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Perspective—A League of Our Own: A Perspective on How to Start and Keep the Flow of Women in Energy Storage

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Women are under-represented in science, technology, engineering and mathematics (STEM) majors and careers in most industrialized countries around the world. The aim of this perspective is to offer a view of the current status in energy storage, mainly in Europe, while focusing on proposed solutions towards gender balance and providing examples of activities that could be carried out within industry and academia. It should be noted that we are not social scientists, the proposed solutions and activities are just based on our own experiences, and our main objective is to continue the discussion of gender equality in the energy storage field.

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Energy storage has been identified as a key element to climate change mitigation. The transition towards a more environmentally friendly future brings an array of social and economic benefits, including growing employment. These opportunities should be equally accessible, and their benefits equitably distributed (Fig. 1). However, the energy sector, similar to other STEM fields (science, technology, engineering, and mathematics), is affected by a persistent problem: it employs too few women, especially in leadership positions. For example, even though there are no reports on the number of women in energy storage, only 22% of the EU energy sector workforce¹ and 35% of the European workforce in the renewable energy sector are women.²

Promoting the role of women within the field can have positive practical consequences. Studies have shown that women bring new perspectives to the workplace and improve collaboration, while increasing the number of qualified women in leadership positions yields better performance overall.⁴ It has been observed in business and management sectors that gender-diverse workplaces have improved productivity, innovation, decision making, and employee retention and satisfaction. Moreover, gender-diverse institutions are more likely to outperform those that are not gender diverse.⁵ In fact, the 2030 agenda for sustainable development by the United Nations adopted a dedicated goal on gender equality: ‘Realizing gender equality and the empowerment of women and girls will make a crucial contribution to progress across all the Goals and targets. The achievement of full human potential and of sustainable development is not possible if one half of humanity continues to be denied its full human rights and opportunities. Women and girls must enjoy equal access to quality education, economic resources and political participation as well as equal opportunities with men and boys for employment, leadership and decision-making at all levels.’⁶ Therefore, this should also be an inherent goal in the rapidly growing energy sector.

Women are more likely than men to leave science (voluntarily or forced by biases, barriers, and toxic and/or non-inclusive environments) at multiple time points from the beginning of college through academic tenure.^{7,8} Herein, we explore the multiple pathways that women can follow in the energy storage field from participation in research postgraduate studies to opportunities in academia and industry. Furthermore, we provide some examples on how to make the work environment healthier and more diverse.

Current Status

Energy storage is a rapidly developing field as it is essential for most electrical devices and a vital tool to facilitate the energy transition. The growth in this field is driven by academia, industry, and government who, respectively, study the processes that take place in these systems, expand and improve the technology and create rules to make sure this transition is regulated and focused on the sustainable growth of our society. Development of more efficient and environmentally friendly devices require innovative solutions which may be easier to achieve with a greater participation from a diverse talent pool. Designing the devices of the future requires cross-disciplinary professionals from all the STEM areas (e.g. scientists help researching innovative energy materials, technicians and engineers help designing electrochemical cells and cases, and mathematicians help developing models to understand the electrochemical processes taking place).

One of the ways to become involved in energy storage research is to find master or PhD programs at universities or research centers and apply to become one of their students. This search can also be done contacting professors or researchers active in the field. However, we would like to highlight certain programs we are aware of in Europe that have been created exclusively to develop the skills essential to be employed in the research, manufacturing and characterization of energy storage devices. BatteryMBA⁹ is a 12-week Continuing Professional Development (CPD)-accredited program aimed at battery enthusiasts without any specific course or degree prerequisites to apply. In the case of masters we can highlight the Materials for Energy Storage and Conversion (MESC+) Erasmus Mundus Joint Master Degree,¹⁰ the Master’s Program in Battery Technology and Energy Storage from Uppsala University,¹¹ the Master’s in Energy Storage program organized by the EIT InnoEnergy network,¹² the MSc Energy Storage from Ulster University,¹³ and the MSc in Energy Conversion and Storage from Technical University of Denmark.¹⁴ To the best of our knowledge the only PhD program entirely dedicated to energy storage is the doctorate program on emerging battery storage technologies inspiring young scientists (DESTINY),¹⁵ a 5-year EU Marie Skłodowska-Curie COFUND project.

