

PERSPECTIVE

Achieving sustainable transformation in science – green grassroots groups need nurturing from the top

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ABSTRACT

Climate change is the greatest challenge of our time, and drastic climate action is needed urgently across industries and sectors to prevent the worst in terms of consequences. Although academic research brings great benefits to society, it leaves behind a considerable environmental footprint at the same time. This is particularly true for lab research within the life sciences. To reduce the climate impact of academic research, both bottom-up and top-down strategies are necessary. On the bottom-up side, 'green' grassroots groups are emerging in academia, but most institutions fail to nurture and harness their potential for driving change. We report findings from a survey of 63 such grassroots groups operating in academic environments, highlighting that their main challenges in making research more sustainable include lack of time, budget, involvement in management decisions and support from management. For the first time, we map the inception, goals and structure of green grassroots groups in academia and outline concrete steps in overcoming barriers to harvest their full potential, thus making academic research fit for the future.

KEY WORDS: Academia, Grassroots groups, Sustainability, Sustainable research

Introduction

Climate change is the greatest challenge of our time, and the window of opportunity for mitigating the worst of its effects is closing rapidly (<https://www.ipcc.ch/reports/>). Our actions within this decade will determine whether we will manage to limit the temperature increase to 1.5°C relative to pre-industrial levels, as agreed by world leaders in Paris in 2015, or whether we are heading for much worse and turbulent scenarios. Sadly, the ambition of current strategies and levels of action are pointing towards the latter; unless we urgently and drastically limit the emissions of greenhouse gases and radically protect biodiversity, we will face numerous interlinked consequences of massive human-caused climate change within this century, including rising sea levels, heat extremes, severe droughts, ocean acidification, and more frequent extreme weather events (IPCC summary for policy makers on impacts, adaptation and vulnerability, https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_SummaryForPolicymakers.pdf).

Academic research has played a central role in documenting the causes and effects of climate change, and the evidence is irrefutable.

Moreover, academic research has positively impacted society in many other ways, from basic research uncovering fundamental biological principles to medical research improving human health. However, an unintended consequence of research, in particular lab experiments within the life sciences and medicine, is its negative environmental impact. In other words, such research itself comes with a considerable environmental footprint (ALLEA report, <https://allea.org/portfolio-item/towards-climate-sustainability-of-the-academic-system-in-europe-and-beyond/>). Not only are laboratories consuming more energy per square meter than any other sector except from data centers (<https://www.mygreenlab.org/energy.html>), academic research alone is producing an estimated 5.5 million tonnes of plastic waste every year (Urbina et al., 2015). On top of that, life science research is causing significant carbon emissions through the consumption of reagents, chemicals, materials and equipment (Borgermann et al., 2022).

For decades, the positive societal impact of academia has seemingly functioned as a *carte blanche* for ignoring its environmental impact. Nevertheless, research organizations and civil societies are now waking up to this dilemma and starting to set climate targets as well as develop strategies to render their operations more sustainable (Borgermann et al., 2022). A key responsibility of academia is to prepare future generations of researchers and decision makers for the challenges ahead while reducing its own climate impact; this can only be done by squarely integrating sustainability into teaching, research and operations. Embracing sustainability will provide significant competitive advantages for research organizations and strengthen their position as trustworthy institutions.

Across sectors, grassroots movements have been identified as essential in catalyzing change, including reaching the sustainable development goals (SDGs) (Flores and Samuel, 2019). The Fridays for Future movement – which started with Greta Thunberg's school strike in front of the Swedish parliament in 2018 and developed into hundreds of thousands of young climate activists taking to the streets and demanding climate action – is a prominent example. Climate activist groups such as Fridays for Future (<https://fridaysforfuture.org/>) and its many spin-offs, including Scientists for Future (<https://scientists4future.org/>), have managed what nobody achieved before – they took sustainability out of the closed sphere of world leaders and into the private concerns of people around the globe. Thereby, sustainability concerns and actions became an integral part of the lives of many individuals as well as society as a whole; these people now want to take environmental action at their place of study or work too. Among other goals, they expect their employers to take responsibility for carbon emissions and other environmental impacts.

