

Tapping all our Talents



Women in science,
technology, engineering
and mathematics:
a strategy for Scotland

April 2012





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CONTENTS	PAGE
Foreword	4
Preface	5
Summary	6
Key Recommendations	7
Programme for Action	8
About the report	9
1. Lost Talents	10
A. The current position	10
The STEM workforce	10
The costs of inaction: Scotland and beyond	12
A co-ordinated plan for action	14
B. The context for action	15
The European context	15
The Scottish context	15
The business and industry context	17
2. Analysing the Issues	18
A. Participation rates and attrition	18
Business and industry	19
Academia	20
Academies, and learned and professional bodies	22
Parliament/Public bodies	23
B. Barriers to the participation of women in STEM	24
The nature and organisation of science and technology	24
Implicit bias	25
Family responsibility and career breaks	26
Access to research resources	28
C. Initiatives and policies	28
3. Tapping all our Talents	30
A. Recommendations to the Scottish Government	30
B. Recommendations to the UK Government	32
C. Recommendations to business and industry	33
D. Recommendations to funders and investors	35
E. Recommendations to universities and research institutes	37
F. Recommendations to academies, and learned and professional bodies	41
G. Recommendations to women and women's organisations	45
4. Concluding Remarks	47
5. Appendices	48
A. Women in STEM Working Group	48
B. Membership of the RSE Review Group	49
C. Women in STEM consultation – evidence and assistance received	49
D. Current UK organisations/initiatives on women in STEM	53
E. Bibliography	54
F. Abbreviations	57



Tapping all our Talents

Women in science, technology, engineering and mathematics: **a strategy for Scotland**

Foreword

The majority of women with qualifications in science, technology, engineering and mathematics (STEM) subjects do not work in STEM areas. This is in marked contrast to men.

The consequence is a serious loss across the whole economy not just in Scotland but throughout the UK as well as many other European countries. Indeed employers in key sectors are reporting large impending shortages of people with STEM qualifications.

Scotland must address this issue. To be a smart economy, we need strength in STEM areas.

Encouraged by Professor Anne Glover, until recently Chief Scientific Adviser for Scotland, the Royal Society of Edinburgh (RSE) established a Working Group, chaired by the eminent astrophysicist, Dame Jocelyn Bell Burnell, to examine this issue.

The Working Group has produced a cohesive and comprehensive strategy aimed at increasing both the proportion of women in the workplace qualified in STEM, and the number who rise to senior positions in universities and research institutes, government, business and industry.

The RSE is most grateful to Dame Jocelyn and her Working Group. We are keen this report will lead to a coherent strategy, particularly in Scotland, to address this most important issue. We stand ready to assist Governments and other key agents to develop and monitor this strategy.

Sir John Arbuthnott MRIA PRSE
President, The Royal Society of Edinburgh





Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

Preface

In 1991 the number of female professors of physics in the UK doubled: it went from one to two! By 2009/10, it had risen to 36 – clearly a huge improvement. But that is still 36 out of a total of 650 professors of physics. A fifth of the UK university departments still have none. Clearly there is still much work to be done before women are more equally represented in this area.

The Scottish data for the career paths of women qualified in science, technology, engineering and mathematics (STEM) show similar trends to the UK. The country cannot afford this wastage of talent. We need to tap all our talents.

The causes of this problem are not simple. Tackling it will require concerted efforts from Governments (both in Scotland and the UK), academe and learned societies, and business and industry. We make specific recommendations to each.

This report is based on an open written consultation, a formal survey of professional organisations and learned bodies, and an extensive review of the research literature. These were complemented by interviews and discussion fora with relevant stakeholder groups, including academia, trade unions, business and representative organisations.

My thanks go to the many people who have contributed to this study and report; particularly to Professor Alice Brown (Deputy Chair of the Working Group), and Dr Caroline Wallace who provided the secretariat.

We are also grateful to the Office of the Chief Scientific Adviser for support to enable this report to be disseminated widely. Through that process we hope to reach those who have it within their grasp to transform this issue.

S. Jocelyn Bell Burnell

Professor Dame Jocelyn Bell Burnell DBE CBE FRS FRSE FInstP FRAS
Chair of the Working Group



Summary

The imperative

- 1 Science, engineering and technology are vital to Scotland's future. They catalyse its development as a modern economy, support public policies for health, wellbeing and environmental sustainability, and contribute greatly to its intellectual vitality. These roles are played by its research base, whose excellence depends on people: on the education and training that form them and the opportunities that stimulate their creativity.

Lost talent

- 2 Scotland fails to realise the full potential of its research base, and will continue to do so if it systematically fails to cope with the debilitating loss of talent represented by the high attrition rate of highly-trained women from employment. Although our universities now graduate large numbers of women in science, technology, engineering and mathematics (STEM), 73% of women graduates are lost from STEM compared with 48% of male graduates, with a corresponding loss of researchers. In academia, expensively trained women are lost in larger proportions than men at every step of the postgraduate ladder and are under-represented in top positions across the spectrum of business, public service and academia.
- 3 Although this represents a loss of opportunity to individuals, it also represents a major, quantifiable loss to the economy and society. It is estimated that a doubling of women's high-level skill contribution to the economy would be worth as much as £170 million per annum to Scotland's national income. It is an economic loss that Scotland can ill afford, but it also represents a loss of distinctive but less quantifiable qualities from key roles in the economy and society that women are demonstrably able to contribute. This rate of loss of highly-trained women from the workforce is taking place at a time when, even though the country is in near recession conditions, many of Scotland's employers in the science and technology sectors are unable to find sufficient qualified, skilled and experienced workers.

What is the cause?

- 4 We have analysed the factors that cause this loss of talent. Some are the practical hurdles of family responsibility, but many are cultural factors that relate to attitudes in the workplace, the organisation of science and technology with concomitant difficulties in accessing career resources and, inevitably with such a low female representation at senior levels, a lack of role models.



