CCQM Micro- and Nanoplastics Task Group National Metrology Laboratory Survey Results

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Background:

The CCQM Microplastics Task Group was established following the CCQM/OAWG Workshop on Microplastic Measurements and Standards. The goal of the Task Group is to guide the CCQM in improving measurement science and measurement standards in the rapidly advancing field of both micro- and nanoplastic measurement. As part of this initiative, a survey was conducted to assess the current capability and status of micro- and nanoplastic metrology at National Metrology Institutes (NMIs) across the globe. This survey was intended to capture this information. Results from this survey were presented to the CCQM in April 2023. This report will be available on the BIPM website partly to inform participants of the results.

Survey development:

The idea for the survey originated from discussions within the CCQM Micro- and Nanoplastics Measurements and Standards Workgroup. Also, one term of reference for the Workgroup, as set out by the BIPM, was to "review activities across National Metrology Institutes" and other measurement organizations. The Workgroup believed a survey was a reasonable approach for gathering this information. Starting in September of 2022, the group developed a series of questions to be answered by the respondents leveraging on-line collaboration tools. The survey aimed to probe NMI activities, capabilities, and advise on how CCQM can best support this rapidly advancing field. The Workgroup limited the survey's duration to within 20 to 30 minutes. Responses were anonymous, while this was intentionally done to protect NMI identity, it did limit the ability to explore some relationships within the survey results.

The survey consisted of 43 questions organized around four topics:

- The **Capabilities** section intended to capture the status of NMI capabilities in performing micro- and/or nanoplastic measurement.
- The **Current Activities** section asked questions about efforts in producing reference materials, performing measurements of the environment, protocol development, and activity in interlaboratory comparisons.
- The **Drivers and Motivating Factors** section aimed to probe if regulations are important justifications for work and if regulations are at the international, national, or at lower levels. The section included questions asking which types of measurements groups were conducting to meet regulatory interests.
- The final section was labeled **Program Demographics** asking questions on how long NMIs have worked on micro- or nanoplastic measurements. Importantly, the section ended with questions on what CCQM can do to help advance comparability of measurements on nano- and/or microplastics. Full survey results can be found in Appendix 1.

Distribution:

The Survey Monkey® platform was used to prepare and send the survey questionnaire and analyze the responses. The survey went live in March 2023 and the active link distributed to stakeholders within the CCQM NMI community. The survey was active for several weeks into April 2023. After the survey closed, data were compiled mostly using the data compilation tools available in the Survey Monkey® platform.

Survey results:

The survey results consisted of two reports. The first was the responses from individual participants. Some respondents skipped questions if they did not pertain to their NMI. The second was a summary report held tables and graphs of responses and percentages relating to the fraction of respondents answering the question for the parameter(s) listed (Appendix 1).

There were 33 responses to the survey. The majority (64 %) of NMIs indicated they were able to perform microplastic measurements while only 50 % reported they could make nanoplastic measurements. Laboratories tended to report using scanning electron microscopy as the most common technique (66.7 %) followed by micro-FTIR (57.1 %), thermogravimetric analysis (TGA) visual identification and differential scanning calorimetry (DSC; all 52.4 %) (Figure 1; Appendix 1)

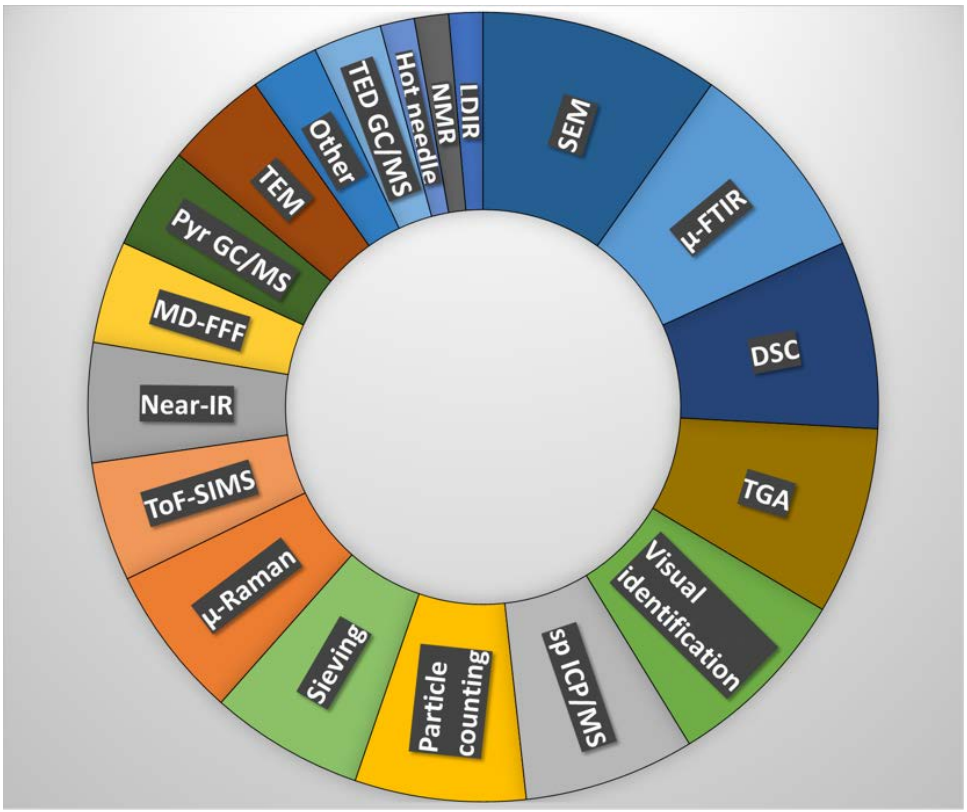


Figure 1: The usage of techniques for microplastic analysis reported by NMIs.

The usage of techniques for nanoplastic measurement was clearer with SEM and dynamic light scattering (DLS) being the most frequently used techniques (70.6 %) (Appendix 1 and Figure 2). There were fewer reported techniques for nano- versus microplastic measurement.

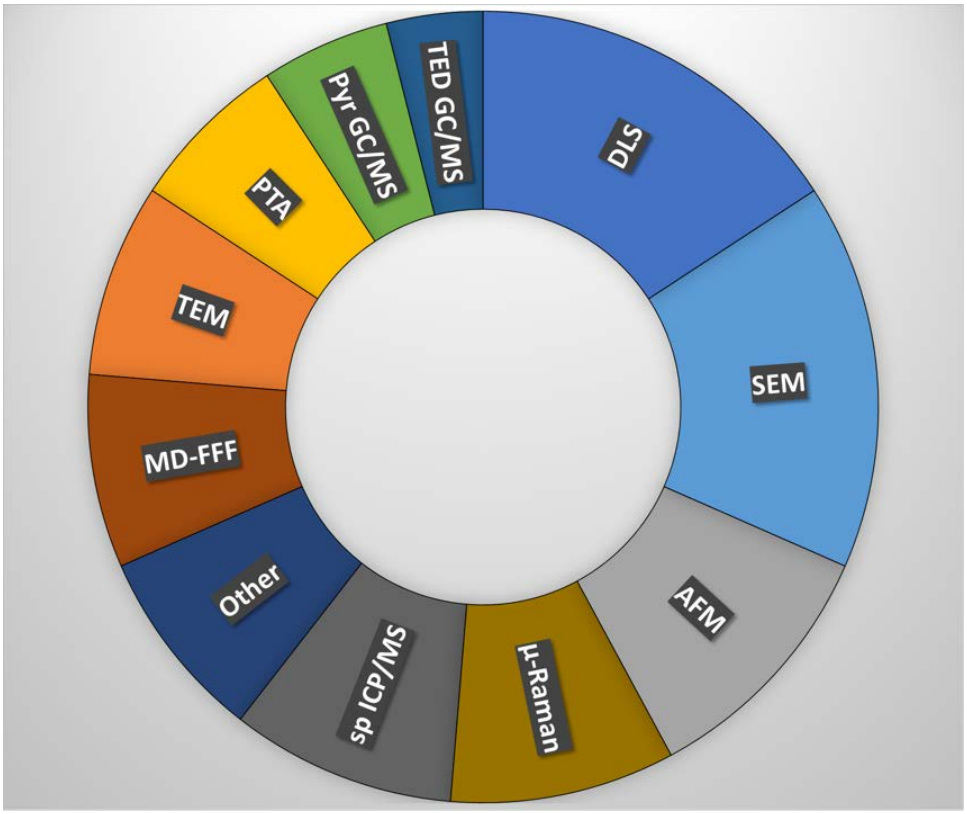


Figure 2: The usage of techniques for nanoplastic analysis reported by NMIs

For those responding, the properties measured of micro- and nanoplastics by NMIs were similar. Most laboratories reported that they can measure size for micro- and nanoplastics, 95 % and 94 %, respectively. 80 % of laboratories determine polymer identity for microplastics versus 65 % for nanoplastics. Particle number concentration could be measured by 75 % of laboratories versus 76.5 % for nanoplastics. 75 % of laboratories can measure morphology of microplastics while only 47 % of laboratories measure morphology of nanoplastics (Appendix 1). Given the interest in differentiating fibers from other particles for microplastics analysis, this is perhaps unsurprising.

NMIs were asked if regulations were driving the measurement of certain types of microplastics including fibers and tire wear particles. Most (52 %) respondents indicated that there are regulations driving work on tire wear particles, fibers or other particles.

Most laboratories did have specialized spaces or facilities for processing micro- or nanoplastics (61.3 %). Only 31.6 % of laboratories did not have specialized facilities for such work.

Current Activities

In terms of current activities in this space, NMIs were queried about their current engagement in developing reference materials (RMs) for microplastics. If they were involved, two follow-up questions were posed regarding the types of reference materials they were producing, and the quantities or other properties assigned to these RMs.

Just over 15 % of participants in the survey are currently developing microplastic RMs and 12.9 % are developing nanoplastic RMs. Figure 3 illustrates the types of RMs and the assigned quantities or properties that were submitted in the survey. In Figure 4 the graphs show the different quantities and properties assigned to the RMs under development.

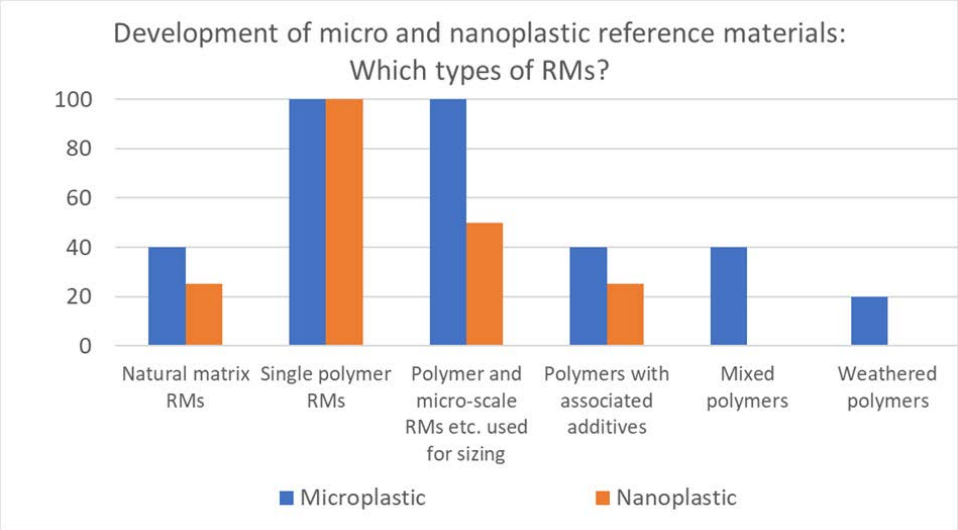


Figure 3: The development of different types of RMs for micro and nanoplastics, as reported by NMIs. Y-axis is the percentage for each category of five total responses to this question.

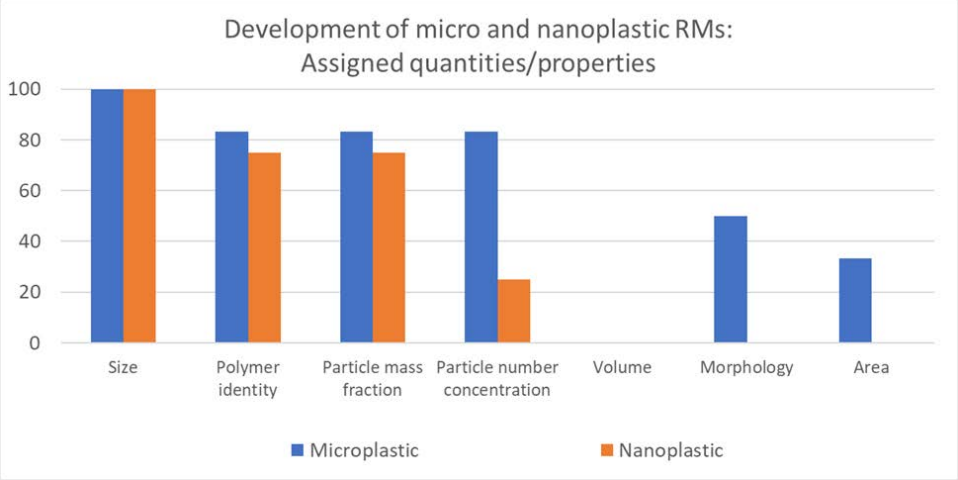


Figure 4: The different measurement quantities and properties assigned to the RMs developed for micro- and nanoplastics. Y-axis is the percentage for each category of six total responses to this question.

The survey also contained a question gauging the participant's knowledge of existing RMs. Specifically, if they were aware of RMs being produced by other NMIs or commercial suppliers and who such providers were. 37.5 % of respondents knew of such RMs, and the remaining 62.5 % were unaware. The providers listed included those producing nanoplastic particles (such as polystyrene standards from Thermo Fischer Scientific and the United States National Institute of Standards and Technology (NIST), commercial companies such as Chiron, and reference materials specialists such as BAM (German Federal Institute for Materials Research and Testing) supplying specific microplastic RMs. Several participants were also aware of the Polymer Kit 1.0 available from Hawaii Pacific University, containing 22 different types of polymeric materials. In addition to these external suppliers, some laboratories produce their own RMs. Several participants indicated awareness of developments at NMIs but were unsure of the status of such developments.

As micro- and nanoplastic materials can be found in a variety of matrices, further questions were asked about what types of matrices were considered for measurements and for potential field sampling protocols. Here, for environmental matrices, 40 % of NMIs reported to be measuring microplastic in a range of matrices, from freshwater to industrial settings (Figure 5a).

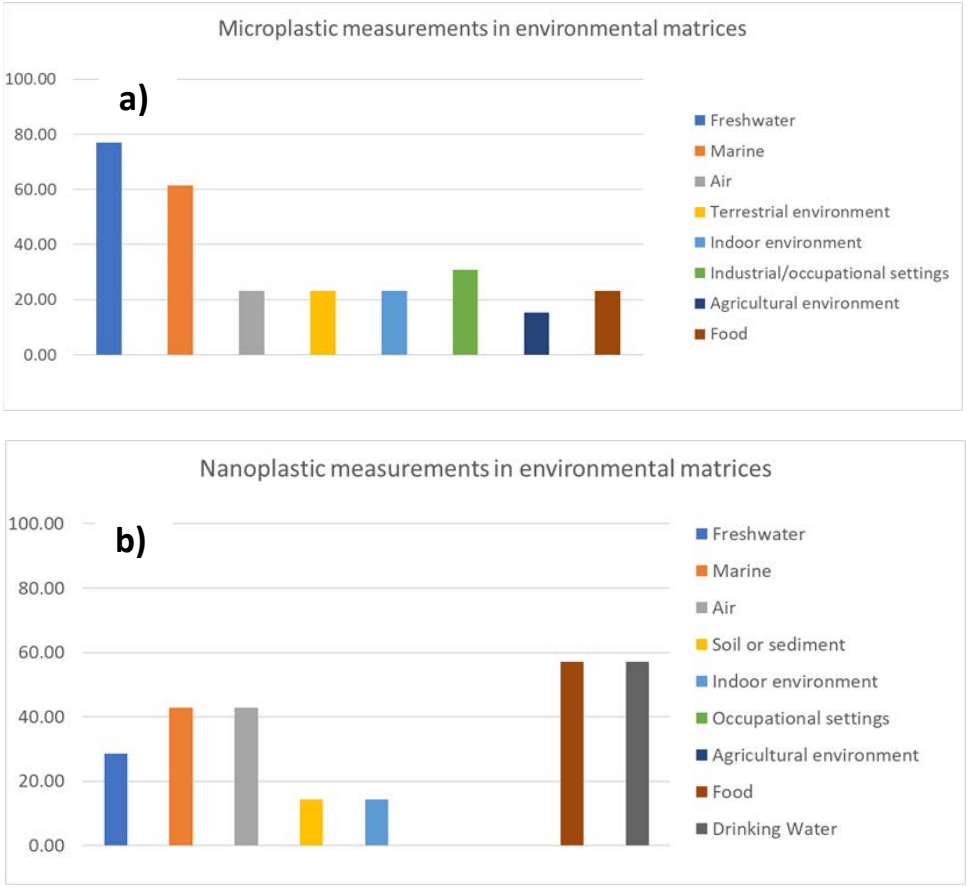


Figure 5: The range and frequency of application of different matrices considered for a) microplastic measurements and b) nanoplastic measurements. Y-axis is the percentage for each category of 13 (a) and seven (b) total responses to this question.

Fewer NMIs reported to be measuring nanoplastics in environmental matrices (22.6 % of a total of 31 submitted answers). For nanoplastics, there were a few different matrices added, including food and drinking water, as shown in the graph in Figure 5b.

In terms of sampling, one question posed was about the development of field sampling protocols. Four out of 32 participants (12.5 %) answered “yes” to the question if this was being done, and the range of different environments considered (Figure 6).

Figure 6: The range of different matrices considered for the development of field sampling protocols in environmental matrices.

One way of showing proficiency in testing is to organize and/or participate in interlaboratory comparisons. This question was asked, and many of the NMIs indicated their experience in this area, where they organize, participate assign reference values, and collaborate with other NMIs (Figure *7*).