This cascading of events is also noticeable in science and academia: the general movement towards sustainability, combined with the growing number of fact-based analyses on the environmental impact of research has prompted students and staff to favor change over status quo (see the ALLEA report,

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<https://allea.org/portfolio-item/towards-climate-sustainability-of-the-academic-system-in-europe-and-beyond/>). They can no longer accept studying concepts and phenomena of life and nature while damaging the environment at the same time, or do medical research to treat diseases when their work is contributing to the greatest threat to global health in this century – climate change.

Research organizations can be compared to large container ships – they cannot easily be turned around. Green grassroots groups are the speedboats that are more dynamic compared to their mother ships and can be very active in raising awareness as well as finding and implementing practical solutions related to, for example, reducing air travel to conferences, reducing single-use plastic waste in labs or providing meat-free catering (Burtscher et al., 2020; Farley and Nicolet, 2022 preprint; <https://zfv.ch/en/group/sustainability/environment>). Thus, instead of waiting for management to turn the ship around, students and staff have banded together in bottom-up grassroots movements to elicit change. Change is possible – in academia and beyond. It is neither easy, nor free of compromise, but it is possible. Despite the importance and potential of these grassroots movements, many universities and research institutions are not supporting or nurturing them, allowing their enormous potential to be lost.

To shed light on how green grassroots groups in academia have developed and define the challenges they need to overcome, we conducted a survey among 63 such groups (for details of the methodology and results of the questionnaire, see the supplementary information and Table S1, also available at <https://sels-network.org/index.php/data-grassroot/>). In the following, we outline the characteristics of the groups as well as their challenges, and we describe three grassroots groups of different sizes in more detail. Finally, we provide a set of practical recommendations, which are relevant for both management as well as grassroots groups themselves, with a view to forming successful bottom-up and top-down partnerships.

The characteristics of green grassroots groups in academia

A snapshot of the grassroots landscape in Europe

The vast majority (61) of the 63 grassroots groups responding to our survey are from Europe, representing 12 different countries; the remaining two groups are from the US and Australia, respectively (Fig. 1A,B). With 31 groups originating in Germany, they account for almost half of the groups participating in the survey. Therefore, our findings provide a snapshot of the green grassroots landscape in Europe, and Germany in particular. Nevertheless, we believe that most of the results of our survey and our recommendations are relevant for most grassroots groups in academia around the world, because of the similar structure of research institutes worldwide. Despite most of the groups being physically far apart from each other and founded during pandemic times, they are highly interconnected; 86% of the groups in our sample are in contact with several other green grassroots groups (Fig. 1C). In Box 1, we describe three different groups or networks and highlight their structures and approaches to making science more sustainable.

Green grassroots groups come in all flavors, but members are mostly PhD students and postdocs

Nearly two-thirds of the grassroots groups responding to our survey are anchored in life science (38/63), while the remaining groups represent a range of different areas (Fig. 1F). While the overrepresentation of life sciences partly stems from our own bias of working in this area, we note that the growing awareness of the high amount of single-use

plastic waste produced by life science research, which tends to serve as a wake-up call and motivate the formation of grassroots groups in basic and applied life sciences (Urbina et al., 2015).

Most of the groups (86%) are still young and started in 2019 or later (Fig. 1D); this means they were founded in the wake of Fridays for Future, Extinction Rebellion (<https://rebellion.global>) and similar movements, and led to a global rise in climate awareness and calls for climate action. One group stands out in terms of foundation year – The Human Ecology Research Group at the University of Vienna was founded back in 1990 (<https://www.humanecology.at/>). This interdisciplinary working group combines natural and social sciences, investigating how human activities, environmental policies and environmental practices impact ecology, natural resources and human well being. By now, this group has been working actively to increase awareness of sustainability within and beyond their university for more than three decades.

The average size of the responding groups is ~18 members, with one-third of the groups having six to ten members and another third having 10 to 20 members (Fig. 1E). Interestingly, in 97% of the responding groups, more than one type of position is represented; 40% of groups consist of a mix of PhD candidates, postdocs and research assistants (Fig. 1G). Professors and principal investigators (PIs), an essential part of the academic system, are represented in about a quarter of the groups (27%). They naturally have more influence on decision making processes at their institutes and universities, as they are members of existing committees. In addition, they often serve on external boards and evaluation panels outside their own university structures. Having these senior people join the grassroots groups automatically empowers the latter to directly raise issues and make requests at a higher level, putting sustainability more prominently on the agenda.

