LIAISE

Cooperation, development
and cross-border transfer
of industrial symbiosis

LIAISE COST Action Gender Equality Plan

Authors
Noemia Bessa Vilela
Andrius Puksas

TABLE OF CONTENT

Project Action Context

In the context of addressing climate change, industrial sectors play a significant role as major contributors to carbon dioxide emissions, energy consumption, and waste generation. To combat these challenges, adopting a Circular Economy strategy is imperative. The Circular Economy model diverges from the traditional linear approach by promoting sustainable production and consumption practices while considering societal, environmental, and economic factors in a balanced manner.

Industrial Symbiosis (IS) emerges as a practical solution within this framework. In IS, waste or by-products generated by one industry are repurposed as resources for another, presenting opportunities for environmental sustainability and economic efficiency. Despite its potential, many companies and industrial actors lack awareness of IS, and its development is hindered by various barriers, including environmental, economic, technical, regulatory, organizational, social, and cultural challenges.

To address these issues, the LIAISE COST Action seeks to foster an inclusive and holistic IS approach. By fostering synergies among stakeholders from diverse sectors and laying the groundwork for knowledge enhancement, LIAISE COST Action aims to bridge the gap between theory and practice. This initiative will involve developing a participatory approach to support cross-sector collaborations and establishing Key Performance Indicators (KPIs) for assessing the effectiveness of IS business models in industry.

The LIAISE COST Action represents a collective effort to make the Industrial Symbiosis a reality across Europe, fostering collaboration among researchers, practitioners, and policymakers. To achieve these objectives, LIAISE COST Action will leverage the expertise of four interdisciplinary Working Groups (WGs) and integrate their findings through a reference framework. This holistic approach aims to drive meaningful progress towards sustainable industrial practices and contribute to a more Circular Economy.

1. Introduction

The field of Industrial Symbiosis, which lies at the intersection of engineering, environmental sciences, industrial ecology and systems innovation, has historically been male-dominated – particularly in its more technical and industry-facing subdomains. Although gender representation in STEM (Science, Technology, Engineering and Mathematics) is improving across Europe, entrenched structural and cultural biases continue to shape the experiences and opportunities available to women and gender-diverse researchers.

COST Action CA22110 is committed to fostering a research environment that not only achieves gender balance between women and men, but also recognizes, affirms and includes individuals of all gender identities, including those who are non-binary, genderqueer, genderfluid, agender or who define their identity outside traditional gender categories.

While current participation data within CA22110 indicates no self-identifying non-binary members to date, this absence must not be interpreted as a lack of relevance. Rather, it points to underlying barriers to participation, visibility and self-disclosure, which must be actively addressed if the Action is to fulfil its inclusivity mandate.

This section highlights four key dimensions of gender bias that are particularly relevant to the context of LIAISE:

Underrepresentation in Technical Leadership: A well-documented bias in the broader field of engineering and industrial systems is the underrepresentation of women in technical leadership roles – particularly those tied to industrial sectors, manufacturing innovation and process optimization. Even when women participate in research consortia or academic collaborations, they are more often assigned supportive or coordination roles rather than being recognized as technical leads, model developers, or data analysts. This leads to skewed perceptions of expertise and limits recognition, citations, and funding prospects.

In the context of Industrial Symbiosis, which requires complex modelling, Life Cycle Analysis (LCA), and data-intensive system mapping, these biases can reinforce the idea that certain tasks (e.g., stakeholder engagement or dissemination) are more suited to women, while others (e.g., system design or process engineering) are "naturally" led by men. Such role segmentation, though often implicit, undermines the interdisciplinary ethos of the field.

Industry-Academia Interface Biases: COST Action CA22110 uniquely engages with industrial stakeholders, especially from sectors like chemicals, energy, construction and waste management. These industries remain largely male-dominated at senior levels and this reality influences the dynamics when researchers – particularly women or non-binary individuals – interact with them.