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

Tapping women's talents

- 5 There have been many laudable schemes that have attempted to stem this loss of talent, but which, because of their often *ad hoc*, partial and short-term nature, have failed to have a sustained impact. If applied with energy and determination as part of a coherent strategy, such initiatives have the potential to make Scotland one of the best places in the world to work in science and technology – a destination of choice for talented women from Scotland and abroad, and with spin-off benefits for the wider role of women in Scottish society.
- 6 We believe that Scotland has the means to develop an integrated, comprehensive and co-ordinated strategy for change. This will require political vision and commitment from leaders and organisations in academia and business. It will also require a major cultural change in attitude and approach. We make the following recommendations to key institutions as component parts of an action plan designed to achieve this change.

Key Recommendations

- 7 **Scottish Government should:** take the lead in committing itself to a national strategy for Scotland – an Action Plan – aimed at retaining and promoting women in STEM and led by a Cabinet Secretary; reaffirm its commitment to close the gender pay gap; and expect university STEM departments to achieve the minimum standards for an Athena SWAN Silver award, or equivalent. Initiatives should be monitored and evaluated.
- 8 **UK Government should:** extend existing parental leave legislation to recognise the equal responsibility of mothers and fathers for parenting.
- 9 **Businesses and industry should:** address the issue of job design and introduce quality part-time employment at all levels for men and women; national STEM Industry Advisory Boards should develop gender equity strategies.
- 10 **Funders of universities and of research should:** link funding to gender equality and seek to encourage a level of performance equivalent to an Athena SWAN Silver award across all Scottish university STEM departments.
- 11 **Universities and research institutes should:** obtain the minimum standard of an Athena SWAN Silver award (or equivalent) for their STEM departments.
- 12 **Academies, and learned and professional bodies should:** set standards that help to change the culture; lead by example – ensuring that appropriate data is being collected, analysed and reported regularly, and trends examined.

Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

13 The figure below sets out a **Programme for Action** which includes key recommendations and the targets and measurable outcomes that flow from them.

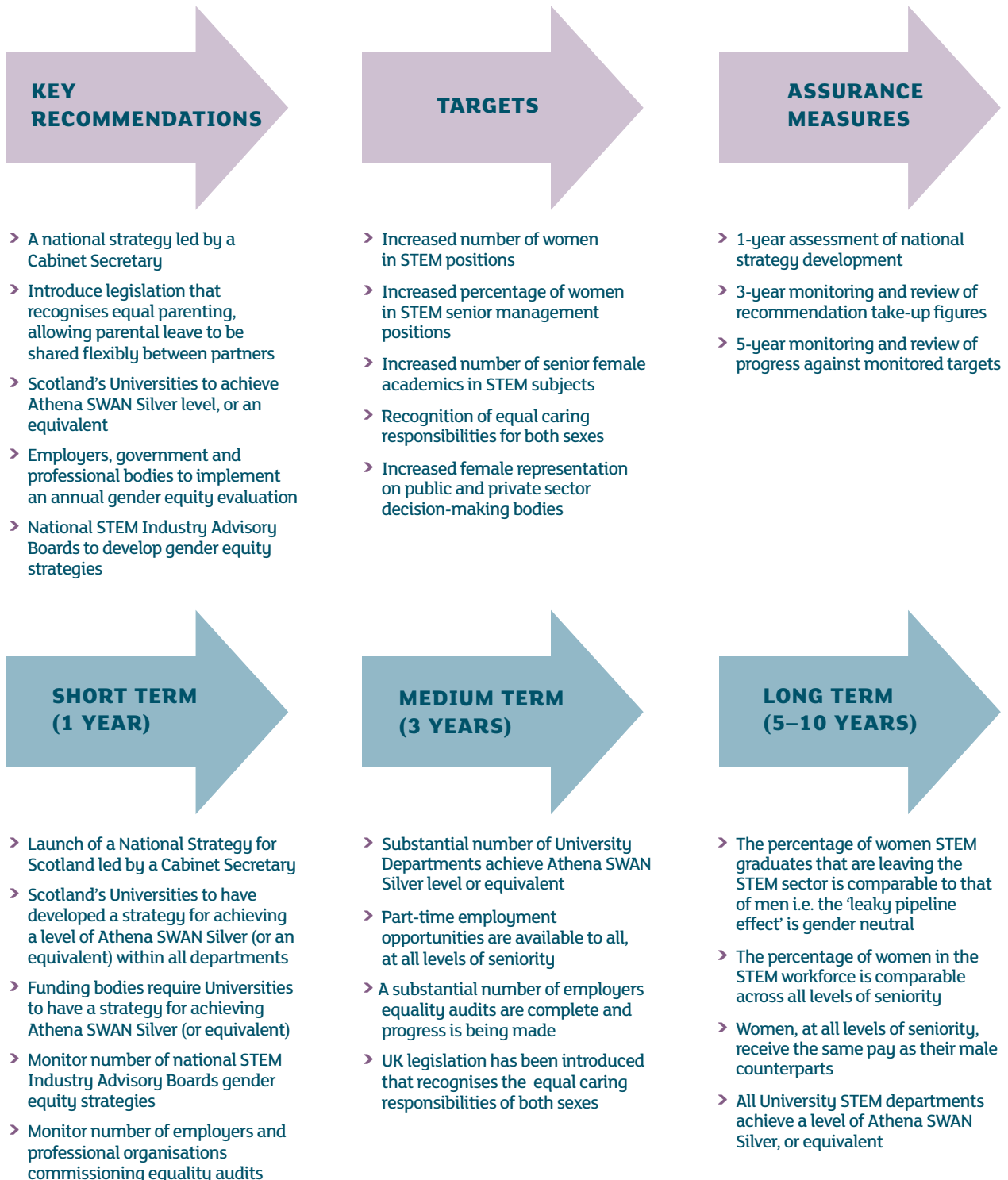


Figure 1. Programme for Action. a) **Key recommendations and targets;**
b) **assurance measures for short, medium and longer term.**