From the PhD graduates’ perspective, their studies have trained them well in analytical, data and technical skills, along with presenting to specialist audiences and writing for peer-reviewed journals; skills traditionally associated with an academic research career. And most of them consider themselves more confident for an academic research career,¹⁶ despite some of those skills also being valuable in industry and other careers. If academia is the career

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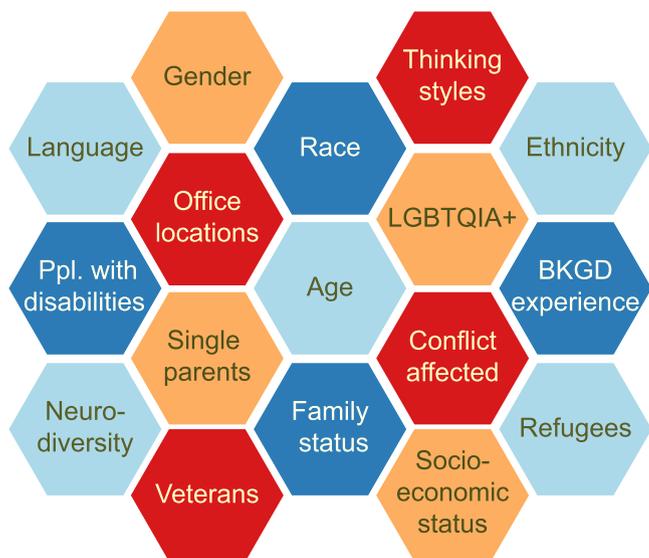


Figure 1. Example of an inclusive workforce. Adapted from mercer.com.³

choice, the conventional next step after a PhD is to pursue a postdoctoral position and/or fellowship (e.g. Marie Skłodowska-Curie Actions,¹⁷ Fulbright Scholar Program,¹⁸ Humboldt Research Fellowship¹⁹), followed by an adjunct or faculty position at a university. However, academic careers are usually less stable than other alternatives mainly because permanent academic positions are often scarce and highly competitive. Nevertheless, it is worth noting that research-intensive jobs can also be found within research institutions and industry which widens the job market and possibilities to do research outside academia.

Although not often acknowledged, PhD programs also provide researchers with a variety of transferable and valuable skills that can be used in other professional environments. Here, we provide some examples of non-academic career paths that can be pursued after a PhD degree or at any other stage. Non-research jobs, that are still close to academia, can be found in education and public outreach, publishing industry, universities, research institutions, industry, consultancy companies, funding agencies, and governmental



Figure 2. Actors involved in driving Equity, Diversity & Inclusion (EDI).

agencies. In the UK, for example, 53% of PhD graduates who left academia were employed in non-research positions.²⁰ PhD holders were also extremely likely to be working in highly skilled jobs as professionals or associate professionals, managers, directors or senior officials.

The battery sector has been forecasted to create, just in Europe, around 64,000 new direct jobs in battery cell manufacturing in 2025 and 100,000 in 2030. Following are some examples of the projected industry growth in Europe. By 2025, Germany will be the country that produces the most batteries in Europe with around half of the European batteries produced there. Second will be Poland with 14% of the European production (LG Chem), while Hungary (Samsung SDI, SKI Innovation), Norway (Morrow and Freyr), Sweden (Northvolt), and France (ACC and Verkor) will reach approximately the same level with around 7%–8% of the production.²¹ Furthermore, there are many other companies and start-ups in the field that are looking for experts to join their teams. This clearly indicates the need for talent in the field of energy storage and the wide variety of jobs and skills required throughout the whole value-chain where women and other under-represented groups can undoubtedly contribute.

Future Needs and Prospects

Research and development of energy storage devices, in industry, research centers and academia, require knowledge and solutions and that can only be achieved by having a greater diversity of perspectives. We would like to encourage the realization of national surveys to collect data about the diversity of the people working in energy storage, their goals, challenges and sources of satisfaction. The analysis of this data could point out where there is room for improvement and how to lead the way to a more inclusive and healthier working environment in Europe.