At this interface, women researchers may face credibility gaps, patronizing attitudes or exclusion from informal decision-making processes, particularly during site visits, stakeholder negotiations, or policy consultations. Gender-diverse researchers may also be misidentified as junior or assumed to be responsible for public relations or communication roles, regardless of their actual expertise.

Such biases hinder equal participation in strategic aspects of the Action and can lead to unequal recognition in deliverables and outputs.

Gendered Assumptions in Sustainability Science: A subtler but equally significant bias emerges within the discourse of sustainability science itself. There is a tendency to idealize women as being

inherently aligned with values such as care, collaboration and environmental stewardship. While this association may appear positive, it can be restrictive and essentializing.

As a result, women in the field may be disproportionately encouraged – or even expected – to focus on the "soft" dimensions of sustainability (e.g., behavioural change, community engagement, education), while men are assumed to be the drivers of the "hard" dimensions (e.g., resource efficiency, infrastructure planning, material science).

This reinforces a binary division of labour, limiting opportunities for women and gender-diverse individuals to gain recognition in technical or quantitative aspects of the field and restricting men from fully engaging with social and behavioural innovation.

Citation and Voice Disparity: Studies have shown that in male-dominated scientific domains, papers led by women are cited less and their interventions in academic meetings or industrial panels are more frequently interrupted or overlooked. In consortia like LIAISE, this can manifest in meeting dynamics, authorship negotiations or editorial biases in publishing outputs.

2. Gender balance in LIAISE COST Action

Table 1. LIAISE participants in a nutshell

	Participation	Leadership positions	Young participants	ITC participants
Women	167	9	72	118
Men	155	9	68	112
Non-binary	0	0	0	0
Do not identify as woman, man, or non-binary, please specify how would you identify	0	0	0	0
Prefer not to say	0	0	0	0

2.1. Gender balance in leadership roles

There is a **perfect gender balance in leadership roles**, which is exemplary and should be recognized as a **model practice**. Maintaining this balance should be a goal throughout the Action's lifetime. Representation of women at decision-making levels is critical for ensuring that gender-sensitive perspectives are integrated into project management and implementation.

There is a perfect gender balance in leadership roles, which is exemplary and should be recognized as a model practice. Maintaining this balance should be a goal throughout the Action's lifetime. Representation of women at decision-making levels is critical for ensuring that gender-sensitive perspectives are integrated into project management and implementation.

2.2. Proportion on young participants

The proportion of young participants is also balanced across genders, with nearly identical engagement from young women and men. This data reflects a healthy level of early-career researcher involvement and could support further targeted mentorship programs to strengthen their engagement and progression into leadership roles.

2.3. Participation from ITC

High levels of participation from ITC countries are seen in both genders, with gender parity in engagement from underrepresented regions. This indicates that the Action is succeeding in meeting both geographical and gender inclusiveness objectives.

3. Good practices and plans to incorporate a gender dimension

Gender equality in research does not happen by accident. It is the result of deliberate choices, inclusive policies, and a willingness to examine how power and opportunity flow within a network. In COST Action CA22110, the Action understand that equality is not just about counting numbers – it's about changing systems.

From leadership selection to grant allocation, training events to scientific missions, every element of the COST programme holds both potential and responsibility. Below, LIAISE COST Action narrate the good practices that guide our community.

3.1. Leadership roles: opening space for diverse decision-makers

Leadership within CA22110 is not simply about titles; it is about influence, visibility and shaping culture. Recognizing this, LIAISE COST Action has adopted open and transparent nomination processes for positions such as Chair, Vice-Chair and Working Group Leaders. Calls for leadership roles are shared widely, with encouragement for self-nominations – particularly from women, early-career researchers and gender-diverse individuals.

LIAISE strives for balanced representation in leadership, not only as a number but as a lived practice. In some cases, this has meant co-leading Working Groups or consciously inviting overlooked voices to the table. We believe that the diversity of thought that follows from diverse leadership makes our Action more resilient, dynamic and just.