About the report

The scope of the study

- 14** The Royal Society of Edinburgh established a Working Group to develop a cohesive and comprehensive strategy for Scotland aimed at increasing both the proportion of women in the STEM workforce and the number who rise to senior positions in universities, institutes, government, business and industry.
- 15** There is no single, agreed definition of what constitutes the STEM sector. For this Report, we have adopted the definition used in the recent BIS study¹ i.e. Physical and Biological Sciences, Engineering and Technology, Mathematics and Computer Sciences.
- 16** This study has focused on the postgraduate employment of women in STEM. Encouraging girls to take up STEM subjects in primary and secondary schools has been the subject of a separate Working Group established by the Chief Scientific Adviser for Scotland².
- 17** Issues of retention, attrition and representation of women in clinical medicine are not addressed specifically in this study. However, our recommendations will be of relevance to the position of women in academic medicine. Similarly, the majority of the recommendations in this Report are generic and can be applied to other disciplinary areas and labour market sectors.
- 18** Scotland-specific data are presented where available. UK data are presented where Scottish data are unavailable or where the data pool is too small to lend itself to statistical analysis.

Our approach and the structure of the report

- 19** We have complemented a literature review with interviews and discussion fora involving representatives from different stakeholder groups including academia, trade unions, business and representative organisations; a formal written consultation and a survey of learned societies/professional organisations. Details are provided in Appendix C.
- 20** The main body of the report addresses, in turn, a consideration of the loss of talent in the STEM sector and an analysis of the current situation and contributing factors. The recommendations which follow in Chapter 3 are set out in several self-contained sections, each addressing a key stakeholder and showing how they can deliver change.

1 Department for Business, Innovation and Skills 2011. Data sources cited in this report may have a wider definition.

2 Science and Engineering Education Advisory Group
<http://www.scotland.gov.uk/Topics/Education/Schools/curriculum/ACE/Science/SEEAG>



Chapter 1 Lost Talents

“Our vision is of a nation of world-class scientific achievement, a magnet for talent and for investment, a powerhouse of technology, innovation and enterprise, increasing sustainable economic growth.”³

A The current position

- 21** Scotland enjoys a strong international reputation in science, technology, engineering and mathematics (STEM). Together they form a key and vital sector of the Scottish economy, contributing significantly to Scotland’s economic growth. To sustain this, we must continue to invest in and make best use of the skills and talents of all our people, and support the flow of knowledge from our schools, colleges and universities into wealth creation.
- 22** Scotland is failing to use fully its available human resources. This is reflected in the number of highly-qualified women who either leave the STEM sector early on in their careers or, where they stay, are under-represented in top positions in academia, government, business and industry.

The STEM workforce

- 23** The number of women STEM graduates and postgraduates has increased significantly in recent years, although women are more likely than men to leave the STEM sector – the so-called ‘leaky pipeline’ effect. In Scotland, 27% of women graduates in STEM work in the sector they qualified in, compared with 52% of male graduates⁴. This means that of the 56,000 female STEM graduates in Scotland, just over 15,000 continue to work in the sector.

³ Scottish Government 2008, p.4

⁴ The UKRC 2009

Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

- 24** Some of the women who do not continue to work in the STEM sector will have made positive choices to pursue careers in other sectors. Indeed, it is desirable that some STEM graduates do move into other sectors (e.g. education, media, government). Evidence from the recent BIS study shows that the most likely reason STEM graduates seek employment in a direction away from STEM is because other fields are “seen to be of more interest”⁵. We are concerned, however, about those women who are discouraged from pursuing STEM careers for negative reasons, and the fact that there is such a large difference between the percentage of women and men who make the decision to leave.
- 25** Women who do remain in the STEM workforce are still segregated by occupation (horizontal segregation) and grade (vertical segregation). These forms of segregation significantly impact on both a woman’s ability to achieve her potential and her earning capacity⁶. The number of women who advance to the most senior positions in STEM remains proportionately much smaller than that of their male counterparts.
- 26** That there are fewer women than men in science is sometimes attributed to biological factors, with the impact of culture largely ignored. Table 1 shows that the number of women participating in astronomy varies hugely from country to country, implying that there are likely to be a number of different factors – cultural, societal and sociological – at play, rather than biology alone. Similar patterns exist for mathematics and physics. Ingrained cultural and societal issues have consequences for the women involved, and for employers, who are unable to capitalise fully on the skills resource base. In Scotland too there are consequences for the wider economy, through the loss of return on public investment in the education and training of women in STEM.

Table 1. The proportion of professional astronomers who are female, country by country, as compiled by the International Astronomical Union. Only those countries with more than 100 members are considered⁷.

International Astronomical Union Countries with >100 members			
Country	% female	Country	% female
Argentina	37	Belgium	15
Ukraine	27	Poland	13
Italy	25	Sweden	13
France	24	Canada	12
Brazil	23	USA	12
Spain	18	UK	12
Mexico	17	Netherlands	12
Russian Fed	17	S. Korea	10
Greece	16	Germany	10
China	15	India	8
Australia	15	Japan	6

Average all member countries: 15% female

⁵ Department for Business, Innovation and Skills 2011

⁶ Whyte 2010

⁷ <http://www.iau.org/administration/membership/individual/distribution>

27 The retention and progression of women in the STEM workforce should be addressed in terms of its impact on individuals and in terms of its microeconomic and macroeconomic implications. The issues, illustrated with statistics for Scotland and the UK, are examined in more detail in Chapter 2; recommendations are set out in Chapter 3. However, we begin by considering the costs of inaction, the urgent need for a coordinated strategy in Scotland, and the context within which such a strategy must be developed.

