Appendix D

Policy briefs (draft)

Policy Brief 1

Maximising the benefits of investment in gender sensitive research and innovation

Key messages

- Large body of scientific evidence shows that biological (sex) and sociocultural (gender) elements may produce different research and innovation outcomes for males and females that call for different tailored interventions – and not only in health – to ensure the same quality of benefits for women and men.
- Scientific quality and societal relevance of research can be improved by increased gender balance and diversity in research/innovation teams and sex/gender sensitivity in research content.
- Understanding when, why and how women and men differ in their biological and socio-cultural characteristics can create novel socio-economic linkages between scientific knowledge production and its translation into new products, processes and services, with improved impact on societal and environmental wellbeing.
- It has been estimated that $12 trillion could be added to global GDP by 2025 by advancing gender parity[4], and that by 2015 women will control $28 trillion of consumer budget globally[5]. This growing economic advancement of women should be seen as opportunities for creating new markets for science knowledge that recognise the different needs and interests of women and men.
- Between 2005 and 2011, the compound annual growth rate for researchers in the EU (as reported in She Figures 2015) was higher for women (4.8%) than for men (3.3%). The accumulation of scientific capital held by women creates advantageous conditions to promote "technology push" type innovations based on scientific discoveries that demonstrate critical sex differences in research results, which may also differentiate outcomes.
- Large and established high-technology companies have been increasingly moving away from in-house knowledge creation to technology acquisition through purchase of technology start-ups or by engaging in Open Innovation. Open Innovation creates variety of opportunities to effectively close gender gaps in innovation systems and activities by creating innovation environments that are more inclusive to women as idea creators, problem solvers, innovators, and as target users/consumers.
- Furthermore, promoting the culture of Open Innovation may provide a vehicle for attracting more tertiary educated women to consider entrepreneurship as a career opportunity. This may be especially attractive in sectors that are not strongly bound by regulatory requirements, where the cost of entry may be too high, or where institutions and cultures have been traditionally dominated by men.

[4] McKinsey (2015) The Power of Parity: How Advancing Women's Equality can add $12 trillion to Global Growth. See https://www.mckinsey.com/featured-insights/employment-and-growth/how-advancing-womens-equality-can-add-12-trillion-to-global-growth

[5] Silverstein, M.J. and Sayre, K. (2009) The Female Economy, *Harvard Business Review*, September 2009. Online available from: https://hbr.org/2009/09/the-female-economy

- Gender balance in innovation is often measured by how many women there are among patent applicants. Women are greatly underrepresented in technological innovation, in general. However, the observed increase in the share of women in international patenting activities (PCT) coincides with the increase in women's participation in higher education, and in particular in life sciences, at both undergraduate and PhD level.
- During 2012-2015, the fields with the highest shares of PCT applications with women inventors were those related to life sciences, including biotechnology, where women are well represented. In contrast, the fields with the lowest shares of PCT applications with women inventors were related to engineering and computer technologies, where women are in a minority.

Conditions that foster participation and success of women in:		
Research[6]	**Innovation[7]**	**Entrepreneurship[8]**
• Fair, transparent and gender bias free recruitment, retention, and competition in career advancement • Fair, transparent and gender bias free evaluation of professional performance • Equal access to and chances of success in being awarded a research grant • Fair, transparent and gender bias free recognition of merit in selection to important panels, committees, and decision-making bodies • Access to professional and leadership training • Opportunities to collaborate with excellent researchers/research teams • Access to research infrastructures and resources • Work-life balance and	Improving innovation environment by making it more inclusive of women • *in design and implementation of innovation strategies* • *in innovation processes* • *as target users* Improving measurement of women's contribution to • *technological advances* • *non-technological innovations that create functional improvements through design* • *creating new services, and more efficient organisational processes.* Improving quality of innovation outcomes, especially for women • *taking into account the potential influence of sex-gender differences (biological, physical, behavioural)* • *equally valuing different interests and preferences of women and men.*	Improving entrepreneurial environment • *Opportunity perceptions* • *Start-up skills* • *Willingness and risk* • *Networking* • *Cultural support* Creating entrepreneurial ecosystem • *Opportunity start-ups* • *Technology sector* • *Quality of human resources* • *Competition* • *Gender gaps* Promoting entrepreneurial aspirations • *Product innovation* • *Process innovation* • *High growth* • *Internationalisation* • *External financing*