In our experience of working with green grassroots groups in academia, having multiple types of positions represented is conducive to success for at least three reasons – first, the group and its actions are more easily communicated and accepted across position types; second, the group is more likely to adopt a holistic (and realistic) approach, as different position types bring in different perspectives, knowledge and experience; and finally, a mixed group allows for sustainability to be part of the agenda of various committees, from PhD representatives to the committees of the senate.

The fact that early career scientists (PhD students and postdocs) are the most highly represented position types in the groups (Fig. 1G) is no surprise to us, as climate awareness is more linked to action in this age group because they have been exposed to the actions of Fridays for Future and others. Nevertheless, staff with permanent contracts are also fairly well represented, with more than half of the groups (53%) including technicians.

Building awareness and reducing resource use and waste are the main focus areas

To make research more sustainable, 69% of the grassroots groups focus their work on the institute level (Fig. 1H). The top three focus areas are raising general awareness (83%), efficiency and the reduction of waste, energy and water (83%), and greener laboratory and research practices (59%) (Fig. 1I). Despite many researchers being frequent fliers, and the fact that air travel emits a significant amount of carbon compared to on-the-ground transport, only one-third of the responding groups identified reducing flights as a main target for their activities (Burtscher et al., 2020; Rimmel, 2021). We see two likely explanations for this – firstly, the COVID response temporarily put a stop to physical conferences and meetings; secondly, air travel is a sensitive topic for many individuals who do

