Gendered Innovations

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Consortium

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Executive Summary

Gendered innovations – innovations in which the gender dimension is integrated into all aspects of the R&D process and which therefore go beyond mere female representation – are gaining popularity in the contemporary innovation discourse. However, despite significant advances in the last years, the literature on gendered innovations remains fragmented, inconsistent and limited. Gendered innovations are not (yet) well established, particularly in the private sector, which has also proven relatively inactive in equality-oriented innovation policies and in many countries has not been subject to binding legislation.

Addressing an urgent need for more comprehensive knowledge about i) the systematic integration of gender aspects – in particular from an intersectional lens – across the different stages of the innovation process and ii) ways to strengthen content-related gender aspects in innovation processes, we conducted a strategic assessment of research on gendered innovations and relevant gendered innovation policies in the business enterprise sector (BES). The analysis is based on a scoping review of 122 documents comprising scientific articles, grey literature and policy documents in 2010-2022. The analysis considers social and cultural factors that enable or hinder the implementation of gendered innovations within companies or innovation clusters. We additionally adopt a feminist and a decolonial approach in the review, with attention to geographies and power relations of knowledge production.

The strategic analysis is based on eight research questions: presence and nature of gender in innovation topics (R1), current state of research and coverage (R2), related key issues (R3), role and implementation of intersectionality (R4), success factors (R5), key challenges (RQ6), future research directions (R7), and the identification of promising policy instruments to promote gendered innovations (R8).

The results of our analysis point to the need for further theoretical, conceptual, and applied knowledge generation on gendered innovation. As the first steps in this process, this report puts forward definitions of inclusive gendered innovation (IGI) and inclusive gendered innovation policy (IGIP). IGI mainstreams sex, gender and intersectional analysis in the R&D and innovation development processes aiming at promoting inclusive gender equality. The IGI approach considers how broader societal influences, such as unconscious bias, gender relations, and intersecting inequalities already present in institutional frameworks and organisational structures, as well as local context, affect innovation development and innovation beneficiaries. IGIPs encourage the mainstreaming of intersectional sex, gender and diversity analysis, promote equal and unbiased and research content and innovation through legislation, regulations, strategies, targeted initiatives and/or dedicated units as well as incentives. We stress that both IGI and IGIP should incorporate the intersectional lens and consider how advancing gender equality affects other dimensions of marginalisation.

The report offers the following key recommendations for future action: (1) develop and trial IGI tools in private companies; (2) continue to identify best IGIP practices, framework conditions and ecosystems; (3) develop and trial real-life approach to incorporating an intersectional lens in IGI and IGIP; (4) while doing so, be aware of the established patterns of knowledge generation about innovation, especially regarding intersecting technologies and geographies on which evidence collection and analysis are based.

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List of Acronyms

AEI	The State Research Agency
BES	Business Enterprise Sector
CoP	Community of Practice
EDI	Equity, Diversity and Inclusion
EIC	European Innovation Council
EIT	European Institute of Innovation and Technology
FFG	Austrian Research Promotion Agency
GEP	Gender Equality Plan
GiSTER	Korean Center for Gendered Innovations for Science and Technology Research
IGAR	Integrating the Gender Analysis in Research
IGI	Inclusive Gendered Innovation
IGIP	Inclusive Gendered Innovation Policy
IRC	Irish Research Council
KSH	Knowledge and Support Hub
NSERC	Canadian Tri-Agency / Natural Sciences and Engineering Research Council
OECD	The Organisation for Economic Co-Operation and Development
PRO	Public Research Organisation
R&D	Research and Development
R&I	Research and Innovation
RFO	Research Funding Organisations
RQ	Research Question

SDGs	Sustainable Development Goals
SG&DA	Sex, Gender and Diversity Analysis
SIPER	Science and Innovation Policy Evaluation Repository
TA CR	Technology Agency of The Czech Republic
UBA	German Federal Environment Agency
UN Women	United Nations Women
UNESCO	The United Nations Educational, Scientific And Cultural Organization
Vinnova	Swedish Governmental Agency for Innovation Systems
WoS	Web of Science

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1 Introduction

This report is a part of the work of Knowledge and Support Hub 4 "Innovation" (KSH4) of the INSPIRE project. KSH4 focuses primarily on gender responsive innovation communities and innovation policies in the private sector paying specific attention to the social and cultural factors enabling the **successful implementation of gendered innovations** within companies or innovation clusters. Hereby, we **focus on the process of implementing gender in research and innovation.** This report specifically aims at consolidating the knowledge base around "gendered innovation" and "gendered innovation policy" that underpin our subsequent work programme.

So far, the business enterprise sector has proven relatively resistant to equality-oriented policy interventions. Therefore, the degree of inequality in this sector remains very high, despite the fact that large companies in particular have established comprehensive policies to bring more women into the companies and especially to the top-level positions. However, progress is still slow in some countries and contexts. In view of the shortage of skilled workers, the same applies to small and medium-sized enterprises.

Overall, however, the research gap on issues of women's representation - in decision-making positions as well as in teams - is small. Countless studies, scientific as well as practice-oriented, have sufficiently dealt with **the obstacles to a better representation of women in the private sector**, also with partial aspects such as women and business start-ups, female inventors, etc. However, the implementation of gendered innovations deals with broader aspects beyond representativeness. If women are present, this does not necessarily mean that they have decision-making power. Representation also does not mean that companies consider how gender relations affect innovation. Against this background, we have focused our strategic analysis on the question of **how content-related gender aspects can be strengthened in innovation processes** and how the concept of "gendered innovations" can be enlarged by intersectionality and inclusiveness as well.

Accordingly, we see the greatest need for research and action in bringing inclusive gender aspects into focus in the innovation process itself, for several reasons:

1) **Innovation research** still leans very heavily on **male perspectives** (Foss and Henry 2016) and addresses men's rather than women's needs.
2) The EU has strongly supported and increasingly prioritised the need for gender mainstreaming in research and innovation. Although some important milestones were achieved, such as the **Gendered Innovations Guidelines (EC 2020)**, the bulk of research and policy action in the area still focuses on strategies for gendering research. Gendered innovations in the private sector have remained on the periphery of these efforts.
3) Current studies and policies on gendered innovations have not yet sufficiently addressed **aspects of inclusiveness and intersectionality**. Innovation is a practical application of new knowledge, or novel recombination of existing knowledge, for a concrete purpose, which includes, but is not limited to, commercial gain, improvement of products and services, or public good. Innovation is gendered when **gender aspects are integrated into all aspects of the R&D process** in order to ensure equity of outcomes (Schiebinger and Schraudner 2011). Inclusive innovation considers all marginalised groups beyond

gender[1]. Within the intersectional approach, **inclusive gendered innovations** should not only take into account issues of gender, but also **how gender fits in broader structures of inequality**.

In advancing the state of the art of knowledge on and practice of inclusive gendered innovation, it is critical to know the roots of the current body of scholarship and how **power imbalances** (including gender, class, race) **have affected the nature of knowledge and data** created so far. Such a review is still missing. Recent studies yet concern themselves with problematising the issue of gender in innovation research, putting gender on the agenda, reviewing the role of gender in particular technological sectors, or in specific parts of the innovation process, e.g. patents.

The identification of the research gap and the increasing importance of the topic on the European policy agenda suggest that the topic of inclusive gendered innovations should be addressed and that a dedicated structure, such as a Knowledge and Support Hub (KSH) should be put in motion. Thus, inclusive gendered innovations will be a major contribution of this review and will move the field of knowledge forward. The growing volume and heterogeneity of this literature creates opportunities for a more comprehensive understanding of **gender and inclusiveness in innovation**. Against this background, there is a need to examine the landscape of research knowledge gathered so far across various scientific disciplines and experiences. Therefore, this report pursues three interlinked objectives:

- Map the extant knowledge landscape on inclusive gendered innovations;
- Since current knowledge shapes directions for future research, we aim to **influence the research and policy agenda on inclusive gendered innovations**;
- Develop conceptual foundations of the INSPIRE work programme, including identifying challenging problem areas and prospective topics for empirical investigation and stakeholder consultation.

Moving forward, we need to collect knowledge about approaches and best practices to promote inclusive gendered innovation, focusing on identifying approaches that work and break down long-standing barriers and power imbalances. In doing so, the ambition of our review is to build upon the already available knowledge in this field and to **broaden the scope towards inclusive innovations**. In achieving its objectives, the review seeks to answer the following research questions:

- **R1**: What are the common definitions of concepts that tackle the topic of gender and innovation? (e.g. gendered innovation, gender-responsive innovation, inclusive innovation etc.) What are the shared characteristics of these concepts?
- **R2**: What are the main concepts and topics that have been investigated so far around the theme 'gender and innovation'? Which aspects, contexts, technologies, and territories have been covered extensively and which ones have been left out?
- **R3**: What are the key issues in the theme "gender and innovation"? (e.g. representation, participation, discrimination...)
- **R4**: How has intersectionality been implemented in the analysis of gender and innovation issues?

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[1] Several related approaches have gained popularity in this regard and need to be mentioned: for example, responsible research and innovation advocates for engaging all relevant stakeholders, including women, in the innovation life cycle. A growing number of studies examines social innovation, which explicitly targets disadvantaged groups. Please see the definitions in Appendix A1.

- **R5**: What are prerequisites and success factors/conditions for developing gendered innovations?
- **R6**: What are the current key challenges for developing Inclusive Gendered Innovations (IGIs)?
- **R7**: What are the future research directions in the area of IGIs?
- **R8**: What are the most promising policy instruments to promote gendered innovations? (at the level of national/regional authorities and RFOs)

This report is structured as follows. Section 2 presents the methodological approach adopted in the study. Section 3 describes the review of scientific and grey literature. Section 4 presents the review of policy literature. Section 5 offers recommendations for the Knowledge and Support Hub and Section 6 concludes the report.

2 Methodology

We employ a scoping literature review as the method to answer the research questions (Peters et al. 2020). The scoping review is different from a systematic review in that the process is iterative and reflexive: the research team conducts additional searches and is attentive to the social context of produced knowledge. A scoping review adopts a systematic approach to exploration. The aim is to present both a broad view on the literature landscape and to conduct in-depth investigations.

The scoping review approach was coordinated across KSHs of the INSPIRE project. In particular, two foundational INSPIRE principles are implemented in this review.

The feminist principle "means to challenge and politicize ways of knowing and knowledge production and envision alternatives to these processes" (Benschop 2021). Any knowledge is performative, political and personal, is embedded in power relations. In our review, we are therefore attentive to how knowledge is produced and by whom, how it is presented, whether the politics of knowledge production are acknowledged in research.

The decolonial principle aspires to give space to the knowledge and experiences to people who were previously excluded from knowledge production, like people of colour, indigenous people, and colonised people from different origins and with different ages (Mignolo 2009). In this review, the principles translate into particular attention to identifying studies that use innovation to reveal power asymmetries in innovation development, as well as in producing knowledge about innovation. Additionally, attention is paid to the representation of countries and territories, and their intersection with technologies and innovation types in the empirical data in the review.

Our scoping review follows a four-step process: (1) building the **glossary of key terms** in order to clarify concepts relevant to the topic of gendered innovation and identifying studies particularly important for the INSPIRE approach; (2) Developing the **review protocol**, which documented decisions about the relevant field of knowledge, datasets to be used in the searches, time period and type of publications, languages to be covered, inclusion and exclusion criteria of search results; (3) **registering searches** by documenting the process of identification of relevant documents and the selection of a small core set for critical analysis; (4) **data synthesis and interpretation** using a charting technique in Microsoft Excel software to develop answers to the research questions.

The four-step process was performed separately for scientific/grey literature and for policy literature, due to significant differences in terminology, data sources and coverage. Although the term 'gendered innovation' is closely linked to the European Commission's discourse, our initial exploration found significant discrepancies between the knowledge base in the scientific literature and the policy literature, to the extent where two separate searches presented a more reasonable strategy for scoping review in KSH4. Hence, the remainder of this document is separated into two independent sections: the analysis of the scientific literature landscape and the analysis of the policy landscape.

3 Analysis of scientific and grey literature

3.1 Method for analysis of scientific and grey literature

3.1.1 Review protocol

Since gendered innovation is a multidisciplinary area, the field of knowledge for searching documents was not strictly defined. A glossary of relevant terms was compiled instead to delineate relevant keywords for the searches (see Appendix A1). We also expected to find results discussing **gendered innovation**, but not using the term itself. The timeframe for analysis was defined as 2010-2022, because the term 'gendered innovation' was introduced in the early 2010s. The Web of Science (WoS) and Scopus were used initially for the searches in scientific databases, but later on, we proceeded with the WoS as the main database[2]. Additional documents were added from the EU websites like Gendered Innovations (EC 2020) and the GEAR tool (EIGE), sources from former EU-projects and internal databases. No restrictions were placed on the document type. Results which were not research articles (e.g. book reviews, letters, and essays) were excluded. The searches were conducted in English. Some results that were added manually from internal databases were in German.

Inclusion criteria were delineated thematically. Relevant studies needed to have the focus on the concept and/or process of gendered innovation. We specifically sought out studies that analyse **innovation development** (as opposed to scientific research or adoption) and include **gendering** (as opposed to raising awareness of a gender gap).

Exclusion criteria were developed dynamically during the process of conducting searches via an iterative approach. The criteria were updated as our understanding of the concepts and the literature landscape evolved. In the broadest searches, all results that covered the topic of gender and innovation were included for further manual screening. Then, studies were excluded if they fell outside of the thematic delineation.

At least one researcher manually checked each WoS search. The process was regularly discussed in research meetings. Results qualifying for screening were saved in a reference software alongside with the available bibliographic data.

3.1.2 Registering searches

The flowchart that registered and screened our searches is visualised in Figure 1. At the **identification stage**, we ran searches in two steps. In the first search, we searched for "gender* AND innovation" in document titles to identify the most relevant contributions. In parallel, we searched in relevant databases and in our internal libraries, casting a wide net. In the second search, we broadened the scope. Searches were conducted in the 'Topic' field and are available in Appendix A2. In total, around 30.000 results were retrieved, among them nearly 5,000 publication titles were screened manually. 1,008 documents were selected for additional screening using title, abstract and, where available, full text data.

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[2] The WoS and Scopus searches can be replicated at any time since permanent search links have been saved.