[6] Laursen, S. L., & Austin, A. E. (2014). StratEGIC Toolkit: Strategies for Effecting Gender Equity and Institutional Change. Boulder, CO, and East Lansing, MI. www.strategictoolkit.org

[7] Lee, H. and Pollitzer, E, (2017), Gender in science and innovation and as components of socio-economic growth, https://gender-summit.com/images/Gender_and_inclusive_innovation_Gender_Summit_report.pdf

[8] The 2015 Female Entrepreneurship Index, The Global Entrepreneurship and Development Institute

conducive working environment		

Recommendations

The following recommendations are intended to inform and improve gender equality policies for upstream interventions (with wide-ranging impact) and mid-stream interventions (with cross-cutting impacts). Relevant intended actors are European Commission (e.g. through Innovation Union, and Framework Programmes), ITRE, STOA and FEMM Committees at the European Parliament, national institutions implementing ERA, cross sectorial bodies such as EARTO, etc.

- **Recognise gender as a driver for economic growth and socio-economic wellbeing** (e.g. by including gender-related indicators in the Innovation Scoreboard), and an opportunity to create advantageous, cross cutting benefits from knowledge production to multiple applications with relevance for society. *For example, scientific discovery that women mount stronger immune response to vaccines calls for new approach to vaccine design (for women and for men), and for redesign of public health vaccination campaigns, e.g. in responses to emerging epidemics.*
- **Recognise women's growing economic and consumer (behaviour influencing) power** as advantageous to promoting new markets for science knowledge that target the special interests and needs of women (that have been traditionally ignored). *For example, car safety systems should be improved to prevent injuries suffered more severely by women than by men in car crash situations.*
- **Recognise the growing (at a faster rate than that of men) scientific capital of women as** advantageous to promoting ("technology push") innovations based on scientific discoveries of important sex differences in research outcomes. *For example, metabolic profiles of women and men are significantly different and this calls for new biomarkers for women and for men in health conditions linked to metabolic disfunctions, such as obesity, Alzheimer's, and diabetes*.
- **Closing the gender gap in innovation is an opportunity to change innovation cultures by making them more inclusive and open to participation by women researchers, and women as users and consumers.** *For example, women have been shown to be very successful in solving technical R&D problems in 'crowd sourcing' innovation environments where companies broadcast problems they cannot solve internally.*[9]
- **Close the gender gap in entrepreneurship** as an opportunity to promote entrepreneurship to the growing body of women graduates, promoting, for example, business-creation conditions that are not strongly bound by restrictive and expensive regulatory compliance requirements (e.g. information and communication technologies), and in knowledge areas where women are well represented (e.g. health). *For example, such opportunities could involve creating entrepreneurial ecosystems linked to the socio-economic and environmental challenges that underlie the goals of the UN Sustainable Development Agenda or the realisation of the vision of the 4th Industrial Revolution.*

[9] Jeppesen, L.B. and Lakhani, K.R. (2010) Marginality and problem solving effectiveness in broadcast search, 2010. Online available from: http://dash.harvard.edu/bitstream/handle/1/3351241/Jeppesen_Marginality.pdf?sequence=2

- **Ensure continued leadership in Europe in advancing gender in research and innovation, established in Horizon 2020, to solidify the progress made and to strengthen the technical and socio-economic impact of the next Framework Programme 9.** The experience of Horizon 2020 of promoting structural change for gender equality and integration of gender dimension in research and innovation content has provided important body of knowledge and experience to make systematic and systemic advancements in FP9. *In FP9, this could provide the basis for promoting gender sensitive socio-economic impact of research outcomes in the fields that have been historically seen as 'gender neutral', e.g. physics, transport, energy, climate change.*
- **Increasing the proportion of women in engineering and retaining those already in the system are key to addressing persistent gender imbalance in product-related, technological innovation**.