The costs of inaction: Scotland and beyond

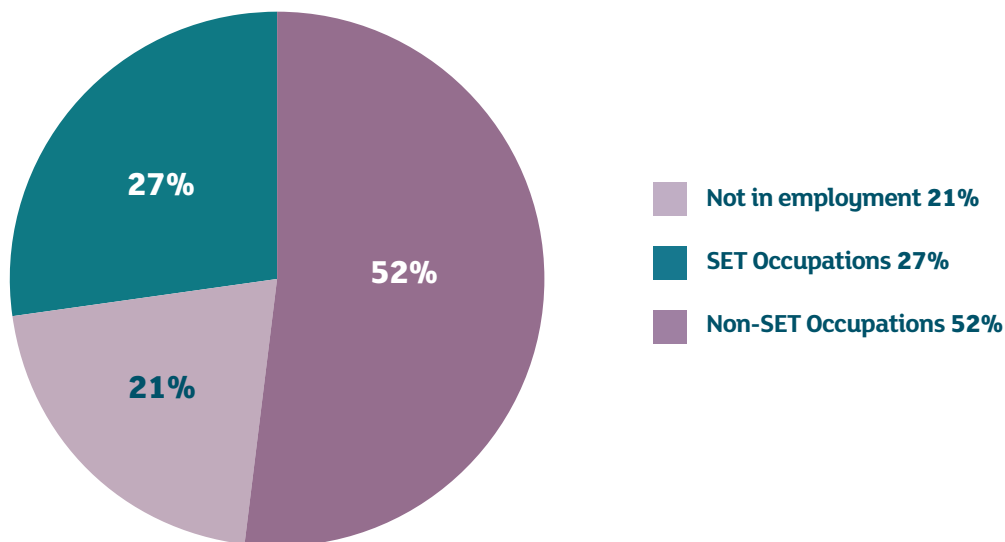


Figure 2. The occupation of female STEM graduates from Scottish Universities at 2009⁸.

28 Figure 2 illustrates the proportion of women graduates who do not choose SET occupations or are not in employment. This demonstrates a serious loss of resource for Scotland given its investment in education, particularly at postgraduate and postdoctoral levels, and the relatively high costs of educating and training professional scientists and engineers. It has been estimated that increasing women's participation in the UK labour market could be worth between £15 billion and £23 billion (1.3–2.0% GDP)⁹, with STEM accounting for at least £2 billion of this¹⁰. In Scotland, the loss of potential income to the Scottish economy is estimated at as much as £170 million per annum¹¹.

⁸ Reproduced with permission from The UKRC 2009

⁹ UK Women and Work Commission 2009

¹⁰ The UKRC website. <http://www.theukrc.org>

¹¹ The potential cost/loss to the Scottish economy has been estimated by highlighting a number of indicators relating to the potential loss of female earnings and labour market participation. The full extent of the cost to the Scottish economy of the under-representation of women in the STEM sector would require significant research into a number of socio-economic conditions as well as the collection and analysis of relevant data. Data provided by Professor Ailsa MacKay, available at http://www.royalsoced.org.uk/1013_Data.html



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

- 29** At the same time, there is evidence that some employers in Scotland are facing difficulties in recruiting people qualified in many of the STEM subjects (see paragraphs 43 – 45), while a recent study undertaken by PricewaterhouseCoopers revealed that replacing a competent member of staff costs businesses approximately a year of that person’s salary¹². Indeed, during the course of this inquiry, we heard that the cost of replacing highly skilled specialists such as colloid scientists, particle scientists, kineticists and physical chemists is closer to two years’ salary¹³.
- 30** In short, the loss of highly-trained, skilled women impacts negatively on Scottish business and the Scottish economy¹⁴.
- 31** Scotland is not alone in failing to harness the full potential of women. European Commission research shows that women are in the minority in science across the EU¹⁵. A recent EU study¹⁶ outlines the reasons why Europe needs more women in science and technology, noting that “the low numbers of women in decision-making positions throughout the science and technology system is a waste of talent that European economies cannot afford.” It is argued further that “the Grand Challenges facing Europe (including climate change and demography) require the full participation of women in its science and technology system if it wants to develop suitable solutions for all its citizens and does not want to continue losing ground in the new economic world order.”
- 32** The ‘cost of no action’ is identified by the EU expert group as:
- Missed innovation and new market opportunities
 - Unfulfilled competitive advantage of available human capital (women scientists and engineers)
 - Increased societal distrust of, and reduced support for, science and its institutions
- 33** Such studies also suggest that the multi-dimensional nature of the issue means there is no single solution, initiative or policy that alone can solve the problem.

¹² PricewaterhouseCoopers press release, 4 Oct 10

¹³ RSE Business and industry discussion forum, 20th June 2011

¹⁴ Whyte 2010

¹⁵ EC 2009a

¹⁶ EC 2011, p.13

A co-ordinated plan for action

34 Developing a coherent and comprehensive strategy for change will require political will and leadership, but is not the job of government alone. It will require the commitment and engagement of individuals and organisations – across academia, business and industry – working together in partnership (see Figure 3). Such an approach offers huge potential and benefits for women in Scotland, for Scottish business, for Scotland’s growth and economy, and for Scottish society more generally. It would also send strong signals to talented and well-qualified people working in STEM sectors throughout the world that Scotland is at the leading edge and is an attractive place to work and develop a career. In turn, businesses in Scotland would have a competitive advantage.