Figure 1 Registering searches of the research literature
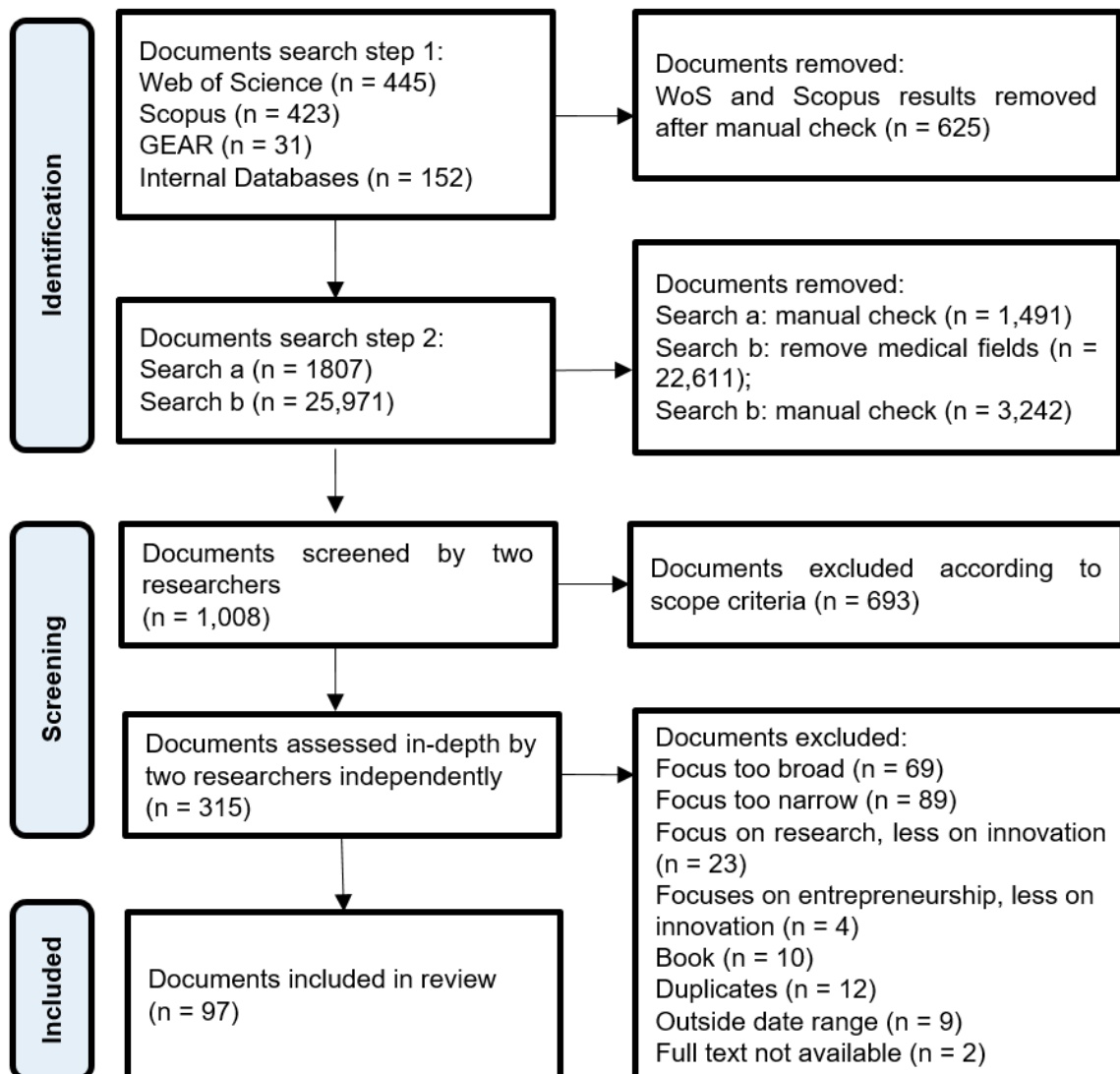
Source: authors, adapted from Page et. al. 2020

At the **screening stage**, two researchers manually scanned the available data of each article and excluded those that matched at least one of the following 'scope criteria': (i) topic in gender in education, science; (ii) document covers development of an intellectual property without innovation perspective (e.g. women as participants in clinical trials); (iii) topic in innovation adoption, gender diversity and innovativeness in a firm, representation of women in science, technology and innovation, other types of gender gap, careers of women in STEM or high tech sectors, entrepreneurship without innovation aspect; (iv) calls, essays, manifestoes; (v) documents which are not research papers.

We applied mainly **content-related exclusion criteria**, aiming to identify contributions that focused on the topic of gendered innovation. We excluded less relevant documents even if they were highly cited or written by famous researchers. Since the title and abstract of articles were screened in most cases, assessing the importance of results, robustness of methods or whether or not the article moved the frontier of knowledge was not feasible. We highlighted

publications that looked like they adopted feminist or intersectional methodologies or mentioned other critical keywords (e.g. inclusive innovations). We were aware that articles covered different territories; also, that different types of innovations were included in the dataset.

After exclusions, 315 documents remained as candidates for an in-depth critical analysis. Since the decision about further exclusion was no longer straightforward, we adopted a double blind review approach. Two researchers scanned the full list of documents independently and marked those they considered suitable for exclusion. Each researcher noted the reason for excluding each document. 99 documents marked by either researcher were selected for critical analysis. 97 had full text available and formed the final sample.

3.1.3 Approach to critical analysis

The data was charted onto an Excel "data charting form" where the rows are studies and the columns are characteristics/dimensions of analysis. Two researchers performed the charting independently. The charting form in our study included three sets of characteristics (Table 1). Basic characteristics of the publication were assigned at the time the publication was identified in the WoS. Data on the characteristics of the study was filled in manually for each paper. For some, we developed predefined drop-down options, for others, the drop-down options were formulated during the analysis. Content-related charting reflects dimensions important to answer our research questions. These columns were filled in when the relevant dimensions are covered in the study. In the process of critical analysis, full text was assessed.

Table 1 Charting dimensions

| Basic characteristics	Characteristics of the study
- Title - Author(s) - Year of publication - Abstract - Periodical / Book title - Publication type - Times cited WoS[3] - Language - DOI - Date added	- Study aims - Fieldwork Location (empirical data) - Technology in focus - Innovation in focus (e.g. gendered, inclusive...) - Methods used in the study - Type of organisation authors are affiliated with - Is policy dimension covered? (Y/N) - Is the innovation in non-private sector? (Y/N) - Study relevance/significance (1-10)
Content-related charting	
- Aims of the study - Definition of gendered innovation and/or of other concepts used in the study - Main results regarding gendered innovation - Factors promoting gendered innovation identified in the study - The role of organisational culture in facilitating gendered innovation - How intersectionality has been implemented - Key challenges/problems/barriers to gendered innovation - Advice and suggestions for practice	

Source: authors

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[3] Last checked 8.3.23

3.2 Scoping analysis

The date range for the studies included in the analysis is 2005-2021[4]. In the dataset, the number of studies increases rapidly after 2015 (Figure 2). 40% of papers in the dataset were published in the last 3 years of analysis with the highest number published in 2022, indicating current and increasing interest in the topic of gendered innovation.

Figure 2 Characteristics of the research dataset: publication number, citation distribution
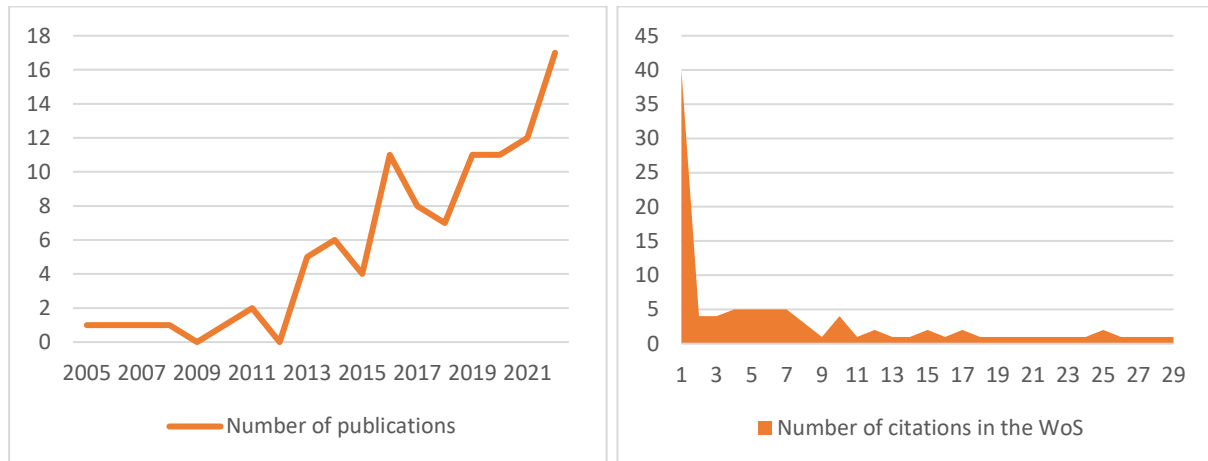
Source: Web of Science, Scopus, author calculations

The majority of scientific publications are not cited and this is also the case in our dataset: around 40% of papers have zero citations and only a minority have more than five citations. Since we selected the papers based on their content, the 'long tail' distribution of citations is an expected outcome. Additionally, **the majority of papers were published recently** and they did not have enough time to accumulate citations.

Journal articles and conference papers constitute over three quarters of the dataset (71% and 5% respectively). 18% are **book chapters**; 6% are **reports** and **other grey literature**. Since innovation research is heavily journal based, the relatively high prevalence of book chapters could indicate that the knowledge base of gendered innovation research depends on contributions from a broader range of social science studies. Reflecting the nature of our search, the vast majority of these documents are written in English and only three are in German.

The dataset includes 70 articles published in 61 different journals, indicating a broad knowledge base. While our focus was on gendered innovations, contributions extend beyond innovation studies. Nearly half of the articles (33) were published in **journals in the domain of innovation, entrepreneurship, technology, or management**. Only a minority were published in well-known innovation studies journals, such as Research Policy, Information Systems Journal, International Small Business Journal (one paper each). The **International Journal of Gender and Entrepreneurship** published the most articles (8). Contributions also came from general social sciences, sustainability, environment, development, and non-social studies journals, including Science and Nature. This wide spread underscores the relevance of gendered innovation across various knowledge communities.

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[4] Several key documents published prior to 2010 were added manually from internal databases.

The studies in the dataset cover 140 countries and territories[5] (Figure 3). The **USA has the most coverage in the dataset** with 19 case studies, followed by **India** (10), **Germany** (9) and **Sweden** (8). China is the only major country missing. When grouped by region, Europe is best covered with 50 case studies. North America, Asia and Africa represent between 16 and 21% of the cases. South America, Oceania and the Middle East are less covered. 21 documents do not have a geographical focus. A notable division is that the **Global South is the empirical arena for studies on frugal, social and inclusive innovations, pro-poor and bottom-of-the-pyramid innovations**. The Global North is the arena for studies both on social/frugal/inclusive *and* high-tech innovations.

Figure 3 Region and Country/Territory coverage in the research dataset
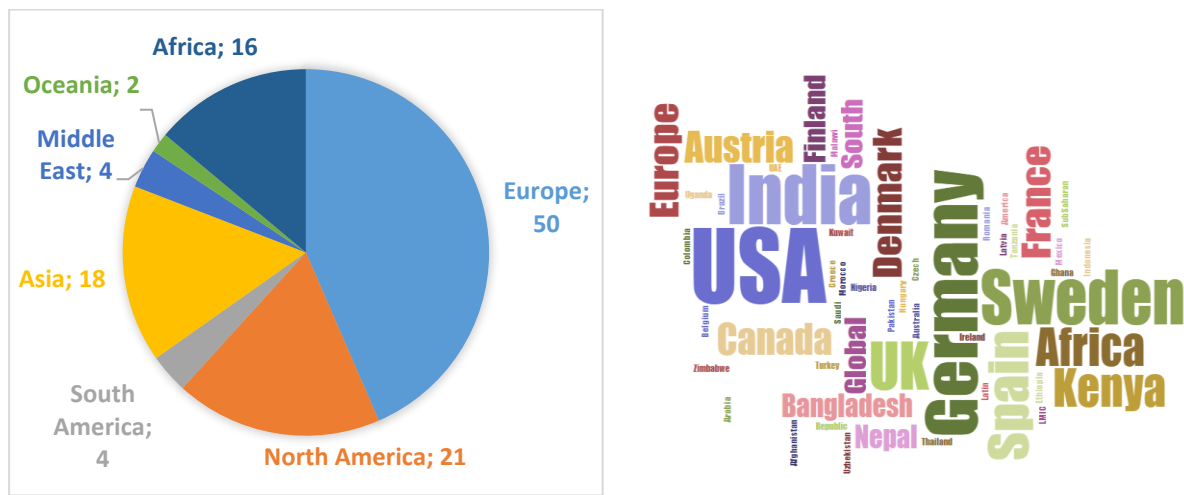
Source: Web of Science, Scopus, author calculations. In the word cloud, the larger country, the more cases in the dataset cover it.

The majority of studies in the dataset (41) use exclusively qualitative methodologies and only 18 studies are quantitative or mixed methods. The rest are conceptual contributions and literature reviews. Such methodological composition reflects, on the one hand, the emergent status of the literature on gendered innovation, where a lot of work is still dedicated to concept development and bringing together different strands of literature. On the other hand, this signals a somewhat marginal status of gendered innovation research in the innovation studies landscape, because innovation studies favour quantitative, large-scale analyses.

3.3 Critical Analysis

R1: What are the common definitions of concepts that tackle the topic of gender and innovation? What are the shared characteristics of these concepts?

Documents in the dataset do not have a common terminology. The largest share of papers - 18 - did not employ any consistent term when they described phenomena associated with the analysis of gender and innovation issues. The lack of consistent terminology reflects the emergent nature of the topic and a certain degree of fragmentation in its knowledge base.

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[5] Most cases are country-based, but a small share covered regions or country groups, such as "Sub-Saharan Africa" or "Low and Middle Income Countries". These groups are not divided into individual countries in this section.

Although the methodology focused on identifying the literature on 'gendered innovation' (15), a comparable number of studies in the dataset use related terms, such as 'inclusive innovation' (11) and 'social innovation' (10). Notably, five studies in the dataset used intersectionality as the main frame of analysis. Other concepts, such as frugal, inclusive, open, norm-critical, responsible or gender-responsive innovation, were less used.

The main term around which this review is structured is **'gendered innovation'**. The project Gendered Innovations, which gave the concept its name, was launched at Stanford University in 2009 (Schiebinger 2021). The project received funding from the European Commission and entered its most recent phase in 2018[6]. The main purpose of gendered innovations is to overcome pervasive unconscious gender bias in science by mainstreaming sex and gender analysis into the research process. Gender is used both as a resource to create new research knowledge and as a dimension of research quality. Londa Schiebinger and Martina Schraudner (2011) argue: "research must 'control' for sex and gender. Sex and gender analysis act as further controls - one set among many standard methodologies - that serve to provide critical rigour in science" (p.155).

Papers in the dataset offer several **extensions to Schiebinger's concept**: (i) the need to consider different contexts and situations for gendered innovation implementation (Kemppainen 2019; Leem 2021); (ii) the need to implement additional perspectives in order to account for intersecting inequalities (Poutanen and Kovalainen 2016; Mickey 2022); (iii) the need to extend the concept from a narrow implementation of sex and gender analysis to taking into account how institutional and organisational set-ups, and innovation systems are themselves gendered (Kingiri 2013).

The concept of gendered innovation has not received much use in our dataset, even in studies that reported on case studies of what could be called 'gendered innovations'. Perhaps this is because, paradoxically, the Gendered Innovations project spoke primarily to researchers, educators, universities, funding agencies, and peer reviewed journals about incorporating sex and gender analysis into the research content. The role of industry remains peripheral, even in the latest writing on Gendered Innovations (Schiebinger 2021).

The lack of attention to incorporating the sex and gender dimension into innovation development remains a significant conceptual gap. Furthermore, extending the concept of 'gendered innovation' in this dimension would also entail tackling **entrenched gendered relations in the private sector**. Since technologies reproduce beliefs about gender, masculinity and femininity (Wajcman 2004), innovation spaces are filled with gender-normative roles, biases and gendered power dynamics. Gender is produced by and materialises within technology, is incorporated into broader institutional frameworks, and influences all aspects of the innovation process (Lai 2021). In other words, innovation is heavily gendered. Any innovation that adopts a gender-responsive approach needs to wrestle with the gendered influences already present on the institutional and organisational levels.