3.2. Grant approvals: making access equitable

Grants such as STSMs, ITC Conference Grants and Dissemination Grants are central to how researchers grow, connect, and share knowledge. But we also know that unconscious bias can shape decisions – who is seen as promising, who is ready, who fits.

To counteract this, LIAISE promotes fair and anonymized evaluation processes wherever possible. We track application rates and success across gender lines and remain attentive to disparities. Our calls for applications are written with care, avoiding elitist or exclusive language and we actively encourage applications from underrepresented groups, including gender minorities and researchers from ITC countries.

We don't stop at selection: we also offer guidance and mentorship to those who are not awarded, ensuring that rejection is not the end of the journey but a step on the path.

3.3. STSMs and Mobility: flexibility as inclusion

Short-Term Scientific Missions are transformative, but not equally accessible to all. Caregiving responsibilities, chronic illness, or simply economic vulnerability can limit mobility – often along gendered lines. That is why we promote flexibility in how STSMs are structured: offering part-time, hybrid or closer-to-home missions when needed.

We also monitor the gender balance among both hosts and grantees, ensuring that mobility does not become a silent filter against those with less privilege or flexibility in their lives.

3.4. Events and Training Schools: Who speak, who is heard

Every panel, every roundtable, every training school is a stage – not just for sharing knowledge, but for shaping whose knowledge is seen as valuable. In CA22110, we take this seriously. We strive for gender balance among speakers and facilitators, and we do not accept "we couldn't find a qualified woman/non-binary expert" as an excuse. They are there – our responsibility is to look more thoughtfully.

Our organizing committees reflect this same diversity. We aim for inclusive event planning that considers time zones, family obligations, and different communication styles. And when people arrive, they are invited to share their pronouns, their ideas, and their voices in a space where respect is the baseline, not a bonus.

3.5. Communications and publications: language matters

In CA22110, members recognize that language shapes culture and culture shapes belonging. Our communications – whether a tweet, a poster or a policy brief – are written with intention.

CA22110 avoid gendered language that assumes binaries. We avoid imagery that reinforces stereotypes of who "belongs" in science and industry. And in the action publications, we track who is cited, who is acknowledged and who is invited to lead.

None of these practices are perfect and none are final. We see our Gender Equality Plan not as a static list of requirements, but as a living commitment. It grows with our members; it learns from feedback, and it evolves in response to the world around us.

In CA22110, gender equality is not the work of a few – it is a shared responsibility. Through these good practices, we strive to create a network where everyone has the opportunity to lead, to contribute, and to be seen – not just equally, but equitably and with dignity.

4. Inclusion and Gender- LIAISE Objectives

The Gender Equality Action Plan for COST Action CA22110 is built around a clear and structured framework, divided into **five strategic objectives**. These objectives reflect our commitment not only to gender balance, but also to genuine inclusion – acknowledging the diversity of identities, experiences, and needs within our network.

Each objective focuses on a specific dimension of participation, representation, and equity, accompanied by concrete actions, responsible leads, measurable indicators, and timelines. Together, they form a roadmap to ensure that gender equality is **woven into the fabric of our collaboration, not treated as an add-on.**

Objective 1: Maintain Gender Balance in Participation

This first objective ensures that the foundation of the Action is equitable, with balanced participation across all activities and roles. It includes:

- Monitoring gender distribution across working groups, STSMs, and leadership roles every six months.
- Embedding gender criteria in the nomination and selection process for leadership and funded opportunities.

By doing so, CA22110 aims to maintain a healthy gender ratio (45–55%) across the Action and ensure no group is structurally underrepresented.

Table 2. LIAISE gender balance in participation

Activity	Description	Responsible	Timeline	Success Indicators
Monitor gender distribution in all new roles and activities	Collect gender-disaggregated data every 6 months across participation, working groups, STSMs, and training schools.	Gender Equality Advisor & Grant Holder	Biannually	Data shows continued gender balance (45–55%) in roles
Ensure gender balance in selection and nomination processes	Include gender as a consideration in appointments to leadership, training grants, and conferences.	MC Chair, WG Leaders	Ongoing	Gender representation within target range in leadership and speaker lists

Objective 2: Promote inclusive participation beyond the binary

Recognizing that gender is not binary, this objective focuses on creating space for non-binary and gender-diverse individuals to participate fully and authentically. Key actions include:

- Revising forms and surveys to allow for self-identification beyond "male" and "female."
- Creating awareness materials on inclusive language and gender diversity, shared with the entire network.