NOTES

This policy brief is the output from GENERA - Gender Equality Network in the European Research Area - a project funded by the European Commission under GERI-4-2014 01 September 2015 - 31 August 2018 grant agreement 665637. GENERA's main goal has been to implement gender equality plans in physics. For further information about GENERA please contact Dr Thomas Berghoefer, thomas.berghoefer@desy.de
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Policy Brief 2

Maximising benefits of gender equality in higher education, and in research and innovation

Key messages

- According to She Figures 2015 there has been a slow but positive trend across several key indicators of women's participation and status in higher education and in academic career progression, in the EU (see table below).
- There are, however, still significant (but decreasing) differences between individual Member States in the rate of progress made, which may have historical backgrounds, or indicate the presence/absence of top-level policy commitment to gender equality at national level.
- There are more men than women in Grade A academic positions across all fields, regardless of how many women there are in the 'talent supply pipeline'.
- In the life sciences, for example, more women gain PhD degree than men (EU-28), but this increase in the supply of new research talent has not been translated into matching improvements in subsequent academic career stages. This is a situation that could benefit from the introduction of (cascading model) quota.[10]
- By contrast in the physical sciences, engineering, and computing the low presence of women persists at each stage, from entry into higher education to Grade A positions. However, small improvements between 2004 and 2012 have been reported in She Figures 2015.
- Across EU-28, more men than women apply for research grants; men are more successful in obtaining research grants; and men receive larger grants than women. Some improvements have been reported but overall men still have 4.4% higher chance of success. Carefully thought out quota mechanisms have been shown to deliver positive but fair impact (see the example in NOTES)
- Due to the fact that men in senior academic positions are generally older than women it can be expected that in the next 10 years more men than women will be retiring, creating opportunities for more women at present in Grade B positions to compete for the top academic posts (with the help, perhaps, of cascading quota intervention).
- Among emerging issues in the workplace has been sexual harassment. Academic workplaces have the highest rate of sexual harassment after military (58% vs. 69%).[11]
- Among persistent issues are work-life balance and employment conditions: fewer women researchers than men researchers have children; more women than men hold part-time

[10] Wallon, G,. Bendiscioli, S., and Garfinkel, M.S. (2015), Exploring quotas in academia, EMBO

[11] National Academies of Sciences, Engineering, and Medicine. 2018. *Sexual Harassment of Women: Climate, Culture, and Consequences in Academic Sciences, Engineering, and Medicine*. Washington, DC: The National Academies Press. doi: https:// doi.org/10.17226/24994.

positions; women earn less than men. This makes academic research careers appear more precarious for women than employment in other sectors.

Data from She Figures 2015 (with some other earlier She Figures data included for comparison)	
Glass Ceiling Index, EU *(GCI = 1.0 means women have same chance top men of being promoted to Grade A position)*	1.76 (decrease from 1.90 in 2004)
Share of women PhD graduates	47.4% (increase from 43.6% in 2004)
Share of women PhD graduates in STEM (LS, PS, M, C)	37.5% (increase from 33% in 2004)
Share of women in Grade A academic positions	20.9% (increase from 15.3 in 2002)
Share of women scientists and engineers in total labour force	2.8% (increase from 1.75% in 2010)
Research grant success rate difference *GSRD = 1.0 means women and men applicants have equal chance to secure a grant*	4.4 (decrease from 6.8 in 2010)
Proportion of RPO's that adopted gender equality plans	36%

Recommendations

The following recommendations are intended to inform and improve policies for midstream interventions (e.g. within a field and/or inter-institutional partnerships) and downstream interventions (within organisations). Relevant intended actors are LERU, EUA, EMBO, FEBS, CESAER, RPOs and RFOs, etc.

