveux/se et provoquent chez moi un stress lié à ma santé.	
RA12	Une haute concentration en radon chez moi NE constituerait PAS une menace grave pour ma santé.	
RA13	Je crois que je risque de développer un cancer si une haute concentration de radon était relevée chez moi.	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 110

RA14	Selon vous, quelle est la probabilité que vous tombiez malade en raison de la présence de radon dans votre maison si vous ne l'assainissez pas ?	1. Très improbable 2. Improbable 3. Moyennement probable 4. Probable 5. Très probable 9. Je ne sais pas / pas de réponse
RA15	Selon vous, quelle est la probabilité que les personnes qui habitent près de chez vous tombent malades en raison de la présence de radon chez eux, s'ils n'assainissent pas leurs habitations ?	
RA16	Selon vous, quelle est la probabilité qu'une concentration de radon soit constatée chez vous au point que vous devriez prendre des mesures ?	
RA17	L'assainissement d'une maison offre une protection efficace contre le radon.	1. Pas du tout d'accord 2. Plutôt pas d'accord 3. Ni d'accord, ni pas d'accord 4. Plutôt d'accord 5. Tout à fait d'accord 9. Je ne sais pas / pas de réponse
RA18	L'assainissement de ma maison NE me protègera PAS contre le cancer des poumons occasionné par la présence de radon dans la maison.	
RA19	Je suis convaincu(e) que (au besoin), un système de neutralisation du radon solutionnerait le problème du radon chez moi.	
RA20	Il est extrêmement difficile de réduire à un niveau acceptable d'un point de vue de la sécurité la concentration de radon dans les maisons avec des problèmes liées au radon.	
RA21	Je suis convaincu(e) que je pourrais mesurer la concentration de radon dans la maison si je le voulais.	
RA22	Je suis convaincu(e) que je pourrais assainir ma maison afin de réduire la concentration de radon à l'intérieur de celle-ci, si je le voulais.	
RA51	L'assainissement suite à des doses trop élevées de radon détruirait l'aspect visuel de ma maison.	
RA23	Je crois que le coût de l'assainissement de mon habitation afin de réduire la concentration de radon à l'intérieur de celle-ci est	0 1 2 3 4 5 6 Gratuit Très élevé
RA24	La procédure pour **mesurer** la concentration de radon est ...	0 1 2 3 4 5 6 Très facile Très complexe
RA25	La procédure pour **assainir** mon habitation est ...	0 1 2 3 4 5 6 Très facile Très complexe
RA26	Il est ... d'obtenir des conseils personnalisés de la part **d'un expert local** sur la façon de gérer la concentration de radon dans ma maison.	0 1 2 3 4 5 6 Très facile Très complexe
RA27	Il est ... d'obtenir des conseils personnalisés de **la part d'instances compétentes** sur la façon de gérer la concentration de radon dans ma maison.	0 1 2 3 4 5 6 Très facile Très complexe

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 111

RA28	Je trouverais dommage qu'aucune mesure de protection contre le radon ne soit prise et que je sois finalement atteint(e) d'un cancer des poumons.	
RA29	Je serais indigné(e) que je ne puisse pas assainir mon habitation si les concentrations de radon dans ma maison dépassaient les limites.	
RA30	Je ne m'estime pas bien informé(e) sur les actions qui sont nécessaires concernant les concentrations de radon dans les habitations.	
RA31	Je ne dispose pas d'informations suffisantes pour pouvoir décider si je dois réaliser ou non un test de détection du radon chez moi.	
RA50	Les informations à propos du radon et ses effets sur la santé sont encore trop floues pour pouvoir agir en fonction de celles-ci.	
RA33	Je suis convaincu(e) que si des concentrations de radon élevées étaient mesurées chez moi, je trouverais les informations utiles pour me protéger moi ainsi que ma famille.	1. Pas du tout d'accord
RA34	La plupart des gens qui comptent pour moi (famille, amis) sont d'avis que je dois mesurer la concentration de radon dans mon habitation.	2. Plutôt pas d'accord
RA34b	La plupart des gens qui comptent pour moi (famille, amis) sont d'avis que j'assainisse mon habitation, si la concentration de radon dépassait certaines limites.	3. Ni d'accord, ni pas d'accord
RA35	La plupart des gens dans mon quartier mesureraient la concentration de radon dans leur maison et assainiraient leur habitation, si les limites étaient dépassées.	4. Plutôt d'accord 5. Tout à fait d'accord
RA36	La plupart de mes amis qui habitent dans ma région mesureraient la concentration de radon dans leur habitation et assainiraient leur habitation, si les limites étaient dépassées.	9. Ne sais pas / non pas de réponse
RA37	Parmi les gens que je connais, personne ne mesurerait la concentration de radon dans son habitation ni n'assainirait son habitation, si les limites étaient dépassées.	
RA38	**FILTRE : Si S7 = 2 ou plus** C'est ma responsabilité en tant que membre du ménage de protéger la santé de ma famille en veillant à ce que la concentration de radon dans mon habitation soit mesurée et que l'habitation soit au besoin assainie.	
RA39	D'un point de vue moral, il convient de mesurer la présence de radon à l'intérieur de l'habitation et de l'assainir si recommandé.	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 112