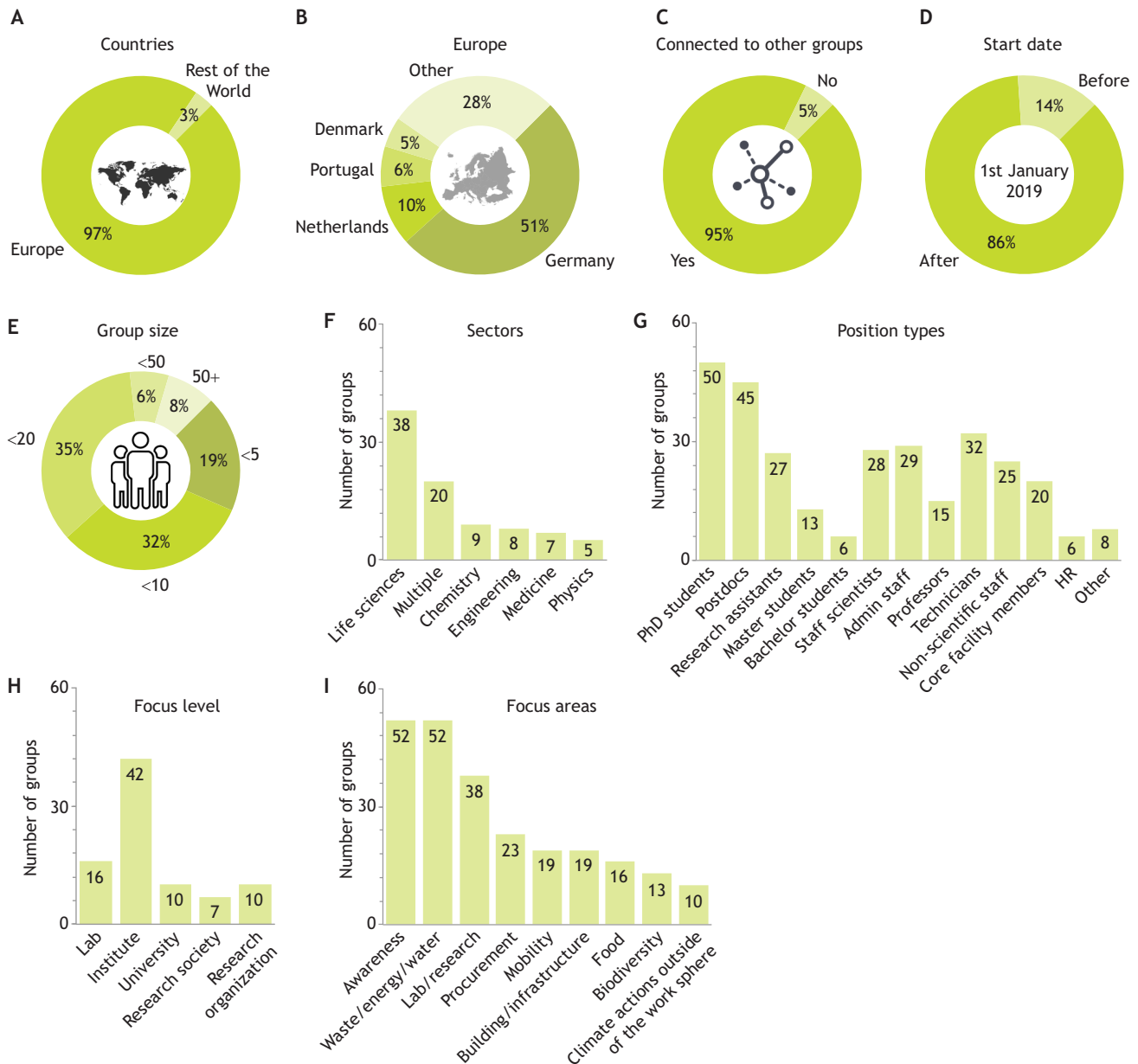


Fig. 1. Characteristics of green grassroots groups in research organizations that participated in our survey. Pie charts (A–E) show (A) the distribution of groups that are located in Europe, (B) which European countries they are located in, (C) their connection to other groups, (D) the start date of groups and (E) group size. Bar charts (F–I) show (F) the different academic areas represented by groups, (G) the position types of their members, (H) the institutional level their activities focus on and (I) the focus areas of their actions. Percentages are indicated on the pie charts. Number of mentions are indicated on the bar graphs. Total number of unique answers was 63.

not want to miss out on career development or holiday opportunities. Therefore, we speculate that grassroots groups avoid targeting individuals and advocate for solutions on the organizational level, which many institutes are now doing (<https://www.flyingless.org>).

Volunteering is the standard, and only a third of the groups have support from a sustainability manager at their organization

Although the work done in and for grassroots groups is conducted fully voluntarily in 80% of the groups, members of at least nine groups are allowed to use some of their paid work time for planning and implementing sustainability projects and meetings (Fig. 2A).

Despite climate inaction being a threat to future recruitment of staff and students, only 23 groups get some form of financial support, and only five of the financially supported groups reported having a paid position to manage the organization's sustainability activities (Fig. 2B). Thus, in more than 90% of the organizations, sustainable transformation is still largely left in the hands of passionate, but mostly self-trained, volunteers taking action outside of their core tasks.

Green grassroots groups in academia have initiated change but many challenges remain

Scanning the European grassroots landscape, it is clear that green groups and their bottom-up approaches have fueled change and made a difference in terms of climate awareness and action by

Box 1. Three inspiring examples of green grassroots groups and networks

Climate@MaxPerutzLabs is an institute-anchored group focused on making biological research more sustainable.

The group Climate@MaxPerutzLabs (<https://www.maxperutzlabs.ac.at/about/sustainability>) at the Vienna Biocenter Campus, Austria, consists of 10 members, including PhD candidates, Master's students, postdocs, technicians and administrative staff. An important step in their work was estimating the institute's carbon footprint and identifying the main sources of emissions in collaboration with the Alliance of Sustainable Universities in Austria (<https://nachhaltigeuniversitaeten.at/>). The group is currently focused on reducing lab plastic waste with Green Labs Austria and on raising awareness via their online VBC Climate Series. Importantly, the group has a seat at the table when decisions are being made at an institute and university level.

The Max Planck Sustainability Network facilitates knowledge-sharing across institutes and presents green interests to the top management.

The Max Planck Sustainability Network (MPSN; <https://www.nachhaltigkeitsnetzwerk.mpg.de/>) consists of more than 40 grassroots groups from the Max Planck Society (MPG). Its steering committee is elected annually by the representatives of the individual groups and represents the interests of the network towards the administrative headquarters of the MPG. A key achievement for the MPSN was the release of the Catalog of Recommendations (CaRe; <https://www.nachhaltigkeitsnetzwerk.mpg.de/doi-2021-care>), which outlines ways of improving sustainability in research institutes. MPSN also runs a Wiki on sustainable research practices that serves as a hub of knowledge and experiences, with most of it open to the public (<https://sustainability.wiki.gwdg.de/doku.php?id=start>).

The newly founded Sustainable European Laboratories Network connects people across Europe and serves as a common voice.