'Inclusive innovation' and 'social innovation' are the two most prominent concepts in a constellation around the idea that innovation definition should be reconfigured from pursuing mainly economic gains to achieving desirable social outcomes. This literature does not highlight gender as the primary dimension of inequality.

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[6] More information and case study data are available on the project website: http://genderedinnovations.stanford.edu/what-is-gendered-innovations.html

Inclusive innovation, broadly understood, facilitates the inclusion of marginalised groups in activities where their participation was previously limited. This may mean including disempowered communities in the development of innovations (Cukier et al. 2022; Mishra 2021), or identifying innovative ways to empower marginalised groups and improve their economic, social or political inclusion (Baud 2016). Inclusion as a process characteristic links up to a range of different ideas regarding the outcomes of such innovations. For example, Mario Pansera and Richard Owen (2018) criticise the way in which inclusive innovation is taken up by neoliberal international development scholars to mean economic inclusion in a narrow sense. Indigenous forms of knowledge, participation and innovation are in fact excluded and whether or not inclusive innovations lead to social justice is questionable.

Others, such as Logan Williams and Thomas Woodson (2019) present inclusion as a means to achieving social transformation. Advancing the inclusive innovation ladder model (Heeks et al. 2013), they call for innovation scholars to interrogate how previously excluded groups can be included in the innovation process, how they can contribute from its outputs, and whether and how inclusive innovations contribute to broader institutions and supra-institutional factors that facilitate inclusion (e.g. language, implicit understanding of inequality, theoretical frameworks).

Social innovation generally aims to address societal needs and challenges. These innovations aim to create social change, with profit-seeking only a secondary goal. Since inclusion is a social goal, there is significant overlap between inclusive and social innovations in our dataset. Yet not all social innovations seek inclusion: some, rather target women's empowerment (Andersen and Banerjee 2020). Social innovation has an interesting relationship with gender. On the one hand, women are the recipients of social innovations - they are the marginalised group that is empowered and included. Other contributions in the dataset argue that entrepreneurs with feminine traits, such as compassion, empathy and emotion, are more likely to establish social ventures and drive the development of social innovations (Rosca, Agarwal, and Brem 2020; Demartini 2019).

The three main concepts and other less popular concepts that we do not cover in detail share the **dissatisfaction with the mainstream understanding of innovation as the activity, which pursues mainly commercial gain**. They open up imaginaries where innovation is a "...terrain for both economic growth *and* social development, and, most importantly, a revolutionary act for the common good" (Pecis and Berglund 2021, 994). Tokenistic representation of minorities is far from sufficient to create meaningful change. These concepts mean to draw attention to who gets to make decisions, who is included and excluded, whom the innovation benefits and what could be its long-term impacts. The intrinsic social value of innovation means that these issues will be considered as a part of good practice in innovation development. A suggestion what the reframing could look like in practice is the Swedish Funding agency VINNOVA's programme that funds projects on norm-critical innovationn (Fuenfschilling, Paxling, and Vico 2022). In such projects, problematic social norms would be identified first and then innovations would be developed to address them.

The other common characteristic is that regardless of which concept is used, most papers in our dataset point to the **need to address complex entanglements of different axes of marginalisation in order to advance social goals**. For example, innovative aquaculture techniques will not empower rural women in Bangladesh unless their cultural and religious roles in households, communities, and the broader society are taken into account (Kantor,

Morgan, and Choudhury 2015). If such complexities are ignored, studies in our dataset warn, innovations may lead to opposite outcomes than intended. For example, Gaurav Raghubanshi, Srinivas Venugopal, and Gordhan Saini (2021) caution that in resource-scarce environments, shared value from social innovations can be usurped by local elites. Inclusion of one marginalised group in innovation may lead to the exclusion of other groups, or to the emergence of new inequalities (Wojciechowska 2019; Barabino 2019). These concerns lead to (i) conceptual work that attempts to integrate various concepts, e.g. inclusive social innovation, gendered social innovation, gendering social innovation and so on; and (ii) to attempts to develop conceptual frameworks that capture broader intended and unintended effects of these various kinds of innovation.

R2: What are the main concepts and topics that have been investigated so far around the theme 'gender and innovation'? Which aspects, contexts, technologies, and territories have been covered extensively and which ones have been left out?

The distribution of studies according to the technologies they cover is also broad (Figure 4). 40 studies did not have a technology focus and the other 59 studies covered 41 different technology domains ranging from high-tech areas of space, IT and engineering to low-tech menstrual hygiene, logistics and tourism. Contributions regarding gendered innovations in **IT, ICT and digital technologies** represent the largest share among them. They cover various aspects of **gendered stereotypes, exclusion and discrimination of women in digital spaces and digital industries**: gender bias in AI, subtle exclusion of women from maker spaces such as fablabs, hostile discrimination in games and the gaming industry.

Figure 4 Technology coverage in the research dataset
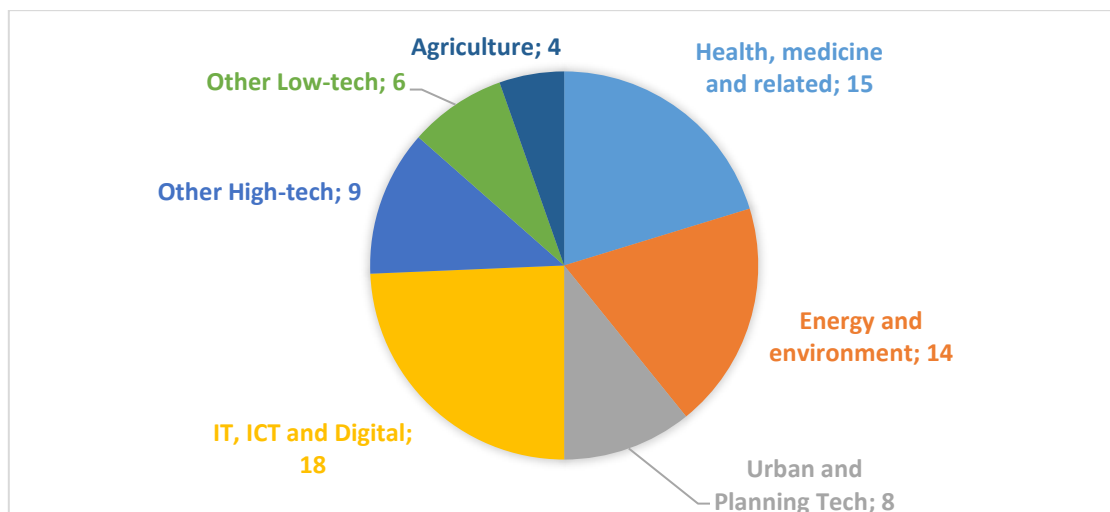
Source: Web of Science, Scopus, author calculations

The second largest group comprises **papers covering health and medical technologies**. Gender is incorporated into these papers not so much from the content side, but rather from the perspective of access to these technologies, the discrepancy between developers and users of technology, across genders and across global North and South divisions. **Energy and Environment** is the third largest thematic group. These contributions are forward-looking, since studies in this domain typically attempt to imagine transitions pathways, which are more inclusive of marginalised groups (this is also true for papers in the urban planning group).

The topic most considered in our data set relates to **IT, ICT and digital innovations** including the use and functionalities of AI systems. Londa Schiebinger (2021), following the research by computer scientists Joy Buolamwini and Timnit Gebru, gives the example of facial recognition, which works mostly better on male faces than females and more efficiently on lighter skin than darker skin and less efficiently on faces using make-up or transgender people. The consequences of such AI malfunctions are that the use of facial recognition can no longer be applied in some areas like in security surroundings. Other studies refer to the under-representation of women in the use of information technology and the resulting consequences for their digital participation in today's life. One study refers to a case in India where women are encouraged to use mobile phones not only to communicate but also for commercial purposes (Warnecke 2017). This is not only related to the use of digital technology but the share of technology-related patents that have been invented by women is very low and the digital gender is clearly measurable (Asi and Williams 2020). In the Indian example, however, the consideration of inclusive design of innovation comes up short and the focus here is on social innovations, too. In another study, the focus is placed on women as users and at the same time creators of technology, namely by already addressing gender-relevant aspects in the design process. It stands out that Dorothea Erharter and Elka Xharo (2014) take a **broader view of the concept of diversity**, for example, by taking into account the dimension of age, and attaching importance to the usability of information technologies, because not all people use technologies in the same way.

The second most considered topic relates to the **health and medical sector** where biological evidences come into play. Londa Schiebinger and Ineke Klinge (2018) argue that women have been mostly neglected during the early-stage development and testing of drug research on both sides: as researchers and as consumers. They suggest that the analysis of sex and gender should be included in every single step of these innovation processes in drug and healthcare development. Not considering women is not only 'unfair'; it also has negative effects on the health of women. In the past and too often presently, drugs are tested mostly on male animals and humans and the health implications certain drugs could have on women were not considered during testing.

In general, the fact that women in health research are underrepresented is stressed, arguing that **women patent significantly less than men**. Yolanda Comedy and Elizabeth Dougherty (2018) give an example on how the American Association for the Advancement of Science addresses this issue by supporting women to invent more. The lack of women in commercial patenting may influence what is invented. An inventor gender gap is still persistent and affects, again, the health of women due to missing female-focused therapies. At the same time, women inventors tend to discover more female-focused ideas in the health sector (Koning, Samila, and Ferguson 2021) which may help to overcome the gap in gender-related medication. Nevertheless, nowadays development in Health IT shows that it is still a male-dominated field. Innovations are developed in Western countries mostly by men and are used by women in low and middle-income countries (Asi and Williams 2020). Women are here looked at as consumers but not as creators of user-centred technologies.

There is one study covering entrepreneurship and the topic of gender at the same time, reinforcing on the one hand **gender stereotypes** but finding a solution by women for women: menstrual pads for women in India. Shobita Parthasarathy (2022) shows how social innovation addresses gender-related problems and this one particularly became an iconic example of successful inclusive (and gendered?) innovation, which targets only girls and women.

The third most covered topic is the **use of energy and participation in the energy transition**. Again, the authors seem to focus on energy research and assume that better representation leads to a better consideration of gender aspects in innovations as well. The discourse goes in the direction of victim-saviour, where the woman has to be protected from climate change and the men are the protectors (Lieu et al. 2020). This view does not only support stereotypes but also shows that a change in the energy transition pathway has to be taken. However, **female representation in energy research is increasing steadily** and their view is being considered in the development of new technologies. Kuschan et al. 2022 claim that an intersectional perspective shall be considered in policies for Germany, proposing a "gender-just and socially just energy transition", changing the perspective from top-down to bottom-up. There are gender difference in perspective on development of energy technologies: men are more likely to stress their work on technological features while women want to protect the planet and focus on the benefits alternative energy carriers have on the environment (van der Merwe, Kock, and Musango, 2020).

The fourth important topic is **urban planning and planning technologies**, which partly overlaps with the energy transition, because sustainable urban planning cannot ignore sustainable energy use. Here, in particular, social innovations can help to address this challenge by developing sustainable and innovative participation processes that take place within and among all levels of society. Smart cities are a positive example given in the literature of how these can or should be designed by all spheres of society (Jayashree et al. 2019; Asteria, Jap, and Utari 2020) meaning that all representatives of society need to be part of the design process. The aim of smart cities is to integrate internet-based technology to facilitate public services and solve problems in urban areas where social life and economic development are improved. Donna Asteria, Janice Jap, and Dyah Utari (2020) showcase the example of the implementation of smart cities in Indonesia and point to the implications the digital gender gap has for the participation of women in urban life. It has to be considered that, especially in societies of the Global North, **the private division of labour between women and men has influenced public policies** and how cities and living environments have developed: men in the public space, women in the private one. Therefore, an **intersectional approach in urban planning** needs to be considered to include the whole society in city design processes (Amorim-Maia et al. 2022).

As already stated, most papers in the mentioned dataset do not refer to specific technologies. Rather, there is a large number covering **organisational aspects,** e.g., how responsibilities are distributed within the companies. It is also easy to observe that - when talking about inclusive or gendered innovation - **entrepreneurship and funding** comes into play. In general, several papers aim at talking about gender and innovation in STEM fields of research, as these are still male-dominated subjects, notably the case of technology. Technology, particularly, used to be seen as a gender-neutral innovation field until this perception was questioned in the 1990s (van der Merwe, Kock, and Musango 2020). This refers above all to energy-related technologies. The literature focuses on energy research and gender, and there seems to be an increased proportion of women in this industry, as energy research is also associated with a high understanding of the environment and the protection of the Earth. Nevertheless, the reference to gender within the concrete innovation process is still missing at this point. More attention is paid to the **institutional distribution of work and the representation of women in male-dominated work environments**, as is engineering, in particular.

In addition to looking at the business sector, academics also analyse the **NGO sector where the gender dimension has been taken into account in relation to social innovation** where women, in particular, are considered to be part of this marginalised group, as already explained in the chapter above. Nonetheless, also here the **gender dimension is not always considered** when talking about social innovation because the literature often talks about 'people' and not women specifically. One paper that addresses this gender-blindness is "Social innovation, gender, and technology: Bridging the Resource Gap" by Warnecke (2017), even though the relation to innovation itself is missing. This is no exception since the organisational aspect is at the forefront of current scientific knowledge. Companies aim at showing publicly that they aim to have more diversity on their premises, but how this diversity is covered within the innovation processes is still a challenge and not visible. There is a claim that innovation needs to be democratised (Alsos 2016) and a general assertion that an open way of working and communicating is linked to diversity or vice-versa. However, specific evidence was not clearly represented in our set.

Several papers refer to **entrepreneurship** when talking about 'gender and innovation' even though scholars criticise that gender-issues are not sufficiently considered in the context of entrepreneurship in the digital sphere and in social innovation (Suseno and Abbott 2021), our findings were that this was one of the most represented results. **Gender-blindness seems to be higher in innovation than entrepreneurship studies** (Alsos, Ljunggren, and Hytti 2013). Even so, it is true that the group of innovators within the entrepreneurs is homogenised and women's experiences tend to be overseen (Owalla 2021). The assumption is that women entrepreneurs, as being their own bosses, are more likely to be able to overcome gender-stereotype barriers, but the truth is that they are still suffering from **gender biases**. At the same time, research on the role of gender in innovation within private companies seems to be still rare (Alsos, Ljunggren, and Hytti 2013).

Often, coupled with the topic of entrepreneurship, there is the factor of **financing and financial independence**. For example, most self-employed women have less access to funding programmes for small businesses. This is particularly the case in emerging and developing countries. At the same time, a development towards financial self-determination for women can be observed in industrialised countries. Here, women are portrayed as investors, especially in media and literature. However, investing in women, as it has been highlighted in Sarah Kaplan and Jackie Vanderbrug (2014), is not an investment in socially neglected people and combined with the aim of creating justice for its simple sense. "[...] gender capitalism is about applying a gender lens to highlight the ways that gender is material to financial outcomes and financial outcomes are material to gender." Therefore, there is a clear **economic reason to invest in women** and their participation in innovation.

The literature offers these answers to the research question but partly ignores the specific relation to the concrete influence women (can) have on innovation processes and the results of it. However, putting on the gender lens on the investment in women can be an approach of a pathway in the right direction.

R3: What are the key issues in the theme "gender and innovation"?

Representation and closing the 'gender gap' has been the main issue raised in the innovation literature to date. At the time when we were selecting the literature, we had to exclude a large number of papers that focused exclusively on the gender gap. Despite that, representation still emerges as the issues raised in the studies we included for critical analysis.