	Si une activité devait être organisée afin de solliciter la participation du public concernant les concentrations de radon à proximité de votre habitation, dans quelle mesure y participeriez-vous ?	**PRESENTEZ CARTE GRAPHIQUE** 1 =Je ne souhaite pas être impliqué(e). 2=Je souhaite recevoir des informations 3=Je souhaite recevoir des informations et donner mon avis. 4=Je souhaite participer à un dialogue visant à prendre une décision 5= Je souhaite être un partenaire dans la prise de décisions. 999. Je ne sais pas / pas de réponse
RA41		
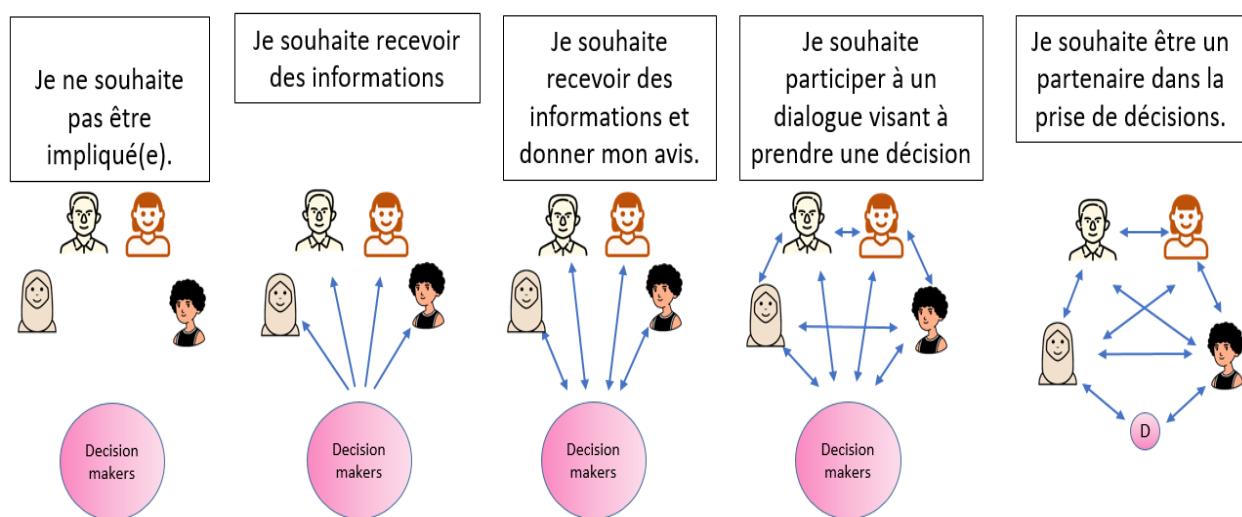
Au sujet du radon, pouvez-vous nous dire :
- c) Si vous connaissez les acteurs ci-dessous
- d) Le cas échéant, si vous savez s'ils :
    - Disent la vérité sur les risques liés au radon
    - Sont compétents sur le plan technique en matière d'assainissement du radon

La non-connaissance d'un acteur sert de filtre pour « disent la vérité » et « compétents sur le plan technique »

« x » dans la première colonne = ne pas poser la question de la connaissance de l'acteur

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 113

Q7.1. Connaissez-vous ?

RANDOMISE

	Je connais	Disent la vérité	Compétents sur le plan technique	
1. Les autorités de santé publique	x			Connais :
2. Des organisations environnementales (ex. Inter-Environnement Wallonie)				1. Oui 2. Non
3. L'agence fédérale de Contrôle nucléaire (AFCN)				Vérité & compétence:
4. Médecins	x			1. Pas du tout d'accord
12. Des entreprises qui mesurent la radioactivité				2. Pas d'accord
13. Les Services d'Analyse des Milieux Intérieurs (SAMI)				3. Ni d'accord, ni pas d'accord
				4.D'accord
				5.Tout à fait d'accord
				99. Ne sais pas / pas de réponse

PART 12. Knowledge about the nuclear domain and perception of radiation risks / Connaissance en nucléaire et perception des risques du rayonnement

Q13.1 What do you think about the following issues:

Que pensez-vous des questions suivantes :

AW1	Does exposure to radiation always lead to radioactive contamination? A votre avis, une exposition aux radiations entraîne-t-elle toujours une contamination radioactive ?	SINGLE RESPONSE 1. Yes 2. No 9. Don't know/ no answer 1 REPONSE POSSIBLE 1. oui 2. non 9. Je ne sais pas / pas de réponse

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 114

AW14	What is the measurement unit for radioactivity? Quelle est l'unité de mesure de la radioactivité ?	1. Watt 2. Becquerel 3. Metres/second 9. Don't know/ NA 1. Le Watt 2. Le Becquerel 3. Le Mètre/seconde 9. Je ne sais pas/pas de réponse

Q13.2 To what extent do you agree or disagree with the following statements?
Dans quelle mesure êtes-vous d'accord ou pas d'accord avec les affirmations suivantes ?

		1. Strongly Disagree 2. Disagree 3. Neither agree, nor disagree 4. Agree 5. Strongly Agree 9. Don't know / no answer 1. Pas du tout d'accord 2. Plutôt pas d'accord 3. Ni d'accord, ni pas d'accord 4. Plutôt d'accord 5. Tout à fait d'accord 9. Je ne sais pas / pas de réponse
AW16	Even very low levels of radiation are harmful for human health. Même des doses très faibles d'irradiation liée à un accident nucléaire sont nocives pour la santé humaine	
AW18	The human body is naturally radioactive. Le corps humain est naturellement radioactif.	
AW19	With time, every radioactive substance becomes more and more radioactive. Avec le temps, toute substance radioactive devient de plus en plus radioactive.	1. Agree 2. Disagree 9. Don't know / no answer 1. d'accord 2. pas d'accord 9. Je ne sais pas / pas de réponse
AW20	Food sterilisation by irradiation makes food radioactive. La stérilisation d'aliments par irradiation les rend radioactifs.	
AW35	Exposure to indoor radon may cause headache. L'exposition au radon intérieur peut provoquer des maux de tête.	
AW36	Exposure to indoor radon may cause breast cancer. L'exposition au radon intérieur peut provoquer un cancer du sein	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 115

5. Appendix B: Questionnaire: survey 2 (N=1060)

Barometer 2020 Questionnaire : Translated Document

Barometer 2020 Vragenlijst

Baromètre 2020 Questionnaire

1.1 PART 1. Socio-demographic variables / Sociaal-demografische variabelen / Variables socio-démographiques

KANTAR - This questionnaire (MAIN) only in FR and NL!

KANTAR – Don't read titeles of sections!

KANTAR – Consent and information sheet in other document!