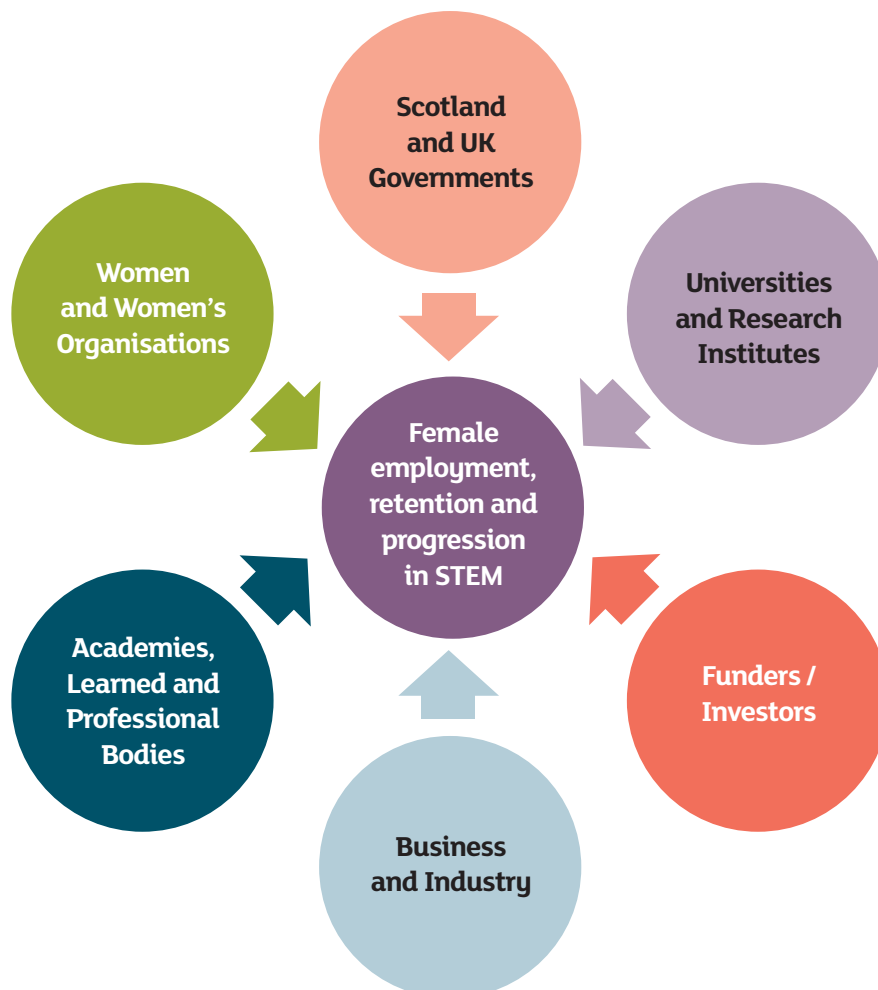


Figure 3. Map of stakeholders in the employment, retention and progression of women in STEM.



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

- 35** The position of women in STEM has improved, but the change has been disappointingly slow. The reasons for this are varied and complex and are in part due to the lack of a concerted and sustained strategy and a commitment to change. Particularly in the current economic climate, when there is a real need to encourage economic growth, Scotland must take full advantage of the knowledge and experience of women in this sector.

B The context for action

- 36** Any coherent and comprehensive strategy for change must reflect the current context for action.

The European context

- 37** The European Expert Group has argued that (1) the EU can become an example of best practice in research development & innovation through underlining the importance of gender equality and making it visible in both European policy and externally; and (2) this would require action at both the EU and EU member state level. Legislative steps recommended at EU level cover the pay gap, parental leave and the Framework Programme. At member state level, they include national action plans/strategies, an awareness of gender in research and in universities/research institutions, and a monitoring programme¹⁷. Although Scotland is not a member state in its own right, it is possible to draw on and implement some of these recommendations in Scotland.

The Scottish context

- 38** In a submission to the United Nations Commission on the Status of Women (Feb 2011), Engender¹⁸ stated that:

The Scottish Government, as a devolved administration of the UK, has obligations to deliver on the Beijing Platform for Action, the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) and the International Covenant on Economic and Social Rights (ICESCR)¹⁹.

- 39** While not all aspects of public policy are devolved to Scotland, the Scottish Government has responsibilities that cover policy areas where it can influence gender equality in STEM, such as education, training and economic development. In addition, although specific powers may not be devolved to Scotland, the Scottish Government can set an example of good practice that can be followed by other agencies in the public, private and voluntary sectors.

¹⁷ EC 2011

¹⁸ Engender is a women's organisation based in Scotland. It is Scotland's representative on the UK Joint Committee on Women which represents UK women on the European Women's Lobby. As a non-governmental organisation, Engender has consultative status within the Economic and Social Council.

¹⁹ Engender 2011, p.3



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

- 40** The Scottish Government has already taken some action to help overcome gender inequalities and promote the engagement of women in STEM. It has:
- reported on the effectiveness of its policies to address gender stereotyping and occupational segregation through a former **cross-directorate working group**;
 - made commitments to **mainstreaming equality** into the everyday work of the Government and Scottish Parliament;
 - implemented the recommendations of the UK Women and Work Commission, established in 2005 to identify solutions to the causes of the **gender pay gap**, and introduced the **Close the Gap** initiative (in partnership with Scottish Enterprise, Highlands and Islands Enterprise, the Equality and Human Rights Commission and the STUC) which aims to raise awareness about the gender pay gap and encourages and supports action by employees and employers to tackle the causes and reduce the gap;
 - used levers of change, such as the **Curriculum for Excellence**, which covers the content and delivery of school education, and employability initiatives, such as **Women@Work** and **Women Onto Work**, which take a supply-side approach to tackling occupational segregation;
 - commissioned the **Scottish Resource Centre for Women in Science, Engineering and Technology** to deliver services to increase the participation of women at all levels in STEM education and employment;
 - acknowledged macro-level effects of occupational segregation and set **Tackling Occupational Segregation** as one of only two Ministerial Priorities for Equalities.
- 41** The Government's actions are welcomed and supported by organisations such as Engender. However, Engender has expressed concern about their sustainability especially at a time of economic and budgetary constraints. They have also argued that there has been “no sustained Government activity around occupational segregation that has delivered significant change”, and that “gender mainstreaming is not evident in many Government departments and non-departmental public bodies responsible for the education, skills and economic development agendas in Scotland.”²⁰