On the one hand, the studies emphasise that **men continue to dominate in STEM subjects**; on the other hand, programmes are presented that encourage women to become more involved in non-typical women's domains. However, it is important to consider that putting on the gender lens means more than empowering women to be able to be part of an existing system. The system and the cultural barriers it entails need to be overcome (Kaplan and Vanderbrug 2014). In particular, there is a strong emphasis on the ICT sector in research, which has the potential to create a balance in gender representation. However, an examination of different IT companies shows that men still not only occupy management positions, but that the companies are also subject to a **male management culture**. Thus, it can be concluded that striving for a greater balance in the distribution of genders does not automatically lead to a more open work culture and diversity in staff. This open work culture is described as a democratised innovation process that supports the incorporation of ideas and creativity of marginalised groups with the effect of less organisational boundaries and hierarchies (Wikhamn and Knights 2013).

This seems to be the case in the field of energy research, too. However, there is no automated abolishment of discriminatory work environments (Szczur 2017). A case study conducted at Google and Facebook gave evidence of the fact that even in open work environments men and masculine company culture can persist, especially in technology-driven companies (ibid.). Other IT companies like Cisco or eBay published data showing an underrepresentation of women and ethnic minorities. Gry Agnete Alsos, Elisabet Ljunggren, and Ulla Hytti (2013) indicate, legitimately, that organisations shall be analysed empirically to find out how "innovation is 'fundamentally gendered'" and therefore more data on the influence women can have in innovation processes. **Inequality in science and technology is not only generated by an underrepresentation of women** e.g., but rather by problems in infrastructure, existing powerful interests, a Eurocentric worldview, privileged user problems and others. **Powerful interests** can lead to an oppression of scientists at their workplace (Williams and Woodson 2019) and further disregard of researchers' questions on certain topics. The same happens with an Eurocentric worldview where knowledge from other regions is not considered as relevant as Western-produced science.

In addition to analysing work structures within companies, research also looks at women in self-employment, so-called **female entrepreneurs** and the challenges they face in different aspects, suffering from gender biases and inequalities and a lack in female role models (Suseno 2021) even though women comprise the majority of informal entrepreneurs, especially in the developing world. However, women are far behind their male counterparts when it comes to the use of technology (Warnecke 2017). This aspect has already been discussed in the previous question, but the consequence of existing stereotypes of entrepreneurs being represented by men leads to a development of policies and practices that only favour men (Cukier et al. 2022) and neglect the needs of female entrepreneurs.

There is strong separation of **how innovation is discussed in developed vs. developing contexts**. In the developing contexts, it seems that the ambition is smaller and as long as women can gain a little bit more independence, even within the traditional gender spaces, the activity is categorised as 'inclusive gendered innovation'. The focus here is on **women's empowerment,** commonly viewed in the reviewed literature via a pathway of economic independence and autonomy achieved as women gain new skills and networks and start generating income. Women are seen as oppressed by traditional patriarchal societies and as needed to be educated and armed with knowledge and skills in order to become independent.

In the developed contexts, the criticisms are different. Papers are more likely to relate innovation development processes to broader structures of inequality and critically discuss how women need to participate in order to address them. There is more focus is put on achieving equitable outcomes. The differentiation between practical and collective needs is useful here. Development literature addresses women's practical needs while papers with empirical data from the developed world focus on how innovations improve (or do not) and contribute to building new more equitable social structures. At the same time, some innovation research still focuses mainly on issues of (under)representation.

Just a few papers (12) discuss **diversity and intersectionality** when it comes to innovation and gender, but one could be the basis for further analyses to answer the question of why there are not so many women represented in innovations processes. It seems, as shown by a study conducted in the UK, that women from disadvantaged backgrounds are less likely to study STEM but are more likely to study social sciences, law or business. This could be an explanation why there are fewer women with an intersectional background in STEM innovation fields than "their more advantaged peers" (Mcmaster 2017, in Owalla 2021). This is, **women coming from a lower socioeconomic status are more likely to choose more gender stereotypical subjects**.

Regarding **discrimination**, there is some evidence on cultural stereotypes and the effects they may have on women's participation in the IT sector, that point to how 'gendered career norms', maternity and other socio-cultural factors have consequences for their career choices and their individual experiences (Suseno 2021). Another example is provided from a developing context, refered to the use of energy technologies and their embeddedness in cultural norms. Stefani van der Merwe, imke de Kock and Josephine Musango (2020) explain how "an important part of enduring that energy transitions happen effectively is considering [...] underlying cultural and social aspects". Here, a reference is made to **women as users/beneficiaries of energy technologies**, but not of their involvement in their development. This aspect is missing.

A relevant consideration when discussing 'gendered innovations' is to **integrate sex and gender aspects within the innovation processes** at the methodology design and data interpretation stages (Schiebinger and Schraudner 2011). Another one is to focus, when analysing, on patent registrations made by women instead of concentrating on the fact that women are under-represented in the STEM fields. Patents are still male-dominated areas in which the law protects a masculine way of valuing information. One reason for fewer patent registrations by women was mentioned before: there are fewer women in STEM-related fields of research. Another reason is the gendered development of the patent law, including its terminology and interpretation. Women, when establishing the patent law, were seemingly not considered (Lai 2021) as being part of the target group due to already mentioned gender-blindness. Data from 1976-2010 has shown that in the medical field, patents for women's health were mostly registered by women whereas patents for men's health were mostly registered by men (Koning, Samila, and Ferguson 2021). This fact makes clear that representation and the group of beneficiaries are interconnected, and that the lack of participation of a certain group in innovation processes leads to a lower coverage of beneficiaries of innovative results.

There is extensive literature on the **benefits of gender diversity in relation to innovation**, which can easily be applied to the positive effects of gendered innovations. We can distinguish

between two lines of argumentation, the social-justice / fairness oriented arguments and the benefit-oriented ones.

- Social justice: It is simply not fair and against European and national laws to systematically exclude important parts of society from research and innovation
- Benefits: The arguments range from more ideas, creativity, user orientation to more responsibility and economic growth

The **social justice** argument mainly refers to the macro-level of societies whereas benefits can occur at the macro (states), meso (organisations) as well as the micro level (teams / individuals). For example, a higher turnover through gendered product development (McKinsey & Company 2007) refers to the meso level of a company. However, when aggregating the effects of gendered innovations, these might also lead to general welfare. Enhanced excellence through gendered innovations (Schiebinger & Schraudner, 2011) strengthens single research institutions but also the scientific performance of states or regions, which might then lead to positive societal impacts like improved quality of life for everybody. The effects that the norm-critical innovation approach mentions are primarily at the meso level, namely development of new interventions, changes in organisational routines and practices and capacity building. Amorim-Maia et al. (2022) mention a further macro level effect by, i.e. a policy impact through an intersectional perspective. This approach can help bring together theory and practice in mission-oriented research or applied research with societal actors, which aims to produce concrete, implementable solutions.

The social justice argument is underlined by the observation (or assertion) that by adopting a gender lens that is sensitive to various marginalised groups fosters the creation of shared social value, social impacts and not only profit.

R4: How has intersectionality been implemented in the analysis of gender and innovation issues?

Intersectionality as an analytical approach emerged from the critique that the focus on one dimension of inequality is insufficient to accurately describe, analyse and address situations of inequality experienced by marginalised groups. Kimberlé Crenshaw (1989) demonstrated that discrimination and violence against black women can only be explained if intersecting influences of systems of oppression taking both race and gender into account. Oppression from multiple sources of disadvantage is compounded and is greater than simply the sum of these separate influences. Many more dimensions of inequality have been discussed, including gender, race, class, caste, ability, and others (Crenshaw 2019).

I**ntersectionality is not widely used in innovation research.** Studies in our dataset were more likely to use concepts such as 'diversity inclusion', 'inclusion', 'inclusivity' and other diversity-related frameworks to talk about various dimensions of diversity (Barabino 2019; Filippova, Trainer, and Herbsleb 2017; Jayashree et al. 2019; Parthasarathy 2022; Williams and Woodson 2019). These approaches are more conventional in the innovation literature. However, the diversity inclusion perspective does not take into account how different diversity dimensions intersect and thereby affect people's experience of innovation. Furthermore, **diversity inclusion is a forward-looking approach,** which emphasises positive outcomes of diversity for firms and stakeholders. It does not focus on barriers preventing certain groups from participating. Therefore, an explicitly intersectional framing acknowledges that the systematic understanding of intersecting systems of oppression is needed.

Perhaps the best example that demonstrates the added insight of incorporating intersectionality in research design can be found in Jenny Lieu et al. (2020). Their international research project examined energy transition pathways in Kenya, Canada and Spain. Neither gender nor intersectionality were incorporated in the analytical framework. However, after gender issues emerged as a significant theme in the Spanish case, the authors conducted ex-post analysis of data collected in Canada and Kenya. In the case of Canada, they discovered important **intersections between gender, class and indigenous identities** that could be influential in building alternatives to the mainstream energy transition. In Kenya, intersections between gender, ethnicity and class influenced which energy technologies were prioritised and which ones were marginalised. Without the gender/intersectionality perspective, these findings would not have been reported. Energy transitions imaginaries built without female and indigenous voices would be disconnected from local realities and not viable in practice.

Further studies in the dataset reveal further advantages from incorporating an intersectional approach in innovation research. Seppo Poutanen and Anne Kovalainen (2016) write that since "the idea of intersectionality challenges the notion of gender as the sole or most significant basis of any social or organizational discrimination process", implementing an intersectional analytical approach shifts "the perspective from individual females and males to the processes of social construction that bring about distinctive female and male actors in specific contexts of action" (p.234). Such an approach can be valuable in several ways.

One **identifies relevant problem areas, objectives and targets for innovation**. In one of the cases discussed by Lea Fuenfschilling, Linda Paxling, and Eugenia Vico (2022), the research team that investigated the lower participation of women in the use of the cycling infrastructure in Stockholm discovered that the problem was experienced differently by different groups of women. The project eventually focused on working with older immigrant women and developed several social innovations that empower them by providing more mobility options. The intersectional approach was useful for identifying a problem and designing appropriate innovative solutions to address it.

The intersectional perspective can help **bring together research and practice** to address 'wicked' problems. It may be especially valuable when projects aim to create concrete, implementable solutions. Real-world problems are associated with complexities because of entrenched social, political and structural inequalities. For example, Ana Amorim-Maia et al. (2022) provide several examples of how compounding and overlapping vulnerabilities, accumulated over a long term, make it extremely difficult to address climate change adaptation in urban planning. Since climate justice research has discussed these problems in fragmented ways and typically focused on one vulnerability at a time (e.g. gender or income), such knowledge was only of limited use for developing measures that benefit all marginalised groups.

Innovation interventions frequently use **participatory approaches**: both problems and solutions are formulated in an interactive process where stakeholders from industry, government, academia and civil society are involved. Participatory methods are the cornerstone of certain innovation approaches (e.g. responsible research and innovation). Intersectionality can particularly be implemented when recruiting stakeholder representatives for innovation development. A convincing account is offered by Marta Wojciechowska (2019). Drawing on the case of democratic innovations and aiming explicitly at including marginalised groups in democratic decision making - popular assemblies and mini-publics - the study shows

that that simplistic inclusion that considers only one dimension of inequality can become explicitly exclusionary. If only one dimension of inequality is considered, then internal divisions will create new stratifications and levels of inequality. The most disempowered groups will be the least likely to speak. Furthermore, recruiting stakeholders along predefined dimensions **ignores people with dynamic identity markers and people with fluid identities** - including gender identities. They would be explicitly excluded from the innovation process. The intersectional approach is therefore absolutely necessary to prevent the appearance of these exclusionary practices.

In a similar vein, the intersectional lens has been implemented in innovation research to **uncover new marginalisations**. The intersectional lens interrogates tokenistic inclusion of marginalised groups in the innovation process, which can often be blind to other dimensions of inequality: for example, female social entrepreneurs from privileged backgrounds or from wealthy countries selling their products to the poor in the developing world (Mahajan and Bandyopadhyay 2021). When women are included in historically male-dominated high-tech spaces, such inclusion can be followed up by in-group discrimination of privileged white women towards black women (Pecis and Berglund 2021). Even when women are generally included in innovation, there is still the lack of role models with intersecting characteristics (Comedy and Dougherty 2018).

The main challenge of applying an intersectional perspective in the analysis of gender and innovation issues is actually implementing it. A significant share of studies in our dataset acknowledged that intersecting influences are important, but only a few attempted to implement it. The vast majority of studies in the dataset focus exclusively on gender as the main dimension of inequality and at best mention other potentially intersecting characteristics. Only a few articles incorporated intersectionality as the core part of their research.

Another challenge, noted in particular in Lara Pecis and Karin Berglund (2021), is **what the intersectional approach aims to achieve**. While so far intersectionality has been used in innovation research to mainly highlight which groups are in the limelight and which ones are marginalised with respect to innovation, much less attention has been paid to **innovations on the margins**. Innovation from the margins, they argue, will overturn power structures of innovation development and will open up new imaginaries of what innovation is and for whom.

R5: What are prerequisites and success factors/conditions for developing gendered innovations?

First, there needs to be clarity about what we are talking about in order to promote gendered innovations in practice. The **lack of conceptual clarity** refers not only to "innovation", but to the question of what exactly "gendered" entails as well, also from an intersectional perspective . Overall, representation and participation of women in the innovation process is found to be a prerequisite for innovations that address problems experienced by women specifically or to a greater degree: "who benefits from innovation depends on who gets to invent" (Koning, Samila, and Ferguson 2021).

Second, we observe that gendered innovations are a deviation from or an addition to "the male norm". To surpass the traditional approach that corresponds innovations to a male norm, there must be **prerequisites in the form of motivations/incentives, skills, knowledge and resources**, to pave a new path from androcentric routines in the development of innovations. Thus, dedicated activities that strengthen these prerequisites are suitable to promote gendered innovations.

In this context, it should be emphasised that an inclusive innovation is easier to achieve if, in addition to technical and product innovations**, other types of innovation are brought into focus, in particular open and social innovations** (Alsos, Ljunggren, and Hytti 2013). As Malin Lindberg, Lena Forsberg, and Helena Karlberg (2016) point out, social innovation helps to challenge social norms that delimit innovation to technical product innovations in industrial and high-tech settings. Tonia Warnecke (2017) emphasises the usefulness of using technology as a social innovation to bridge the gap in technology use between men and women by giving an example on how women can be empowered to use technology for their own purposes. An example of a success factor closely related to open innovation are the recommendations of Yara Asi and Cynthia Williams (2020) to include women as prospective users in technology design and development and, as concrete case example, to promote the use of health information technologies among women frontline workers.

Specific **rules and regulations** to incorporate gender and inclusive perspective in new policies or projects can further promote the emergence of inclusive gendered innovations (Amorim-Maia et al. 2022). This is particularly important given that, as Seppo Poutanen & Anne Kovalainen (2016) point out, the representation of women is important, but even more important is to consider the process of gendering innovations and understanding the gendered contexts in which innovations emerge.

Other success factors mentioned, put forward the need for the **promotion of gender equality** as a whole, for example motivating girls and women to engage in STEM disciplines, mentoring, fighting against implicit biases and hostile environments (Barabino 2019; Jayashree et al. 2019; Demartini 2019), or improving their access to funding, as well as measures against the glass ceiling and the still existing perception that women are less innovative. In addition, **communication issues in team processes** are mentioned, particularly the fact that minorities are not heard, ignored, intimidated, or receive mansplaining. This discourages participation and requires suitable action against these phenomena (Filippova, Trainer, and Herbsleb 2017).