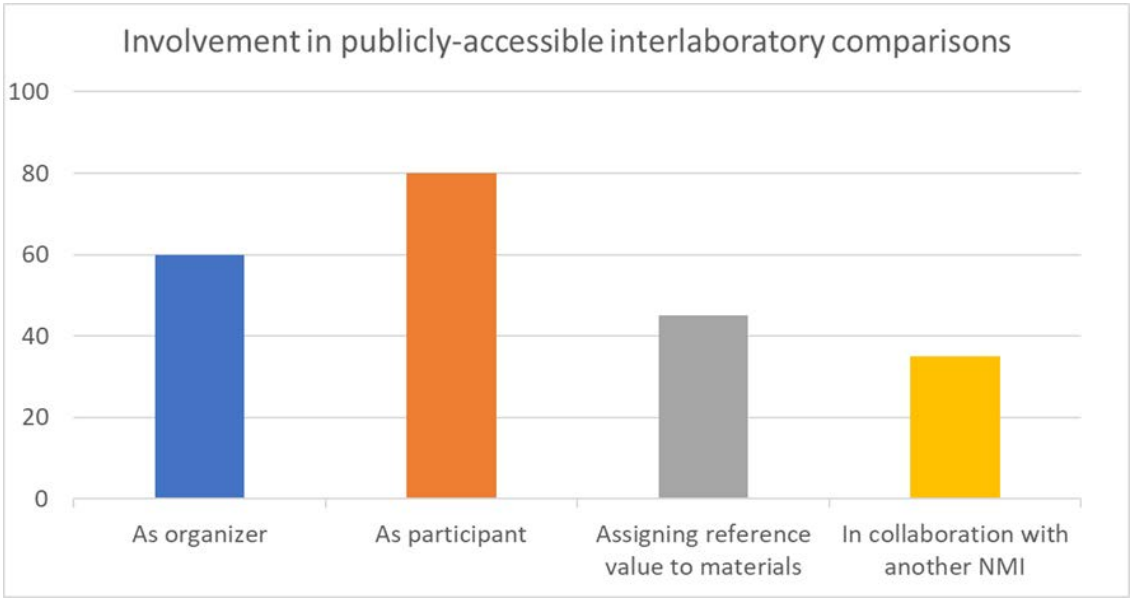


Figure 7: The involvement of the surveyed NMIs involvement in interlaboratory comparisons. Y-axis is the percentage for each category of 20 total responses to this question.

Motivating Factors

Respondents were asked to indicate their efforts in the sectors of food, environment, industry, human health, and agriculture with respect to micro- and nanoplastic measurement. For microplastic (30 respondents), over half of labs indicated some or significant activity in environment-related measurements, followed by food (32 %), industry (27 %), human health (22 %) and agriculture (12 %) (Figure 8). For nanoplastic (29 respondents), 41 % of labs indicated some or significant activity in environment-related measurements, followed by human health (30 %), food (26 %) and agriculture (12 %) (Figure 8).

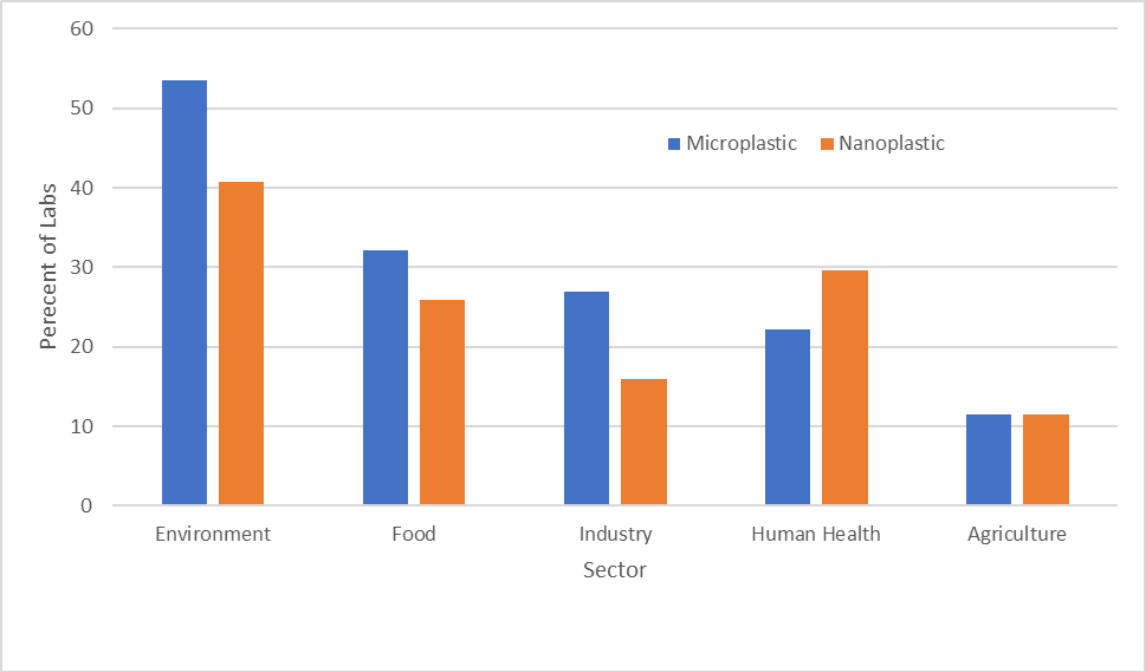
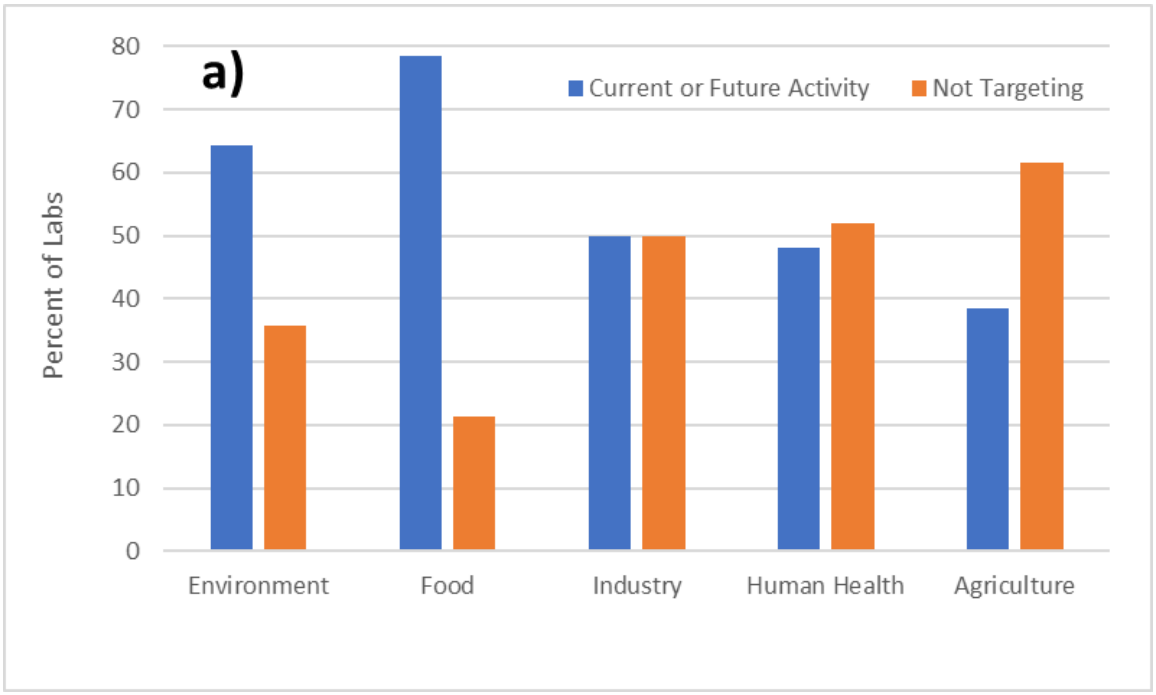


Figure 8: Percentage of respondents indicating some or significant activity in a sector.

Participants were asked to indicate if they were intending to start work on micro- or nanoplastic measurement in environment, food, industry, human health, or agriculture or if they had plans to start work in these areas. The purpose of this question was to better understand NMI priorities among the five sectors. Generally, NMIs' current and future interests stress work related to the environment and food for either micro- or nanoplastics, with fewer current or future activities planned for industry, human health or agriculture (Figure 9).



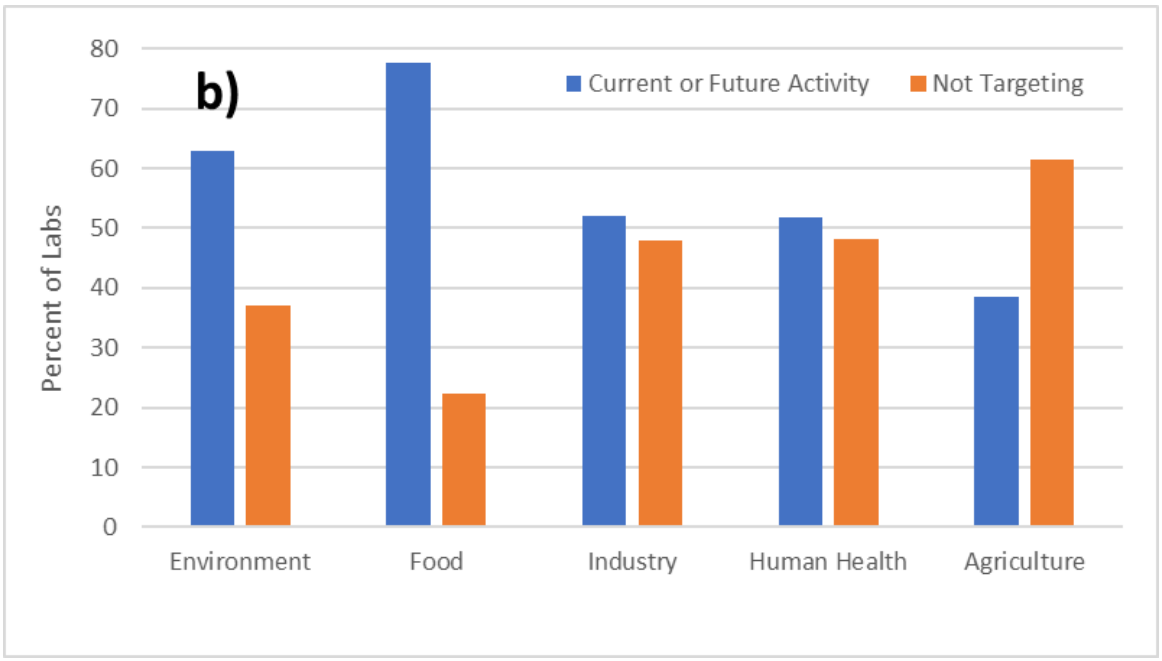


Figure 9: Current or planned activity of respondents for a) microplastic measurement (n=30) and b) nanoplastic measurement (n=29).

The next section of the survey investigated if there are or are not factors motivating NMIs to be active in micro- and nanoplastic measurement. One such factor is demonstrating equivalence with other NMIs. More than half of labs (53 %, 16 labs) are not sure whether other NMIs provide measurement service or need to demonstrate the extent of equivalence, and nine labs (30 %) show their needs for equivalence.

22 of 31 labs (71 %) stated that their work does not meet the regulatory requirements. Of the nine positive responses, five labs were able to meet the national and internal regulatory requirements and can measure both microplastics and nanoplastics. The regulatory drivers mentioned included: Pollution Control Department, US Food and Drug Agency; United Nations-related directives, needs by pollution control departments, for marine monitoring, EU drinking water and wastewater directives and ISO/TC 147/SC 2 N 2132 water quality draft standard.

10 labs (six labs for both micro- and nanoplastics standards and four for only microplastics standards) were involved in writing standards or guides actives, the coordinating organizations including ISO/TC 147/SC 2 N 2132 Water quality, CEN, SFS, AFNOR T91M, VAMAS TWA45. Those who responded indicated that size, polymer identity and particle number were the main characteristics being requested for micro- and nanoplastic by forces motivating their work. Only 19% of responses are involved with the creation of documentary standards for microplastic analysis and none are involved in documentary standards production for nanoplastics analysis.

Demographics:

This section of the survey sought to obtain a broader understanding of the participants' experience in micro- and nanoplastic measurement. For both micro- and nanoplastics, only one response indicated experience greater than five years, with 11 reported one to five years' experience, and the majority (20) had no prior experience in the field. However, 67 % of those responding indicated they plan to start work in these areas. Notably, more than half of respondents acknowledged encountering barriers to starting such work, with 65 % reporting barriers in commencing nanoplastic measurement and 55 % for microplastic measurement. Among those facing barriers in microplastic measurement, the most common challenge was the need for equipment and instrumentation (7), followed by a lack of a facility (4), regulatory clarity (3), absence of physical standards (2), funding (2), shortage of experienced personnel and the need for training (3), political problems in their country (1), or overall newness to the NMI space. For nanoplastics, the responses were similar with the lack of instrumentation/equipment and experienced people being the largest barriers (5), a lack of facility (3), lack of regulatory clarity (2), and funding, lack of physical standards, or political problems in the country (1-each).

NMI feedback on CCQM involvement:

Laboratories were asked about their abilities, interests and experience regarding micro- and nanoplastic measurement. Laboratories were evenly divided between having or not having capabilities for micro- or nanoplastic measurement. Of laboratories without capabilities (16), half did not have plans and half did have plans to work in this measurement space. There was only one laboratory in this last category claiming to have measurement capabilities for micro- and nanoplastic measurement that had no plans to apply capabilities specifically to micro- and nanoplastic measurement. Reasons for not currently working in this measurement space include a lack of resources, instrumentation and experience. One laboratory commented that a barrier is the need to clarify measurands and associated measurement challenges in terms of inorganic analysis. For all laboratories, there was a preference for guidance in microplastic measurement (Figure 10) and a slight preference for workshops for nanoplastic measurement (Figure 11).

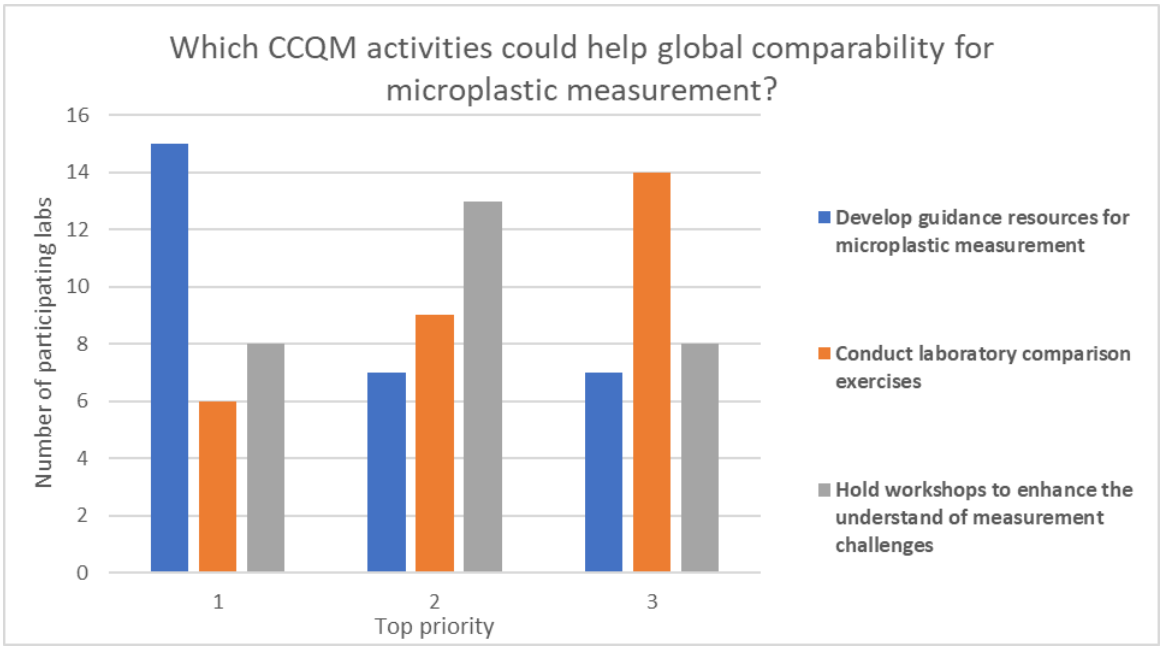


Figure 10: Preference of all laboratories for activities related to microplastic measurement.

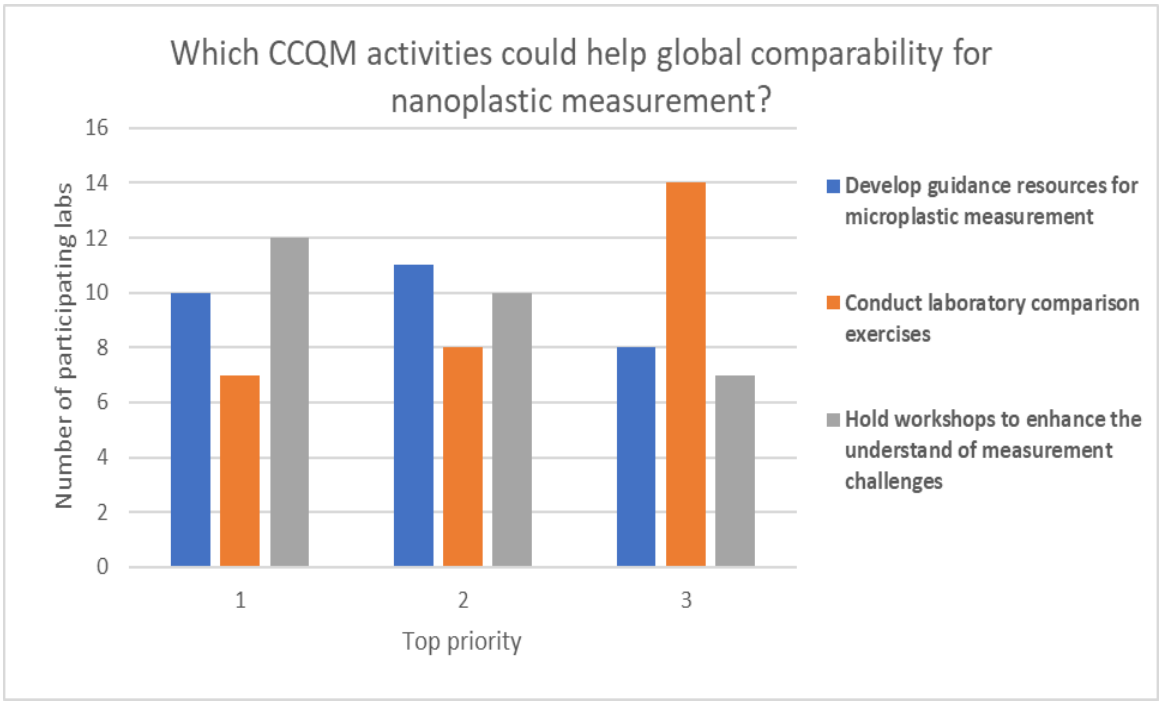


Figure 11: Preference of all laboratories for activities related to nanoplastic measurement.