Sustainable European Laboratories Network (SELS; <https://sels-network.org/>) was founded in March 2022 by members of the FENS Kavli Network of Excellence (FKNE, <https://fenskavlinetwork.org/>), which is a collaboration between the Federation of European Neuroscience Societies (FENS) and The Kavli Foundation, Green Labs Austria (<https://greenlabsaustria.at/>), Green Labs Netherlands (<https://www.greenlabs-nl.eu/>) and the UK-based Laboratory Efficiency Action Network (LEAN) (<https://www.lean-science.org/>). The network will serve as a publicly available hub of knowledge on sustainable research practices and provides assistance and connections to groups and individuals with an interest in sustainable science. Additionally, the network aspires to function as a united voice to influence policymakers and key stakeholders on a European level.

universities. The hybrid Sustainable Research Symposia organized by Danish and Dutch green grassroots groups attracted more than 1000 participants over the past 2 years (www.suresymp.com); the Austria-based Green Labs Austria (<https://greenlabsaustria.at>) and Climate@MaxPerutzLabs have integrated plastic waste awareness and taught laboratory courses (Box 1); green groups have enrolled their institutes in the International Freezer Challenge (<https://www.freezerchallenge.org/>); and the Max Planck Sustainability Network has developed its Catalog of Recommendations (CaRe) on sustainability (Box 1).

Although these examples highlight that bottom-up approaches can make a significant difference, the results from our survey indicate that the green grassroots groups are suffering from a series of challenges that prevent them from unleashing their full potential.

Lack of time and high personnel turnover are key challenges

Lack of time stands out as a major challenge, being cited by 67% (42/63) of the survey respondents (Fig. 2D). In an environment

where people tend to work long hours due to considerable peer and career pressures, and where research and teaching are clear priorities over climate action, this might not be surprising and highlights the need for a cultural change to squarely include environmental action into research and teaching, i.e. the core business of the universities. Having 80% of the groups run in a purely voluntary manner (Fig. 2A) without sustainability activities implicitly or explicitly included in job descriptions, contracts or performance assessments, shows that research organizations do not facilitate sustainable transformation from within.

In addition to a lack of time, >50% (33/63) of the respondents identified sustainment, or continuity, of the group as a major challenge (Fig. 2D). Considering that most of the groups consist primarily of PhD students and postdocs – who have non-permanent contracts and might change their workplace every few years – this is expected but makes long-term progress very difficult (Dana et al., 2021). While a high turnover rate in a group on one hand can result in a desirable influx of knowledge and experience from other institutes and research organizations, it can also mean fizzling out of green activities as well as a recurring loss of momentum every time a key member leaves the group. The results from our survey clearly indicate that the latter is the case.

Groups struggle with budgets, involvement in decisions, and managerial support

In addition to the lack of time and high turnover of people in the group, 47% of the respondents stated 'no or limited budget' as a major challenge. While certain green activities can be implemented without a budget or can even reduce costs (e.g. reducing water, energy and material consumption), other activities require a budget to reach their potential. This includes the hosting of talks and workshops, developing campaigns, purchasing bins for waste sorting and expanding washing facilities to reduce the use of single-use plastics. Only 40% of the respondents reported that they receive financial support, of which most (70%) comes from their center, institute or university (Fig. 2B). A few groups have managed to get external grants, for example, from the Medical Research Council (UK) or Greenlab Zürich (Switzerland). Indirect funding is currently the major form of support that groups receive from the research organizations they are embedded in, often in the form of employees being granted a dedicated number of working hours for their activities.

Another important challenge, mentioned by more than a third of the respondents in the survey, is lack of involvement in decision-making processes (Fig. 2D). To understand how grassroots groups try to integrate in decision-making and to shed light on the interplay between management and the green grassroots groups in more detail, we included specific questions in the survey addressing how the groups are integrated in their institute or research organization structure (Fig. 2E). 77% of the respondents stated that the management of their research organization is aware of the group's actions, and 69% reported to be widely accepted by the management (Fig. 2E). At the same time, only 50% of the groups feel well supported financially or non-financially by management. A mere 37% of the groups have been offered a seat in a committee, and only one quarter reports that they can influence management decisions. Thus, our findings show that there is clear room for improvement when it comes to acceptance, support, involvement and influence.