S1	Language of the interview Taal van het interview Langue de l'interview	1. Dutch/Nederlands /Néerlandais 2. French/ Frans/ Français
S2	What is your gender? Wat is uw geslacht? Que est votre sexe?	1. Male/Man/ Homme 2. Female/Vrouw/Femme 3. Other/Ander /Autre 4. I prefer not to say/Dat zeg ik liever niet/Je préfère ne pas le préciser
S3	Place of residence Woonplaats van de respondent Lieu de résidence de la personne interrogée	.... [zip code] Postcode Code postal
S4	Year of birth Geboortejaar Année de naissance	.... [year] Geboortejaar Année de naissance
S5	What is the highest diploma you have obtained? Wat is uw hoogst behaalde diploma? Quel est le plus haut diplôme obtenu?	1. Primary school or no education 2. Lower secondary – general 3. Higher secondary – general 4. Lower secondary – technical or arts 5. Higher secondary – technical or arts 6. Lower secondary – vocational 7. Higher secondary – vocational 8. Higher non-university 9. University 1. Lager onderwijs of geen scholing 2. Secundair - algemeen (ASO) lager 3. Secundair - algemeen (ASO) hoger 4. Secundair - technisch of artistiek (TSO of KSO) lager 5. Secundair - technisch of artistiek (TSO of KSO) hoger 6. Secundair - beroeps (BSO) lager 7. Secundair - beroeps (BSO) hoger 8. Hoger - niet universitair 9. Hoger – universitair

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 116

		1. Primaire ou sans éducation 2. Secondaire inférieur - général 3. Secondaire supérieur - général 4. Secondaire inférieur - technique ou artistique 5. Secondaire supérieur - technique ou artistique 6. Secondaire inférieur - professionnel 7. Secondaire supérieur - professionnel 8. Supérieur - non universitaire 9. Supérieur – universitaire
S7	How many family members are currently living in your household (including yourself)? Children living in student accomodation who come home during the weekend also count as a household member. Met hoeveel van uw gezinsleden woont u momenteel samen (inclusief uzelf)? Kinderen op 'kot' die in het weekend naar huis komen tellen ook mee als gezinslid. Combien de membres compte votre ménage, vous inclus(e) ? Les enfants en 'kot' qui reviennent le week-end à la maison comptent également comme membres du ménage.	
S8	And how many of those are children younger than 18? Hoeveel daarvan zijn kinderen jonger dan 18 jaar? Combien d'enfants de 18 ans ou moins compte votre ménage?	
S10	Is the dwelling that you spend most of your time a property of yours or your family, or does it belong to someone else? Is de woning waarin u het merendeel van uw tijd doorbrengt eigendom van u of uw gezin, of is het van iemand anders? L'habitation dans laquelle vous passez la majorité de votre temps vous appartient-elle, appartient-elle à votre famille ou appartient-il à quelqu'un d'autre?	1. I am owner or co-owner 2. It is the property of another family member 3. It is the property of someone else 99. Don't know/ NA 1. Ik ben eigenaar of mede-eigenaar 2. De woning is eigendom van een ander gezinslid 3. De woning is eigendom van iemand anders 99. Ik weet het niet / n.v.t. 1. Je suis propriétaire ou copropriétaire 2. L'habitation appartient à un autre membre de ma famille 3. L'habitation appartient à une autre personne 99. Je ne sais pas / pas applicable
S11	For how long have you been living in this dwelling? Hoe lang woont u al in deze woning? Depuis combien de temps occupez-vous cette habitation ?	1. Less than 1 year 2. More than one year : (Indicate in years) _____ 1 . Minder dan een jaar 2. Meer dan een jaar (Duid aantal jaren aan) 1. Moins d'un an 2. Plus d'un an (Indiquer le nombre d'années)

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 117

1.2 PART 2. Risk perception and confidence in authorities / Risicoperceptie en vertrouwen in de overheid / Perception des risques et confiance dans les autorités

Q2.1 *I will now read out a list of domains, among which some may pose higher health risks than others. How do you perceive the potential risk **to your health within the next 20 years** from each of the following sources?*

Ik zal u nu een lijst voorlezen met domeinen, waarvan het ene een groter gezondheidsrisico kan vormen dan het andere. Kunt u hieronder aangeven hoe u het potentiële risico voor **uw eigen gezondheid** in de komende 20 jaar inschat met betrekking tot de volgende domeinen?

Je vais vous lire une série d'éléments dont certains peuvent présenter plus de risques pour la santé que d'autres. Dans quelle mesure chacun de ces éléments présente, selon vous, un risque potentiel pour **votre propre santé** dans les vingt prochaines années ?

RP1	Environmental pollution Milieuvervuiling La pollution environnementale	
RP2	Radioactive waste Radioactief afval Les déchets radioactifs	1. No risk at all 2. Very low 3. Low 4. Moderate 5. High 6. Very high 9. Don't know / no answer
RP3	Chemical waste Chemisch avfal Les déchets chimiques	1. Geen enkel risico 2. Zeer laag 3. Laag
RP4	An accident in a chemical installation Een ongeval in een chemische installatie Un accident dans une installation chimique	4. Gemiddeld 5. Hoog
RP5	An accident in a nuclear installation Een ongeval in een nucleaire installatie Un accident dans une installation nucléaire	6. Zeer hoog 9. Ik weet het niet/geen antwoord
RP6	Natural radiation (from the soil or from space) Natuurlijke straling (uit de grond of uit de ruimte) Les rayonnements naturels (provenant du sol ou le rayonnement atmosphérique)	1. Aucun risque 2. Très faible 3. Faible
RP7	The use of ionising **radiation** for medical tests or treatments Het gebruik van ioniserende straling voor medische testen of behandelingen. L'utilisation du rayonnement ionisant pour les tests et traitements médicaux.	4. Moyen 5. Elevé 6. Très élevé
RP8	The use of ionising radiation for food sterilization Het gebruik van ioniserende straling voor sterilisatie van voedsel L'utilisation du rayonnement ionisant pour la stérilisation de produits alimentaires.	9. Je ne sais pas, pas de réponse

RadoNorm

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 118

RP20	The use of recycled material with low levels of radioactivity for buildings.	
	Het gebruik van gerecycleerd materiaal met lage hoeveelheden radioactiviteit voor gebouwen	
	L'utilisation de matériaux recyclés faiblement radioactifs dans ces bâtiments.	
RP21	Extension of the operational lifetime of nuclear reactors Doel 1 and 2.	
	Levensduurverlenging van de kernreactoren Doel 1 en 2.	
	La prolongation de la durée de vie des réacteurs nucléaires Doel 1 et 2.	
RP9	Malicious use of nuclear technologies by terrorists	
	Het misbruik van nucleaire technologieën door terroristen	
	L'usage malintentionné des technologies nucléaires par des terroristes.	
RP10	Large-scale epidemic	
	Een grootschalige epidemie	
	Une épidémie a grande échelle	
RP11	Climate Crisis	
	Klimaatcrisis	
	La crise climatique	
RP12a	**SPLIT BALLOT:** Indoor air pollution due to radon	
	OPGEDEELDE VRAAG: vervuiling van binnenlucht door radon	
	ENQUETE A 2 ECHELONS : pollution de l'air intérieur par le radon	
RP12b	**SPLIT BALLOT:** The presence of the naturally radioactive gas- Radon indoors.	
	OPGEDEELDE VRAAG: de aanwezigheid binnenhuis van het natuurlijk radioactief gas radon	
	ENQUETE A 2 ECHELONS : presénce de radon, gaz radioactif naturel, a l'intérieur	

Q2.2 How much confidence do you have in the authorities for the actions they undertake to protect the population against risks from each of the following sources?