This section considers laboratories with experience in measurement of either micro- or nanoplastics. Among the labs surveyed, 16 labs are involved in measuring microplastics and four of those labs have been active for 5-10 years. Here, barriers to expanding the work include instrument availability and sample handling equipment, financial support, specialized facilities and staffing. Among these labs, there was greater interest in developing guidance resources for microplastic measurement (top priority for five labs), followed by conducting laboratory comparison exercises and

holding workshops to enhance the understanding of measurement challenges (chosen as top priorities for four labs each). Figure 12 shows the prioritisation of the proposed CCQM activities for the surveyed labs experienced in measuring microplastics, where 1 indicates high priority, 2 medium priority and 3 the lowest priority.

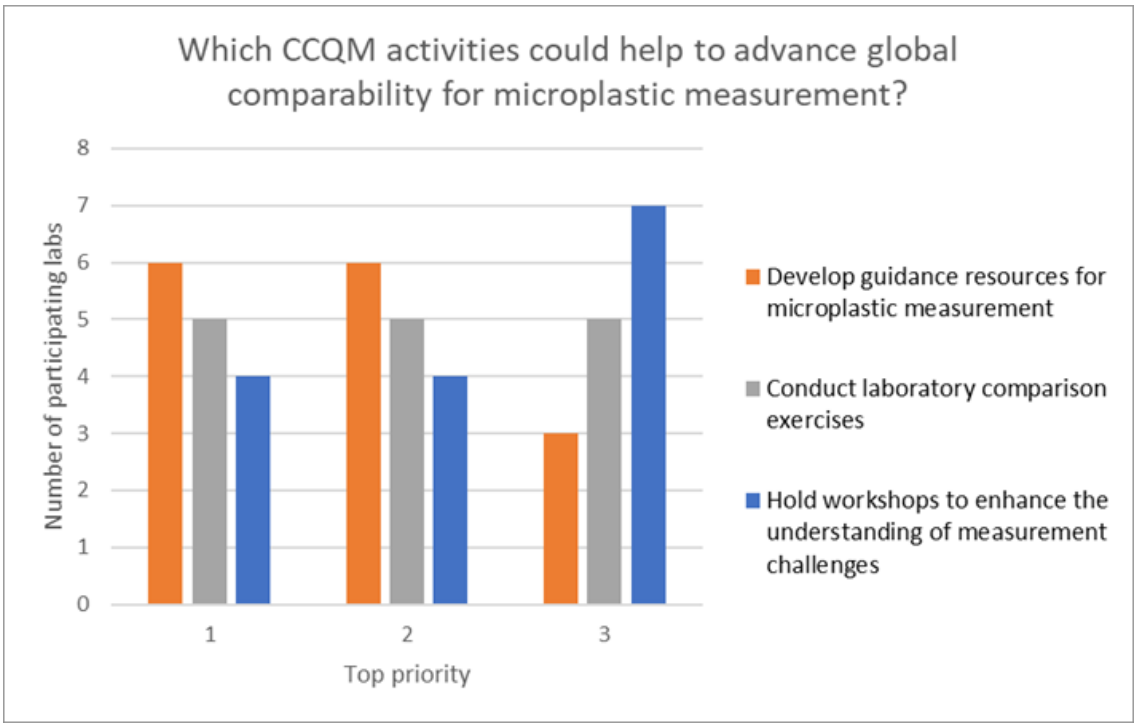


Figure 12: Chart showing the prioritisation among the labs experienced in measuring microplastics regarding the proposed CCQM activities to help advance global comparability of microplastic measurements.

When it comes to measuring nanoplastics, 11 laboratories report to have 1-5 years' experience in measuring nanoplastics. Barriers here are appropriate instrumentation, financial support, experienced people to make the measurements and concerns regarding handling of samples.

Regarding CCQM activities, there was significant interest (Figure 13) in conducting laboratory comparison exercises (top priority for five of the 11 labs), followed by holding workshops to enhance the understanding of measurement challenges (top priority for four labs) and lastly developing guidance resources for nanoplastic measurement.

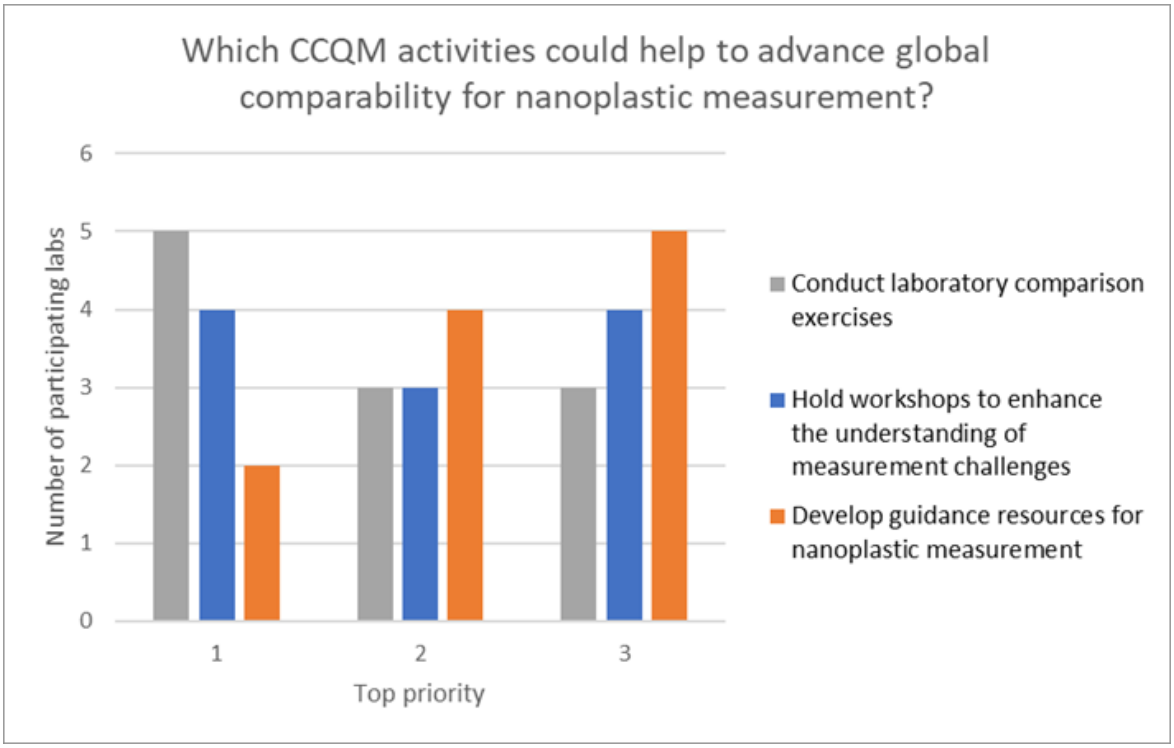


Figure 13: Chart showing the prioritisation among the labs experienced in measuring nanoplastics regarding the proposed CCQM activities to help advance global comparability of nanoplastic measurements.

Discussion and Conclusions

Overall, the survey was reasonably successful in assessing the status of NMIs with respect to micro- and nanoplastic measurements. Many laboratories are interested in both fields and if not already working in the area, plan to be which was true for 25% of respondents. While most NMIs that responded have capabilities for measurements at the micro- and nanoscale, not all were applying these capabilities to micro- and nanoplastic. Also, an interesting finding from the survey was that there are very few highly experienced NMIs in this measurement space with most having limited experience (<5 years). The reasons for not working in these areas are complex and range from resource limitations to lack of sufficient motivation from regulation. As the regulations around micro- and nanoplastics continue to grow, we expect more NMIs will build capabilities. For example, there are proposed regulations both in the US and Europe to regulate microplastics in drinking water. Given this, establishing NMI comparability should be of interest to the CCQM in the future.

There was limited activity among NMIs in producing RMs, with only five NMIs engaged in this area for microplastics and four for nanoplastics, mostly involving single polymer materials that are not associated with a matrix. Given the difficulty in preparing RMs of this nature, this is not surprising. We recommend that NMIs closely collaborate in RMs production to allow for more robust measurements and prevent duplication of effort. Linking RM production plans to proposed regulations is also suggested. If NMIs begin production of matrix-based RMs, these should be environmental- or food-matrix related based on the survey.

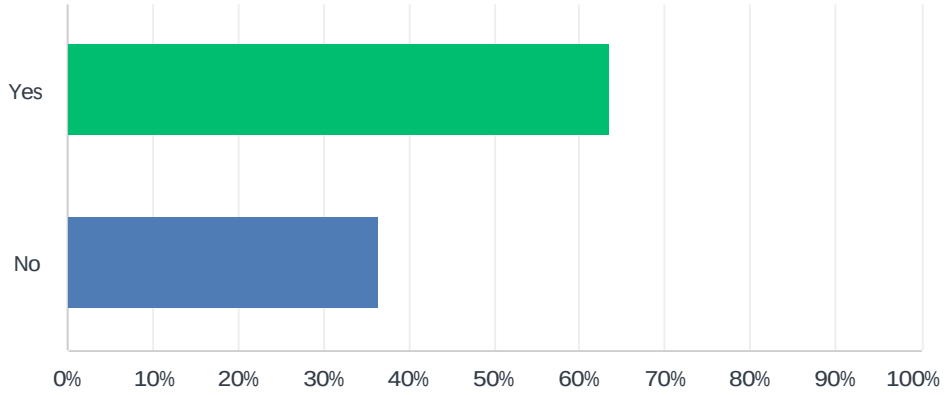
Our survey was limited to not asking NMIs to provide their identity. Consequently, we have no information on which NMIs participated or if multiple responses were sent by one NMI. Having NMI identity would have been useful to assess NMI capabilities on a regional basis and to understand which NMIs may be active in the field but were not captured in the survey. Regardless, we feel this was at least a reasonable attempt to extract enough relevant information to inform the CCQM about its next steps.

Given that the survey was directed to NMIs, we recommend probing measurement needs more broadly by engaging stakeholders through activities such as an online workshop. Stakeholder needs are evolving based on regulatory drivers and CCQM needs to fine tune its efforts to best meet needs. Given that half of those surveyed are actively measuring nano- or microplastics, it would be reasonable for CCQM to consider a pilot comparison. In practice, organizing such a comparison takes at least one year by which time more laboratories will have established their measurement capabilities for micro- and nanoplastics, thus increasing the size of the participant pool.

Appendix 1: Full Survey Results

Q1 Q 1a Is your NMI capable of making microplastic measurements?

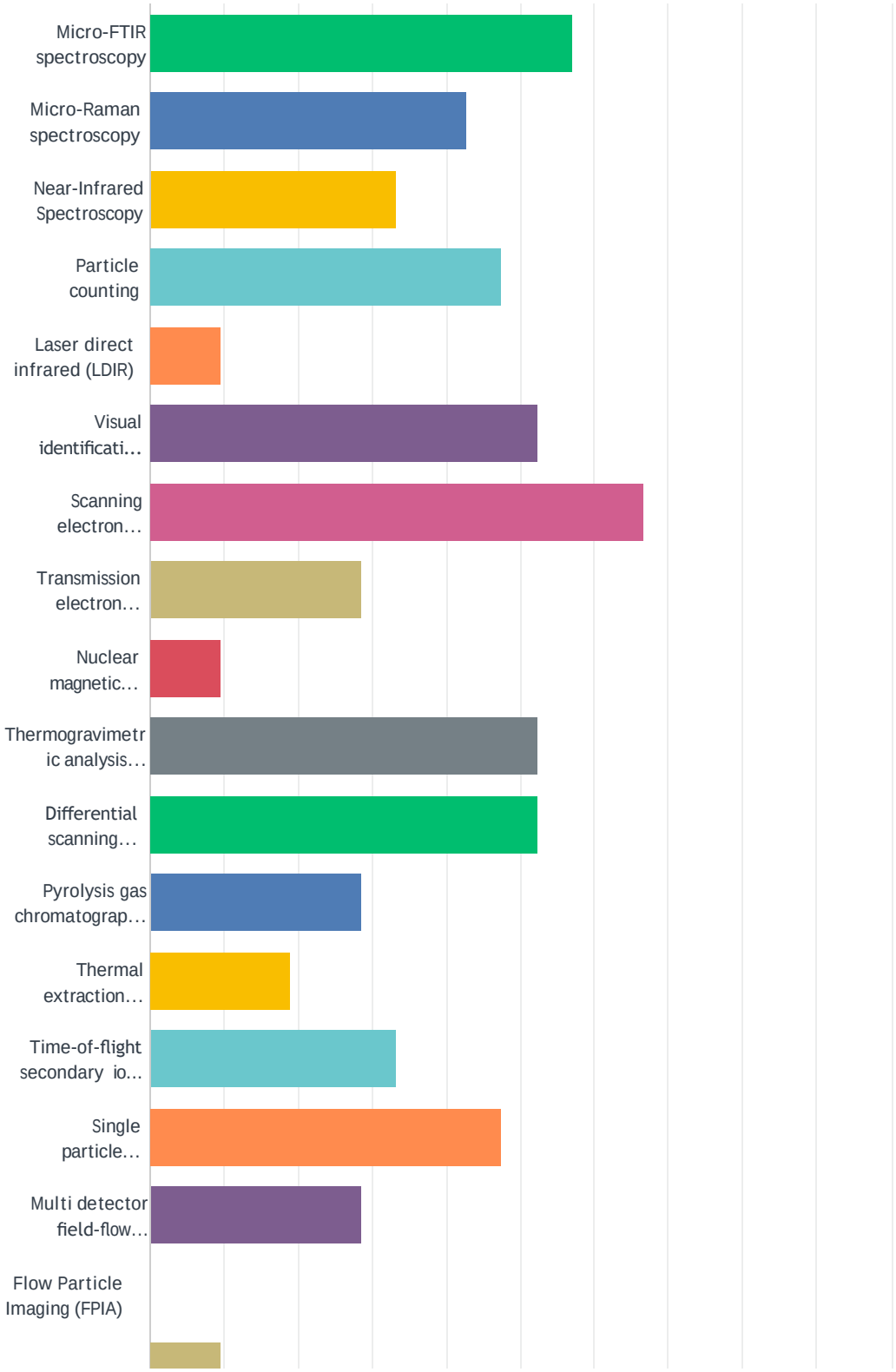
Answered: 33 Skipped: 0

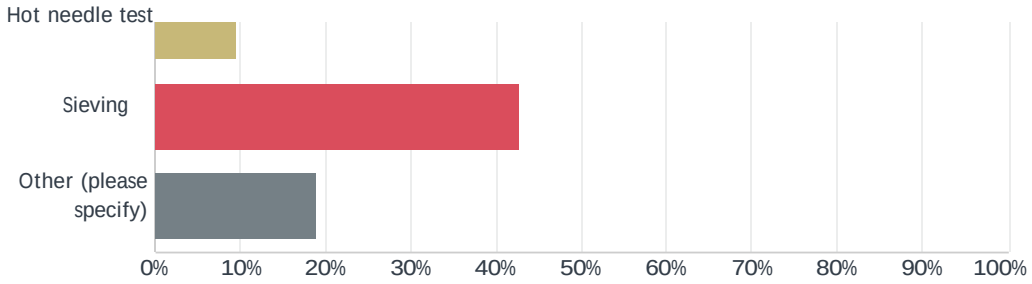


ANSWER CHOICES	RESPONSES	
Yes	63.64%	21
No	36.36%	12
TOTAL		33

Q2 Q 1a.1 If “Yes” to Q 1a, please select from the following list the types of analytical methods you use for microplastic identification or quantification (or plan to use within one year)

Answered: 21 Skipped: 12



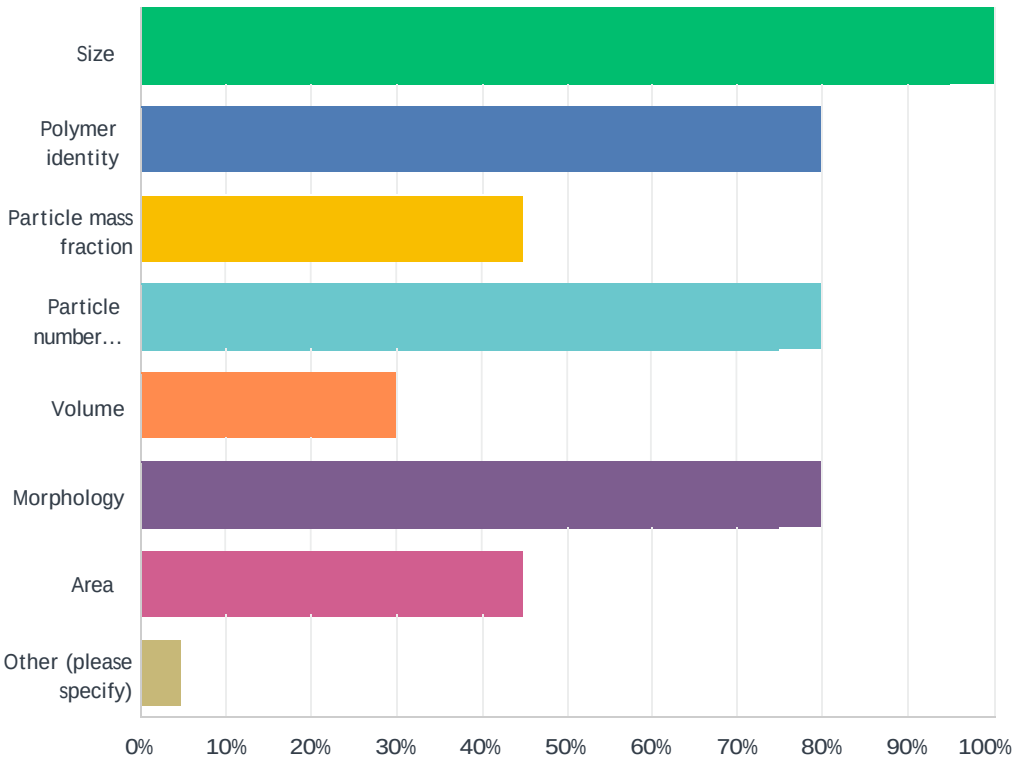


ANSWER CHOICES	RESPONSES	
Micro-FTIR spectroscopy	57.14%	12
Micro-Raman spectroscopy	42.86%	9
Near-Infrared Spectroscopy	33.33%	7
Particle counting	47.62%	10
Laser direct infrared (LDIR)	9.52%	2
Visual identification using light microscopy	52.38%	11
Scanning electron microscopy (SEM)	66.67%	14
Transmission electron microscopy (TEM)	28.57%	6
Nuclear magnetic resonance spectroscopy (NMR)	9.52%	2
Thermogravimetric analysis (TGA)	52.38%	11
Differential scanning calorimetry (DSC)	52.38%	11
Pyrolysis gas chromatography mass spectrometry (Pyrolysis GC/MS)	28.57%	6
Thermal extraction desorption gas chromatography mass spectrometry (TED GC/MS)	19.05%	4
Time-of-flight secondary ion mass spectrometry (ToF-SIMS)	33.33%	7
Single particle inductively coupled mass spectrometry (sp ICP/MS)	47.62%	10
Multi detector field-flow fractionation (MD-FFF)	28.57%	6
Flow Particle Imaging (FPIA)	0.00%	0
Hot needle test	9.52%	2
Sieving	42.86%	9
Other (please specify)	19.05%	4

Total Respondents: 21

Q3 Q 1a.2 If “Yes” to Q 1a, what quantities or other properties can your laboratory measure for microplastics?