Grassroots groups are essential in delivering emission reductions

In large organizations with many layers of management, which is typical for research organizations, the gap between top and bottom

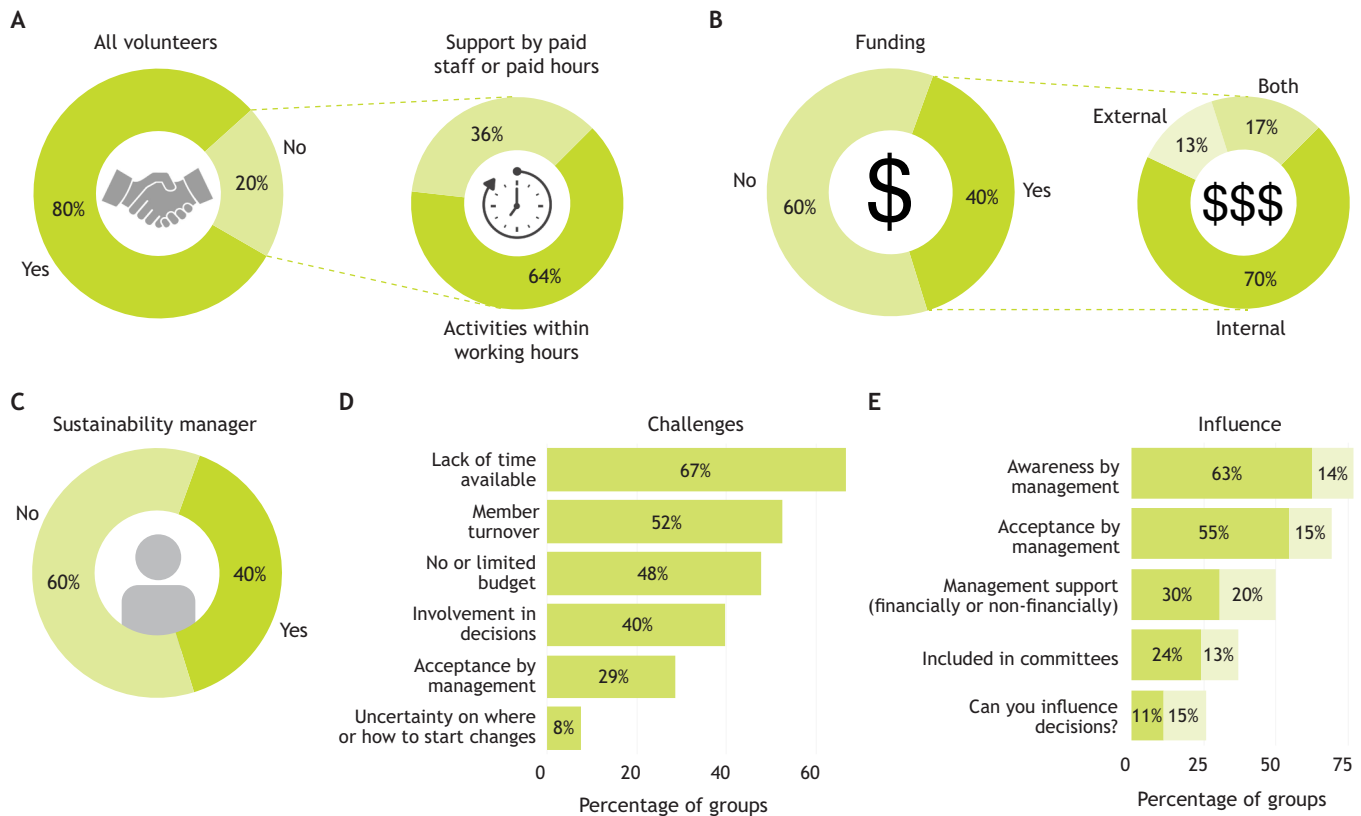


Fig. 2. Funding and support of the grassroots groups in our survey. (A) The percentage of grassroots groups relying fully on volunteers. The inset pie chart shows whether the supported groups have direct financial support or indirect support (activities within working hours). (B) The percentage of grassroots groups that received funding for projects. The right-hand pie charts shows the source of funding. (C) The percentage of the institutions that have a paid sustainability manager. (D) Current challenges limiting the success of green groups, with the percentage of groups mentioning each challenge indicated. (E) The current influence of the groups within their organization. Percentages are indicated on the bar chart. Dark green indicates strong agreement, light green indicates medium agreement.