- **Continue the use of She Figures** as a source of reliable statistical overview of progress in achieving gender equality in research and innovation in the EU, including integration of gender dimension in research content, which was introduced in the 2015 edition. However, She Figures do not provide contextual information that can help explain for the observed statistical trends.
- **Information is needed to provide field-specific context, behind the statistics in She Figures about the shares of women at each education and academic career level,** to help better understand how women transit over time from one level to the next, especially Grade C and Grade B before tenure and after. This would help institutions to improve their gender equality interventions, and make them more responsive to the issues that are specific to each stage, also reflecting the differences between the fields.
- **Quantitative, gender-segregated data on career paths and working conditions of researchers are needed** to monitor and better understand how the patterns or moves through career positions, institutions, sectors, and nations develop during the 17 years that it takes on average to traverse from gaining a PhD to reaching Grade A position.[12]

[12] MORE. (2017). *Final report MORE3: Comparative and policy-relevant analysis of mobility patterns and career paths of researchers*. https://cdn5.euraxess.org/sites/default/files/policy_library/final_report_1.pdf

- **Systematic analyses of the evolving discourse on why more women should choose STEM subjects to study, and/or as a research career, are needed** to improve future efforts to promote gender balance. Four separate but interconnected general reasons have dominated the calls to improve women's participation in STEM in the past: social justice; economic benefits from women's intellectual contributions different to those of men; improved intellectual quality and impact of research and innovation; and improved research and work cultures. Choosing the core argument can dictate action, for example, the 'economic' argument has been embraced by industry. The 'quality' argument is attractive to science policy makers. Corrective actions will tend to focus on a particular intervention. For example, many companies have adopted quota in hiring staff. To make STEM more attractive to girls, the focus has to be on why women are not attracted to engineering or computing, perhaps because they simply are not aware of the opportunities or because they do not know what work engineers do, then corrective actions will have to focus on outreach and informing girls of the opportunities engineering careers offer them.[13]
- **Work environments, employment conditions, and work-life balance need improving** so that women researchers do not have to feel that pursuing a research career means not being able to be a parent or fulfil caring responsibilities; or that pursuing a research career means committing to potentially precarious and uncertain employment future, with short term contracts and necessity to be geographically mobile; resulting in economic penalties in terms of salary and pension levels.
- **Actions to prevent and tackle sexual harassment are needed** by enabling easy and confident reporting and monitoring of unprofessional behaviour. Academic science and research institutions exhibit at least four characteristics that create higher levels of risk for sexual harassment to occur: 1) strongly male-dominated environments, with men in positions of power and authority; 2) organizational tolerance for sexually harassing behaviour (e.g. failing to take complaints seriously, failing to sanction perpetrators, or failing to protect complainants from retaliation); 3) the fields share hierarchical and dependent relationships between faculty and their trainees (e.g. students, postdoctoral fellows, residents), 4) the fields share isolating environments (e.g. labs, field sites, and hospitals) in which faculty and trainees spend considerable time. Such actions should be included in the design and implementation of gender equality plans (GEPs), and in the institutional commitments to adopt the Euraxess HRS4R.
- **Improve the criteria and processes used in the assessment and awarding of research grants to ensure that men have the same chances of winning as women**[14], but also allowing time flexibility in grant duration due to maternity leave, maternity cover, and eligible care costs.
- **Provide opportunities for leadership training** targeting young women researchers, in particular, to provide them with confidence to compete for more senior research and management roles.
- **Promote and monitor implementation of Gender Equality Plans** by research performing and research funding institutions to ensure systematic and systemic structural and cultural change, across different scientific fields, and sectors.[15]