Hoe groot is uw vertrouwen in de autoriteiten voor de maatregelen die ze nemen om de bevolking te beschermen tegen risico's in elk van de volgende domeinen?

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 119

Quel niveau de confiance accordez-vous aux mesures que les autorités prennent pour protéger la population contre les risques liés à chacun des éléments suivants ?

RC1	Environmental pollution Milieuvervuiling La pollution environnementale	
RC2	Radioactive waste Radioactief afval Les déchets radioactifs	
RC3	Chemical waste Chemisch avfal Les déchets chimiques	
RC4	An accident in a chemical installation Een ongeval in een chemische installatie Un accident dans une installation chimique	1. None 2. Very little 3. Little 4. Moderate 5. Quite a lot 6. Very much 9. Don't know / no answer
RC5	An accident in a nuclear installation Een ongeval in een nucleaire installatie Un accident dans une installation nucléaire	
RC6	Natural radiation (from the soil or from space) Natuurlijke straling (uit de grond of uit de ruimte) Les rayonnements naturels (provenant du sol ou le rayonnement atmosphérique)	1. Geen 2. Zeer laag 3. Laag 4. Gemiddeld 5. Hoog 6. Zeer hoog 9. Ik weet het niet/geen antwoord
RC7	The use of ionising radiation for medical tests or treatments Het gebruik van ioniserende straling voor medische testen of behandelingen. L'utilisation du rayonnement ionisant pour les tests et traitements médicaux.	
RC8	The use of ionising radiation for food sterilization. Het gebruik van ioniserende straling voor sterilisatie van voedsel L'utilisation du rayonnement ionisant pour la stérilisation de produits alimentaires.	1. Pas du tout 2.Très faible 3. Faible 4. Moyen 5. Elevé 6. Très élevé 9. Je ne sais pas / pas de réponse
RC20	The use of recycled material with low levels of radioactivity for buildings. Het gebruik van gerecycleerd materiaal met lage hoeveelheden radioactiviteit voor gebouwen L'utilisation de matériaux recyclés faiblement radioactifs dans ces bâtiments.	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 120

RC21	Extension of the operational lifetime of nuclear reactors Doel 1 and 2. Levensduurverlenging van de kernreactoren Doel 1 en 2. La prolongation de la durée de vie des réacteurs nucléaires Doel 1 et 2.	
RC9	Malicious use of nuclear technologies by terrorists Het misbruik van nucleaire technologieën door terroristen L'usage malintentionné des technologies nucléaires par des terroristes.	
RC10	Large-scale epidemic Een grootschalige epidemie Une épidémie a grande échelle	
RC11	Climate Crisis Klimaatcrisis La crise climatique	
RC12a	**SPLIT BALLOT:** Indoor air pollution due to radon OPGEDEELDE VRAAG: vervuiling van binnenlucht door radon ENQUETE A 2 ECHELONS : pollution de l'air intérieur par le radon	
RC12b	**SPLIT BALLOT:** The presence of the naturally radioactive gas- Radon indoors. OPGEDEELDE VRAAG: natuurlijk, radioactief gas binnenhuis – radon ENQUETE A 2 ECHELONS : presénce de radon, gaz radioactif naturel, a l'intérieur	

![RadoNorm logo] Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 121

1.3 PART 3. Uncertainty Preference Scale/ Omgaan met onzekerheid / Gérer l'incertitude

Q3.1 To what extent do you agree or disagree with the following statements? In welke mate gaat u akkoord of niet akkoord met de volgende uitspraken? Dans quelle mesure êtes-vous d'accord ou pas d'accord avec les déclarations suivantes ?

UP1	I tend to avoid information about health effects of radiation Ik heb de neiging om informatie over de gezondheidseffecten van straling te vermijden J'ai tendance a éviter les informations concernant les effets du rayonnement sur la santé	1. Strongly Disagree 2. Disagree 3. Neither agree, nor disagree 4. Agree 5. Strongly Agree 9. Don't know / no answer 1. Helemaal niet akkoord 2. Eerder niet akkoord 3. Noch akkoord, noch niet akkoord 4. Eerder akkoord 5. Helemaal akkoord 9. Ik weet het niet / Geen antwoord 1. Pas du tout d'accord 2. Plutôt pas d'accord 3. Ni d'accord, ni pas d'accord 4. Plutôt d'accord 5. Tout à fait d'accord 9. Je ne sais pas / pas de réponse
UP1a	**IF UP1= AGREE OR STRONGLY AGREE:** I tend to avoid information about health effects of radiation because I get anxious when I think about health effects of radiation **Indien UP1= EERDER AKKOORD OF HELEMAAL AKKOORD:** Ik heb de neiging om informatie over de gezondheidseffecten van straling te vermijden omdat ik angstig word wanneer ik over de impact van straling op de gezondheid nadenk **SI UP1= PLUTOT D'ACCORD OU TOUT A FAIT D'ACCORD :** J'ai tendance a éviter les informations concernant les effets du rayonnement sur la santé parce que je deviens anxieux lorsque je réfléchis aux les effets du rayonnement sur la santé	
UP1b	**IF UP1 = AGREE OR STRONGLY AGREE:** I tend to avoid information about health effects of radiation because the recommendations are always changing. Indien UP1= EERDER OF HELEMAAL AKKOORD: Ik heb de neiging om informatie over de gezondheidseffecten van straling te vermijden omdat de aanbevelingen voortdurend veranderen **SI UP1= PLUTOT D'ACCORD OU TOUT A FAIT D'ACCORD :** J'essaie d'éviter les informations concernant les effets du rayonnement sur la santé parce que les recommandations changent constamment	
UP1c	**IF UP1 = AGREE OR STRONGLY AGREE:** I tend to avoid information about health effects of radiation because the amount of information out there can be overwhelming. Indien UP1 = EERDER AKKOORD OF HELEMAAL AKKOORD: Ik heb de neiging om informatie over de gezondheidseffecten van straling te vermijden omdat de hoeveelheid informatie overweldigend kan zijn **SI UP1= PLUTOT D'ACCORD OU TOUT A FAIT D'ACCORD** J'essaie d'éviter les informations concernant les effets du rayonnement sur la santé parce que la quantité d'informations est colossale	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 122