²⁰ Engender 2011, p.4



The business and industry context

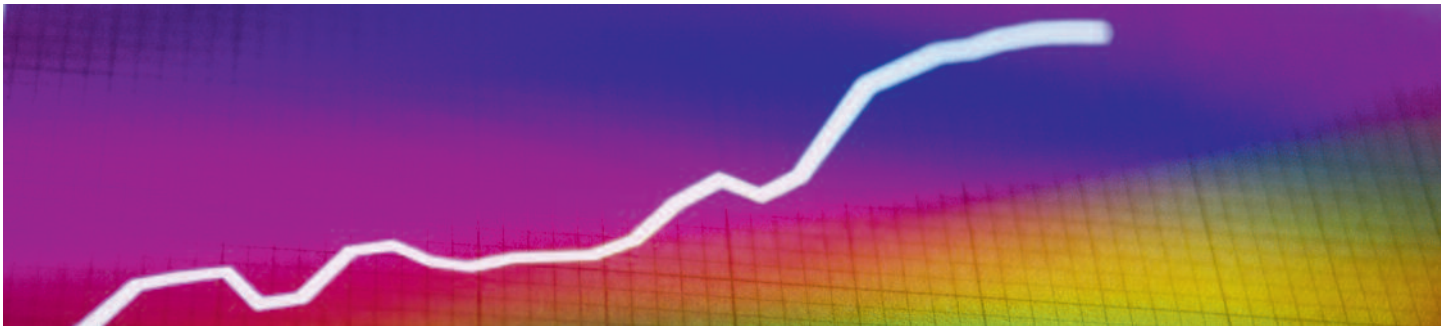
- 42** The Scottish Government's Economic Strategy has identified several key sectors in business and industry with high growth potential and the capacity to boost productivity, including the life sciences, energy, the creative industries, and food and drink. In common with Scotland's construction sector and the finance and business services sector, they all rely heavily on STEM occupations.
- 43** Despite the recession, many of Scotland's employers in the STEM sectors are unable to find qualified, skilled and experienced workers. Scotland's IT and Computing sector continues to report an increase in demand for technical staff ²¹, with vacancies rising faster than in other sectors.
- 44** SEMTA, the Sector Skills Council for science, engineering and manufacturing technologies, reports a growing skills shortage facing STEM employers, with 21% of them struggling to fill vacancies. This is accelerated by an ageing workforce, with 14% of SEMTA's sector workforce aged 60 plus ²².
- 45** The Energy sector faces similar challenges: Scottish Power has warned of a major skills shortage in the sector, as 80% of their engineers are due to retire within the next 20 years ²³. The expansion of renewable energy and the increase in 'green' energy jobs is central to the Scottish Government's strategy to build a low carbon economy. At present, only 16% of the energy workforce is female ²⁴. There is potential, therefore, to recruit more women in this area and help reduce the skills gap.
- 46** Government and employer strategies to meet the demand for a skilled STEM labour workforce will fail if they do not address the barriers to women entering, staying, returning and progressing in the STEM sectors. They will fail too if they do not take a more strategic and sustained approach to change, including effective monitoring and evaluation of the impact of policies aimed at reducing gender inequality.

²¹ The Bank of Scotland Labour Market Barometer, Sep 2011

²² SEMTA, Engineering Policy Group Scotland, Sep 2011

²³ Scottish Power, 5 April 2011

²⁴ Blake Stevenson 2010



Chapter 2

Analysing the Issues

- 47** Chapter 1 has shown that the under-representation of women in the science, technology, engineering and mathematics workforce is a persistent phenomenon that transcends national boundaries and employment sectors, with implications for both society and the economy.
- 48** The issues are analysed below, pulling together data from many sectors. Statistics and indicators to allow monitoring and evaluation are key to a strategy that aims to promote the equal participation of women in the STEM workforce, but while gender-disaggregated workforce data are generally available for the academic sector, the availability of sufficiently detailed data is variable in the public sector and is limited in the private sector.
- 49** Data for Europe as a whole are presented in Box 1 at the end of Section A.

A Participation rates and attrition

- 50** In Scotland there are 56,000 female STEM graduates of working age²⁵. However, as stated in Chapter 1, only 27% are using their qualifications to work in STEM occupations compared with 52% of men²⁶. Female STEM graduates are also more likely than male STEM graduates to be unemployed or economically inactive, with an employment rate of 80.2% compared with 85.3% for men²⁷. Some 11,000 female STEM graduates in Scotland currently fall into the unemployed or economically inactive category. So although not all STEM graduates pursue careers in STEM occupations, the attrition rate is significantly higher for women.

²⁵ Office of National Statistics 2010

²⁶ The UKRC 2009

²⁷ Office of National Statistics 2010

- 51** Data from the UKRC show that in 2007/08, twice as many men entered STEM occupations as soon as they achieved undergraduate qualifications in STEM (41.8%) as did women (21.0%). Women were more likely to delay careers in STEM until they achieved graduate-level qualifications. Independent of degree, male graduates who entered STEM occupations were much more likely to enter at higher levels than female graduates and more likely to take up management positions ²⁸.

Business and industry

- 52** There is a growing body of evidence demonstrating that the inclusion of women in workplace teams and on company boards significantly increases organisational performance and profitability, and improves corporate governance²⁹. Despite this evidence, the recent Davies report³⁰ found that women account for only 10.7% of the directorships in STEM FTSE 100 companies compared to 14.7% for the non-STEM companies, and almost 30% of the STEM companies in the FTSE 100 have no female directors on their boards, compared to 9% of the non-STEM companies.
- 53** Women directors are rarely Chairs of Boards, Executive Directors or CEOs. In 2009 there were just four female CEOs within FTSE 100 companies, and only one of these positions was held by a woman in the STEM sector. There were only three female Chairs of FTSE 100 companies and none of these were in the STEM sector. There were only four female Executive Directorships in STEM companies (no increase since 2004), compared to 12 in non-STEM companies³¹.
- 54** The relative proportion of women-owned businesses is known to be a key driver of the overall level of entrepreneurial activity in national economies³². At UK-level, women represent only 7.6% of all people who either have a controlling interest or own a company in STEM industries. In contrast, within non-STEM industries women make up 41.2% of people who either have a controlling interest or own a company.
- 55** Research shows that female entrepreneurs are more likely than their male counterparts to be providing a product new to the market, more likely to be using technology in their products or services and more likely to be offering a product or service that has been developed in the last year³³. This research also finds that women are nearly three times more likely to collaborate with research institutes – universities in particular – than male-led businesses (11.4% compared with 3.8%).
- 56** A recent survey of UK PhD students in STEM found pronounced differences between the sexes in their attitudes to, and knowledge of, enterprise. Women reported having less business training and/or experience, being less aware of entrepreneurial possibilities, and being less likely to believe that their business ideas could have commercial potential, or to discuss enterprise with their supervisor ³⁴.