To include more women in the energy storage field, and based on our own experience, work reported for other areas and policies used in the renewable energy sector,^{2,22–24} we propose a series of strategies and activities to recruit, promote, and empower women in this field across different sectors (Fig. 2). Even though, we are focusing on women, it should be noted that gender equality is not a binary problem as it includes a major diversity regarding gender. Thus, some of these strategies could potentially be beneficial for other under-represented groups.

- Diversity recruitment programs: Creating events that bring prospective students from diverse backgrounds together with world-renowned faculty, students, and alumni. This type of programs can also be organized by industries in order to attract diverse talented people.

- Mental health programs: Highly-qualified professionals are among the occupational groups with the highest levels of common mental disorders.^{25,26} Although it is more common in academia, it is also present in industry and other work places. Depression and anxiety as well as harassment and bullying at work are some examples of common reported problems.²⁷ Besides the large impact they have on mental health, they also have a negative effect on the global economy.²⁸ Therefore, it is necessary to create healthy workplaces by enforcing guidelines for mental health care and wellbeing at work. Wellness events and the World Mental Health Day are great ways to raise awareness of mental health issues around the world and to mobilize efforts in support of mental health. More initiatives such as Dragonfly mental health,²⁶ Cactus foundation mental health,²⁹ and the Researcher Mental Health Observatory (ReMO)²⁵ focusing on wellbeing and mental health within academia should be developed. These initiatives could be combined with specific programs offered by the groups, institutions, and companies for achieving mental health wellness.³⁰

- Gender policies: Gender imbalances in different areas and at different levels can be corrected by introducing institutional gender policies such as gender quotas as they ensure the inclusion of women

and promote equal access to training opportunities or jobs. For example, the inclusion of gender quotas in France showed an increment of female workforce in French companies of 9% in 6 years.² However, employees at all levels should be trained about the benefits of a diversified workforce to reduce negative attitudes. Another gender policy started in 2019 by Chalmers University of Technology (Gothenburg, Sweden) is “Genie” (Gender Initiative for Excellence). Genie is a university-wide effort to increase the representation of female faculty and promote gender equal systems and processes as well as to create an inclusive work environment and campus culture. By providing, for example tailor-made activities to the people on leadership positions to reach gender equality in their teams. After just one year, the Department Heads and faculty at Chalmers have already reported the building of trust in the system and an increased awareness of diversity and equity issues.³¹ Furthermore, in cases where bullying or hostile behavior appears, clear reporting procedures should be in place and enforced without repercussion to the victim’s career and mental well-being.³² In this context, the Academic Parity Movement is a global initiative fighting to end discrimination, violence and bullying, by empowering students, postdocs, and early career academics (including junior faculties) with the help of legal professionals, psychologists, researchers and their own legislators.³³

- Funding agencies to institute equity policies: Diversity of the investigator team should be a score-driving criteria in grant review as it has been shown that diverse teams generate the most creative, innovative, and impactful solutions and science.³⁴ We would like to encourage more funding agencies to follow the example set by the Marie Skłodowska-Curie Actions fellowship¹⁷ including a gender dimension section in their proposals. Furthermore, funding agencies should also contact former students, researchers, or employees that can attest to the manager’s practices without being coerced. Another suggestion is for funding agencies to regularly analyze and present reports of the diversity of their applicants and awardees.³⁵ Finally, funding agencies should also follow up with the grantees and make sure they commit to the equity policies and, in case they do not, funding agencies should act and sanction accordingly.^{36,37} For example, The Leverhulme Trust revoked the funding from a researcher who had breached their anti-harassment policy.³⁸

- Equity, Diversity, and Inclusion (EDI) Committees: EDI committees can address and implement proactive strategies regarding human rights (e.g. religion, age, disability) and discrimination (e.g. racism, sexism, homophobia, transphobia, ableism). The members of the EDI committee should reflect the diversity of the university/industry. We have seen mostly women attending activities organized by these committees and we would like to encourage everyone to attend as they are a way of gaining awareness and deal with unconscious biases.

- Equity, diversity, and inclusion trainings at all levels: It is important to create an environment, both in industry and academia, in which inequities in power and privilege are addressed, to build a respectful and diverse community that ensures welcoming spaces and opportunities to flourish for all.