UP2	I tend to ACTIVELY SEEK OUT information about health effects of radiation	
	Ik ben geneigd om ACTIEF OP ZOEK TE GAAN naar informatie over de impact van straling op de gezondheid.	
	Je suis plutôt enclin à RECHERCHER ACTIVEMENT des informations concernant les effets du rayonnement sur la santé	
UP2a	**IF AGREE OR STRONGLY AGREE:**	
	I tend to ACTIVELY SEEK OUT information about health effects of radiation because I want to get this information from different sources.	
	Indien UP2 = EERDER AKKOORD OF HELEMAAL AKKOORD	
	Ik ben geneigd om ACTIEF OP ZOEK TE GAAN naar informatie over de impact van straling op de gezondheid omdat ik vanuit verschillende bronnen deze informatie wil krijgen.	
	SI UP2 = PLUTOT D'ACCORD OU TOUT A FAIT D'ACCORD	
	Je suis plutôt enclin à RECHERCHER ACTIVEMENT des informations concernant les effets du rayonnement sur la santé parce que je souhaite avoir ces informations de différentes sources.	
UP2b	**IF AGREE OR STRONGLY AGREE:**	
	I tend to ACTIVELY SEEK OUT information about health effects of radiation because new information can give me hope that I can protect myself from radiation	
	Indien UP2 = EERDER AKKOORD OF HELEMAAL AKKOORD	
	Ik ben geneigd om ACTIEF OP ZOEK TE GAAN naar informatie over de impact van straling op de gezondheid omdat nieuwe informatie me hoop kan geven dat ik mezelf tegen straling kan beschermen	
	SI UP2 = PLUTOT D'ACCORD OU TOUT A FAIT D'ACCORD	
	Je suis plutôt enclin à RECHERCHER ACTIVEMENT des informations concernant les effets du rayonnement sur la santé parce que de nouvelles informations peuvent me donner l'espoir que je peux me protéger des rayonnements	
UP2c	**IF AGREE OR STRONGLY AGREE:**	
	I tend to ACTIVELY SEEK OUT information about health effects of radiation because new information can help me assess my own risks.	
	Indien UP2 = EERDER AKKOORD OF HELEMAAL AKKOORD	
	Ik ben geneigd om ACTIEF OP ZOEK TE GAAN naar informatie over de impact van straling op de gezondheid omdat nieuwe informatie me kan helpen om de risico's voor mezelf beter in te schatten	
	SI UP2 = PLUTOT D'ACCORD OU TOUT A FAIT D'ACCORD	
	Je suis plutôt enclin à RECHERCHER ACTIVEMENT des informations concernant les effets du rayonnement sur la santé parce que de nouvelles informations peuvent m'aider à mieux évaluer les risques pour ma santé	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 123

1.4 PART 4. Attitude towards science and technology/Houding tegenover wetenschap en technologie/ Attitude vis-à-vis des science et technologie

Q3.1 I will now read out a number of statements related to science and technology. Please indicate to what extent you agree or disagree with this statement:

Nu zal ik u een aantal uitspraken voorlezen in verband met wetenschap en technologie. Kunt u voor elk van deze uitspraken aangeven in welke mate u hiermee akkoord gaat of niet?

Je vais vous lire un certain nombre d'affirmations relatives à la science et la technologie. Pouvez-vous me dire dans quelle mesure vous êtes d'accord ou non avec chacune de celles-ci ?

AX2	Future generations will have a better quality of life as a result of science and technology. Wetenschap en technologie zullen zorgen voor een betere levenskwaliteit voor toekomstige generaties. Grâce à la science et à la technologie, les générations futures auront une meilleure qualité de vie.	1. Strongly Disagree 2. Disagree 3. Neither agree, nor disagree 4. Agree 5. Strongly Agree
AX3	Science and technology make our lives easier Wetenschap en technologie maken ons leven gemakkelijker. La science et la technologie rendent nos vies plus faciles.	9. Don't know / no answer 1. Helemaal niet akkoord 2. Eerder niet akkoord
AX9	The benefits of science and technology are greater than its harmful effects. De voordelen van wetenschap en technologie zijn groter dan de schadelijke effecten Les bénéfices apportés par la science et la technologie dépassent les effets nocifs	3. Noch akkoord, noch niet akkoord 4. Eerder akkoord 5. Helemaal akkoord 9. Ik weet het niet / Geen antwoord 1. Pas du tout d'accord 2. Plutôt pas d'accord
AX11	We do NOT need further development of science & technology We hebben GEEN verdere ontwikkeling van wetenschap & technologie nodig Nous n'avons PAS besoin du développement des science & technologie	3. Ni d'accord, ni pas d'accord 4. Plutôt d'accord 5. Tout à fait d'accord 9. je ne sais pas / pas de réponse
AX10	Overall, to what extent are you favourable or unfavourable towards the development of science and technology? Are you… In het algemeen, in welke mate bent u voor of tegen de ontwikkeling van wetenschap en technologie? Bent u… En général, dans quelle mesure êtes-vous pour ou contre le développement de la science et de la technologie? Vous y êtes …	1. Totally against 2. Somewhat against 3. Neither in favour nor against 4. Somewhat in favour 5. Totally in favour 9. Don't know/no answer 1. Helemaal tegen 2. Eerder tegen 3. Noch voor, noch tegen 4. Eerder voor 5. Helemaal voor 9. Weet niet/geen antwoord 1. Tout à fait contre 2. Contre 3. Ni pour ni contre 4. Pour 5. Tout à fait pour 9. Ne sait pas / Pas de réponse

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 124

1.5 PART 5. Attitude towards nuclear energy/Mening over nucleaire energie/Opinion vis-à-vis de l'énergie nucléaire

Q5.1 Now I will ask you some questions related to nuclear energy / Ik ga u nu een aantal vragen stellen over kernenergie / Je vais maintenant vous poser une série de questions concernant l'énergie nucléaire.