This objective positions CA22110 as a welcoming and affirming space for all gender identities.

Table 3. LIAISE promoting inclusive participation

Activity	Description	Responsible	Success Indicators
Review and revise data collection tools	Adapt registration forms, survey forms to allow self-identification beyond binary gender categories.	IT Coordinator, Core Group	Updated forms include non-binary and self-describe options
Develop awareness materials on gender diversity	Create and share a short guide or infographic on inclusive language and gender diversity.	Gender Equality Advisor	Materials shared with >80% of Action members; feedback collected

Objective 3: Support gender equality among young researchers

Early-career researchers (ECIs) are vital to the future of our field. This objective ensures they have equal access to mentorship, visibility, and support, especially those from underrepresented genders. Actions include:

- A structured mentoring scheme that pairs ECIs with experienced researchers from diverse backgrounds.
- Ensuring representation of women and gender-diverse ECIs in speaking slots and poster sessions at events.

Through these efforts, the Action cultivates a pipeline of inclusive leadership and future collaboration.

Table 4. LIAISE supporting equality

Activity	Description	Responsible	Success Indicators
Launch a mentoring scheme	Match YRIs with experienced mentors across genders and ITCs.	STSM Coordinator, WG Leaders	≥15 ECI participants mentored; equal representation of genders

	Reserve speaking slots and poster highlights for young female and underrepresented researchers.	Conference Organizers	≥40% of ECI speakers are women or gender minorities
Feature young researchers in Action events			

Objective 4: Foster a gender-inclusive culture

Beyond quotas and metrics, a truly inclusive Action requires cultural change. This objective nurtures a shared ethos of respect and belonging by:

- Hosting gender and inclusivity sessions during annual meetings.
- Celebrating important milestones like International Women's Day and Women in Science Day through campaigns or events.

These visible commitments send a powerful message: equity is part of who we are, not just what we do.

Table 5. LIAISE fostering inclusiveness

Activity	Description	Responsible	Success Indicators
Host gender and inclusivity sessions	Organize panels or talks during annual meetings focused on gender equity and EDI (Equity, Diversity, Inclusion).	Core Group, Local Organizers	Annually
Celebrate International Gender Equality Days	Plan events or campaigns for International Women's Day (8 March) and Women in Science Day (11 February).	Gender Equality Advisor	Annually

Objective 5: Ensure equal access to funding, evaluation and reporting

The final objective focuses on ensuring that resources, opportunities, and evaluations are distributed fairly. It includes:

- Publishing a yearly Gender Equality Progress Report, shared with the Management Committee.
- Contributing to COST-wide knowledge exchange on gender practices.

Table 6. LIAISE assuring equal access to funding (access, evaluate, report)

Activity	Description	Responsible	Success Indicators
Publish yearly GEP progress report	Share updates on gender equality initiatives, challenges, and improvements.	Gender Equality WG	Report published and discussed in MC meeting
Contribute to COST-wide gender dialogue	Share best practices with other Actions, present in COST Connect events.	Action Chair, GEP Team	Presentation or shared case study by Q4 2026

Table 7. LIAISE assuring equal access to funding (funding)