- Career guidance: Supervisors and mentors should ensure that their students, researchers, and mentees are aware of their transferable skills and the wide range of career pathways they could follow. This could also be a way to deal with impostor syndrome by promoting the students’ accomplishments and talents, reinforcing their confidence.

- Leadership and management trainings: New and seasoned leaders should have access to resources to become more adept at developing and engaging students/mentees/employees, and inspiring and guiding teams. It has been suggested that bad leaders and managers are the strongest contributors to unhealthy lab cultures.³⁹ Great workers tend to join departments with a reputation for healthy cultures, ultimately leading to major breakthroughs.⁴⁰

- Paid parental leave for both parents: These leave policies have been shown to promote gender equality, as well as being instruments for supporting child, maternal and paternal health and well-being,

birth rates and various labor-market outcomes, such as increased women’s participation in the labor market and reduced gender pay gaps.⁴¹

- Career restarts: People take career breaks for a variety of reasons including maternity or caring responsibilities, physical health, mental health, relocation, etc. Returning to STEM jobs after a career break requires overcoming biases in the recruitment processes as recruiters perceive these breaks as a deterioration of skills. We suggest creating career restart programs where returnees can update their knowledge and skills or to support individual to resume research. For example, the STEM Returners program⁴² in the UK (co-supported by the Institute of Marine Engineering, Science and Technology and the Women’s Engineering Society) offers paid short-term employment placements for female and male professionals returning to work after a career break. The program also provides support for the candidate in advice, career coaching, networking opportunities and mentoring. Another example is the Career Restart (CAR) Panel of the Individual Fellowships (IF)¹⁷ action that looks to provide wider access to those who have been absent from research for at least a year, for whatever reason, including displacement because of conflict.

- Stimulation through role models: Stereotype barriers can be overcome through the intervention of female role models, who can increase the sense of belonging to the field. Ideally, these role models should be an example of successful work-life balance and flexibility in gender roles in addition to professional conduct. Recently, several initiatives have celebrated the contributions of the women working on energy storage^{43–50}; however, further diversity is needed in the role models highlighted.

- Mentoring programs: Early-stage researchers/workers could benefit from continuous and dynamic feedback through which an experienced researcher/worker shares knowledge, skills, information, and perspective to foster the personal and/or professional growth of their mentee. The women in energy storage mentoring program organized by the GWNET,⁵¹ for example, has supported 25 women since 2020 in junior/middle management positions in the energy storage field towards leadership positions. Moreover, reverse mentoring could also help driving culture change and promoting diversity.

- Creation of a network: A network of women in energy storage can reinforce the competence, visibility, and capacity of emerging researchers, change the global and/or local direction of research activity, promote collaboration among partners, and make visible its members and their science. Activities developed within this network could include female mentoring programs, and a database of women speakers.

- Stop “manels” and “manferences”: All-male speaking panels and conferences are a superficial manifestation of the lack of gender equality in leadership positions in industry and academia. Panel and conference organizers should cast their nets wider to find women speakers for their events. Moreover, we would like to invite our male colleagues to proactively suggest names of their female colleagues or to decline the opportunity to participate if the panel is not diverse.

Finally, we would like to bring attention to the “leaky pipeline” expression that is sometimes used to describe the drip out of women in the academic career when moving to higher positions, suggesting that women are doing something wrong instead of highlighting that the problem is in the system.⁵² For us, and many other colleagues,⁵³ it is misleading and an inappropriate description for nearly all other pathways in STEM as it implies a sense of failure at not following the academic tenure track path. We believe there are a wide variety of leadership positions that are fundamental in the energy storage field that women can pursue without feeling burdened for leaving academia.

Conclusions

Women have and keep playing significant roles in the development of the energy storage technologies of the future. While their relative participation in the energy storage field is increasing, representation in higher management and leadership roles is still lacking. We need the entire energy storage community to actively lean into solving this gender bias problem, and in general the lack of diversity, instead of asking only the under-represented communities to solve it among themselves. While companies, institutions and organizations need to address this issue, it is also important to face it at an individual level. However, being aware of the issue is not enough and actions should also be taken. We encourage everyone to promote gender equity in their everyday actions and situations and to react against inequalities and discrimination. Clear and specific goals with targets and timelines for five and ten years in the future need to be set within each workplace to achieve true gender equality and diverse society.

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