



Gender and Sustainable Chemistry: How women can benefit from sustainable chemistry ...and sustainable chemistry from them

"We need chemistry to move forward the [UN] 2030 Agenda for Sustainable Development. We need chemistry to eradicate poverty. We need chemistry to bolster health. We need chemistry to mitigate the impacts of climate change. In a word, we need chemistry for human rights and dignity, to leave no one behind. Not just any chemistry..."

We need green chemistry...sustainable chemistry...chemistry that respects the boundaries of the planet...chemistry that is inclusive, that works for the benefit of all...Indeed, the modern world, as never before, needs green [and sustainable] chemistry."
Irina Bokova, Director-General, UNESCO, 2017 ¹

These few sentences by Irina Bokova, Director-General of UNESCO, depict in a nutshell what sustainable chemistry is about. The transition to sustainable chemistry requires a new approach of systems thinking which builds upon green chemistry, addresses the full lifecycle of chemical products and embraces the triple bottom line of sustainability – people, planet and prosperity. Sustainable chemistry strives not only to provide safer alternatives, but also aims at contributing to the UN Sustainable Development Goals (SDGs) through innovative and viable solutions that enable a circular economy.

But what can sustainable chemistry mean from a gender perspective?

Sustainable chemistry (SC) provides a promising opportunity to mainstream gender-specific aspects in the chemicals sector and beyond. As a holistic

¹ Address at the PhosAgro / UNESCO / IUPAC Award-Giving Ceremony (Grants for research projects proposed by young

scientists in green and sustainable chemistry) St. Petersburg, 2 June 2017

approach, it encompasses ethic principles and social aspects. It addresses vulnerable groups and human right issues (women's rights, rights of the child, workers' rights), ethics of science (e.g. against military purposes), the prevention of future legacies, the precautionary principle and calls on the responsibility of all stakeholders involved in producing and using chemicals. Similar to the gender mainstreaming approach, SC helps us understand and tackle root causes of unsustainable behavior and make trade-offs visible.

Let's have a look at the innovation field

Entrepreneurs, researchers and founders in industrialized countries and even more so in developing countries represent the change-makers and innovation drivers of their communities by solving key local and global societal problems through innovative products and processes, for example, in waste management and renewable feedstock.

Innovative solutions very often originate from the chemical sector, its research community and start-up companies in different areas. Unfortunately, these solutions do not easily find their way to the market, and particularly female researchers and founders face a long and stony way towards success, especially in searching for funding sources, financial support from investors, training possibilities or lack of equipments and adequate lab spaces. Female founders are strongly underrepresented in technology-intensive areas, which is closely related to the low number of women with a background in science, technology, engineering and math (STEM). According to the *Silicon Valley Bank Report 2019* about Women in Technology Leadership 2019², only 28% of all technology start-ups have at least one female founder. Kuschel et al (2020) "This underrepresentation of women in innovation-driven business startups highlights existing gender biases and systemic disadvantages in social structures,

making visible the double masculinity that exists at the intersection of STEM and entrepreneurship."³

STEM fields show a high level of gender imbalance, chemistry included, and in all regions of the world. Traditional structures persist, and structural barriers hinder the equal engagement of women in entrepreneurship. Furthermore, they limit opportunities for women as entrepreneurs within fields "where earnings are higher, startups have higher growth expectations, and both public support systems and private venture capital tend to focus."⁴

The *Female Founders Monitor 2019* makes it clear that while women are indeed more strongly represented than in previous years, they are still drastically underrepresented when it comes to founding young, innovative companies.

Looking at the green and sustainable chemistry startups landscape in Germany, for example, we see that green startups have a significantly higher female founder quota (22%) compared to non-green startups (13%)⁵. In fact, female founders are more motivated by social and societal issues, thus establishing new business fields at the interface between economy and society. Moreover, social entrepreneurship and green economy seems to be a high priority for women. Hence, we can assume that increasing women's leadership in STEM fields and fostering female entrepreneurship in green and sustainable chemistry could further strengthen the introduction of green applications and circular business models.

Why is progress so slow? What are the difficulties for female start-ups?