[13] Beddoes, K. D. (2011). Engineering education discourses on underrepresentation. Why problematization matters. International Journal of Engineering Education, Vol. 27 No 5, pp.1117-1129, 2011
[14] https://www.gender-summit.com/attachments/article/1346/Ferguson_GS9Eu.pdf
[15] http://genera-project.com/portia_web/GENERA_Toolbox_2017_final_revision.pdf

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Best Practice in advancing gender equality in research organisations

Science Foundation Ireland: *Increasing the number of applications for research grants from women*

In 2013, the SFI put a cap on 6 applications per University. This resulted in 27% of applicants being female and 27% of awardees being female. In 2015, the SFI added a gender dimension to the process by raising the cap per university to 12 but the maximum 6 could be men. There was no change to the assessment and selection process. This has produced 47% of applications from women and 55% of awardees being female.

GENERA: *Toolbox for implementing GEPs in physics, as well as other fields*

The GENERA Toolbox aims at assisting GENERA partner organisations that are in the process of the implementation of gender equality plans (GEPs) in tailoring their GEPs and gender equality measures to their needs. The Toolbox is a structured collection of over 100 good practices – measures, instruments, and activities –the information for which was collected and catalogued to reflect related structural, social, cultural, and political aspects of work environments in various (mainly physics related) research performing organisations (RPOs) and research funding organisations (RFOs) as well as higher education institutions (HEIs).

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POLICY BRIEF 3

Evidence and recommendations for Physics institutions to implement Gender Equality Plans

Key messages

- Working within the context of Physics, the GENERA project has circumvented problems that are common to GEP implementation by institutions when conducted in isolation from others, through processes that differ widely in terms of their scope and effectiveness, and often without a proper assessment of gender equality needs and priorities, or the necessary monitoring and evaluation. GENERA's disciplinary focus brought not only recognition and comparability, but also a shared belief in data, measurement, and an experimental approach.
- On the basis of this shared conviction, one of the main strengths of the GENERA project was the development (through an intensive iterative process) of the specifications of a so-called "minimal dataset" (MDS) that physics institutions can use to track gender representation and progress on several comparable indicators across local and national settings. These data currently cannot be found in the She Figures (Europe's go-to statistical source) because information there is: a) not provided on a disciplinary level, and b) is restricted to indicators that can apply to the majority (if not all) of EU countries.
- The role of the evaluation partner in GENERA was transformed into a 'critical friend', realized operationally through ex-ante and ex-post interviews with managers and leaders in the partner institutions. Reflections from the interviews were combined with the data collected elsewhere throughout the project by the evaluation partner to produce a monitoring tool (not anticipated in the deliverables), the Monitoring Tree, which organizations can use to monitor progress made in implementing gender equality policy measures.
- GENERA's aim was to create GEPs that can be adapted to the needs of different organizations but at the same time could promote systematic and systemic improvements. Key to identifying what was needed were the interviews with 83 physics researchers (women and men) from the partner organizations as well as senior leadership and HR staff. This led to a growing understanding and reconciliation of top and bottom expectations of GEP design and implementation in physics organizations.
- The work done in GENERA will be shared, expanded and improved through the GENERA Network, one of the project outputs. The purpose of the Network is to act as a channel for sharing knowledge and experience as well as best practices in implementing GEPs. The practical opportunity to do this is the Horizon 2020 funded project ACT in which three of the GENERA partners are also involved. The purpose of ACT is to develop Communities of Practice for gender equality in research and innovation and the GENERA Network is included as one target for transformation into such a community.

The GENERA protocol "Physics best for all"

Based on several brainstorming and argumentation mapping sessions, the GENERA partners jointly developed "Physics best for all" protocol of predefined procedural method for improving gender equality in physics organizations (in the same vein as the protocols for conducting scientific experiments). This protocol, aimed at institute directors and senior HR, serves as an umbrella under which to develop local, customized GEPs and actions.