²⁸ The UKRC 2010

²⁹ McKinsey & Company 2007; Catalyst 2007; Adams and Ferreira 2009; Gavurin 2007

³⁰ Davies 2011

³¹ Zalevski and Maruyama 2010

³² Global Entrepreneurship Monitor website. <http://www.gemconsortium.org>

³³ Harding *et al.* 2004

³⁴ Zalevski and Swiszcowski 2009

Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

57 These figures are all the more surprising given Prowess' observation that STEM enterprises "may enable more women to pursue a career in their chosen field, at a level that matches their skills and experience on a more flexible basis."³⁵

Academia

58 There has been an increase in the percentage of women in the academic staff in most STEM areas (Figure 4). Data from HESA show that in 2007/08 women accounted for 30.3% of researchers, 26.1% of lecturers, 18.3% of senior researchers or senior lecturers and 9.3% professors in STEM full-time employment. Even in disciplines such as biosciences, where there is a critical mass of female students, researchers and lecturers, women still account for only 15% of professors in Scottish institutions (Figure 5). Figure 6 shows a year-on-year increase in the percentage of women at all grades in the biosciences across the UK. While there has been a noticeable increase in the percentage of female lecturers, and senior lecturers/researchers, this is not seen to the same extent at professorial grade.

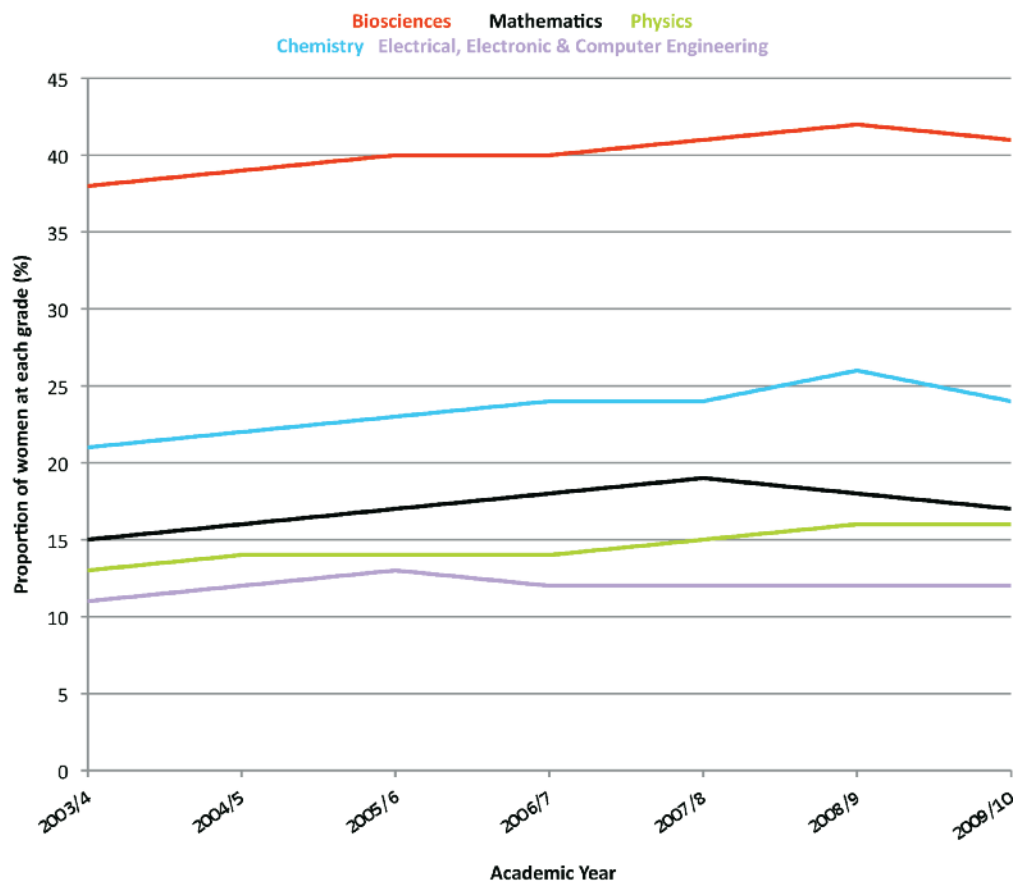


Figure 4. Proportion of academic staff that is female, by year³⁶.

³⁵ Prowess 2007, p.2

³⁶ Institute of Physics. Statistical Report: Academic Physics Staff in UK Higher Education Institutions. January 2012.