RT2	What is your opinion about the use of nuclear energy for electricity production? Are you.. Wat is uw mening over het gebruik van kernenergie voor de productie van elektriciteit? Bent u… Quelle est votre opinion concernant l'utilisation de l'énergie nucléaire pour la production d'électricité? Vous y êtes …	1. Totally in favour 2. Rather in favour 3. Neither in favour, nor against 4. Rather against 5. Totally against 9. Don't know/no answer 1. Helemaal voor 2. Eerder voor 3. Noch voor, noch tegen 4. Eerder tegen 5. Helemaal tegen 9. Ik weet het niet/geen antwoord 1: Tout à fait favorable 2: Favorable 3: Ni favorable ni opposé(e) 4: Opposé(e) 5: Tout à fait opposé(e) 9: Je ne sais pas / pas de réponse

Q5.2 To what extent do you agree or disagree with the following statements?/ In welke mate gaat u akkoord of niet akkoord met de volgende uitspraken?/ Dans quelle mesure êtes-vous d'accord ou pas d'accord avec les déclarations suivantes ?

RT3	Overall, the benefits of nuclear energy outweigh the disadvantages. Globaal genomen zijn de voordelen van kernenergie groter dan de nadelen. Globalement, les bénéfices de l'énergie nucléaire sont plus importants que ses inconvénients.	1. Strongly Disagree 2. Disagree 3. Neither agree, nor disagree 4. Agree 5. Strongly Agree 9. Don't know / no answer 1. Helemaal niet akkoord 2. Eerder niet akkoord 3. Noch akkoord, noch niet akkoord 4. Eerder akkoord 5. Helemaal akkoord 9. Ik weet het niet / Geen antwoord 1. Pas du tout d'accord 2. Plutôt pas d'accord 3. Ni d'accord, ni pas d'accord 4. Plutôt d'accord 5. Tout à fait d'accord 9. Je ne sais pas / pas de réponse
RT4	The reduction of the number of nuclear power plants in Belgium is a good thing. De vermindering van het aantal kerncentrales in België is een goede zaak. La réduction du nombre de centrales nucléaires en Belgique est une bonne chose.	
RT5	Nuclear power plants endanger the future of our children. Kerncentrales vormen een gevaar voor de toekomst van onze kinderen. Les centrales nucléaires mettent en péril l'avenir de nos enfants.	
NC1	Nuclear energy is a climate-friendly technology. Nucleaire energie is een klimaatvriendelijke technologie. L'énergie nucléaire est une technologie respectueuse du climat.	
NC2	I am willing to pay more for electricity to support the use of renewable energy. Ik ben bereid meer te betalen voor elektriciteit om het gebruik van hernieuwbare energiebronnen te ondersteunen. Je suis prêt(e) à payer plus cher pour mon électricité pour soutenir l'utilisation des énergies renouvelables.	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 125

NC3	Renewable energy sources are currently not able to cover our current energy needs. Hernieuwbare energiebronnen zijn momenteel niet in staat om onze huidige energiebehoeften te dekken. Les sources d'énergies renouvelables ne sont actuellement pas capables de couvrir nos besoins actuels en énergie.	
G1	Which of the following statements about nuclear power plants in Belgium is closest to your opinion? Welk van de volgende standpunten over Belgische kerncentrales sluit het dichtst aan bij uw mening? Laquelle des affirmations suivantes se rapproche le plus de votre propre opinion concernant des centrales nucléaires en Belgique ?	Only one answer possible 1. Belgium should close all its nuclear power plants as soon as possible. 2. Belgium should use the nuclear power plants it already has, but not build new ones. 3. Belgium should use the nuclear power plants it already has and build new nuclear power plants to replace the old ones. 4. Belgium should close the existing power plants and build new ones. 5. Other (OPEN OPTION) 9. Don't know / no answer **Slechts één antwoord mogelijk** 1. België moet zo snel mogelijk al haar kerncentrales sluiten. 2. België dient de bestaande kerncentrales te gebruiken, maar mag geen nieuwe bouwen. 3. België dient de bestaande kerncentrales te gebruiken en dient nieuwe kerncentrales te bouwen om de oude te vervangen. 4. België dient de bestaande kerncentrales te sluiten en dient nieuwe kerncentrales te bouwen 5. Andere: (OPEN OPTION) 9. Ik weet het niet/geen antwoord **Une seule réponse possible :** 1. La Belgique devrait fermer toutes ses centrales nucléaires aussi rapidement que possible. 2. La Belgique devrait utiliser les centrales nucléaires existantes mais ne devrait pas en construire de nouvelles. 3. La Belgique devrait utiliser les centrales nucléaires existantes et en construire de nouvelles pour remplacer les

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 126

		anciennes. 4. La Belgique devrait fermer les centrales nucléaires existantes et en construire de nouvelles. 5. Autre : (OPEN OPTION) 9. Je ne sais pas / pas de réponse

1.6 PART 6. Confidence in the management of nuclear technologies / Vertrouwen in het beheer van nucleaire technologie / Confiance dans la gestion des technologies nucléaires

Q5.1 Now we will discuss the management of nuclear technologies. To what extent do you agree or disagree with the following statements?

Laten we het nu hebben over het beheer van nucleaire technologieën. In welke mate gaat u akkoord of niet akkoord met de volgende uitspraken?

Abordons maintenant le sujet de la gestion des technologies nucléaires. Dans quelle mesure êtes-vous d'accord ou pas d'accord avec les affirmations suivantes ?