Christian Voigt, Elisabeth Unterfrauner, and Roland Stelzer (2017) add organisation-related recommendations that relate primarily to the recognition that there are challenges in the area of equality and diversity, e.g. the need to actively promote a culture that appreciates diversity, acknowledges the gender gaps and the need for firm policies to avoid behavioural aberrations, commitment to investigate transgressions of codes of ethics or general norms of conduct.

Payyazhi Jayashree et al. (2019) contribute somewhat more general recommendations on how to strengthen the development of inclusive gendered innovations. The authors emphasise, as well known from **gender equality initiatives in general**, the commitment of the top management, the availability of sex disaggregated data, participatory decision-making and "a climate of inclusion that is embodied in fairness in implementation of policies and procedures".

Additionally, Paula Kantor, Miranda Morgan, and Afrina Choudhury (2015) highlight the **need for technology-focused projects** to engage with social barriers if they are to achieve their desired results. Accordingly, a crucial success factor lies in an inclusive approach to Research and Innovation (R&I) in which the knowledge and perspectives of various stakeholders are included, facilitating the inclusion of women and other marginalised groups. The authors also emphasise the need to engage with the whole social system when considering who will access and benefit from innovations to ensure more equal, sustained outcomes. This is very much in line with the issue raised by Saskia Vossenberg (2018), namely that people have to be made

visible in the innovation process, otherwise they become invisible and it is not clear, about whom we are talking (ibid.).

Finally, the **importance of alliances and networks** should be highlighted when aiming to overcome masculine hegemony in innovation: resources can be sourced from unconventional places, or with the help of allies. Additionally, there are papers in the dataset showing how women can make innovation work when they act collectively to overcome patriarchal barriers, especially in developing contexts.

R6: What are the current key challenges for developing (inclusive) gendered innovations?

Currently, most **innovation spaces are highly gendered towards the masculine norm**. This marginalises women, feminine knowledge and feminine practices in multiple ways, on multiple levels. For example, othering[7], micro-aggressions, exclusion through language, or symbolic exclusion in addition to physical exclusion. Women who want to participate in these spaces sometimes need to adopt traditionally masculine attitudes and avoid expressing or aligning with feminine behaviours.

Other important barriers towards more gendered innovations are **gendered power dynamics, both in terms of concepts and of the social organisation of innovation research**. Since innovation is a highly masculine concept, it favours masculine ways of knowing and doing, protects masculine knowledge and devalues feminine knowledge. Technological innovations that advance masculine ideas find support among e.g. investors and are prioritised in innovation policymaking. Quantitative research of technological innovation are easier to publish in highly ranked journals, which brings higher career returns. The innovation community is dominated by male researchers who are less likely to recognise gender power dynamics as an issue. Social, inclusive and gendered innovation studies are more likely to draw the attention to the issue of gender, but are more likely to be qualitative and are thus harder to publish in innovation journals.

Moreover, the **hegemonic concept of innovation**, which usually means technological innovation with marginal concepts that try to extend it, such as inclusive, social and responsible innovation, is a further crucial challenge. The need to add a qualifier 'social' or 'inclusive' means that the 'normal' definition of innovation does not by default include achieving social goals. With respect to gender, it is established that technological innovation is highly gendered towards the masculine, while innovation by women is marginalised, including via the use of language. That is why it is normal to talk about 'innovators/entrepreneurs' and secondary 'women innovators/entrepreneurs'.

Further challenges mentioned in the literature are:

● **Difficult access to funding** (in particular for the scaling up stage) due to discrimination, chauvinistic attitudes, etc. (Mahajan and Bandyopadhyay 2021).
● Strengthening gender stereotypes through **gender-sensitive product development** (Rommes 2013)
● Challenges of implementing an **intersectional approach** due to a lack of incorporation intersectionality in the toolkits/methodologies for participatory methodologies, as explicated above;

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[7] 'Othering' is a postcolonial concept referring to how people are marginalised and are identified by their difference from the hegemonic group, considered different, inferior and less valuable (Spivak, 1985)

- A lack of **attention to female issues** because they are not recognised or prioritised by predominantly male researchers / inventors (Reardon 2021)
- Women are not perceived as innovators, and consequently their ideas are not heard in the first place, or they are deemed inferior to men's ideas and therefore never proceed to the implementation phase (Cooper, Reimann, and Cronin 2012). Hence, it is not women who are lacking innovation capability but **organisational practices** that condition or **inhibit women's innovative behaviour** (Alsos, Ljunggren, and Hytti 2013)
- **Feminine intellectual labour is not recognised as a patentable subject matter** - for example, methods of medical treatment vs method of caretaking, other process-based knowledge (Lai 2021)
- The **negative bias from patenting** is reproduced in innovation spaces, discouraging the participation of women (Lai 2021)
- The **innovation process deeply favours the masculine attitudes** because of the established culture and ways of thinking associated with STEM (Lai 2021)
- Gendered innovations aim to include women, but end up reinforcing feminine/masculine divisions and norms (Poutanen and Kovalainen 2016)
- Workplaces are infused with gendered practices and these practices take active positioning in the ways the work is labelled as gendered (Poutanen and Kovalainen 2016).
- Lack of consideration of existing social and power relations in program/innovation design (Kantor, Morgan, and Choudhury 2015).

Logan Williams and Thomas Woodson (2019) contribute reflections on the question of why certain science and technology issues - as prerequisites for innovation - are not addressed. As they point out: "Negative non-knowledge refers to the known unknowns of a research system, controlled by powerful elites, deliberately chooses not to pursue due to practical and political interests. Undone science is systematically-produced negative non-knowledge that would, if available as knowledge, be of interest to marginalised groups and social movements". They call for researchers and practitioners to consider the issue of which kind of knowledge could be produced but is not. They identified six main reasons for non-knowledge: scientific bandwagon, powerful interests, a Eurocentric worldview, profit orientation, exclusion of groups not being able to purchase access to knowledge and finally privileged user biases.

R7: What are the future research directions in the area of (inclusive) gendered innovations?

Dedicated inclusive and intersectional gendered innovations can, from our own point of view, be one format to overcome the above-mentioned challenges. These will be elaborated on in the concluding section of our report.

4 Analysis of policy documents

4.1 Method for analysis of policy documents

The focus of this part of the review was to identify promising policy instruments promoting gendered innovations and knowledge gaps in the development and implementation process of gendered innovation policies by conducting a scoping literature review.

4.1.1 Protocol

Funders, national and regional authorities employ **policy instruments to promote gendered innovations**. Due to diverging contextual conditions, we expect different challenges for gendered innovation policies. Therefore, we anticipate deriving favouring factors and barriers in the policy development and implementation process across different countries by analysing policy documents, funding lines and their respective projects.

We adopted a **decolonial** and **intersectional** perspective, by paying attention to policy papers and documents that **challenge established epistemologies** in innovation research. We made sure to avoid this common blind spot by including sources from non-European countries (South Korea, Canada), international comparative reports and analysis from internationally operating organisations (UN Women) that provide valuable insights. Since the term "gendered innovation" is not widely adopted in many countries, gendered innovation policies are yet to be developed. To include perspectives from those territories in our analysis, we broadened the perimeter of the study and included some policy documents on gender in research that contain learnings that can be transferred to gendered innovation policies. In the early 2010s, the concept of gendered innovation was developed. Therefore, the **timeframe for our analysis was set from 2010 to 2022**. The search was mainly conducted in English and German. Concerning the document type identified in the search results, no restrictions were made. Therefore, the list contains working papers, progress reports, policy documents, final reports and evaluations[8].

We had to adopt a diverging **search strategy**, because there are no databases that contain all policy documents. At first, we started searching on the SIPER (Science and Innovation Policy Evaluation Repository) database for projects and funding lines that have been evaluated. Secondly, we looked into communications from the European Commission, the European Council and Science Europe. Thirdly, reports of international organisations such as UNESCO, UN Women, reports from a range of research projects (Gendernet, Genderaction, etc.) and joint framework events (e.g. Gender Summit) and lastly, national sources and policy documents were searched.

Then, **inclusion criteria** were delineated. Documents to be included had to focus on the concept and/or process of policy making in the realm of gendered innovation and research. Accordingly, throughout the search process **exclusion criteria** were dynamically developed. In the beginning, all policy documents and funding lines that covered the field of gender and innovation were included by a researcher for further screening. Following this, two other researchers scanned the titles and abstracts and excluded literature that was not relevant and

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[8] In the further course of the literature analysis, information on individual funding programmes of websites was also included.

included literature they identified as highly relevant and explained their decision. In the last step, a third researcher selected the most relevant documents for an in-depth analysis based on the exclusion criteria formulated up to that point and a screening of those documents that could not be clearly included or excluded so far.

The results were exported to a reference manager. At this point, the list contains influential documents in the field, latest trends, relevant documents in the knowledge field, relevant documents from different countries and leading-edge research.

4.1.2 Registering searches

At the identification stage, we searched several **databases** for funding lines, individual projects and project evaluations (Figure 5).

Figure 5 Registering searches of the policy literature
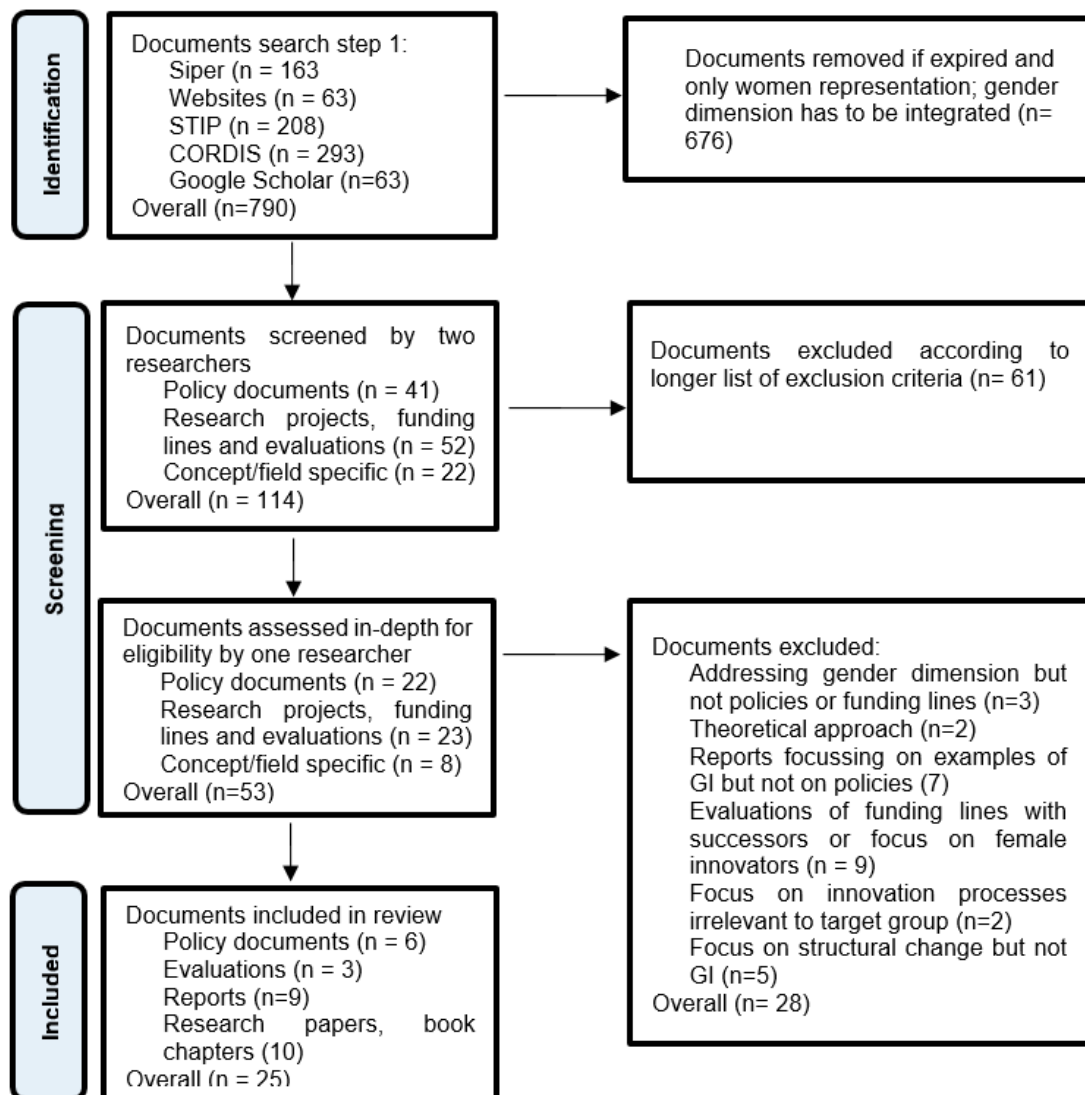
Source: authors, adapted from Page et al. 2020.

We used several combinations of the following key concepts, presented in Table 2:

Table 2 Key concepts with keywords

Block 1 - women	Block 2 - innovation	Block 3 - INSPIRE keywords
Gender	Innovation	Inclusivity
Woman / women	Invention	inequality
female		Intersectional
		Mainstreaming
		Policy / Policies

Source: authors

In the SIPER database, we checked 163 results and listed them in an Excel sheet for further screening. During the screening process, we excluded funding lines and projects that only considered women representation and lacked an integration of gender dimension as well as a focus on innovation (included: n=41). Additionally, we excluded funding lines and projects that expired or already have a successor (excluded: n=15).

In addition, we searched for **policy papers, reports and projects** on other websites (n=63). We covered the websites of the European Commission, European Council, European Innovation Council, the European Research Council, European Institute for Gender Equality, OECD, Gender Summit Network Database, UNESCO Women in Science database, Gender and Science Knowledge Network Database and the Gender-based innovation portal. Therefore, a variety of databases has been searched. When searching the STIP Compass database of the OECD with the keywords "Gender" "Innovation" "Policies" out of 208 results no sources could be included, because most of the documents only included policies on female representation or gender-balance in entrepreneurship or did not contain any policies at all.

Additionally, we searched **reports on the websites of particular projects** e.g. Genderaction, GenderInSite. We obtained the project information of the CORDIS database and looked into 293 projects (Keywords: "Gender"; "Innovation"). Additionally, we looked into members of networks (e.g. FORGEN, TAFTI-network) and banks promoting innovation (e.g. KFW). We also searched for grey literature on Google Scholar with the aforementioned key words. In this second search, we were able to obtain 63 sources containing policy papers, reports and projects. These results were checked manually and added to a reference manager with additional bibliographic data.

After pre-selection, there were 114 documents in the reference manager software. In a next step, we excluded literature based on relevance, citation, robustness, quality, date. We attempted to apply content-related exclusion criteria and aimed to identify contributions that focus mainly on policies. However, the limited time hindered a thorough screening beyond information obtained from the title and abstract. Therefore, criteria suggested in the scoping review process such as the importance of the results or the robustness of methods could not be fully taken into account.