Grant Type	Eligibility Actions for Balance	Review Process Actions	Post-Award Follow-Up	Gender Balance Target (per call)
Short-Term Scientific Missions (STSM)	Encourage applications from underrepresented genders; promote flexible mission formats (e.g., hybrid, short duration).	Use anonymized evaluation where feasible; include gender-aware reviewers.	Monitor gender balance in grantees and hosts; collect optional feedback on inclusivity.	Minimum 40% representation of any one gender
ITC Conference Grants	Highlight eligibility and simplify application for non-binary and female early-career researchers, especially from ITCs.	Track gender distribution in submitted and approved applications.	Publish yearly data on gender distribution and success rates; share testimonials from underrepresented grantees.	Minimum 40% representation of any one gender
Dissemination Grants	Actively reach out to underrepresented genders in technical areas; offer mentorship for preparing dissemination outputs.	Review panels instructed to consider diversity of representation in evaluation.	Offer follow-up mentorship and visibility for grantees from minority genders (e.g., featured blog/interview).	Minimum 40% representation of any one gender

5. Challenges and difficulties in gender mainstreaming

While COST Action CA22110 demonstrates an encouraging baseline of gender balance across participation and leadership, the process of mainstreaming gender equality in a meaningful and sustainable way presents several nuanced challenges. These are not always evident through quantitative data alone and require a deeper engagement with both the culture and operational structure of the Action.

One of the first difficulties encountered is the **absence of gender diversity beyond the binary framework.** Currently, all participants identify as either women or men, with no individuals identifying as non-binary or self-defined. While this may simply reflect the current demographics of the field, it also raises concerns about inclusivity. It is possible that individuals who identify differently may not feel comfortable disclosing their identity or may not feel represented within the Action's language and forms. This reveals a need to critically examine how gender is framed and recorded, and to promote a more welcoming and visibly inclusive environment.

Another key challenge lies in the **presence of implicit bias** – subtle but pervasive assumptions that can shape how opportunities are distributed and how individuals are perceived, even in the context of numerical parity. For example, women or gender minorities might still feel underrepresented in strategic conversations or may be overlooked for visible roles such as speakers or chairs. Ensuring equality in numbers is only the starting point; equity in influence, voice, and recognition is equally vital.

Furthermore, although the overall participation statistics suggest a balanced gender composition, **imbalances may still exist within individual Working Groups or specific events**. These localized disparities can go unnoticed unless data is disaggregated at the subgroup level. In practice, this could mean that certain teams or panels lack gender diversity, which could inadvertently skew research perspectives or limit the networking potential of underrepresented members.

There is also the issue of **microaggressions and subtle exclusion**, which are difficult to track and often go unreported. Participants might experience discomfort, dismissive remarks, or unwelcoming dynamics but may hesitate to voice concerns – particularly in academic settings where hierarchies are deeply ingrained. Without clear reporting mechanisms or a culture of psychological safety, these experiences remain hidden, undermining the overall objective of inclusivity.

Finally, there is the **challenge of sustainability and fair distribution of equality-related tasks**. Often, the responsibility for promoting gender equality falls to a few motivated individuals – frequently women or early-career researchers – who volunteer their time without formal recognition. This can lead to burnout and create the impression that equality is an optional or secondary effort, rather than a shared commitment across the network.

Non-binary and gender-diverse individuals may not feel safe or seen in academic or industrial spaces where gender is implicitly framed as binary, or where registration forms and organizational culture do not reflect inclusive language. In the context of LIAISE – which often engages with traditional industrial partners – this lack of visibility can be amplified by conservative workplace norms and unfamiliarity with gender diversity.

Non-binary researchers may face **pronoun misgendering, social exclusion, or lack of recognition** in professional settings – especially in industries like construction, waste management, or energy, where rigid gender norms often persist. These experiences are compounded when non-binary individuals must repeatedly educate peers or advocate for their own inclusion without structural support.

Gender-diverse individuals often face multiple, overlapping barriers – such as those based on nationality, ethnicity, disability, or sexual orientation – especially when coming from Inclusiveness

Target Countries (ITCs) where legal and social protections for LGBTQ+ individuals may be limited. In cross-border collaborations, this intersectionality must be recognized and proactively supported.

Finally, the **content and language of the research itself** should reflect awareness of gender diversity. In sustainability and industrial symbiosis literature, references to "citizens", "workers", or "households" often default to gendered norms. CA22110 can lead by example in challenging these defaults.