Answered: 20 Skipped: 13

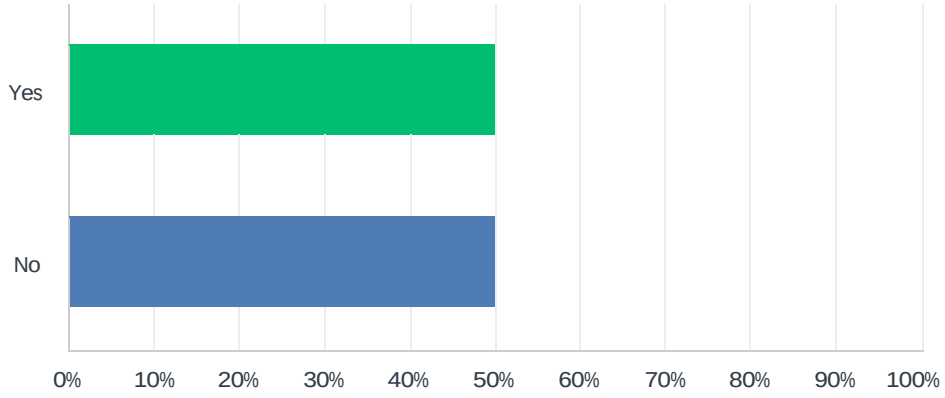


ANSWER CHOICES	RESPONSES	
Size	95.00%	19
Polymer identity	80.00%	16
Particle mass fraction	45.00%	9
Particle number concentration	75.00%	15
Volume	30.00%	6
Morphology	75.00%	15
Area	45.00%	9
Other (please specify)	5.00%	1

Total Respondents: 20

Q4 Q 1b Is your NMI capable of making nanoplastic measurements?

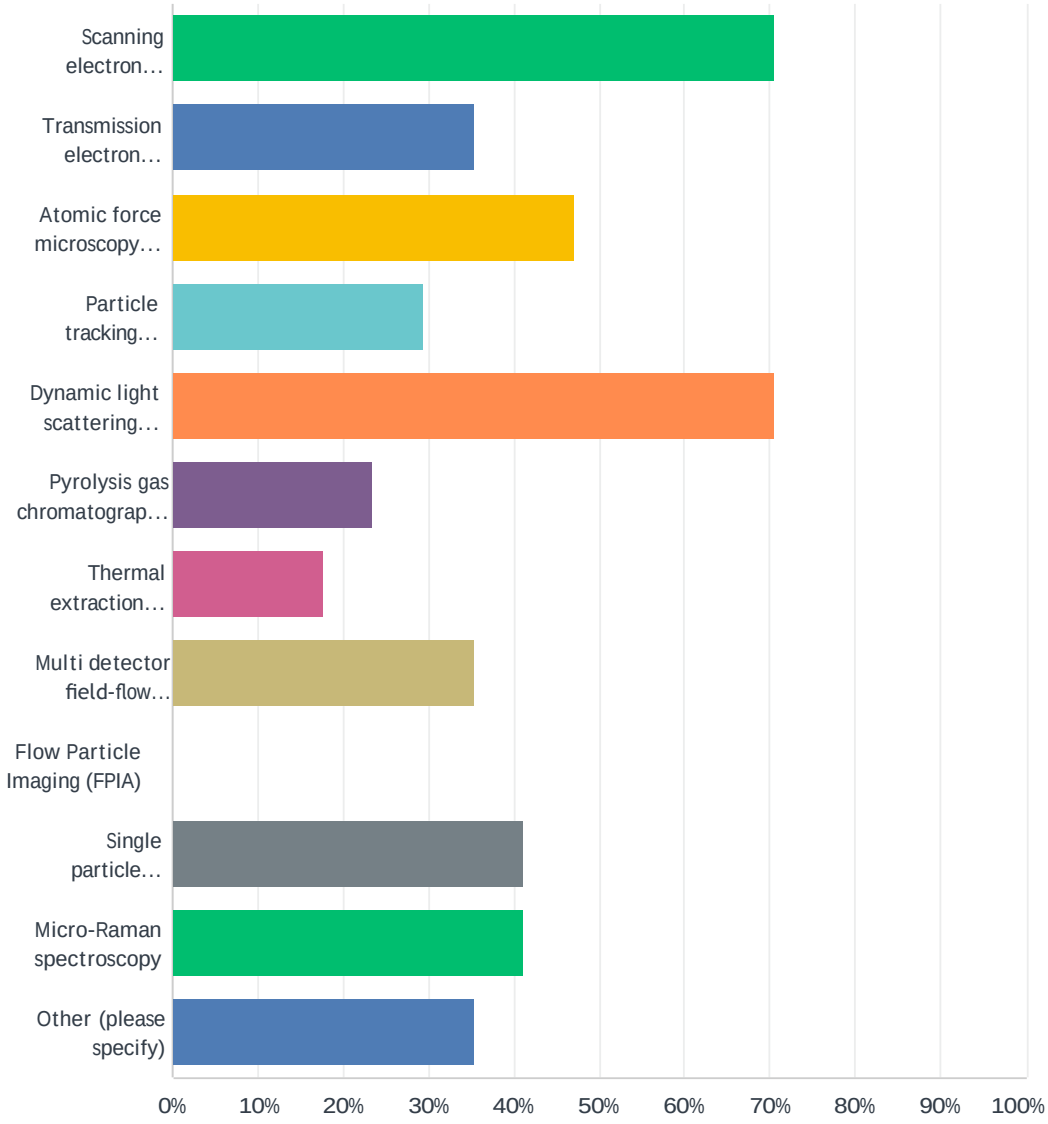
Answered: 32 Skipped: 1



ANSWER CHOICES	RESPONSES	
Yes	50.00%	16
No	50.00%	16
TOTAL		32

Q5 Q 1b.1 If “Yes” to Q 1b , please select the types of analytical methods you use for nanoplastic identification or quantification (or plan to use within one year)

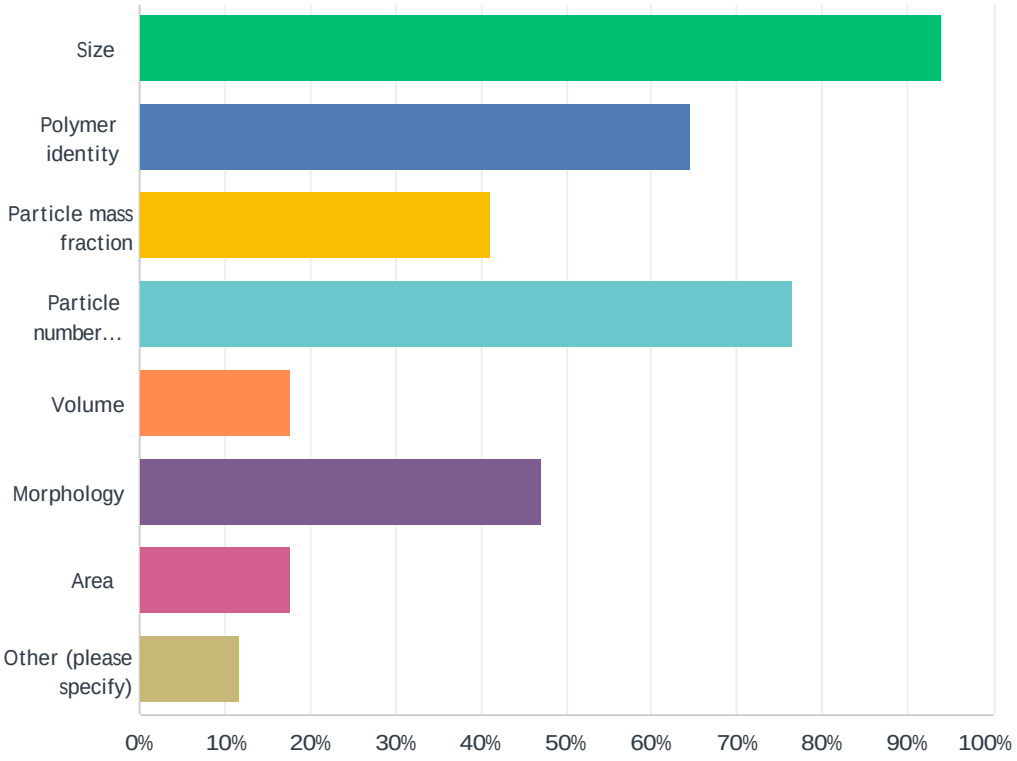
Answered: 17 Skipped: 16



ANSWER CHOICES	RESPONSES	
Scanning electron microscopy (SEM)	70.59%	12
Transmission electron microscopy (TEM)	35.29%	6
Atomic force microscopy (AFM)	47.06%	8
Particle tracking analysis (PTA)	29.41%	5
Dynamic light scattering (DLS)	70.59%	12
Pyrolysis gas chromatography mass spectrometry (pyrolysis GC/MS)	23.53%	4
Thermal extraction desorption gas chromatography mass spectrometry (TED GC/MS)	17.65%	3
Multi detector field-flow fractionation (MD-FFF)	35.29%	6
Flow Particle Imaging (FPIA)	0.00%	0
Single particle inductively coupled mass spectrometry (sp ICP/MS)	41.18%	7
Micro-Raman spectroscopy	41.18%	7
Other (please specify)	35.29%	6
Total Respondents: 17		

Q6 Q 1b.2 If “Yes” to Q 1b, what quantities or properties can your laboratory measure for nanoplastics?

Answered: 17 Skipped: 16

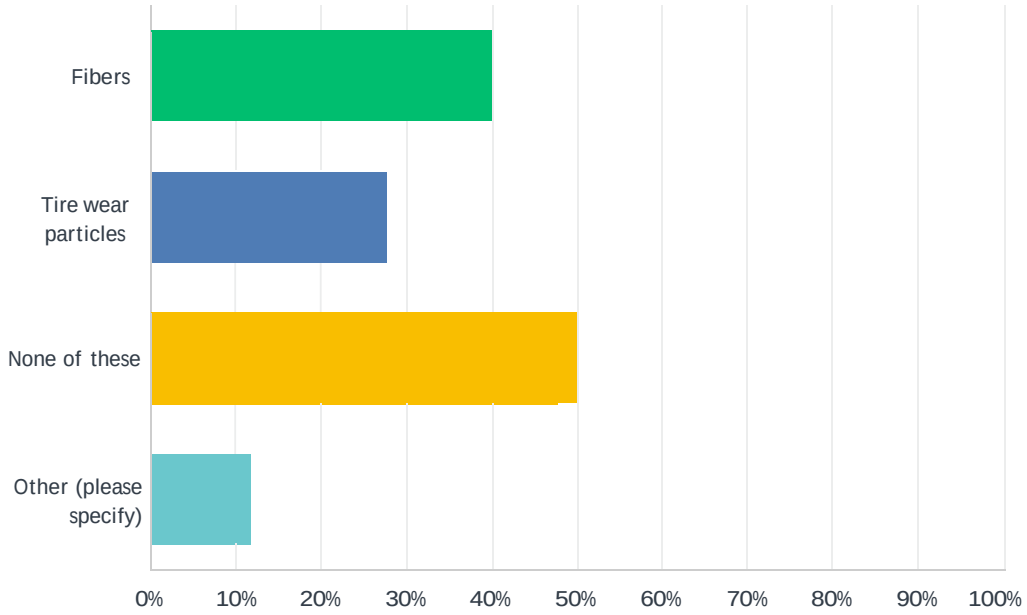


ANSWER CHOICES	RESPONSES	
Size	94.12%	16
Polymer identity	64.71%	11
Particle mass fraction	41.18%	7
Particle number concentration	76.47%	13
Volume	17.65%	3
Morphology	47.06%	8
Area	17.65%	3
Other (please specify)	11.76%	2

Total Respondents: 17

Q7 Q 1c There is regulatory interest in specific classes of microplastics. Is your NMI currently able to measure quantities and other properties for:

Answered: 25 Skipped: 8

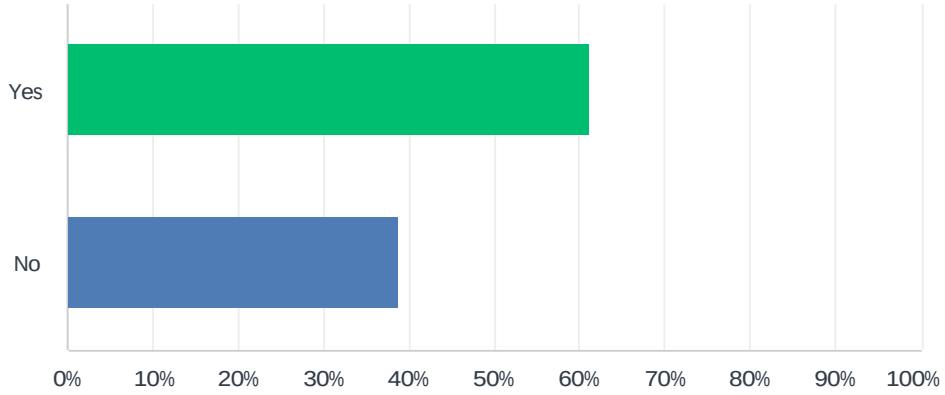


ANSWER CHOICES	RESPONSES	
Fibers	40.00%	10
Tire wear particles	28.00%	7
None of these	48.00%	12
Other (please specify)	12.00%	3

Total Respondents: 25

Q8 Q 1d Does your laboratory have specialized laboratory spaces facilities such as clean rooms or clean benches for micro- or nanoplastic measurement?

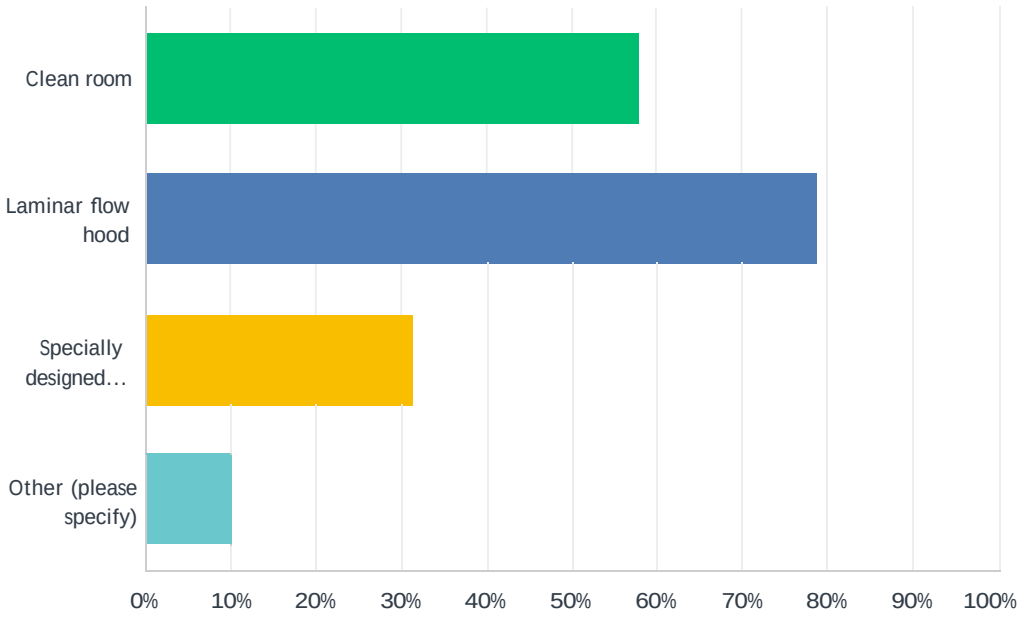
Answered: 31 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	61.29%	19
No	38.71%	12
TOTAL		31

Q9 Q 1d.1 If “Yes” to Q 1d, what type of facility (select from list)?

Answered: 19 Skipped: 14

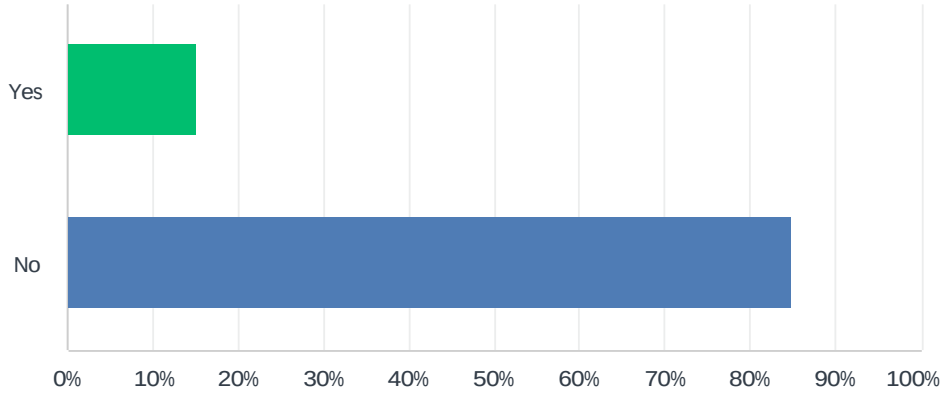


ANSWER CHOICES	RESPONSES	
Clean room	57.89%	11
Laminar flow hood	78.95%	15
Specially designed laboratory (not classified as a clean room)	31.58%	6
Other (please specify)	10.53%	2

Total Respondents: 19

Q10 Q 2a Are you currently developing reference materials (RMs) for microplastics?