In this process, the 114 documents were manually scanned (title, abstract information) and highlighted for exclusion if they met at least one of the following **criteria**:

- Documents that address gender dimension but not policies or funding lines
- Documents with a strong theoretical approach
- Documents focussing on examples of gendered innovations but not on policies

- Documents on the meta-level without concrete connection to policies or gender dimension
- Evaluations of funding lines that already have successors
- Documents focussing on innovation processes that are not relevant for the KSH4 target group
- Documents focussing only on structural change and not on gendered innovation
- Documents focussing on gender of applicants
- Funding lines that focus on start-ups of female innovators

Thereafter, 53 documents were selected for further screening, 61 documents were excluded according to the previously defined exclusion criteria. Then, each document was assessed in-depth for eligibility by another researcher, who decided to in- or exclude the literature based on an in depth screening of the content. The excluded articles were moved to separate folders in the reference manager in case they are relevant at later stages. After the exclusion, at this point, 25 policy reports and funding evaluations (focussing on national initiatives or international comparisons in Europe, North America, Sub-Sahara Africa and South-East Asia) are included in the final sample for an in-depth critical analysis.

4.1.3 Approach to critical analysis

For the **critical analysis**, the data was charted on two different excel sheets (Table 3). The first excel sheet contains the policy documents. The second excel sheet contains the funding lines and projects. The rows of the sheets cover the respective documents. In the columns are descriptive and analytical characteristics for the analysis.

Table 3 Characteristics of policy papers and funding lines

Characteristics of policy papers	Characteristics of funding lines
Title	Title
Author(s) / Organisation	Project / Organisation
Year of Publication	Funder
Authors	Year of Publication
Publication / Report Type	(Policy) Instrument / Innovation focus
(Policy) Instrument / Innovation focus	Impact / Result
Impact / Results	Comments (discussion of in-/exclusion)
Comments (discussion of in-/exclusion)	

Source: authors

One researcher performed an in-depth analysis of the list of policy documents, while the other investigated the funding lines. In the process of critical analysis, the full text was accessed and examined.

4.2 Scoping Results

This is part of the WP2 literature analysis and addresses one of the topics: Innovation policies; these are analysed on two levels: National policy makers and RFOs.

Gendered Innovations stimulate gender-responsible science and technology development by employing practical methods of sex, gender and intersectional analysis. Considering these approaches, adds valuable dimensions to research. The concept of gendered innovation was developed and gained the interest of policy makers in the early 2010s. Therefore, the timeframe for our analysis was set from 2010 to 2022. The selected literature was published

in the period from 2012 to 2022. More than 50% of the reports have been published in the period 2019-2022. Most of the publications were written in universities or in cooperation with the RPOs, but also by international organisations like UN Women. The selected literature contains three evaluations, two policy reviews, five papers, two book chapters, four policy briefs and nine reports (Figure 6). In addition, we analysed six websites for information on company-specific funding, as these were not covered in scientific publications but are highly relevant for INSPIRE.

Figure 6 Types of sources in the policy dataset
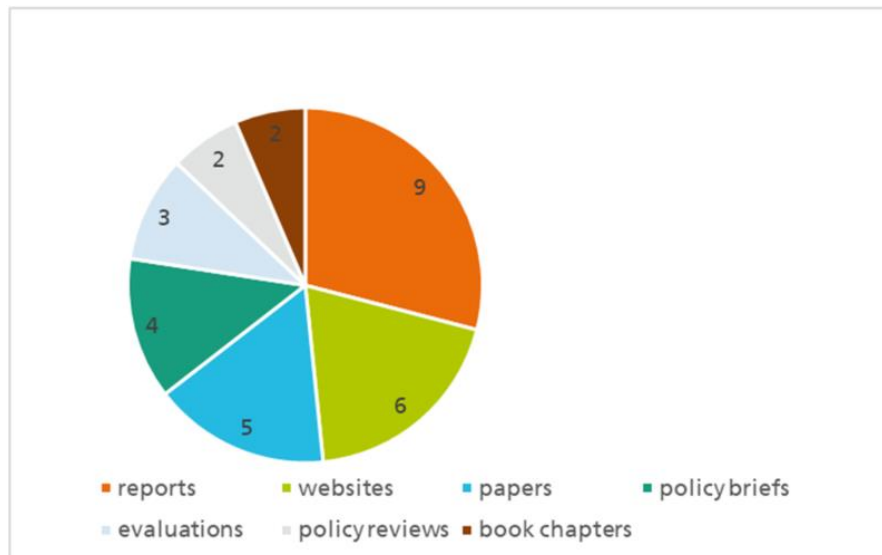
Source: authors, based on multiple databases

Most documents investigate the **relationship between gender and innovation**. While some documents deal with R&I from a **feminist perspective** (Benschop and Husu 2021; Picardi 2022), others try to shape a **new conception of innovation** or incorporate participatory elements such as "open innovation" ('Gender in Open Science & Open Innovation' 2018) or "inclusive innovation" (Lindberg and Berglund 2016). The policy briefs reflect on gendered innovation policies and various policy instruments or measures and investigate potential barriers, success factors and best practices. For instance, Schiebinger reports on different policy approaches to gendered innovation and provides recommendations for further actions (Schiebinger 2021). Some policy briefs address various stakeholders such as national policy makers, research performing organisations and research funding organisations and recommend actions (Altamirano and González 2021; GENPORT 2017; Rødland 2021) while others, for example, focus solely on funders (Håkansson and Sand 2021; Hunt and Schiebinger 2021).

We also analysed **project evaluations**, because they often incorporate, develop and implement gendered innovations and therefore provide valuable insights for gendered innovation policies. For instance, the Austrian funding line "Förderschwerpunkte Talente" included FEMtech research projects, a funding programme that funds gendered innovations (launched in 2008) developed by research institutions in cooperation with companies (Heckl, Sheikh, and Wolf 2014).

During our research we adopted a decolonial and intersectional perspective by paying close attention to policy papers and documents that challenge established epistemologies and therefore include sources from non-European countries. For example, the paper of "A study

on the Prioritization of Policy for Gendered Innovation" reflects the discourse on gendered innovation in South Korea as an integral part of the third and fourth national plan by conducting focus group interviews (Hwangbo, Park, and Lee 2019). The ongoing debate in the Korean context is also reflected in a paper co-authored by the president of the Korean Center for Women in Science, Engineering and Technology on the role of gender-based innovations for the UN sustainable development goals (Lee and Pollitzer 2016b). We also included a brochure of UN Women ("Innovation for Gender Equality"), because it displays vast experience in promoting gender-responsive innovations, including IT projects, partnerships, and especially new ways to deliver services for marginalised women, while addressing the risk of bias and ensuring that technology benefits all equally (Mlambo-Ngcuka 2019).

4.3 Critical Analysis

R8: What are the most promising policy instruments to promote gendered innovations (at the level of national/regional authorities and RFOs)?

4.3.1 What policy instruments defined as measures were particularly successful for promoting gendered innovation and why?

This section identifies which policy instruments (defined as measures) have been successful in **promoting gendered innovation at the national and RFO level**. In addition, a focus is placed on instruments that aim to promote gendered innovations in enterprises.

4.3.1.1 National Level

National policy makers undertake various initiatives to encourage the **integration of sex and gender analysis in research content and organisations**. However, there are significant differences between countries and individual organisations as the pressure and legal obligations to consider the gender dimension varies. Countries also use legislation differently. While the majority uses legislation as a general framework for targeted initiatives, some countries have more detailed laws that incorporate concrete measures (Rødland 2021). The literature analysed describes the following targeted measures introduced in legislation and connected frameworks focussing on gendered innovations:

Some countries have **dedicated national units within ministries** (e.g. France, Slovenia and Spain) that influence national policy on gender in research, monitor the R&I sector and report on the implementation and impacts of laws and regulations. Others established independent national committees outside ministries that function as advisory boards for ministries and institutions (e.g. Norway, United States) (Rødland 2021). For instance, Spain set up a Women and Science Unit and a new Observatory on Women, Science and Innovation. It aims to achieve gender equality at all levels of R&I, as well as an adequate integration of gender analysis in R&I content, programmes and projects (ibid.)

Some countries have **national strategies and plans** that are adopted by RFOs and ministries (Switzerland, Spain, France, Norway, Ireland, Austria). For instance, at ministry level, the Czech Republic adopted its Governmental Strategy for Equality of Women and Men 2014-2020 with sections dedicated to the integration of the gender dimension in R&I content (ibid.). Other examples are the national legislation on the integration of Sex, Gender and Diversity Analysis (SG&DA) set in Japan within the basic plans for science, technology and innovation

and gender equality as well as the amendment in the Korean Framework Act on Science and Technology, which included the integration of sex and gender analysis into research content (Hunt and Schiebinger 2021).

Some countries also require the **development and implementation of gender equality plans by law** (e.g. Spain, France, Norway), require it for research funding (e.g. Belgium) or use them as a crucial Instrument (Switzerland, UK). For Instance, the French CNRS has a Transformational Action Plan, which is a comprehensive Gender Equality Plan (GEP) with defined indicators to measure success. It includes the integration of the gender dimension into the content of R&I projects. In December the CNRS introduced a new Action Plan (2021-23) aligned with the framework of the French legislation, which makes it mandatory for all public entities, including RFO and RPOs to have a GEP until January 2021 (Rødland, 2021). However, to address the gender dimension in research and innovation in GEPs is recommended in the French legislation but not mandatory.

Another best practice is the **funding of studies and evaluations** that inform policy making in the field of gendered innovations. For instance, a study funded by the National Research Foundation of Korea, investigated optimal priorities for incorporating gendered innovation in STI and R&D in Korea's political and legal background. It also suggests various policy instruments in the domain of planning, budgeting, project management, evaluation and impact assessment (Hwangbo, Park, and Lee 2019).

Unfortunately, national measures mostly address HEIs as public institutions and there is **limited regulation of private R&I companies**. In addition to the implementation of measures mandated by the state, RFOs are probably the most important drivers of gendered innovations, as they not only implement government requirements, but also promote both gender equality work and the integration of the gender dimension into the entire funding cycle.

4.3.1.2   RFO Level

In the literature analysed we identified four reports that put forward **good practices of fostering gendered innovation on the level of RFOs**: The GENDER-NET Plus comparative analytical report includes a survey and comparison of initiatives for Integrating the Gender Analysis in Research (IGAR) (Altamirano and González 2021). The report of the Gender-Summit provides additional examples of how policymakers have incorporated gender mainstreaming into national research and innovation strategies (Lee and Pollitzer 2016a) and Fritch et al. (2021) show various possibilities to foster gendered innovations along the funding cycle. The study by Lilian Hunt and Londa Schiebinger (2021) provides a map of best practices of RFO policies worldwide supporting SG&DA and explores key considerations for each part of the SG&DA policy roadmap and highlight leading edge policies that may serve as models (Hunt and Schiebinger 2021). The following policy instruments are mentioned most often:

Regarding the **definition of clear terms for sex, gender and diversity analysis,** Schiebinger and Hunt (2021) and Heisook Lee and Elizabeth Pollitzer (2016a) highlight the ambitions of the European Commission and underline that some countries (e.g. Australia) use guidelines set through national legislation as drivers for updating definitions. Schiebinger and Hunt (2021) evaluated whether agencies provide definitions of sex and gender and other intersectional characteristics. By doing so they go beyond the GENDER-NET report, which focused merely on sex and gender. In line with this, the FORGEN report argues that RFOs need universal, standard definitions for the concept of sex and gender in place and underlines the need for an

intersectional approach (Fritch et al., 2021). In agreement, a report by GENPORT (2017) puts forward that to improve the quality of R&I, diversity and intersectionality must be fostered by legislation and "soft measures".

In addition, a **comparative analysis on national and regional initiatives** for integrating the gender dimension in R&I content found that there is a common confusion between gender balance and gender equality policies as well as on how the gender dimension should be taken into account (GENDER-NET/Rodríguez and Pérez 2015). To avoid this, they highlight the need for providing clear definitions and also examples for the integration of the gender dimension in research contents when talking about sex/gender analysis and gender in research (GENDER-NET/Rodríguez and Pérez 2015).

With regards to **proposal guidelines for applicants** and **gender-criteria in proposals**, Schiebinger and Hunt (2021) state that agencies take four diverging approaches:

a) Most encourage applicants to integrate sex, gender and diversity analysis,
b) Some flag research areas,
c) Few require this type of analysis, and
d) Some encourage applicants but instruct evaluators to score this element.

As with key definitions, agencies provide instructions in various ways. Some funders provide checklists (e.g. Irish Research Council) or key questions (e.g. Science Foundation Ireland), others provide FAQs (e.g. the Netherlands Organisation for Health Research and Development) or include descriptions (e.g. German Research Foundation DFG). Still others include mandatory open-ended text boxes in the submission forms (Schiebinger and Hunt, 2021). In line with this, the FORGEN report highlights that not all RFOs have clearly defined guidelines, checklists and assessment criteria for applicants and reviewers and therefore not always include mandatory questions for applicants regarding the relevance of the sex and gender dimension in research proposals (Fritch et al. 2021).

Another success factor for RFO policies integrating the gender dimension is the **provision of instructions for evaluators** (Schiebinger and Hunt 2021). Some RFOs also provide **training for applicants, evaluators and staff**. In line with this, the FORGEN report by Rochelle Fritch et al. (2021) underlines the use of compulsory training for applicants, which can be performed by RPOs but also supported by RFOs. They also highlight the need for further training for evaluators and reviewers monitoring grant awardees to ensure that the sex and gender dimension within applications are properly implemented (Fritch et al. 2021).

According to Fritch et al. (2021), the establishment of **permanent positions for gender experts** in RFOs is a useful tool as they can check whether gender is relevant and offer support to the programme calls before they launch. The GENDER-NET Report underlines that some RFOs are including trained gender experts on their evaluation committees and therefore guarantee that the gender dimension is taken into account (GENDER-NET/Rodríguez and Pérez 2015).

Regarding the **evaluation of policy implementation**, Schiebinger and Hunt (2021) found that within their sample only three agencies performed evaluations of policy implementation although nine were in the planning stages. They strongly recommend that agencies implement evaluation plans as they develop policies (Schiebinger and Hunt, 2021). For this purpose, they suggest a multi-part evaluation focussing on the quality of the sex, gender and diversity analysis in proposals and the number and proportion of peer-reviewed publications and other

forms of dissemination resulting from the sex, gender and diversity analysis incorporating grants among others (Schiebinger and Hunt, 2021). In line with this, Fritch et al. (2021) call for further actions regarding the evaluation of policy implementation.

While the individual points of the funding cycle with best practices were described in this section, the next section will now present various organisations that stand out because of their large number of gendered innovation policies either in the funding cycle or because of their rapid, innovative transformation processes.

4.3.1.3   Frontrunners and best practices

According to the literature analysed, the following organisations are good practices, especially as they mostly integrate the gender dimension into the whole funding cycle.

Irish Research Council (IRC)

The IRC is one of the **most experienced** RFOs across Europe regarding the implementation of gender equality policies and served as role model for other RFOs. Its Gender Strategy & Action Plan 2013-2020 considered the integration of the gender dimension as one of the key priority areas. Only the IRC reported measures on all above-mentioned aspects of the cycle and as only RFO covered by the survey, performs a **monitoring and evaluation of funded projects** (Altamirano and González 2021). The organisation has monitoring tools for the whole policy and particularly for the quality of the gender dimension of research projects. For this purpose, the IRC created an independent evaluation mechanism to ensure a positive gender impact. Therefore, the IRC also accomplishes the criteria of sustainability and consistency (Altamirano and González 2021).