MN1	Nuclear reactors in Belgium are operated in a safe manner. Kernreactoren in België worden op een veilige manier uitgebaat. Les réacteurs nucléaires en Belgique sont exploités de manière sûre.	1. Strongly Disagree 2. Disagree 3. Neither agree, nor disagree 4. Agree 5. Strongly Agree 9. Don't know / no answer 1. Helemaal niet akkoord 2. Eerder niet akkoord 3. Noch akkoord, noch niet akkoord 4. Eerder akkoord 5. Helemaal akkoord 9. Ik weet het niet / Geen antwoord 1. Pas du tout d'accord 2. Plutôt pas d'accord 3. Ni d'accord, ni pas d'accord 4. Plutôt d'accord 5. Tout à fait d'accord 9. Je ne sais pas / pas de réponse
MN2	There is insufficient control by authorities on the safety of nuclear installations in Belgium. Er is onvoldoende overheidscontrole op de veiligheid van nucleaire installaties in België. Il n'y a pas suffisamment de contrôles de sécurité effectués par les autorités dans les installations nucléaires en Belgique.	
MN3	In Belgium, radioactive waste is handled in a safe manner. Het radioactief afval wordt in België op een veilige manier beheerd. En Belgique, les déchets radioactifs sont gérés de façon sûre.	
MN6	I feel well protected against risks from nuclear installations. Ik voel me goed beschermd tegen de risico's van nucleaire installaties. Je me sens bien protégé(e) contre les risques générés par les installations nucléaires.	
MN7	Nuclear installations in Belgium are vulnerable to terrorism Nucleaire installaties in België zijn kwetsbaar voor terrorisme. Les installations nucléaires en Belgique sont vulnérables au terrorisme.	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 127

1.7 PART 7: Actors in the nuclear field / Actoren op nucleair gebied / Acteurs du secteur nucléaire

When we look at the nuclear energy sector and nuclear activities, can you tell us:

a) Whether you know the following actors

b) If so, can you tell us if you think they are:

- telling the **truth** about the risks and benefits of nuclear technologies
- **technically competent** to point out the risks and benefits of nuclear technologies
- **Not knowing an actor is a filter for "telling the truth" and "being technically competent"**

"x" in first column = don't ask respondents if they know them

Q7.1.

Do you know….?

RANDOMISE

		NST	NSC	
	Know them	*Telling the truth*	*Technically competent*	
				Knowledge:
1. Environmental organisations such as Greenpeace or Bond Beter Leefmilieu (NL) / Inter-Environnement Wallonie (FR)				*1. Yes* *2. No*
2. ENGIE Electrabel				*Truth & competence:*
3. The Federal Agency for Nuclear Control (FANC)				*1. Strongly disagree*
				2. Disagree
4. The national agency for radioactive waste and enriched fissile materials (ONDRAF/NIRAS)				*3. Neither agree, nor disagree*
				4. Agree
5. SCK CEN (the Belgian Nuclear Research Centre) in Mol				*5. Strongly agree*
6. Scientists from Universities				*9. Don't know / no answer*

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 128

Wanneer we kijken naar het domein van kernenergie en andere nucleaire activiteiten, kunt u mij zeggen:
a) of u de volgende actoren kent?
b) en indien u ze kent:
- kunt u ons vertellen of u denkt dat zij de waarheid vertellen over de risico's en voordelen van nucleaire technologieën? (NST)
- of u hen als technisch bekwaam beschouwt om de risico's en voordelen van nucleaire technologieën te duiden? (NSC)

Kent u…

RANDOMIZE

	Bekend	NST Vertelt de waarheid	NSC Technisch bekwaam	
1. Milieubewegingen, zoals Greenpeace of Bond Beter Leefmilieu				Kennen: 1. Ja 2. Nee Waarheid & technisch bekwaam:
2. ENGIE Electrabel				
3. Het Federaal Agentschap voor Nucleaire Controle (FANC)				1. Helemaal niet akkoord
4. De Nationale Instelling voor Radioactief Afval en verrijkte Splijtstoffen (NIRAS)				2. Eerder niet akkoord 3. Noch akkoord, noch niet akkoord
5. Het Studiecentrum voor Kernenergie (SCK CEN) in Mol				4. Eerder akkoord 5. Helemaal akkoord
6. Wetenschappers uit universiteiten	x			9. Ik weet het niet / geen antwoord

Si nous considérons maintenant le secteur de l'énergie nucléaire et ses activités, pouvez-vous nous dire :
a) si vous connaissez les acteurs suivants ?
b) si oui :
 - Dans quelle mesure êtes-vous d'accord ou non que chacun des acteurs suivants dit la vérité à propos des risques et des bénéfices des technologies nucléaires ? (NST)
 - Et dans quelle mesure êtes-vous d'accord ou non que chacun des acteurs suivants est techniquement compétent en ce qui concerne les risques et bénéfices des technologies nucléaires ? (NSC)

Ne posez pas la question « dit la vérité » et « est compétent » que si la personne connaît l'acteur « x » dans la première colonne = ne pas demander si la personne connaît l'acteur RANDOMIZE

RadoNorm
Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 129

Connaissez-vous …?

	Connu	NST Dit la vérité	NSC Compétent	
1. Les associations environnementales, par exemple Greenpeace ou Inter-Environnement Wallonie				Connu : 1. Oui 2. Non
2. ENGIE Electrabel				Dit la vérité & compétent : 1. Pas du tout d'accord 2. Plutôt pas d'accord 3. Ni d'accord, ni pas d'accord 4. Plutôt d'accord 5. Tout à fait d'accord 9. Je ne sais pas / pas de réponse
3. L'agence fédérale de contrôle nucléaire (AFCN)				
4. L'organisme national des déchets radioactifs et des matières fissiles enrichies (ONDRAF)				
5. Le Centre d'étude de l'énergie nucléaire (SCK CEN)				
6. Les scientifiques des universités	x			

1.8 PART 12. Knowledge about the nuclear domain and perception of radiation risks / Kennis op nucleair gebied en perceptie van stralingsrisico's / Connaissance en nucléaire et perception des risques du rayonnement

Q13.1 The following questions concern nuclear technology in general. What do you think about the following issues:

De volgende vragen hebben betrekking op nucleaire technologieën in het algemeen. Hoe denkt u over de volgende kwesties:

Les questions suivantes font référence aux technologies nucléaires en général. Que pensez-vous des questions suivantes :