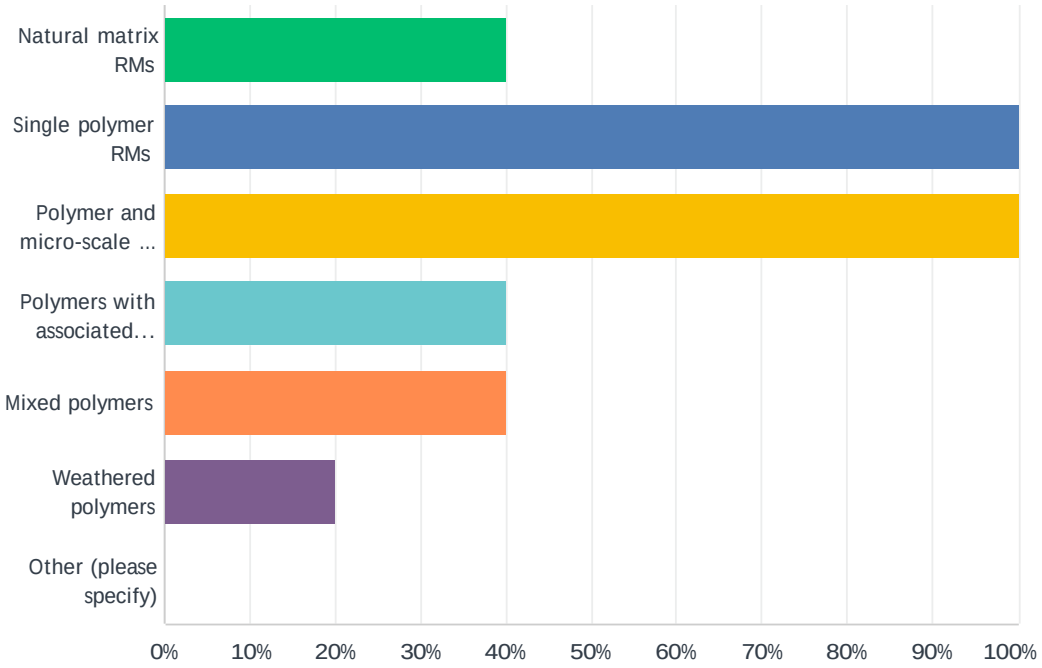
Answered: 33 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	15.15%	5
No	84.85%	28
TOTAL		33

Q11 Q 2a.1 If “Yes” to Q 2a, which types of RMs are you producing?

Answered: 5 Skipped: 28

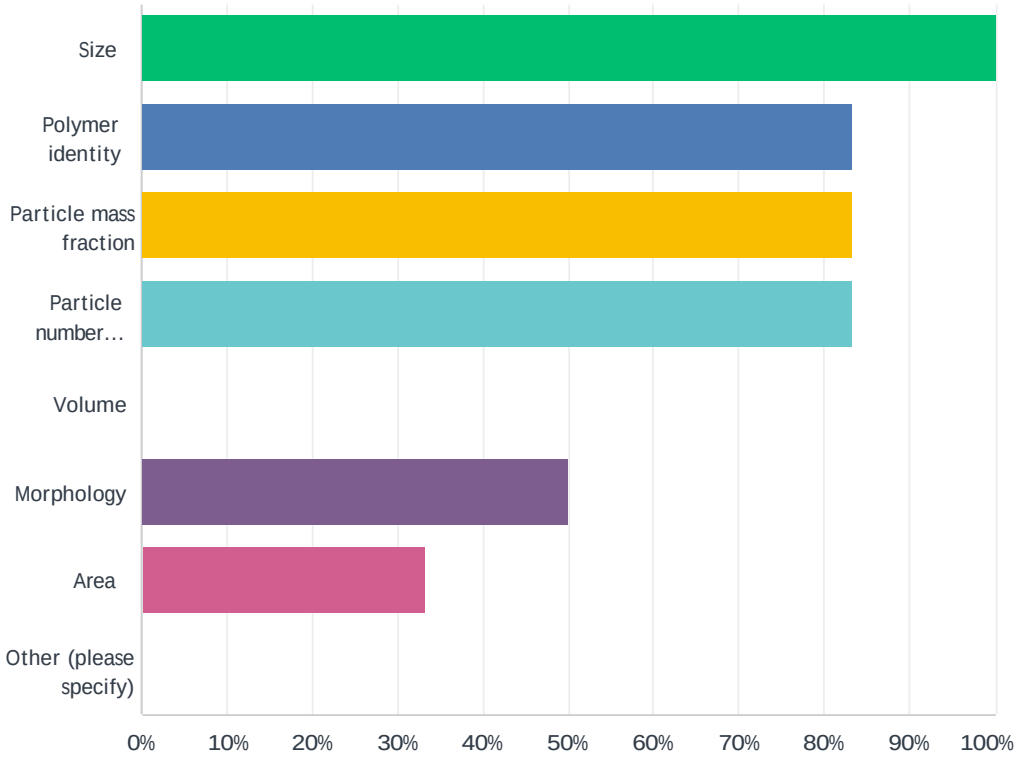


ANSWER CHOICES	RESPONSES	
Natural matrix RMs	40.00%	2
Single polymer RMs	100.00%	5
Polymer and micro-scale RMs etc. used for sizing	100.00%	5
Polymers with associated additives	40.00%	2
Mixed polymers	40.00%	2
Weathered polymers	20.00%	1
Other (please specify)	0.00%	0

Total Respondents: 5

Q12 Q 2a.2 If “Yes” to Q 2a, please specify the quantities or other properties assigned in the RMs:

Answered: 6 Skipped: 27

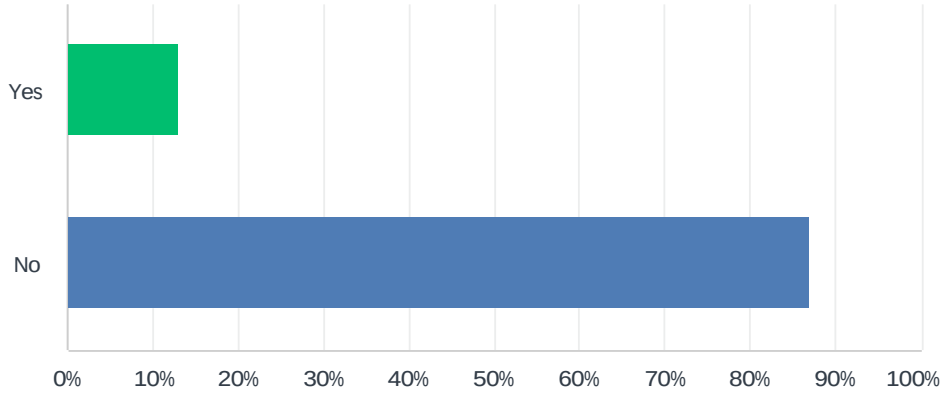


ANSWER CHOICES	RESPONSES	
Size	100.00%	6
Polymer identity	83.33%	5
Particle mass fraction	83.33%	5
Particle number concentration	83.33%	5
Volume	0.00%	0
Morphology	50.00%	3
Area	33.33%	2
Other (please specify)	0.00%	0

Total Respondents: 6

Q13 Q 2b Are you currently developing reference materials (RMs) for nanoplastics?

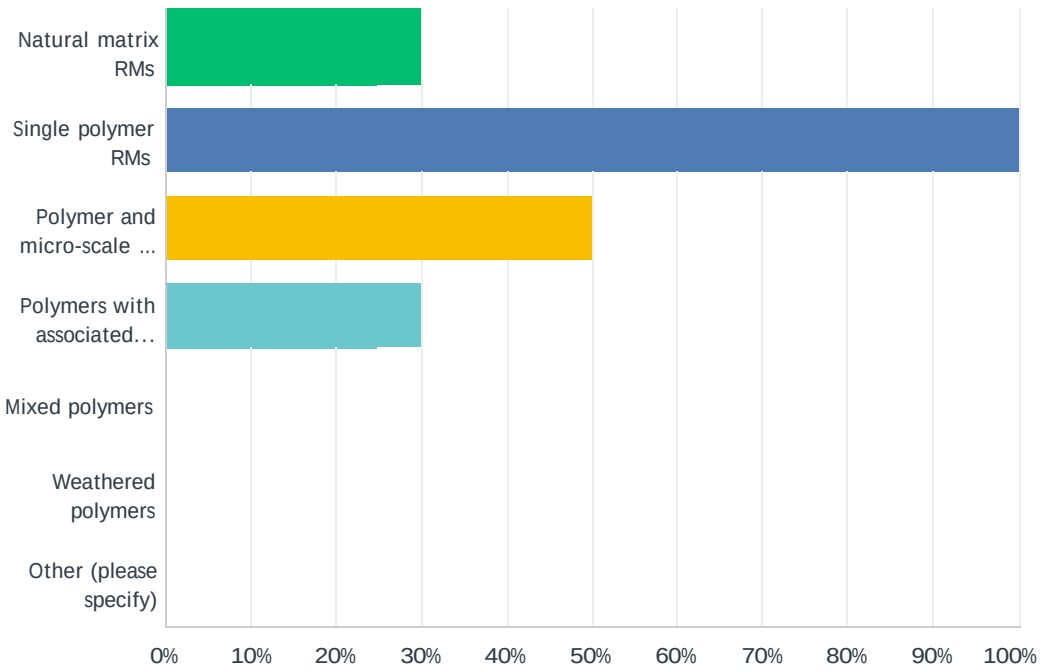
Answered: 31 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	12.90%	4
No	87.10%	27
TOTAL		31

Q14 Q 2b.1 If “Yes” to Q 2b, which types of RMs are you producing?

Answered: 4 Skipped: 29

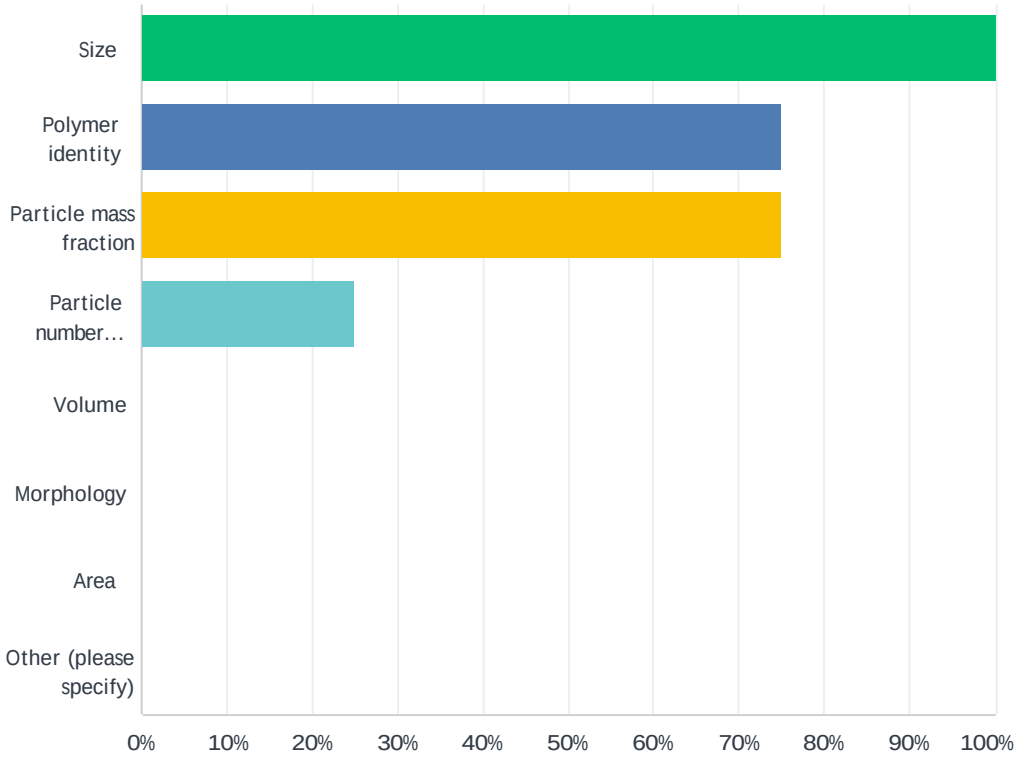


ANSWER CHOICES	RESPONSES	
Natural matrix RMs	25.00%	1
Single polymer RMs	100.00%	4
Polymer and micro-scale RMs etc. used for sizing	50.00%	2
Polymers with associated additives	25.00%	1
Mixed polymers	0.00%	0
Weathered polymers	0.00%	0
Other (please specify)	0.00%	0

Total Respondents: 4

Q15 Q 2b.2 If “Yes” to Q 2b, specify the quantities or other properties assigned in the RMs:

Answered: 4 Skipped: 29

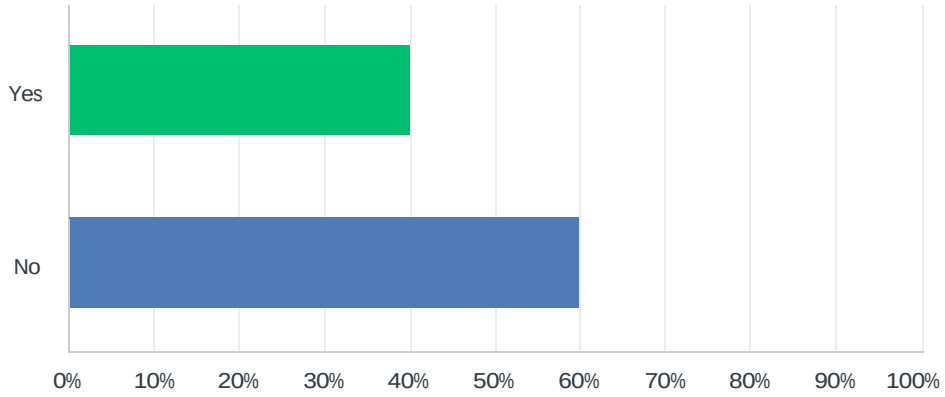


ANSWER CHOICES	RESPONSES	
Size	100.00%	4
Polymer identity	75.00%	3
Particle mass fraction	75.00%	3
Particle number concentration	25.00%	1
Volume	0.00%	0
Morphology	0.00%	0
Area	0.00%	0
Other (please specify)	0.00%	0

Total Respondents: 4

Q16 Q 2c Are you currently making microplastic measurements in environmental matrices?

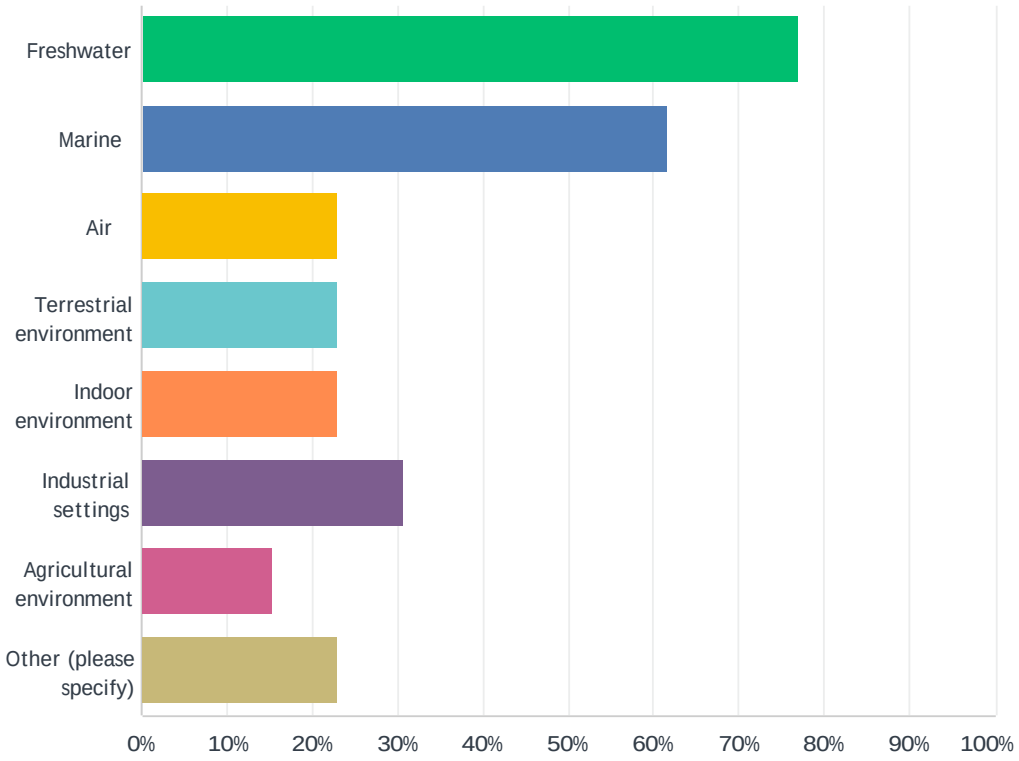
Answered: 30 Skipped: 3



ANSWER CHOICES	RESPONSES	
Yes	40.00%	12
No	60.00%	18
TOTAL		30

Q17 Q 2c.1 If “Yes” to Q 2c, in which types of RMs are you producing?

Answered: 13 Skipped: 20

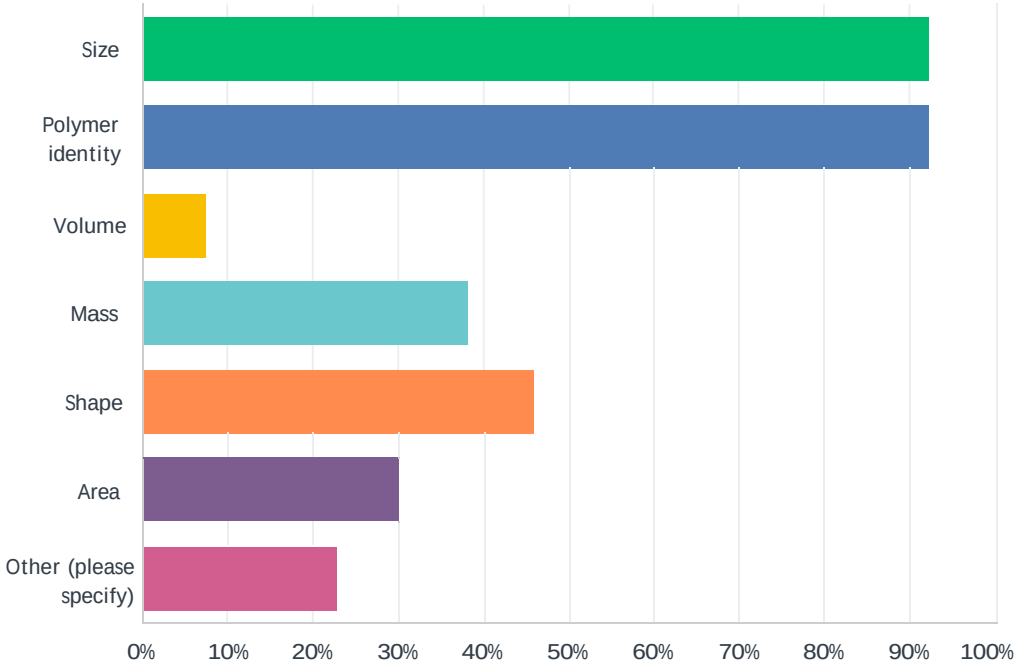


ANSWER CHOICES	RESPONSES	
Freshwater	76.92%	10
Marine	61.54%	8
Air	23.08%	3
Terrestrial environment	23.08%	3
Indoor environment	23.08%	3
Industrial settings	30.77%	4
Agricultural environment	15.38%	2
Other (please specify)	23.08%	3

Total Respondents: 13

Q18 Q 2c.2 If “Yes” to Q 2c, specify the quantities or other properties being measured:

Answered: 13 Skipped: 20

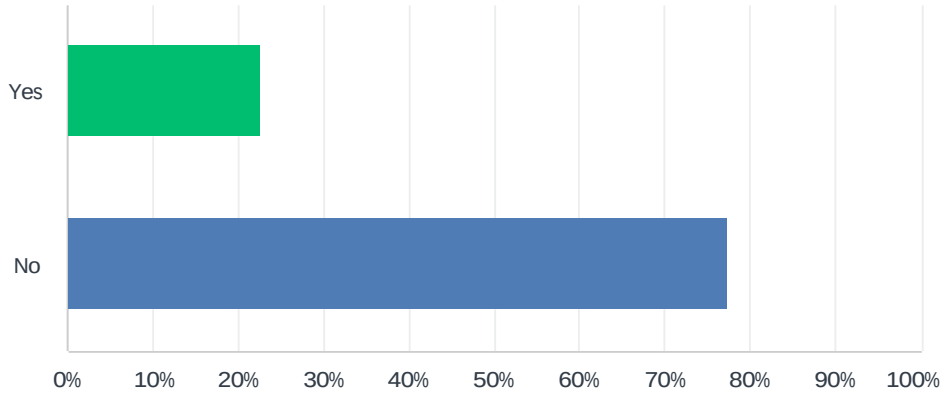


ANSWER CHOICES	RESPONSES	
Size	92.31%	12
Polymer identity	92.31%	12
Volume	7.69%	1
Mass	38.46%	5
Shape	46.15%	6
Area	30.77%	4
Other (please specify)	23.08%	3

Total Respondents: 13

Q19 Q 2d Are you currently making nanoplastic measurements in specific matrices?