Canadian Tri-Agency / Natural Sciences and Engineering Research Council (NSERC)

Schiebinger and Hunt (2021) highlight the Canadian Tri-Agency as best practice, because it **provides guidance and incorporates the Gender-Based Analysis Plus** and additional material. One of its members - NSERC has evolved and adopted a wide range of initiative and policies during the last years. For instance, **monitoring mechanisms** such as milestones and timelines as well as indicators were introduced (Altamirano and González 2021). Moreover, the RFO has **dissemination materials** on its website, including online training modules on unconscious bias for evaluators. NSERC considers its framework as a living document and joined their efforts with the Canadian Institutes for Health Research and the Social Sciences and Humanities Research Council to create a shared Equity, Diversity and Inclusion (EDI) action plan. In this process, the Tri-Agency Statement on EDI was established. The networking activity is partly the reason why the authors consider it a best practice (Altamirano and González 2021).

Technology Agency of the Czech Republic (TA CR)

TA CR only recently started implementing IGAR policies. According to Zulema Altamirano and Lydia González (2021), they have the **most potential** in terms of IGAR policies and can be considered a frontrunner in Central and Eastern Europe. They completed a pilot programme (ZETA) to integrate the gender dimension into research proposals and had positive results. Following this, they are extending initiatives and research programmes that integrate IGAR policies. After ZETA, TA CR refined their guidelines and criteria for future research programmes that integrate IGAR policies. In addition TA CR is using **new methods for**

communicating and disseminating sex/gender analysis content within the research community (e.g. YouTube channels, QR codes on leaflets) (Altamirano and González 2021).

German Federal Environment Agency (UBA)

UBA has exhaustive knowledge regarding the integration of the gender dimension into environmental studies. There are **obligations and support** for the integration of the gender dimension (e.g. guidelines and an office for requests on gender mainstreaming: "gender focal points"). UBA also commissioned an evaluation of two of its areas from a gender perspective: firstly, in the area of departmental research, quantitative gender equality aspects and qualitative gender aspects of research projects are considered. On the other hand, in the area of project funding of environmental associations, selected project applications were assessed in order to evaluate the fulfilment of requirements regarding gender aspects (Lee and Pollitzer 2016a).

Horizon 2020 and Horizon Europe

The EU Horizon 2020 and the Horizon Europe programmes are considered frontrunners, as they **explicitly require gender to be taken into account in research projects**. Applicants to Horizon 2020 are encouraged to address a gender dimension in the research content. The gender dimension is explicitly integrated into a range of topics across all the sections of the Work Programme. A topic is considered gender relevant when it and/or its findings affect individuals or groups of persons. In these cases, gender issues should be integrated at various stages of the action and when relevant, specific studies can be included. Under H2020, these topics are flagged to ease access for applicants. This should not however prevent applicants to a non-flagged topic from including a gender dimension in their proposal if they find it relevant. Evaluators are required to check how sex and/or gender analysis has been incorporated into the proposals submitted under the flagged topics. A novelty of Horizon 2020 is the inclusion of gender training among the eligible costs of an action. The aim is to help researchers to further develop and share gender expertise in relation to the funded project (Lee and Pollitzer 2016a).

Agencia Estatal de Investigación (AEI, Spain)

Almost **all stages of the funding cycle** have been covered and consider the sex and gender dimension at AEI. AEI requires the consideration of S&G analysis and **provides guidelines for applicants and evaluators**. For instance, there is a formal assessment procedure in place with training modules for evaluators. AEI also performs **monitoring of the impact** of the integration of the gender dimension into research projects. As mentioned before, most RFOs require the integration of the gender dimension. However, due to a lack of monitoring, in many cases it is therefore not possible to determine whether this integration had actually been carried out in the respective research projects. The AEI not only examines whether the gender dimension has actually been integrated and implemented, but also how and to what extent.

4.3.2 Funding lines addressing R&I companies (SMEs, international companies, start-ups, clusters).

There is only a limited number of funding lines which address R&I companies that seek to integrate the gender dimension and the female workforce into the innovation process.

The governmental agency **Vinnova** (Swedish Governmental Agency for Innovation Systems) seeks to promote sustainable growth in Sweden through the financing of needs-based

research and development of efficient innovation systems (Lee and Pollitzer 2016a, 27)**.** An essential aspect of Vinnova's mission is to foster greater collaboration between companies, universities, research institutions, and other organisations within the Swedish innovation system. Vinnova strongly promotes gender equality in this context as an enabler of innovation effectiveness, recognising that society is gendered and women and men bring with them different perspectives of problems (Lee and Pollitzer 2016a, 27). For this purpose, they fund projects mitigating gender inequalities. For instance, they launched a call in 2023 with a focus on integrating gender equality into the rapid digital transformation in Swedish industries. ('New Tools and Methods for Gender Equality in the Digital Technology Development | Vinnova' 2023). Vinnova also participates in gender equality projects. For example, in the GENDERACTIONplus project, Vinnova leads a Community of Practice (CoP), working on four thematic areas: Intersectionality and inclusion, the gender dimension in the content of R&I projects, GEPs and gender bias in the funding process for R&I (Vinnova, 2023).Vinnova is bound to the rules on government support and can only provide funding for certain types of activities or projects in order not to distort the market (Vinnova, 2023). Therefore, the funding rate depends on the size of organisation and type of project. SMEs often have more opportunities, but there are also co-funding possibilities. This is also due to the EU regulation on minor support (max. € 200,000 per recipient).

Another example for the cooperation between researchers and R&I companies regarding innovations, are the **FEMtech Research Projects** launched in 2008 and funded by the **Austrian Research Promotion Agency** (**FFG)**, which are considered successful, as they provide incentives for companies to introduce gender equality measures when cooperating with research institutes. As stated by FFG, in the FEMtech Research Projects, "the beneficiaries are mainly enterprises and research institutions that were already considering gender issues in their research activities. It is true for all projects and research institutions that the implementation would not have been possible without funding of "FEMtech Research Projects" due to insufficient financial means" (GENDER-NET/Rodríguez and Pérez 2015). Therefore, the funding enabled this crucial work. After evaluating their FEMtech Research Projects, FFG reached some conclusions regarding the level of satisfaction of applicants: "Enterprises and research institutions are highly satisfied with the sub-programme and the persons questioned confirm interest in re-participating in "FEMtech Research Projects" (Part of the results of the evaluation of the programme "Talents") (GENDER-NET/Rodríguez and Pérez 2015).

Moreover, within the framework of the **European Innovation Council (EIC), European Institute of Innovation and Technology (EIT), UN Women** and **Horizon Europe** several funding opportunities and incentives for female R&I initiatives were created. EIC funds grants and selected 32 applicants from 14 countries to the Accelerator Open call (EIC, 2023). During the pitches for Accelerator funding, there was a gender-balance in the committee and women-led companies were prioritised when sending out invitations for interview pitches (Calder-Wang, Gompers, and Sweeney 2021). For instance, "CurifyLabs OY" received funding for a project that aims to enable patient-specific medicines, using 3D printing in hospitals and pharmacies and takes the gender-dimension into account[9]. The "Women TechEU" is funded under the work programme Horizon Europe and offers coaching and mentoring to female founders as well as targeted funding to help their business to the next level ('Women TechEU'

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[9]https://eic.ec.europa.eu/system/files/2023-03/EIC%20Accelerator-January%2011%202023%20Cut%20Off.pdf

2023). It offers financial support for companies as grants for the initial steps in the innovation process, mentoring coaches under the new "Women Leadership Programme", including networking and pitching events and the possibility to participate in the Enterprise Europe network (ibid.). There are also grants as for instance, the European Prize for Women Innovators ('European Prize for Women Innovators Powered by EIC & EIT' 2023). With the Fund for Gender Equality, UN Women supports national, women-led civil society organisations in achieving women's economic and political empowerment and the Sustainable Development Goals (SDGs). The funding is "based on principles of accessibility, trust, and women's ownership, the Fund is a unique global grant-making model. It transforms financing from diverse donors into high-impact initiatives by women-led organisations, investing in their ideas and abilities to pursue interventions closely attuned to women and girls left furthest behind" ('Fund for Gender Equality' n.d.).

5 Results and Conclusions: Gaps and future research

We conclude the report by outlining the gaps and directions for further research. Our main finding from this analysis is that there is a lot of academic interest in gendered innovation and the field is dynamically developing. However, at the same time, the current knowledge base is fragmented and inconsistent. Work is needed on all conceptual levels: from theory development to applied research in formulating an approach to integrate sex, gender and intersectional analysis into innovation development in BES.

R7 What are the future research directions in the area of IGIs?

The main conclusion from our analysis is **the need to extend the conceptual development of both the definitions of IGI and IGIP**. The original definition, proposed in Schiebinger and Schraudner (2011) and developed in subsequent works (Schiebinger and Hunt, 2022; Schiebinger, 2021; Schiebinger and Klinge, 2018) is still lacking important elements that would enable its wider uptake in the community. With the view of criticisms and the content of related concepts, we extend the gendered innovation definition to include the following elements:

- Considerations of inclusivity and intersectionality, in particular, how sex and gender interventions interact with other characteristics of diversity and dimensions of inequality;
- Directionality: beyond scientific excellence and quality of outcomes, IGIs ultimately aim at promoting inclusive gender equality;
- Focus on the innovation process, not just in basic and applied research;
- Focus on the wider scope of beneficiaries at all stages of innovation development;
- Focus on the structuring role of societal influences, institutional frameworks, and organisational structures;
- The crucial need to consider specific local context.

With these elements in mind, we propose the following definitions:

Table 4 Inclusive Gendered Innovation Definition

Inclusive Gendered Innovation
IGI mainstreams sex, gender and intersectional analysis in the R&D and innovation development processes aiming at promoting inclusive gender equality. The IGI approach considers how broader societal influences, such as unconscious bias, gender relations, and intersecting inequalities already present in institutional frameworks and organisational structures, as well as local context, affect innovation development and innovation beneficiaries. IGI involves a diverse group of beneficiaries in the innovation process. While intersectionality should be an aspirational goal of IGI, it may be difficult to realise empirically. In these cases, IGI should strive for an inclusive approach grounded in SG&DA.

Source: authors

Table 5 Inclusive Gendered Innovation Policy Definition

Inclusive Gendered Innovation Policy
IGIPs encourage the mainstreaming of intersectional SG&DA, promote equal and unbiased and research content and innovation through legislation, regulations, strategies, targeted initiatives and/or dedicated units as well as incentives. *IGIPs on the RFO level aim at promoting the integration of intersectional SG&DA throughout the whole funding cycle, by providing a definition of clear terms for SG&DA, establishing gender criteria in application forms, assessment criteria for the evaluation, and by providing guidelines and training for applicants and evaluators on how to deal with these criteria. RFOs should evaluate the success of their IGIPs by conducting regular monitoring.*

Source: authors

A particular issue with advancing IGI research is that in the literature as well as the policy discourse, intersectionality often remains declarative. We need to expand the state of knowledge about the **systematic integration of gender aspects and in particular the adoption of an intersectional perspective across the different stages of innovation processes**, i.e. from theory / discovery over (technical / product) design, innovation, diffusion up to imitation / improvement / exploitation. We need to improve our understanding of how intersectional IGIs can unfold across various types of innovations (technical, process, product, service, frugal, social) and across geographic contexts. A better integration of the intersectional approach in IGI research will enable a better understanding of **how to develop truly intersectional IGIPs and IGI guidelines for BES**.

Further, the process of gendered innovation, how it is affected by gendered relations and power dynamics in the workplace and by gendered institutions is poorly understood. **A framework that integrates fragmented understanding of prerequisites, favouring factors and barriers to gendered innovation needs to be developed.** Finally, the **effects of gendered innovations** are insufficiently explored: what added value does the implementation of gendered innovation create (e.g. financially)? How do they actually advance gender equality in the long term? How can the impact be measured?

Such a framework will enable **systematic, theory-informed analyses about who gets to innovate and who benefits from innovation.** Further analysis on how successful innovations take into account different needs of different genders will guide the development of **more tailored policy instruments that support IGIs**. We agree with the argument added by Alsos et al. (2013), namely "to develop methods to examine what people do, rather than how they talk about it". One approach could be to conduct research that involves the actors as well as their interactions" when looking for more gender neutral concepts for the empirical investigation of (gendered) innovations.

An important research strand is presented by Fuenfschilling et al. (2022). They emphasise that **aligning innovation with societal goals cannot be done without transforming normative underpinnings of innovation per se.** There is inequality within the notion of innovation whereby some types of innovation (e.g. technological) are prioritised while others are marginalised. Innovation can and should pursue both economic growth and social goals. Therefore, gendered, inclusive or social innovations should not be marginal concepts, but constitute a core component of innovation, understood broadly as implementing novel

solutions to change the world for the good. Achieving this requires more research on IGI, but also community-wide discussions among innovation research scholars about power relations in the field.

These novel solutions are also strongly reflected in the current policy literature, which discusses various national initiatives, frameworks and instruments for the implementation of gendered innovations in order to outline promising developments and best practices of different research performing and research funding organisations. Here, different national frameworks and RFOs are examined by means of comparative analyses, as they are considered to have the greatest impact by implementing binding requirements and creating incentives for RPOs. **Through the analysis of policy literature, we were able to identify promising actors and instruments**.

Similar to the conceptual discussions, a **broadening of the concept and scope of policies is also proposed in the policy discourse** (e.g. participatory approaches, reflections of design: by whom for whom) and therefore entry points for future directions are suggested. For instance, in the discourse on gendered innovation policies, an integration of intersectionality and diversity in R&I (organisation and content) as well as in the global framework (e.g. Africa Strategy, SDGs, OECD) is emerging. However, we observed that the instruments mainly promote research and only very rarely promote innovation for companies. We also identified a need to improve the measurement of GI policy output, outcome and impact.

6 Recommendations

Based on the literature reviews on gender and innovation and promising policy instruments we propose the following recommendations for the further work for the KSH on innovation in INSPIRE. Most importantly, this concerns the selection of case studies and research questions that should be addressed as well as for the selection of institutions for the Business Enterprise Sector CoP and features they need to have.

Regarding the conduct of case studies, we examined individual organisations and their policy instruments, while paying close attention to conceptual and policy discourses and current trends. In our analysis we identified several **best practices for possible case studies.** Some are frontrunners with the most exhaustive list of measures that cover the whole funding cycle, some implemented various measures within a short period of time in an unexpected national context, and others are intriguing examples of the cooperation and institutionalisation of gendered innovation policies or actively promote the cooperation between R&I companies and other RPOs. It has to be noted that, although there is a **good understanding of barriers and challenges** for gendered innovation reflected in the literature, more research could be done on **prerequisites, success factors and contextual conditions of gendered innovation development in BES**. The existing literature provides only a fragmented view and, until this point, in-depth case studies of gendered innovation development in private settings are lacking. In addition, the literature discusses how other diversity dimensions can be taken into account beyond gendered innovation and how **intersectional analyses** can be implemented, as well as which suitable policy instruments can be used for concrete implementation. Our case studies could also increase the level of knowledge in this area. A major challenge for our KSH is the **risk to fall into established patterns of knowledge production**, e.g. do a case of social innovation in the Global South and a case of technological innovation in the Global North. We should be sensitive to assumptions about which knowledge is valuable when it is produced in certain contexts and that there are existing asymmetries in innovation research.

Therefore, case studies could be conducted in **different countries** and should consider regional differences. For instance, more resistance is expected in countries where there is no long-standing history of gender equality measures and less experience with the integration of the gender dimension in the R&I content.