AW1	Does exposure to radiation always lead to radioactive contamination? Leidt blootstelling aan radioactieve straling volgens u altijd tot radioactieve besmetting? A votre avis, une exposition aux radiations entraîne-t-elle toujours une contamination radioactive ?	**SINGLE RESPONSE** 1. Yes 2. No 9. Don't know/ no answer 1 MOGELIJK ANTWOORD 1. Ja 2. Nee 9. Ik weet het niet/geen antwoord 1 REPONSE POSSIBLE 1. oui 2. non 9. Je ne sais pas / pas de réponse
AW2	Is radioactive waste produced only by nuclear power plants? Wordt radioactief afval volgens u enkel geproduceerd door kerncentrales? A votre avis, les déchets radioactifs sont-ils exclusivement produits par les centrales nucléaires ?	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 130

AW14	What is the measurement unit for radioactivity? *Wat is de meeteenheid voor radioactiviteit?* Quelle est l'unité de mesure de la radioactivité ?	4. Watt 5. Becquerel 6. Metres/second 10. Don't know/ NA *1. Watt* *2. Becquerel* *3. Meter/seconde* *9. Ik weet het niet/geen antwoord* 1. Le Watt 2. Le Becquerel 3. Le Mètre/seconde 9. Je ne sais pas/pas de réponse

Q13.2 To what extent do you agree or disagree with the following statements?
In welke mate gaat u akkoord of niet akkoord met de volgende uitspraken?
Dans quelle mesure êtes-vous d'accord ou pas d'accord avec les affirmations suivantes ?

AW15	Vegetables grown near a nuclear power plant are not good for consumption because of the presence of radioactivity. *Groenten die geteeld worden in de buurt van een kerncentrale mogen niet geconsumeerd worden omwille van de aanwezigheid van radioactiviteit.* Les légumes cultivés à proximité d'une centrale nucléaire ne sont pas bons pour la consommation à cause de la présence de radioactivité.	1. Strongly Disagree 2. Disagree 3. Neither agree, nor disagree 4. Agree 5. Strongly Agree 9. Don't know / no answer *1. Helemaal niet akkoord* *2. Eerder niet akkoord* *3. Noch akkoord, noch niet akkoord* *4. Eerder akkoord* *5. Helemaal akkoord* *9. Ik weet het niet / Geen antwoord* 1. Pas du tout d'accord 2. Plutôt pas d'accord 3. Ni d'accord, ni pas d'accord 4. Plutôt d'accord 5. Tout à fait d'accord 9. Je ne sais pas / pas de réponse
AW16	Even very low levels of radiation are harmful for human health. *Zelfs heel lage dosissen radioactiviteit zijn gevaarlijk voor de gezondheid van de mens.* Même à faibles doses d'irradiation elles sont nocives pour la santé de l'homme.	
AW18	The human body is naturally radioactive. *Het menselijk lichaam is van nature radioactief.* Le corps humain est naturellement radioactif.	
AW19	With time, every radioactive substance becomes more and more radioactive. *Na verloop van tijd wordt elke radioactieve substantie alleen maar meer radioactief.* Avec le temps, toute substance radioactive devient de plus en plus radioactive.	1. Agree 2. Disagree 9. Don't know / no answer *1. Akkoord* *2. Niet akkoord* *9. Ik weet het niet / Geen antwoord* 1. d'accord 2. pas d'accord 9. Je ne sais pas / pas de réponse
AW20	Food sterilisation by irradiation makes food radioactive. *Het steriliseren van voedsel door middel van bestraling maakt voedsel radioactief.* La stérilisation d'aliments par irradiation les rend radioactifs.	
AW35	Exposure to indoor radon may cause headache. *Blootstelling aan radon binnenshuis kan hoofdpijn veroorzaken.* L'exposition au radon intérieur peut provoquer des maux de tête.	
AW36	Exposure to indoor radon may cause lung cancer. *Blootstelling aan radon binnenshuis kan longkanker veroorzaken.* L'exposition au radon intérieur peut provoquer un cancer du poumon.	

Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 131

1.9 PART 13: Intolerance for uncertainty/ Intolerantie voor onzekerheid/ Intolérance à l'incertitude

Q12.1: *To what extent do you agree or disagree with the following statements?*
In welke mate bent u akkoord of niet akkoord met de volgende verklaringen:
Dans quelle mesure êtes-vous d'accord ou pas d'accord avec les affirmations suivantes :

IU1	Unforeseen events upset me greatly. Van onverwachte gebeurtenissen geraak ik overstuur. Les événements imprévus m'indisposent.	1. Strongly Disagree 2. Disagree 3. Neither agree, nor disagree 4. Agree 5. Strongly Agree 9. Don't know / no answer
IU2	It frustrates me not having all the information that I need. Het frustreert me wanneer ik niet over alle informatie beschik die ik nodig heb. Je suis frustré(e) lorsque je ne dispose pas de l'ensemble des informations dont j'ai besoin.	1. Helemaal niet akkoord 2. Eerder niet akkoord 3. Noch akkoord, noch niet akkoord 4. Eerder akkoord 5. Helemaal akkoord 9. Ik weet het niet/ geen antwoord
IU3	I can't stand being taken by surprise. Ik kan niet tegen verrassingen. Je ne supporte pas être pris(e) au dépourvu.	1. Pas du tout d'accord 2. Plutôt pas d'accord 3. Ni d'accord, ni pas d'accord 4. Plutôt d'accord 5. Tout à fait d'accord 9. Je ne sais pas / pas de réponse
IU4	When I'm uncertain, I can't function very well. Wanneer ik onzeker ben, functioneer ik niet naar behoren. Lorsque je suis dans l'incertitude, je ne fonctionne pas bien.	
IU5	I always want to know what the future has in store for me. Ik wil altijd weten wat de toekomst voor mij in petto heeft. Je veux toujours savoir ce que l'avenir me réserve.	
IU6	I must get away from all uncertain situations. Ik moet weg gaan van alle onzekere situaties. Je dois m'éloigner de toutes les situations incertaines.	

RadoNorm
Title: RadoNorm pilot study report from public opinion survey, Belgium 2020-2021
Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu   Page 132

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Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu　　　　　　　　　　　　　　　　　　　　　　　Page 133

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Date of issue: **10/11/2021; version 3 (19.03.2022)**

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Page 135

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Dissemination level: public
Date of issue: **10/11/2021; version 3 (19.03.2022)**

www.radonorm.eu

Page 136