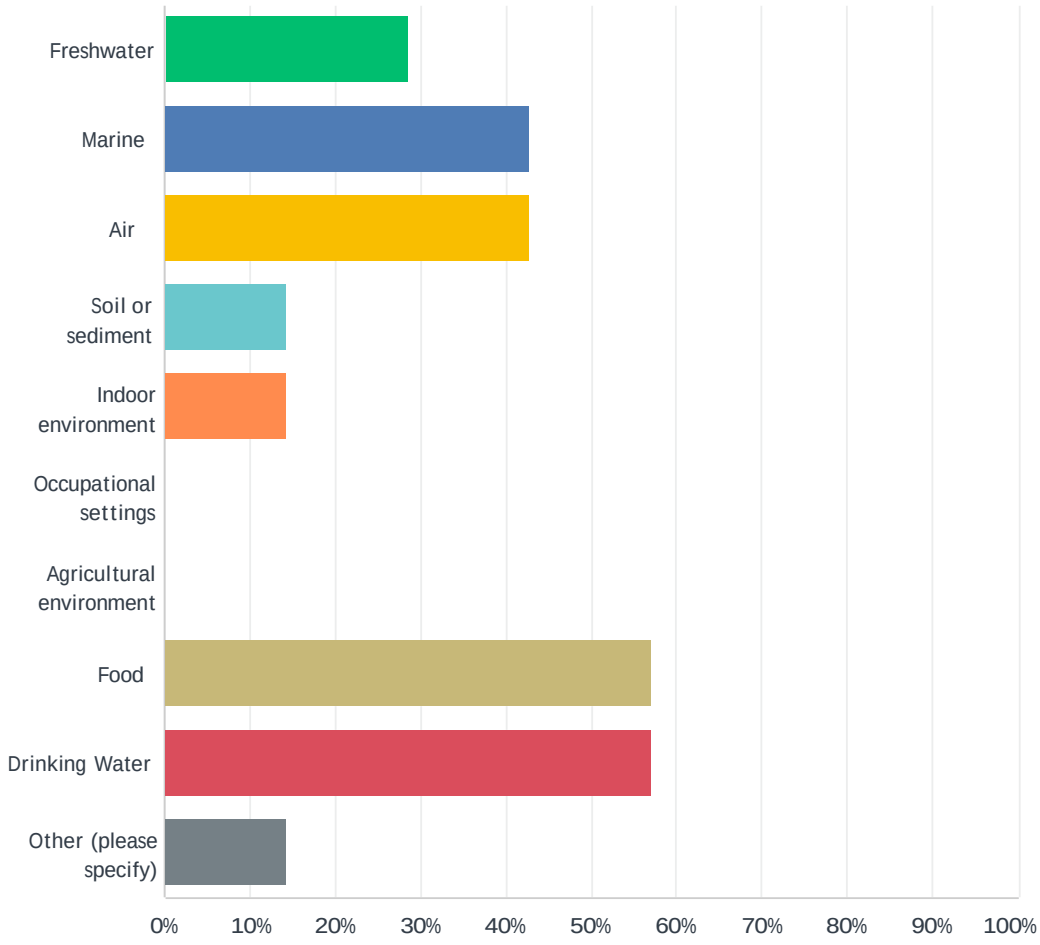
Answered: 31 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	22.58%	7
No	77.42%	24
TOTAL		31

Q20 Q 2d.1 If “Yes” to Q 2d, in which matrices?

Answered: 7 Skipped: 26

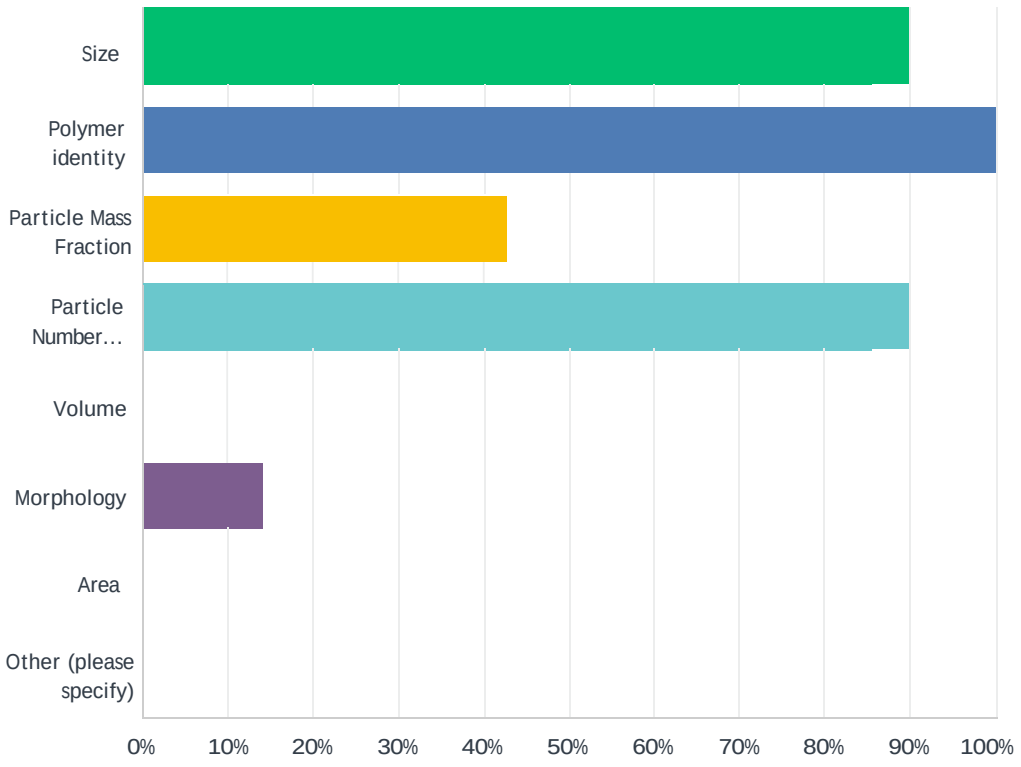


ANSWER CHOICES	RESPONSES	
Freshwater	28.57%	2
Marine	42.86%	3
Air	42.86%	3
Soil or sediment	14.29%	1
Indoor environment	14.29%	1
Occupational settings	0.00%	0
Agricultural environment	0.00%	0
Food	57.14%	4
Drinking Water	57.14%	4
Other (please specify)	14.29%	1

Total Respondents: 7

Q21 Q 2d.2 If “Yes” to Q 2d, specify the quantities or other properties being measured:

Answered: 7 Skipped: 26

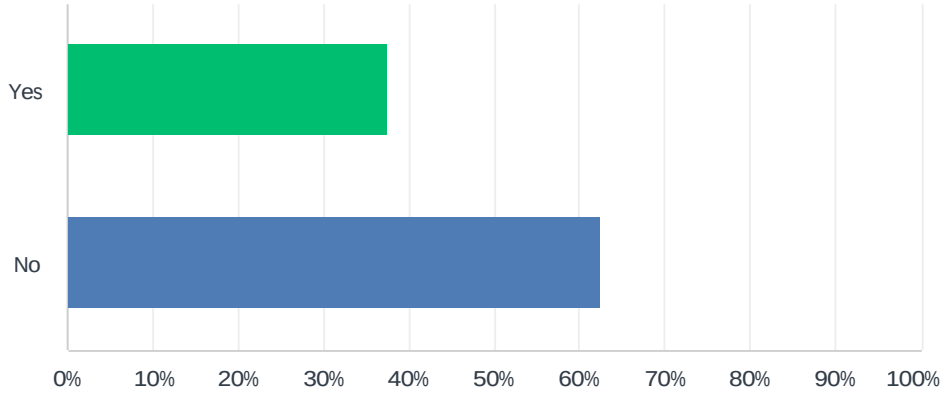


ANSWER CHOICES	RESPONSES	
Size	85.71%	6
Polymer identity	100.00%	7
Particle Mass Fraction	42.86%	3
Particle Number Concentration	85.71%	6
Volume	0.00%	0
Morphology	14.29%	1
Area	0.00%	0
Other (please specify)	0.00%	0

Total Respondents: 7

Q22 Q 2e Are you aware of RMs being produced by other NMIs or commercial suppliers?

Answered: 32 Skipped: 1



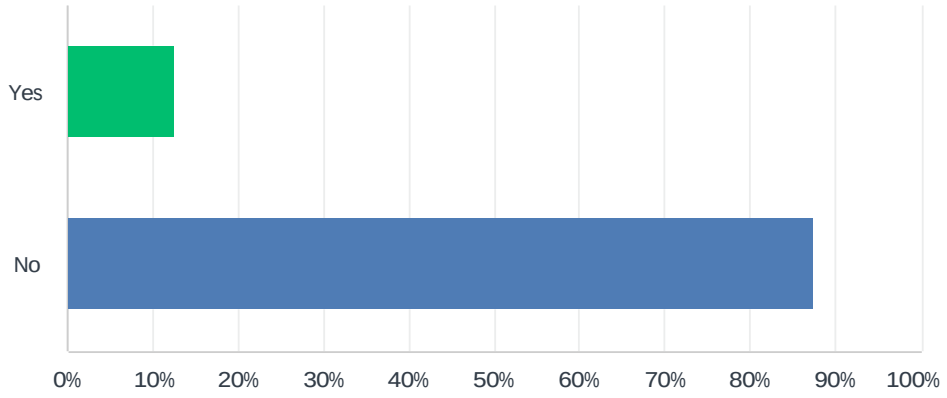
ANSWER CHOICES	RESPONSES	
Yes	37.50%	12
No	62.50%	20
TOTAL		32

Q23 Q 2f If you answered yes to Q 2e can you provide details of the supplier, the quantity or property assigned and the material?

Answered: 12 Skipped: 21

Q24 Q 2g Has your laboratory developed protocols for field sampling?

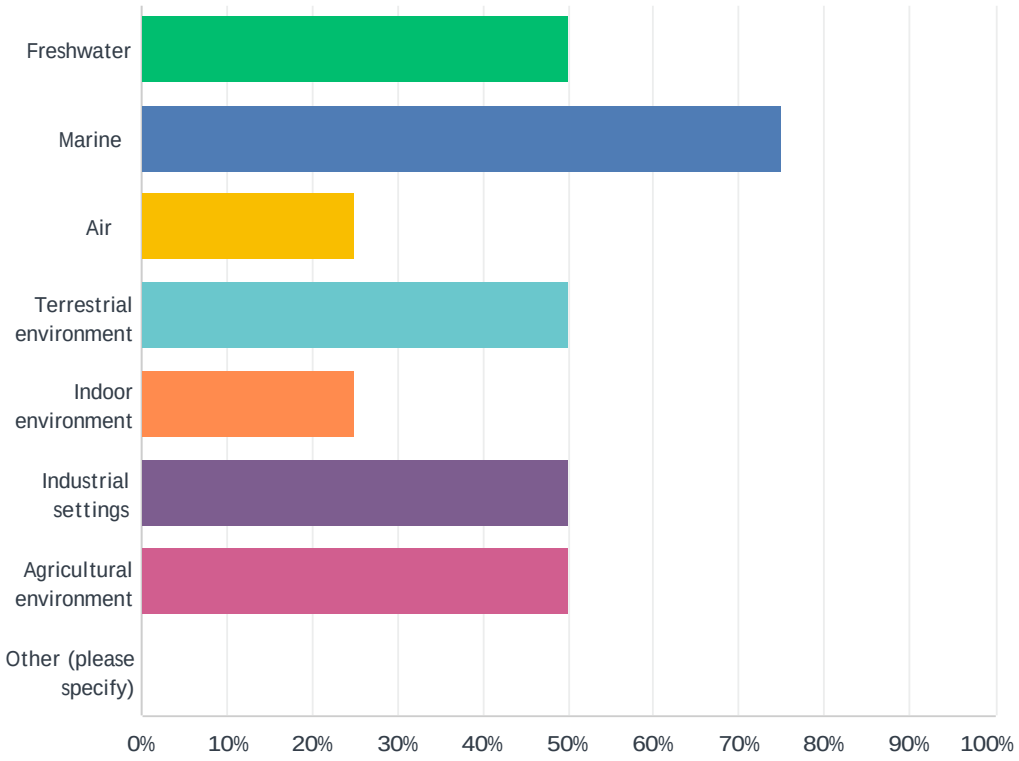
Answered: 32 Skipped: 1



ANSWER CHOICES	RESPONSES	
Yes	12.50%	4
No	87.50%	28
TOTAL		32

Q25 Q 2g.1 If “Yes” to Q 2g, in which environments?

Answered: 4 Skipped: 29

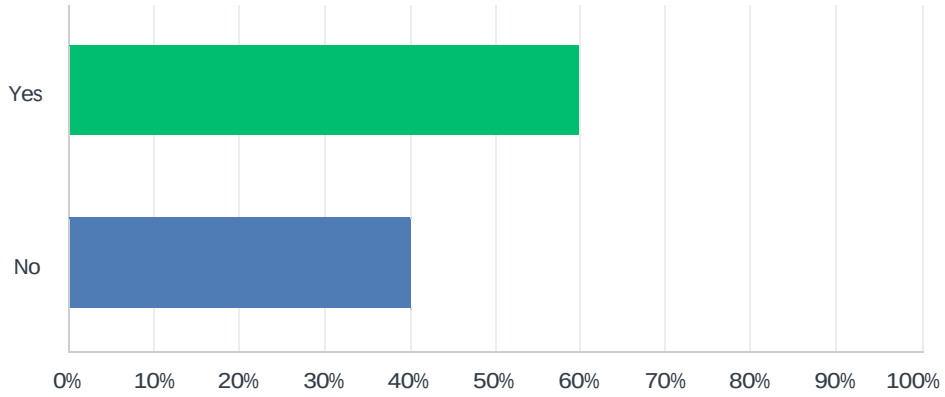


ANSWER CHOICES	RESPONSES	
Freshwater	50.00%	2
Marine	75.00%	3
Air	25.00%	1
Terrestrial environment	50.00%	2
Indoor environment	25.00%	1
Industrial settings	50.00%	2
Agricultural environment	50.00%	2
Other (please specify)	0.00%	0

Total Respondents: 4

Q26 Q 2h Is your laboratory involved in publicly-accessible interlaboratory comparisons?

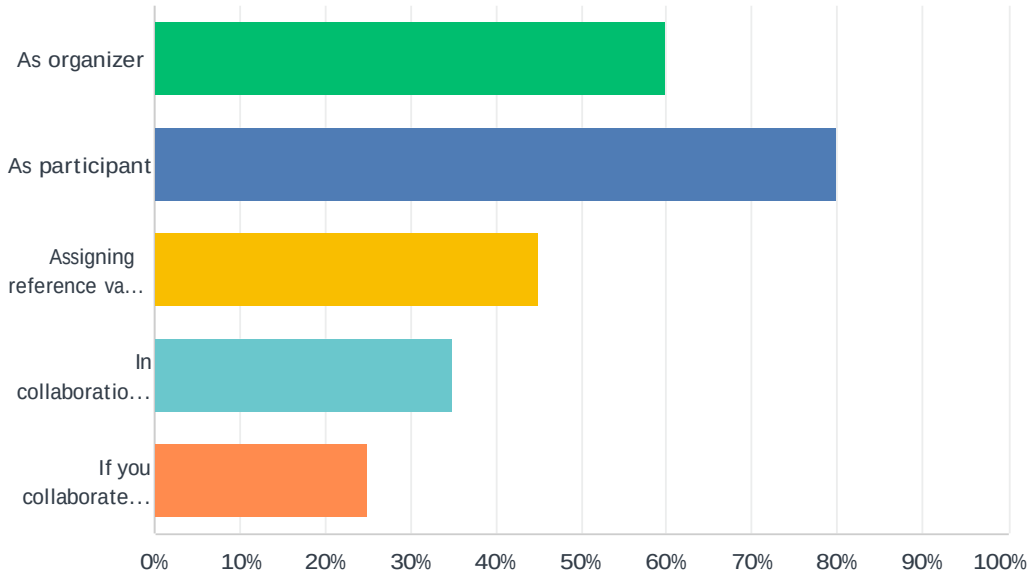
Answered: 32 Skipped: 1



ANSWER CHOICES	RESPONSES	
Yes	59.38%	19
No	40.63%	13
TOTAL		32

Q27 Q 2h.1 If “Yes” to Q 2h, what is your role?