From our analysis of the relevant literature, we suggest the following **research questions** to be addressed in the **case studies**:

1) What is the relevance of GI funding instruments for private companies? What is the motivation for companies to apply for Gender in Research and Innovation (GiRI) funding? What hinders their participation?
2) How is the gender dimension considered in the innovation process?
3) How is intersectionality incorporated, implemented and monitored in promising policy instruments and funded projects?
4) How do gendered innovations lead to gender equality?
5) What output, outcome and impact can be generated with gendered innovation policy instruments? (for beneficiaries, for users, for the ecosystem)
6) What (supra-)national framework conditions effectively support gendered innovations or would be necessary? What conditions hinder GI?

Based on our analysis of different organisations and policy instruments, we recommend the following case studies:

We propose one case study in Western Europe, namely the Swedish governmental agency **Vinnova**, as there is a supportive legal background in Sweden which actively promotes the cooperation between R&I companies and other RPOs. They have vast experience in the interaction and collaboration with private R&I companies and therefore can shed light on the facilitators and barriers for approaching and collaborating with R&I companies. In addition, as a CoP leader in the GENDERACTION plus project they are working on integrating further diversity dimensions and critically reflect on intersectionality. We also suggest an RFO from Eastern Europe, namely **TA CR**. Although TA CR only recently started implementing IGAR policies, they can be considered a frontrunner for Central and Eastern Europe as they have extended their gender equality initiatives and research programme considerably in the past few years and explore new methods of communication and dissemination regarding the integration of the gender dimension into the research content. The Spanish RFO "**AEI**" could be an intriguing case study, as they cover almost all stages of the funding cycle, considering the sex and gender dimension and monitoring the impact of the integration of the gender dimension into the research projects.

So far, only a few RFOs integrate monitoring procedures and there is a lot to learn regarding the data collection (e.g. intersectional dimensions) and how to perform the analysis. In order to increase the comparability of results, standardised procedures need to be developed. Although, in a first step we need to decide in T3.6 if the selection criteria "policy instrument" is more important than "region", in our opinion it is crucial to conduct a non-European case study. A potential candidate is the Canadian Tri-Agency **NSERC** as they provide guidelines for evaluators and applicants of research projects, also incorporate monitoring mechanisms and disseminate materials and training modules. NSERC is also of interest, as it is a cooperation of different universities and therefore can be an example of the institutionalisation of gender equality efforts across universities. However, it would also be fruitful to select a case that has been out of scope of most researchers so far, namely **GiSTER** (Korean Center for Gendered Innovations for Science and Technology Research). GiSTER develops and promotes GI policies for the Korean ministries, seeks to strengthen GI capabilities by creating content and providing training, improves awareness and is globally connected.

Regarding the selection of CoPs and the collaboration within CoPs, our analysis contributes to our understanding of **features that institutions need to have** to be part of the **Business Enterprise Sector CoP**. For the **policy CoP**, they need to be funders (or policy makers), which are interested in addressing the BES Sector or are already doing so. For the company CoPs, the scope is broad. It would be beneficial to include both R&D and non-R&D performing companies, but a prerequisite is that companies need to be innovative. If they already have gender-responsive innovation guidelines, that is excellent, because then the CoP could implement peer-to-peer learning. However, in practice, this is unlikely. We assume that BES actors may be interested in implementing the gendered innovation approach, but do not know how to. Thus, it is sufficient as an inclusion criterion if they are interested in gendered innovation.

As in the case studies, **implementing intersectionality** should be a priority area for CoPs, and we regard this as a major challenge in our empirical work. We will also need to consider the **composition of industries** in CoPs, because the findings from the literature have

highlighted industries with particularly toxic masculine cultures where feminist interventions are particularly needed. Therefore, within the **policy CoP** we need to work on how to engage stakeholders in the BES sector with GI policy instruments and find out how these policy instruments need to be designed to provide effective incentives. Furthermore, it is important to reflect which national framework conditions are conducive for this purpose. Within the framework of the **company CoP**, we propose to reflect on how to inform what the gendered innovation approach entails, which benefits it brings and how gendered innovations can be implemented in concrete terms.

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8 Appendix

8.1 A1 Glossary of key terms

The first set of glossary terms defined our key concept gendered innovation and other related concepts

- **Innovation** is composed of two parts: (1) the generation of an idea or invention, and (2) the conversion of that idea/invention into a business or other useful application (Roberts 2007).
- **Invention** is a process of creation of new technologies (Arthur 2007).
- **Gendered innovation** refers to the integration of considerations of sex and gender in all aspects of the innovation life cycle in order to ensure equity of outcomes (Schiebinger and Schraudner 2011).
- The process of including sex and gender considerations is called **gendering**.
- **Gender-responsive approach to innovation** means "going beyond acknowledging and raising awareness of gender gaps, to make sure women's and men's concerns and experiences are equally integrated in the design of innovative products or services and that due consideration is given to gender norms, roles and relations" (UN Women 2023).
- **Inclusive innovation** refers to the inclusion of marginalised groups in the innovation process. The inclusion can be achieved in at least two ways: in terms of the process of innovation and in terms of the problems and solutions it is related to (Cozzens and Sutz 2012).
- **Responsible research and innovation** entails engaging all actors (from individual researchers and innovators to institutions and governments) through inclusive, participatory methodologies in all stages of R&I processes and in all levels of R&I governance (from agenda setting, to design, implementation, and evaluation).
- **Patent** is an exclusive right granted for an invention, which is a product or a process that provides, in general, a new way of doing something, or offers a new technical solution to a problem (WIPO 2023).

In the study, a set of terms related to sex and gender was also defined:

- **Gender** refers to socially constructed definitions of positions of women, men, non-binary people, and of the meanings of femininity and masculinity that are characterized by unequal power relations (Benschop, 2007, in Chaves and Benschop, 2023).
- **Sex** refers to biological attributes, which in humans distinguish male, female and intersex (EC 2020). While our approach acknowledges the social dimension of sex, it is used as a construct in our study to delineate physiological characteristics of female, male and intersex bodies, which are significant in development of certain types of innovations, e.g. in medicine.
- **Female** is a biological attribute, which in humans distinguishes this group according to their sex from male and intersex.
- **Woman** is a type of gender identity, which describes a particular way in which individuals perceive themselves in relation to gender norms. Although we recognise the existence of other definition for both sex and different gender identities, the ones listed here served the instrumental purpose of identifying and analysing literature results. These definitions in the form listed here do not for conceptual foundations of the INSPIRE project.
- **Gender identity** is a person's sense of their gender. Gender is a spectrum rather than a binary and can be fluid. While most gendered innovations may address previously neglected needs of women, it is important to keep in mind that gendering an innovation means including considerations of all gender identities.

Other relevant terminology:

- **Inclusivity** is fair and equal treatment of all types of people, things and ideas, especially those that were previously excluded or marginalised.
- **Marginalisation** refers to the lack or absence of economic resources, knowledge or power, isolation and disempowerment. Marginalisation can be experienced by a person or a social group - the group does not need to have a minority status to be marginalised.
- **Disempowerment** is more closely related to the denial of power to a group of people by another group.
- **Diversity** refers to variation in the workplace, both individual-based (broad diversity, including all possible differences between people), and group based (small diversity, based on social categories) (Chaves and Y. Benschop 2023).
- **Intersectionality** refers to the various ways in which class, race, gender and other social categories interact to shape the multiple dimensions of a person's life and experiences.
- **Inequality** is a systematic disparity in power and control over goals, resources, outcomes, influence on decisions, in opportunities, security and benefits, and pleasures (Acker, 2006, in Chaves and Benschop, 2023).
- **Gender mainstreaming** is a gender equality strategy that aims to transform organisational processes and practices by eliminating gender biases in existing routines, involving the regular actors in this transformation process (Council of Europe, 2016, in Chavez and Benschop, 2023).

8.2 A2 Web of Science search queries

We ran two queries:

- **Search a**: gender* OR women* OR woman* (Topic) and inclusi* OR inequality OR unequal* OR intersectional* OR mainstreaming (Topic) and innovat* (Topic)
- **Search b**: woman OR women OR female (Topic) and inventor* OR patent* OR innovator* (Topic)

8.3 A3 Overview on measures: What GiRI policy instruments – defined as measures – are in place (with a specific focus on RFO level) to foster gender in research?

Policy instruments of National Policy Makers:

National policy makers play an important role as they shape the context in which gendered innovations occur. Various national initiatives have already been undertaken to encourage greater sensitivity and the integration of sex and gender analysis in science knowledge and practice[10]:

- Require the **gender dimension to be included** in all aspects of the research process (ES).
- Require RFOs to **provide funding for the gender dimension** in research and innovation by the government (SE)
- mainstreaming **gender participation** and issues in research (Spain's Science, Technology and Innovation strategy)
- **legislation** and "soft" measures to promote an intersectional approach in science.

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[10] Policy instruments derived from: (GENPORT 2017), (Håkansson and Sand 2021), (Hwangbo, Park, and Lee 2019), (GENDER-NET/Rodríguez and Pérez 2015), (Lee and Pollitzer 2016)

- promoting **gender statistics** training programmes and accountability mechanisms for gender mainstreaming at various levels
- **Funding studies** about the establishment of optimal priorities for incorporating GI in STI and R&D
- **funding a comparative analytical report** on national and regional initiatives that include a gender dimension in R&I content (ES)
- **implement S&T policy instruments** for GI, e.g. basic planning, trainings establishment, impact assessment system, R&D budget mediation and investigation/analysis/assessment/reflection
- installation and management of various **departments and offices to support GI**
- **Revise research and innovation regulations** to incorporate the gender dimension (as well as ethnicity, age, and other relevant factors) in the recommended procedures
- **collaborating/networking** on international level (e.g. The Helsinki Group on Gender in Research and Innovation)

Policy instruments of RFOs

Research funding organisations (RFOs) are key stakeholders, who often implement national policies and have a strong impact on the policy discourse. The selected body of literature lists the following policy instruments that have been implemented by RFOs:

POLICIES AND POLICY EVALUATION[11]

- **Policies/Commitment and strategies** aimed at integrating sex/gender analysis in research (in all initiatives)/ promoting responsible innovation (H2020) (CIHR)
- Regular **implementation evaluation** of programmes to inform iterative developments in the sex and gender dimension
- **collaborate** with stakeholders such as member states, international organisations, academia, civil society and the private sector (UN Women) (Seoul Declaration Principles)
- **support national level** in setting global standards for achieving gender equality and works together with governments and civil society, to design laws, policies, programmes and services needed to implement these standards (UN Women)

TRAINING / INFORMATION / GUIDANCE[12]

Clear definition of terms

For applicants:

- (Proactive) **Guidelines and information** for applicants on the gender dimension in R&I (CIHR, IRC, CNRS, NIH, GESIS) (H2020)
- Provide (proactive) **training** (materials) for applicants
- Provide **gender relevance check**
- Provide **ex-ante impact assessment**
- Provide **gender consultant** for the program
- Provide **training for grant recipients** on sex/gender analysis and gender impact assessment of research projects as eligible cost (H2020)

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[11] Policy instruments derived from: (European Commission, 2017), (GENDER-NET/Pépin and Zemborain 2015), (Sharman and Johnson 2012), (Fritch et al., 2021), (Hunt et al., 2022), (Mlambo-Ngcuka 2019), Lee and Pollitzer 2016

[12] Policy instruments derived from: (Hunt et al., 2022), (Fritch et al., 2021), (Lee and Pollitzer 2016), (GENDER-NET/Pépin and Zemborain 2015), (Håkansson and Sand 2021), (GENDER-NET/Rodríguez and Pérez 2015), (Sharman and Johnson 2012) ,(European Commission, 2017)

For reviewers / evaluators:

- **Guidelines** for grant proposal reviewers /evaluators
- **Training** for grant proposal reviewers /evaluators
- higher level implementation with specific resources targeted for reviewers (e.g. CIHR and IRC)
- provide consistent **instructions** for evaluators to consider sex and gender throughout the evaluation process

For internal staff:

- provide **training** for staff
- **Trainings** for national contact points are provided (H2020)

FUNDING[13]

Gender as a cross-cutting issue:

- **gender in research content requirement** is explicitly integrated **in all the programmes**, as a cross cutting question (CIHR, MINECO, RCN and IRC)
- require consideration of **gender in all aspects of research and innovation** (UK's Official Development Assistance funds)

Specific funding programs:

- Launching **specific funding programs** dedicated to sex/gender dimension in R&I (BMWFW (Sparkling Science), FWF (in 2 pilot programmes), FFG (FEMTech Research Projects), WBF-SERI, and CNRS (funding program Gender Challenge))
- Launching programs that aim at ensuring that **innovations meet the needs of women**. (She Innovates Chapter program (UN Women), Fund for Gender Equality (FGE) (UN Women))
- fund **activities** that welcome the inclusion of innovative ideas **from different disciplines** and perspectives. (Nordforsk and Riksbankens Jubileumsfond)

Gender-Criteria for applications

- integrate **mandatory questions** about the relevance of sex and gender in research proposals (Canadian Institutes of Health Research) requiring applicants how this analysis is included in the proposals
- Proposal templates require **sex- and gender-based analysis** (if flagged) in R&I contents (excellence criterion)
- promotion of **gender experts in research teams**

assessment of applications:

- sex and **gender dimension criteria as integral part of assessment and decision**, integrated with other evaluation criteria and assessed as part of the overall application, generating a final overall score or a separate score

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[13] Policy instruments derived from: (GENDER-NET/Rodríguez and Pérez 2015), (European Commission 2020), (Håkansson and Sand 2021) , (Fritch et al. 2021), (GENDER-NET/Pépin and Zemborain 2015), (Mlambo-Ngcuka 2019), (Benschop and Husu 2021), (Sharman and Johnson 2012), (Lee and Pollitzer 2016)

- **revise the protocol for reviewing** research to only focus on studies related to gender/sex.
- **formal process** to evaluate the integration of the sex/gender dimension
- **raise awareness of the effects of gender bias** in peer-review panels and assessment processes

Panels:

- **gender expert** on every review panel (IRC, Technology Agency of the Czech Republic and "la Caixa" Foundations)
- **interdisciplinary** peer review panels
- involve **external experts** in review committees if gender expertise is lacking

MONITORING[14]

- monitor the **percentage of grant recipients who addressed sex/gender dim**ension, and how effectively it is addressed
- monitor **outcomes** to ensure that the sex and gender dimension are considered

ADDITIONAL ACTIVITIES & SUPPORT[15]

- require all research reports to be written in a **gender-inclusive language**
- **Gender mainstreaming research officer** to consult on gender content and appropriate language
- **expert database** to find gender experts
- create a **communication strategy** (social media, information on website, meetups and events, mentoring programs, and labs) (UN Women) (VSCHT Praha)
- **raise awareness for** the need of reflecting **sex and gender definitions** in research projects because of blurred boundaries
- reflect and **publish experience in promoting gender-responsive innovations**, reflect on how gendered innovations are developed, but also to what use (UN Women)
- **Forming partnerships** with key representatives from the private sector, academia and non profit institutions to building market awareness of women's innovative potential (UN Women)

- introduce an **award to support the inclusion of gender** in student theses

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[14] Policy instruments derived from: (GENDER-NET/Rodríguez and Pérez 2015), (Lee and Pollitzer 2016), (Fritch et al., 2021), (Hunt et al., 2022), (European Commission 2020)

[15] Policy instruments derived from: (Fritch et al., 2021), (European Commission 2020), (Håkansson and Sand 2021), (Mlambo-Ngcuka 2019), ('Final Report Summary - TRIGGER (TRansforming Institutions by Gendering Contents and Gaining Equality in Research)', n.d.), (Sharman and Johnson 2012)

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