GENERA Protocol for improving gender equality in Physics:

- Gender Equality Plan (GEP)-driven
- Systemic change using a transformative approach
- Data-driven, evidence based
- Addressing notions of excellence
- Promoting inclusion and belonging

Recommendations

Based on GENERA experience in designing and implementing GEPs in eleven physics organizations, reflecting on the experiences of the implementation managers (IMs), observers, evaluators, and experts, and taking into account the very different nature of the physics institutions in which many operate, the project offers the following recommendations for improving the GEP approach to promoting gender equality. These recommendations (based on the identified gaps in GEPS) are particularly relevant for physics organizations, but more generally could be adapted to institutions in other STEM fields in which women are severely underrepresented at all career levels.

- **IMs** should be skilled in forging **organizational change**, dealing with resistance, and building support networks to ease their burden. If hiring IMs specifically for this role, project funding should be earmarked and capacity building should be incorporated for skill development.
- Provisions should be built into calls for proposals for the position of **IMs beyond the direct scope of the project**. If IM positions and contracts are directly tied to project income, this puts them in a precarious position within the institution, and generates issues of continuity and sustainability beyond the project lifetime in terms of gender equality policies and progress tracking.
- **Experts** have relevant knowledge and experiences in promoting gender equality in research organizations above and beyond projects. For future calls for proposals, infrastructure and/or financial support should be built-in to effectively **broker** this expertise among project partners.
- **Instructions for internal evaluators** should be clearer on the task of measuring progress in terms of gender equality, and/or gender equality plans, and/or project management.
- **Symbolic change** is important, next to meeting project deadlines and tracking representation. A well-visited gender in physics day, an exciting video from a school competition, or the signing of a GEP by institute directors need to celebrated.

- Call for proposals should clarify the unique role of **observers** and should allow the reservation of funds for travel etc. for observers to participate in project events. If observers cannot take on a full partner role because of legal or budget constraints, or if observers want to join the project while it is already running, this lack of funding and clarity limits the potential seeding and community building inherent in the collaborative, cross-national approach of GEPs.
- Most GEP projects develop ways to track and quantify **career progress** of women (and other minorities) in their institutions and/or disciplines, from entry-level students to senior levels. These efforts have rarely been held against guidelines developed for measuring progress in research careers and often do not go beyond representation (in %) at different career stages. We therefore recommend the utilization and further development of the GENERA **Minimal Dataset** (MDS) and a **career progress indicator** to longitudinally collect and compare career data within and across institutional, disciplinary, and national borders.
- GENERA prioritized "**unconscious bias training**" as its number one gender equality measure in terms of quality, feasibility, and fit in physics institutions during its first stakeholder workshop. Mitigating gender bias in performance evaluation is a diversity intervention that aims to fix the system, uncover meritocracy discourses and bend stereotypically masculine norms dominant in research organizations. At the same time, research shows that only raising bias awareness may result in resistance, denial, and anger. It is therefore crucial to take into account evidence-based design specifications for effective bias interventions.[16]

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According to Nielsen (2018), few studies have systematically evaluated the effectiveness of different types of gender equality policies and measures in promoting gender equality in research organizations. Furthermore, the field is fragmented in terms of theoretical frameworks and evaluation standards (Müller ea, 2011). Examples of such evaluation studies are Nielsen, 2018 on Scandinavian countries, Timmers ea 2010 on the Netherlands, and Zippel ea 2015 on Germany. Taken together, these studies suggest several important conditions to be met for GEPs to be effective, from support from senior leadership; adaptability to institutional, disciplinary and national gender equality and equal opportunity structures; monitoring of progress on multiple indicators beyond representation; to building a community of practice to share and build knowledge and expertise beyond the lifetime of the funding of GEP projects.

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16 EHRC 2018, Unconscious bias training: an assessment of the evidence for effectiveness; LERU 2018, Implicit bias in academia; Vinkenburg, 2017