Answered: 20 Skipped: 13

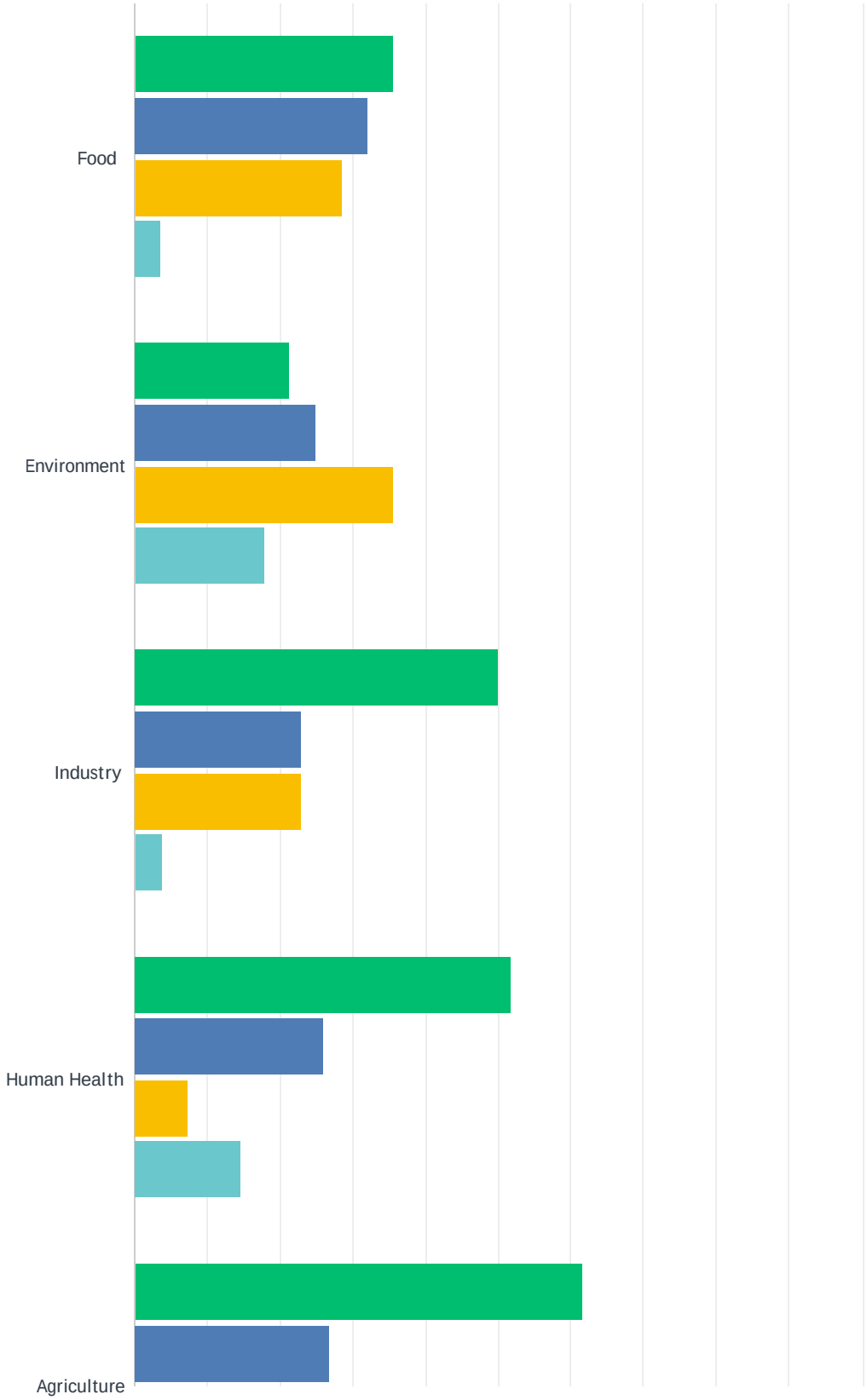


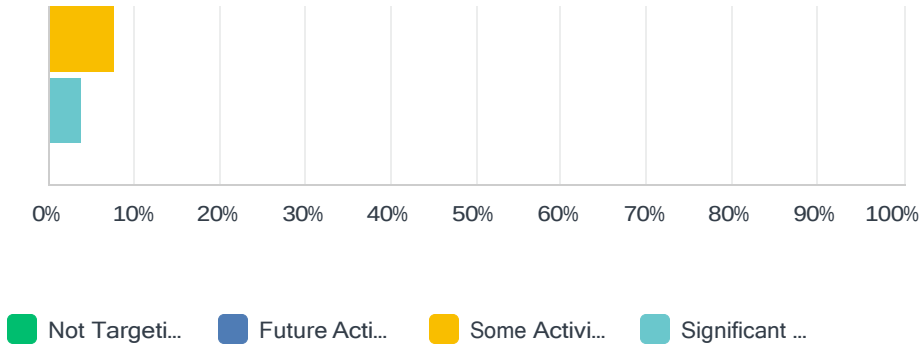
ANSWER CHOICES	RESPONSES	
As organizer	60.00%	12
As participant	80.00%	16
Assigning reference value to materials	45.00%	9
In collaboration with another NMI	35.00%	7
If you collaborate with another NMI, which one?	25.00%	5

Total Respondents: 20

Q28 Q 3a Please indicate your effort in the following sectors of microplastic metrology (one selection per row)

Answered: 30 Skipped: 3

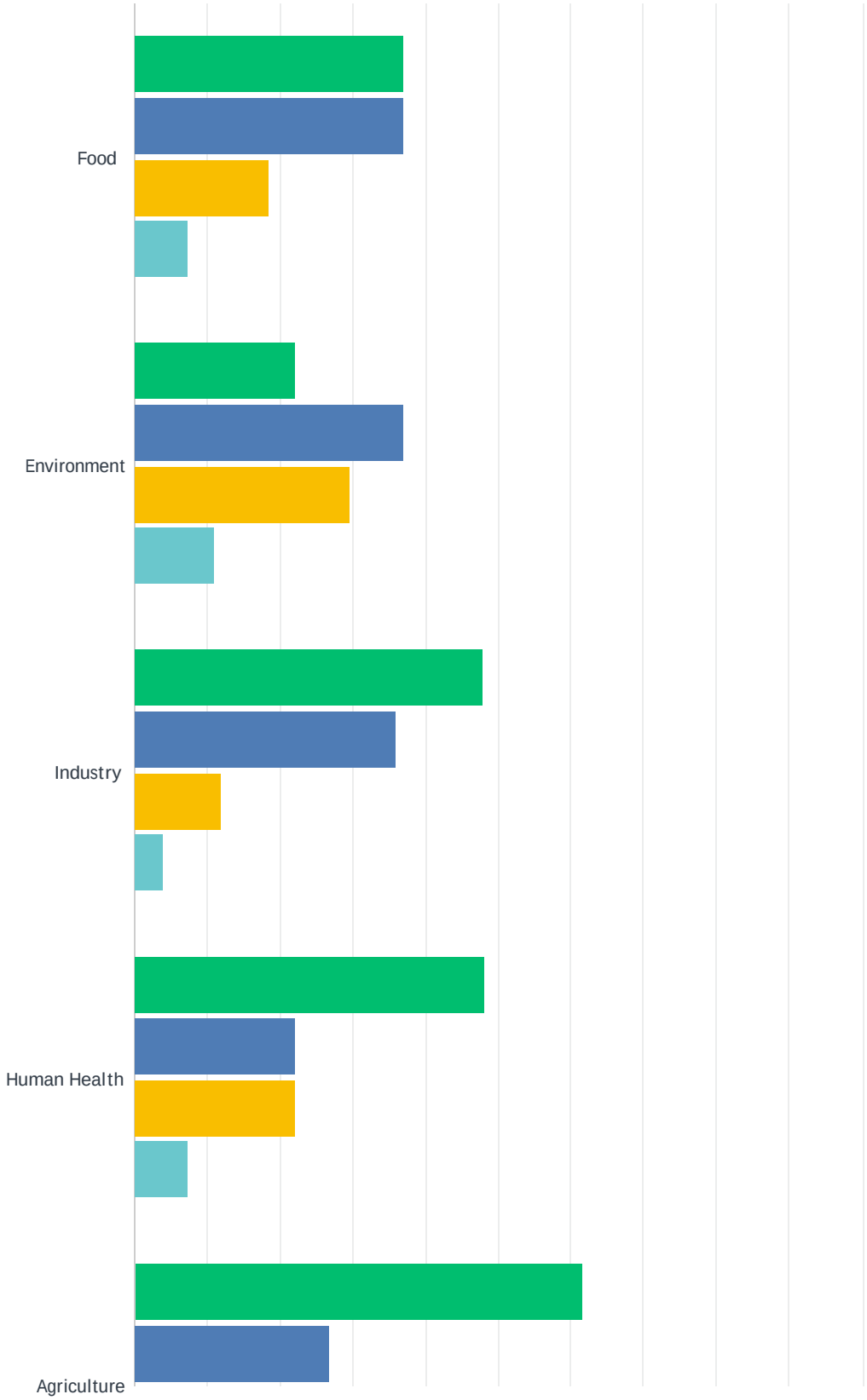


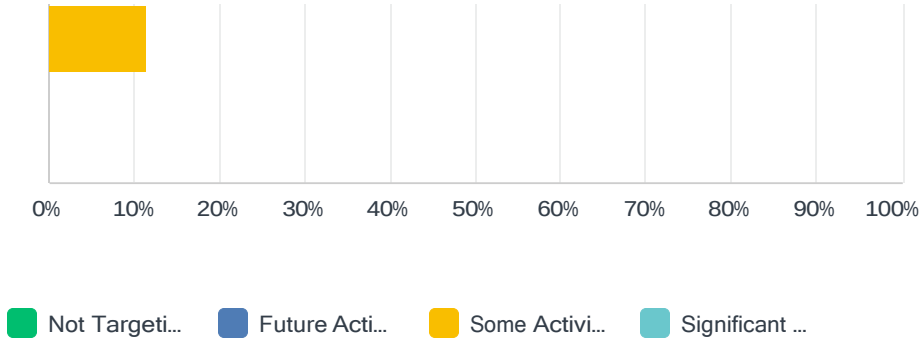


	NOT TARGETING	FUTURE ACTIVITY	SOME ACTIVITY	SIGNIFICANT ACTIVITY	TOTAL
Food	35.71% 10	32.14% 9	28.57% 8	3.57% 1	28
Environment	21.43% 6	25.00% 7	35.71% 10	17.86% 5	28
Industry	50.00% 13	23.08% 6	23.08% 6	3.85% 1	26
Human Health	51.85% 14	25.93% 7	7.41% 2	14.81% 4	27
Agriculture	61.54% 16	26.92% 7	7.69% 2	3.85% 1	26

Q29 Q 3b Please indicate your effort in the following sectors of nanoplastic metrology (one selection per row)

Answered: 29 Skipped: 4

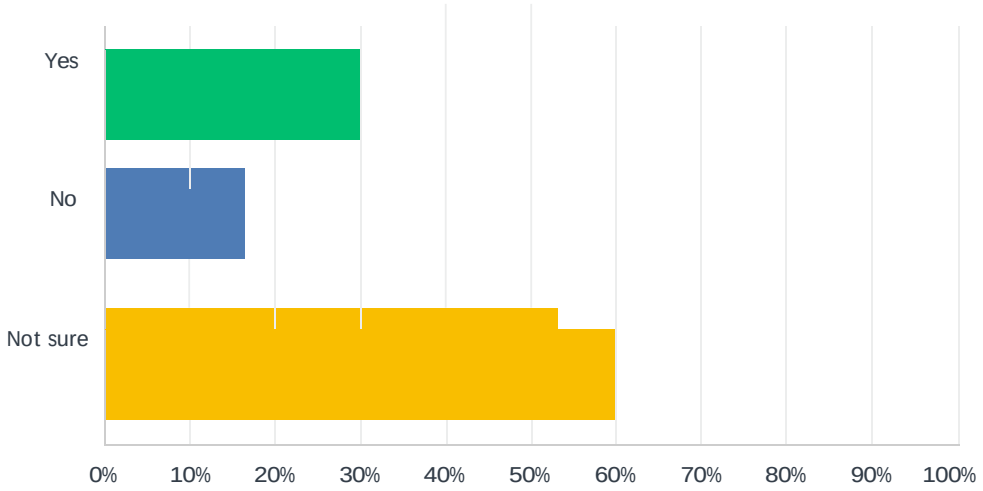




	NOT TARGETING	FUTURE ACTIVITY	SOME ACTIVITY	SIGNIFICANT ACTIVITY	TOTAL
Food	37.04% 10	37.04% 10	18.52% 5	7.41% 2	27
Environment	22.22% 6	37.04% 10	29.63% 8	11.11% 3	27
Industry	48.00% 12	36.00% 9	12.00% 3	4.00% 1	25
Human Health	48.15% 13	22.22% 6	22.22% 6	7.41% 2	27
Agriculture	61.54% 16	26.92% 7	11.54% 3	0.00% 0	26

Q30 Q 3c Are there other NMIs providing similar services and is there a need to demonstrate the extent of equivalence of your results with theirs?

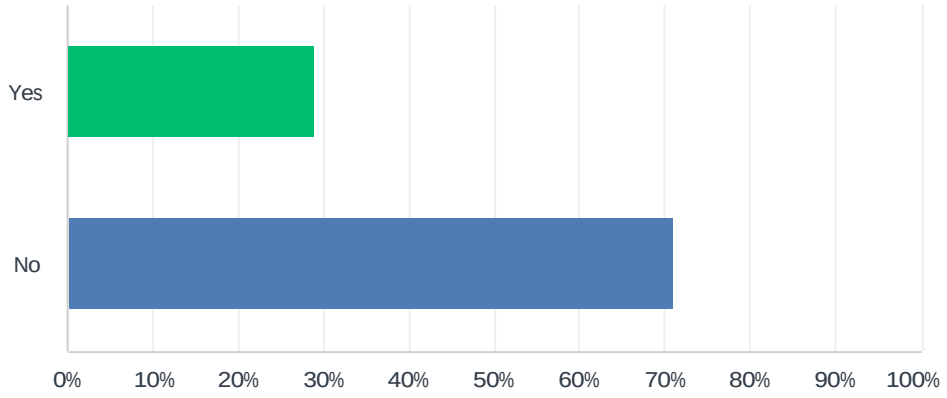
Answered: 30 Skipped: 3



ANSWER CHOICES	RESPONSES	
Yes	30.00%	9
No	16.67%	5
Not sure	53.33%	16
TOTAL		30

Q31 Q 3d Is you work meeting a regulatory need?

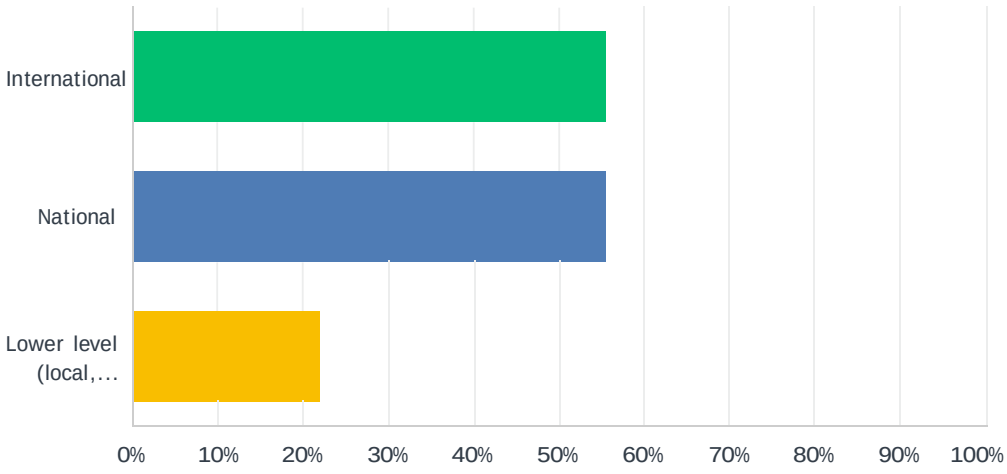
Answered: 31 Skipped: 2



ANSWER CHOICES	RESPONSES	
Yes	29.03%	9
No	70.97%	22
TOTAL		31

Q32 Q 3d.1 If “Yes” to Q 3d, at what level is the need?

Answered: 9 Skipped: 24

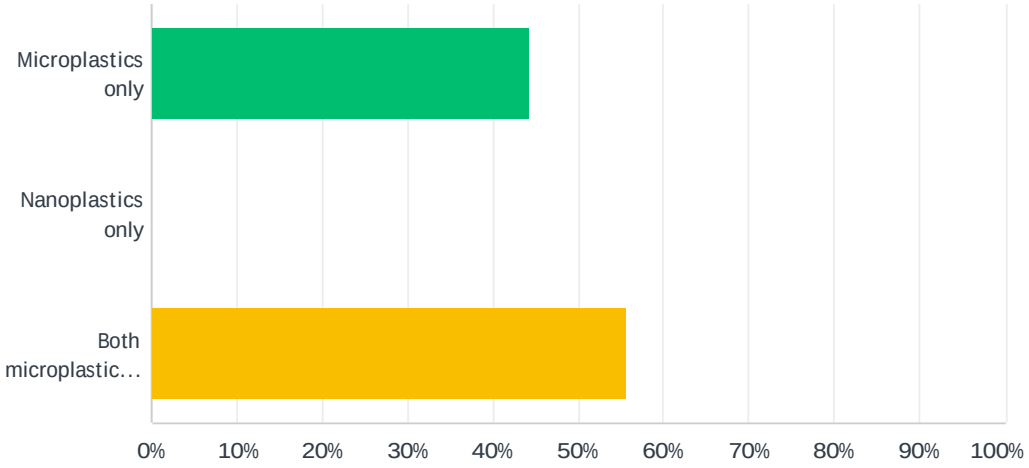


ANSWER CHOICES	RESPONSES	
International	55.56%	5
National	55.56%	5
Lower level (local, regional, provinical)	22.22%	2

Total Respondents: 9

Q33 Q 3d.2 If “Yes” to Q 3d, is the need for measurements of:

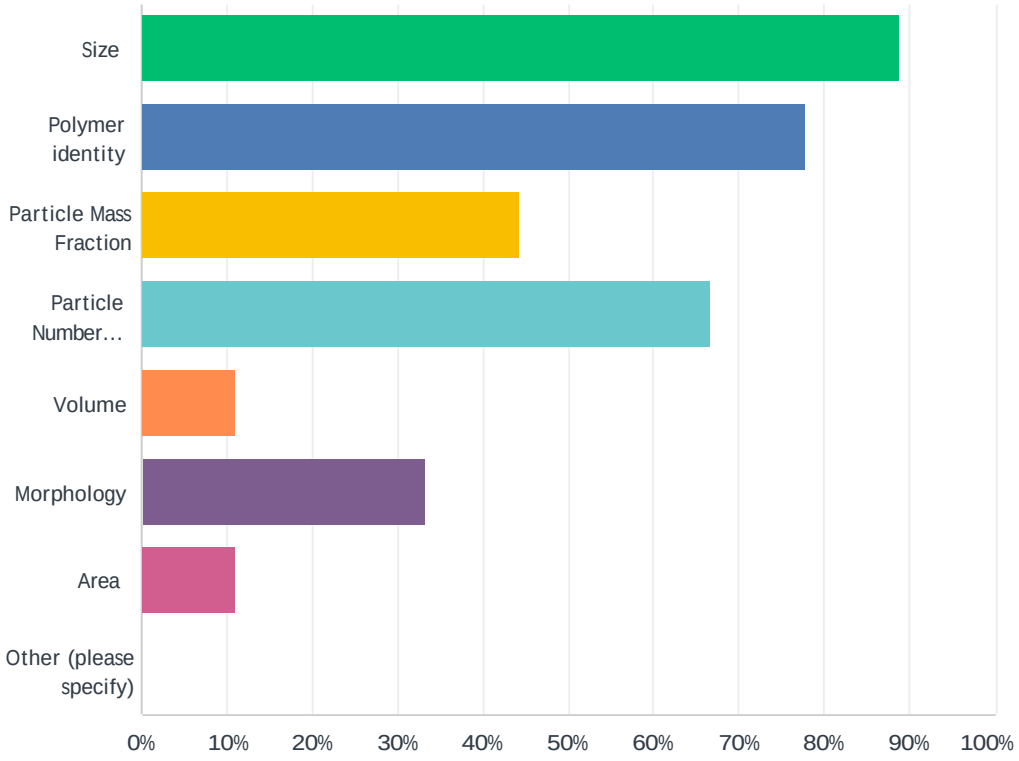
Answered: 9 Skipped: 24



ANSWER CHOICES	RESPONSES	
Microplastics only	44.44%	4
Nanoplastics only	0.00%	0
Both microplastics and nanoplastics	55.56%	5
TOTAL		9

Q34 Q 3d.3 If “Yes” to Q 3d, specify the quantities or other properties to be measured related to the regulatory need:

Answered: 9 Skipped: 24



ANSWER CHOICES	RESPONSES	
Size	88.89%	8
Polymer identity	77.78%	7
Particle Mass Fraction	44.44%	4
Particle Number Concentration	66.67%	6
Volume	11.11%	1
Morphology	33.33%	3
Area	11.11%	1
Other (please specify)	0.00%	0

Total Respondents: 9

Q35 Q 3e If "Yes" to Q 3d, which/what regulation(s) are the motivating factors?