management levels can prevent even the best strategies from becoming reality. This applies for green transformation, too. Research organizations already have the essential resources needed for sustainable transformation, such as research and data-crunching skills, technological insights, and highly motivated, well-educated students and staff in all areas of science. Besides the available technical know-how, this great foundation can also help create a culture of change. While only a handful of research organizations have estimated their total carbon footprint, including University College London (UK), University of Copenhagen (Denmark), and Norwegian University of Science and Technology (Norway), evidence clearly shows that the largest part of the footprint of research organisations (75–90%) stems from indirect emissions from products and services employed (Borgermann et al., 2022). Therefore, if a research organization wants to drastically reduce its carbon impact, it will need support and engagement from staff and students; it will simply not be enough to invest in electric cars or become self-sufficient with renewable energy. The consumption of products and services by staff and students, including travel behavior, will need to be addressed, and success in doing so will rely on broad support.

The autonomy that is given to groups, departments, and institutions in research organizations makes it difficult, if not impossible, for all staff to accept and adopt policies and procedures created at the top management level. Unlike the situation in similarly sized private corporations, this is not part of the culture.

Although changes such as electrification of fleets or a switch to renewable energy can be implemented with minimal engagement of staff and students, changing the research and consumption behavior of staff and students is hard; without engaging and informing them, and without locally anchored, tailored efforts, it is arguably impossible. Therefore, green grassroots groups are instrumental in reaching the climate targets of a research organization. These green groups must, however, be supported to reach their fullest potential.

How green grassroots groups can reach their fullest potential

To make it easier for grassroots to develop, thrive and increase their impact, we recommend that management supports them in ways that address the major challenges they are facing – lack of (paid) time, a high turnover of people, limited budgets and too little involvement in management decisions. Fig. 3 summarizes our advice on this matter and can serve as a tool for both management and green grassroots groups.

Firstly, we recommend encouraging staff, especially permanent staff, to join the groups. To represent the whole spectrum of the academic system, group leaders and professors should also be part of green groups. A higher number of group members reduces the individual workload, and having permanent staff in the group lowers the risk of activities fizzling out when key members leave. As part of encouraging people to join, the groups and their work should be acknowledged and endorsed at institute meetings and in newsletters, for example. People are more likely to join a group

How to support and nurture a green grassroots group



Fig. 3 Schematic overview of how green grassroots groups can be supported and nurtured to make academia and research more sustainable. The recommendations outlined in this figure address the major challenges that the green grassroots groups are facing, namely a lack of time, a high turnover of people, limited budgets and too little involvement in management decisions.

that is publicly supported by the management and has visible impact.

Members of green groups will have more time for green activities if their group leaders exempt them from lab duties or other tasks. It is important that the engagement in a green group is acknowledged as an activity that adds value to the institute rather than an activity that takes time from doing research. On top of this, group leaders, professors, and PIs should be encouraged to support this change by including sustainable criteria in their performance reviews and funding.

As a means to recruit members, increase awareness and promote their activities, the green groups should be offered time slots at institute meetings. We also recommend letting the groups access the digital infrastructure of the organization, for example by letting the groups have internal email lists and subpages on the website, and by giving them access to digital information screens where they can advertise their existence, their work and campaigns.

The groups should be provided a budget for events, workshops and other activities that will promote sustainability and engagement at the institute. We also recommend offering the groups support for

grant and funding applications, as well as reinvesting green cost savings into sustainable measures, including green group budgets.

We strongly recommend to invite the groups into decision-making platforms by giving them a seat at the table at management meetings and when institute issues are being discussed. The groups should be informed of any key meetings and their outcomes, particularly, but not only, when decisions related to sustainability are made. In practice, this can be achieved by assigning a focal person in the administration or management. Such a point of contact would also benefit the groups when they need logistical support or introductions to others within the organization, for example facility management staff. Finally, we recommend that sustainability managers are hired at the institute or research organization level to promote and implement the ideas and evidence-based recommendations of green groups within a coordinated sustainability strategy.

Only when bottom-up initiatives, including green grassroots groups, are supported and nurtured, and staff and students are engaged, can the operations of research organizations be rendered

environmentally sustainable and thus be aligned with the Paris agreement. It is high time for research organizations to make sustainable transformation a priority and to nurture green groups, particularly those with an anchor in life sciences. Thus, to turn the large research institute container ships around, it is time to mobilize the crew.

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Competing interests

The authors declare no competing or financial interests.

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