As Brigitte Zypries, former German Federal Minister of Economics and Energy, put it, "the existing [political] measures designed to help women to set up their own businesses are far from adequate. [...] It is still made much more difficult for women to obtain the necessary funding. This is clearly reflected in access to venture capital or business angels. [...] We must overcome these and other obstacles. Then it will be much easier for women entrepreneurs to think bigger and to realize their full potential."⁶

² Women in Technology Leadership 2019, Key insights from the Silicon Valley Bank Startup Outlook Survey https://www.svb.com/globalassets/library/uploadedfiles/content/trends_and_insights/reports/women_in_technology_leadership/svb-suo-women-in-tech-report-2019.pdf

³ Stemming the gender gap in STEM entrepreneurship – insights into women's entrepreneurship in science, technology, engineering and mathematics by Katherina Kuschel & Kerstin Ettl & Cristina Díaz-García & Gry Agnete Alsos, Published online: 5

March 2020, in *International Entrepreneurship and Management Journal* (2020) 16:1–15, <https://doi.org/10.1007/s11365-020-00642>

⁴ <https://link.springer.com/article/10.1007/s11365-020-00642-5>

⁵ Green-Startup Monitor 2020 by Borderstep Institut für Innovation und Nachhaltigkeit gemeinnützige GmbH and Bundesverband Deutsche Startups e. V.

⁶ Female Founders Monitor 2019, by Bundesverband Deutsche Startups e.V. The translation into English is done by the author of this article



Let's have a look now at education in chemistry

When looking at school or university curricula in chemistry, gender aspects are rarely considered.

Statistics on chemistry courses 2008-2018 by Gesellschaft Deutscher Chemiker (GDCh) make it clear, that in Germany there has been a slight and steady increase in the proportion of female new chemistry students since 2011, from 36% to 43% in 2018, although the difference between the genders is greater when it comes to degrees: only about a third of these degrees are held by women (Bachelor's: 37%, Master's: 35%, doctorate 34%; as of 2018).

More attention is needed, for instance on gender relevant aspects in toxicology - also in connection with gender medicine, which is currently gaining popularity in medical research, (see <https://www.journals.elsevier.com/gender-medicine>), but also with regard to gender-aspects in chemicals management.

Sustainable chemistry offers a different way of thinking and teaching chemistry. By adopting a more comprehensive perspective, SC raises the awareness for the fact that the chemistry of the future has to find sustainable answers for global problems. Teaching sustainable chemistry means challenging chemists and engineers to design substances, processes and services by considering the whole lifecycle of materials, focusing on closing loops and circularity processes, on non-chemical alternatives and the producers and consumers themselves. It requires out of the box thinking and new curricula in chemistry education, where gender-specific aspects are included. A novel programme teaching this new holistic approach to sustainable chemistry was jointly developed by the Institute of Sustainable and Environmental Chemistry at Leuphana University and ISC3. The programme was successfully launched at Leuphana Professional School in March 2020.⁷

Looking ahead

Much has still to be done to strengthen and mainstream the gender topic within the chemicals sector.

Developing sustainable chemistry with its holistic approach can help mainstreaming gender-relevant

aspects in chemistry - in education, innovation, entrepreneurship and beyond.

It can help raising questions and highlighting the shortcomings that still exist.

It can point out how women's participation and leadership in STEM affects the chemical environment.

It can underline where there is lack of progress and it can help realize unused potentials for further development in chemistry. Sustainable development cannot be achieved without sustainable chemistry, and sustainable chemistry cannot be implemented without the empowerment of women and gender equality.

The International Sustainable Chemistry Collaborative Centre (ISC₃) is an international think tank, dedicated to shape the transformation of the chemicals sector towards sustainability. By promoting the emerging concept of sustainable chemistry as a new holistic approach, the ISC₃ strives to contribute to the sound management of chemicals and waste as well as to the Agenda 2030 and the achievement of the UN Sustainable Development Goals (SDGs). The ISC₃ has taken on the gender topic in its portfolio as a part of its sustainability agenda with the goal of strengthening the specific gender aspects in entrepreneurship, innovation, research etc.

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This article has been initially published in the Blog Series "How to create a Gender-Just Healthy Planet" by the MSP-Institute.

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⁷ www.leuphana.de/sustainable-chemistry