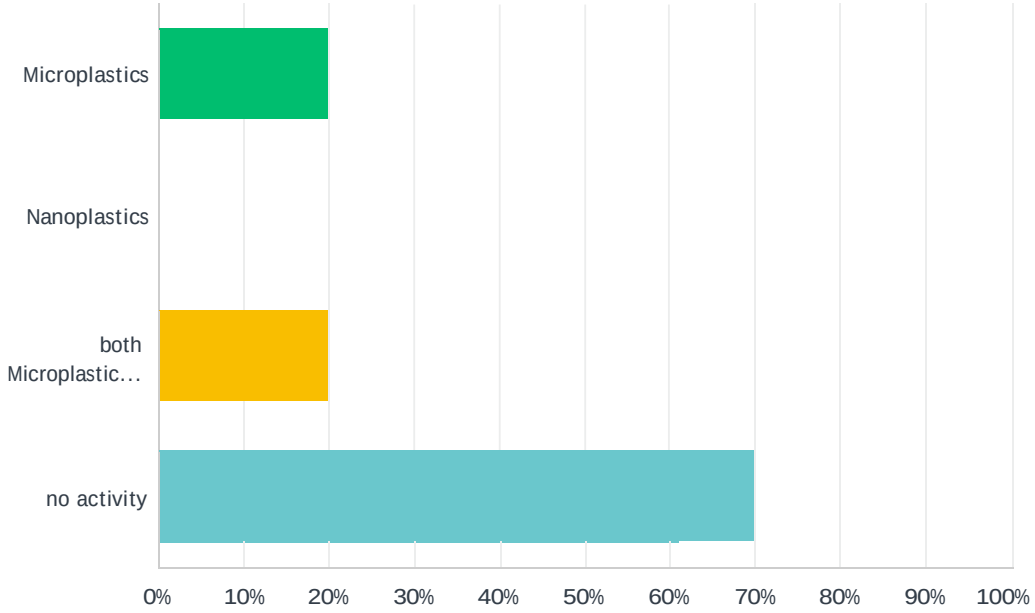
Answered: 6 Skipped: 27

Q36 Q 3f Are you aware of regulatory requests for microplastic detection?

Answered: 12 Skipped: 21

Q37 Q 3g Is your laboratory involved in developing documentary standards for micro- or nanoplastic measurements?

Answered: 31 Skipped: 2



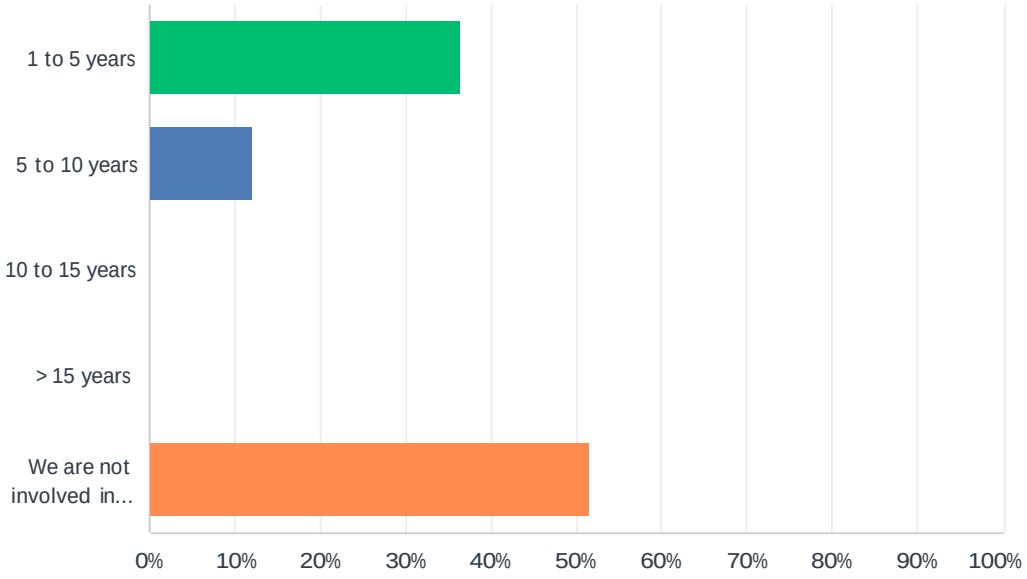
ANSWER CHOICES	RESPONSES	
Microplastics	19.35%	6
Nanoplastics	0.00%	0
both Microplastics and Nanoplastics	19.35%	6
no activity	61.29%	19
TOTAL		31

Q38 OPTIONAL: If you are involved in developing documentary standards, can you indicate which organization (international, national or regional) is coordinating the activity (ISO, VAMAS, etc.)

Answered: 7 Skipped: 26

Q39 Q 4a How long has your laboratory been involved in microplastic measurement?

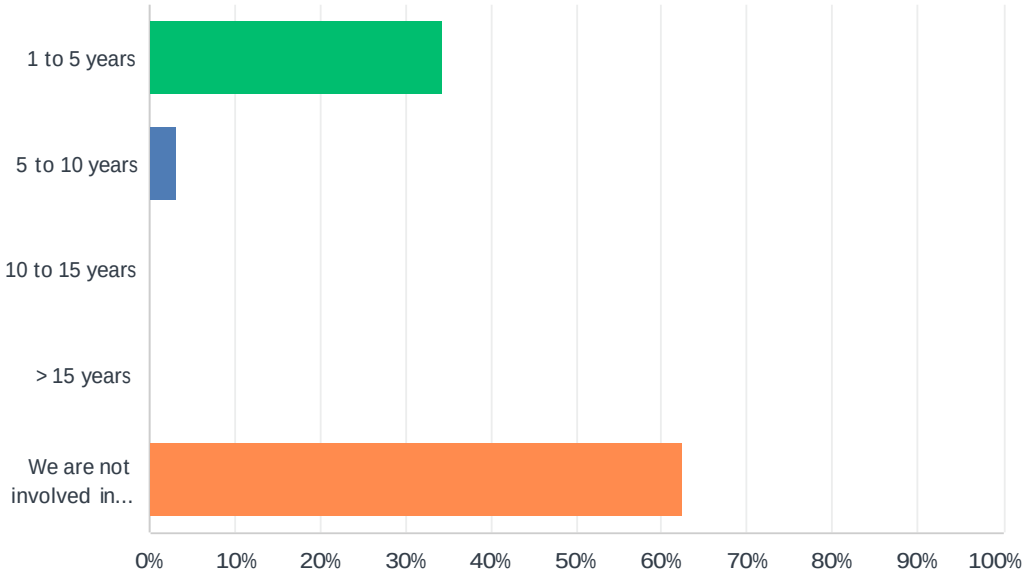
Answered: 33 Skipped: 0



ANSWER CHOICES	RESPONSES	
1 to 5 years	36.36%	12
5 to 10 years	12.12%	4
10 to 15 years	0.00%	0
> 15 years	0.00%	0
We are not involved in microplastic measurement	51.52%	17
TOTAL		33

Q40 Q 4b How long has your laboratory been involved in nanoplastic measurement?

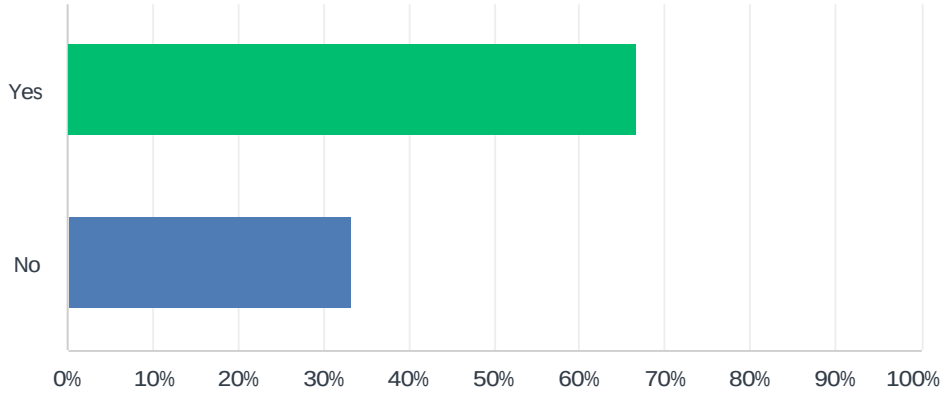
Answered: 32 Skipped: 1



ANSWER CHOICES	RESPONSES	
1 to 5 years	34.38%	11
5 to 10 years	3.13%	1
10 to 15 years	0.00%	0
> 15 years	0.00%	0
We are not involved in nanoplastic measurement	62.50%	20
TOTAL		32

Q41 Q 4c If not currently working on micro- or nanoplastic measurement, is this an area you plan to work in soon?

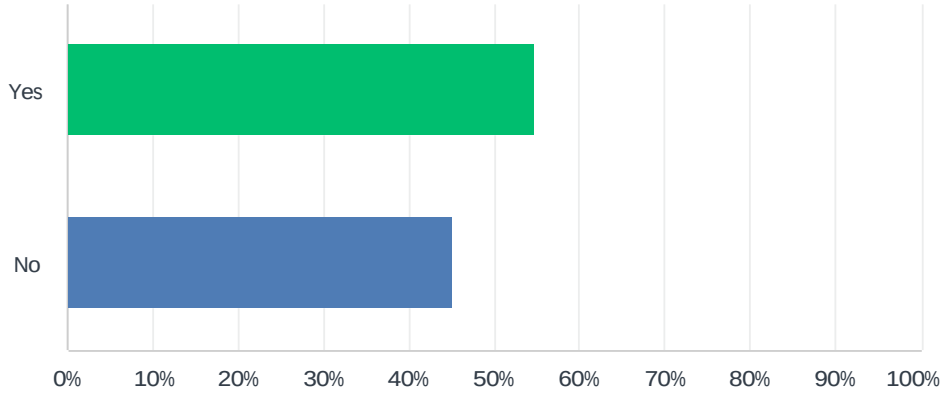
Answered: 24 Skipped: 9



ANSWER CHOICES	RESPONSES	
Yes	66.67%	16
No	33.33%	8
TOTAL		24

Q42 Q 4d Are there barriers to your laboratory working in microplastic measurement?

Answered: 31 Skipped: 2



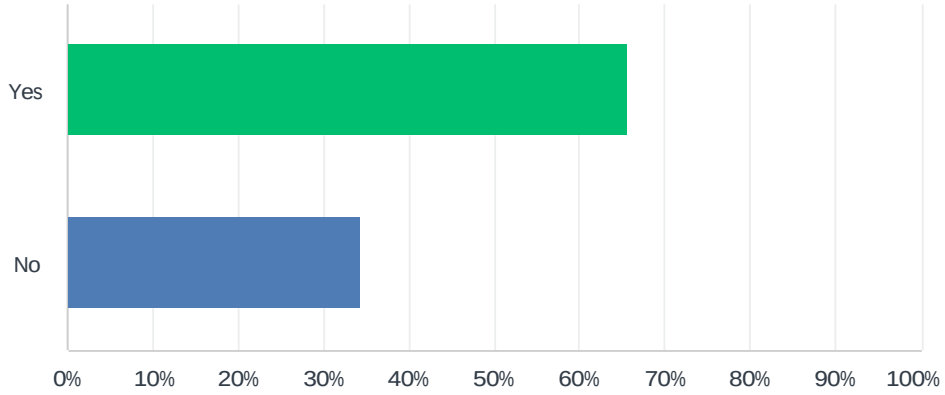
ANSWER CHOICES	RESPONSES	
Yes	54.84%	17
No	45.16%	14
TOTAL		31

Q43 Q 4d.1 If “Yes” to Q 4d, what are they?

Answered: 17 Skipped: 16

Q44 Q 4e Are there barriers to your laboratory working in nanoplastic measurement?

Answered: 32 Skipped: 1



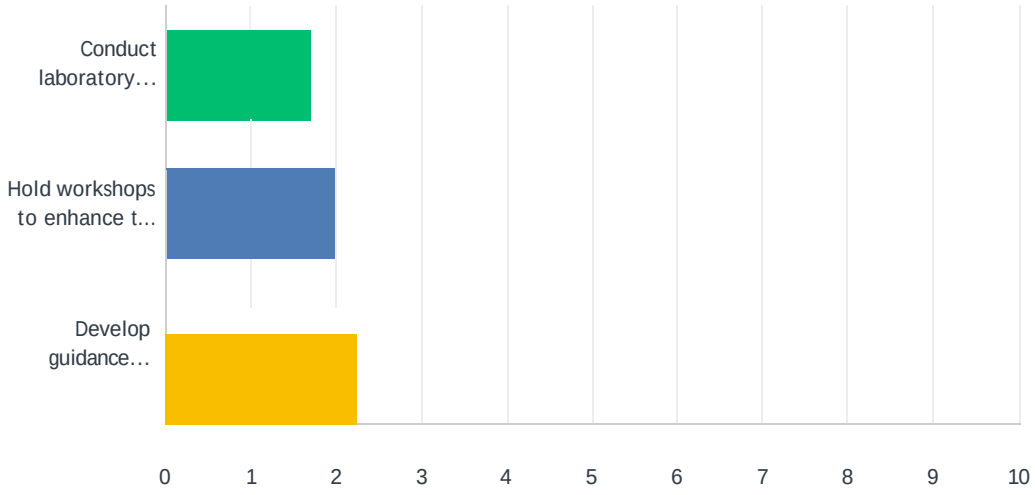
ANSWER CHOICES	RESPONSES	
Yes	65.63%	21
No	34.38%	11
TOTAL		32

Q45 Q 4e.1 If “Yes” to Q 4e, what are they?

Answered: 21 Skipped: 12

Q46 Q 4f Which CCQM activities could help to advance global comparability for microplastic measurement? Please use the arrows to rank the options from highest priority (at top of list) to lowest.

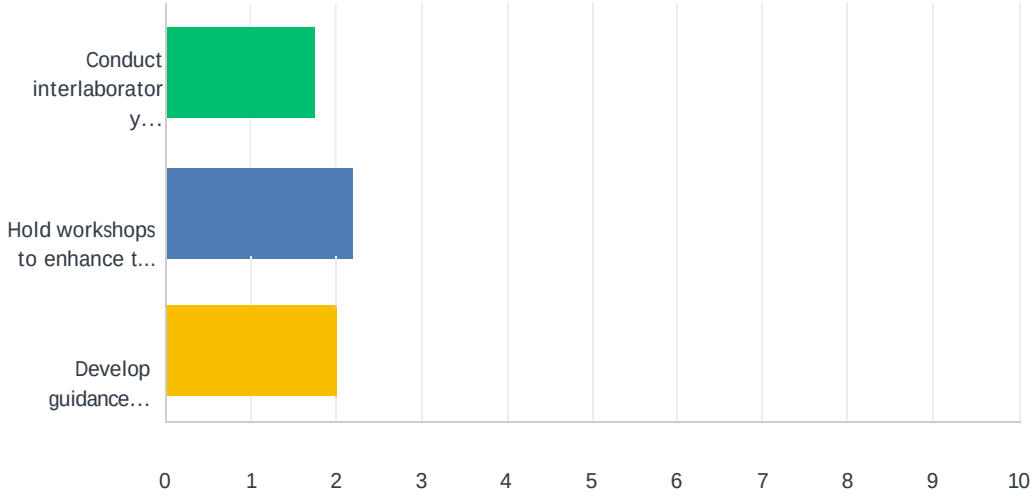
Answered: 30 Skipped: 3



	1	2	3	TOTAL	SCORE
Conduct laboratory comparison exercises	20.00% 6	33.33% 10	46.67% 14	30	1.73
Hold workshops to enhance the understanding of measurement challenges	30.00% 9	40.00% 12	30.00% 9	30	2.00
Develop guidance resources for microplastic measurement	50.00% 15	26.67% 8	23.33% 7	30	2.27

Q47 Q 4g Which CCQM activities could help to advance global comparability for nanoplastic measurement? Please use the arrows to rank the options from highest priority (top) to lowest

Answered: 29 Skipped: 4



	1	2	3	TOTAL	SCORE
Conduct interlaboratory comparison exercises	24.14% 7	27.59% 8	48.28% 14	29	1.76
Hold workshops to enhance the understanding of measurement challenges	44.83% 13	31.03% 9	24.14% 7	29	2.21
Develop guidance resources for nanoplastic measurement	31.03% 9	41.38% 12	27.59% 8	29	2.03