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

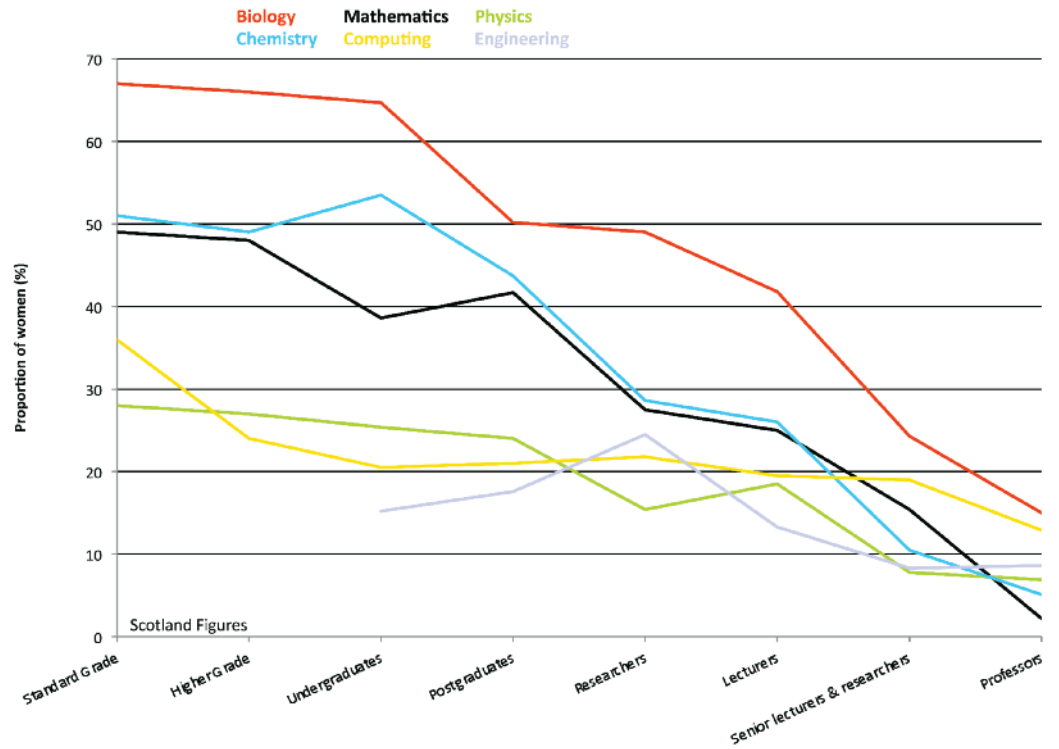


Figure 5. Women in Scottish academia: the proportion that is female at each level³⁷

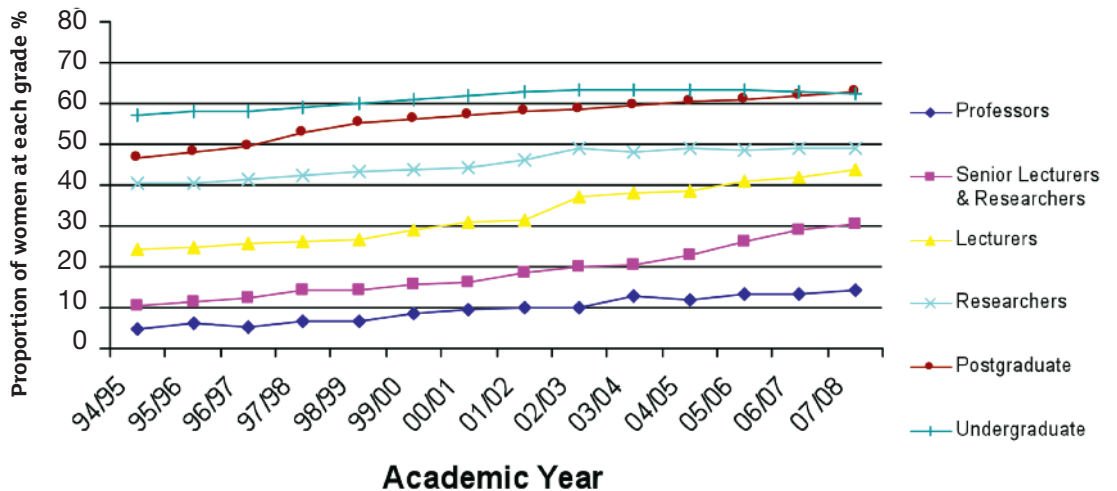


Figure 6. Proportion that is female at various levels in the Biosciences. (Reproduced with permission from RCUK)³⁸

³⁷ Data sourced from SQA statistics 2007 <http://www.sqa.org.uk/sqa/26543.html> and HESA Resources of Higher Education Institutions 2007/8 <http://www.hesa.ac.uk/>.

³⁸ RCUK 2009

59 Women's presence among research directors is also limited. For example, in all the projects funded by the Directorate-General for Research of the European Commission under the 6th Framework Programme for Research and Technological Development (10,755 projects), only 17% had a woman as 'scientific coordinator' and only 16% had a woman as 'scientist in charge', as reported by the Gender Equality Report³⁹.

Academies, and learned and professional bodies

60 Using the percentage of STEM Professors (FTE) as an estimate of the pool of talent⁴⁰, women are under-represented to varying degrees in all the academies, and learned and professional bodies that responded to our consultation.

61 Currently, women make up 5.8% of the Fellowship of the Royal Society, compared to a female talent pool of 8.9% of professors in STEM in the UK; the Royal Academy of Engineering has 3.5% of its Fellowship female, compared with a female pool of 8.4% of professors in engineering; in the STEM disciplines, the Royal Society of Edinburgh has 7.9% of its Fellowship female compared with a female talent pool of 9.7% of professors in STEM in Scottish HEIs; the Institution of Civil Engineers has 1.2% female Fellows compared with a pool of 5.4% female professors in civil engineering; the Royal Society of Chemistry has 4.9% female Fellows compared with a pool of 6.7% female chemistry professors; the Institute of Physics has 4.7% female Fellows compared with a pool of 5.8% female physics professors.

62 However, as admission implies Fellowship for life, the above figures may be skewed by many previous years of male-dominant admissions. A better indicator is the percentage of newly-elected Fellows who are female. Election data provided by the Institute of Physics, the Royal Society of Edinburgh and the Royal Academy of Engineering show the proportion of women elected broadly matches the proportion nominated. Several societies and academies have taken initiatives to improve the representation of women in their Fellowship, including the formation of proactive nominations committees. Over the last 10 years about 10% of new Fellows elected to the Royal Society and 13% elected to the Royal Society of Edinburgh (STEM disciplines) have been women.

³⁹ EC 2008a

⁴⁰ HESA data 2007-08, supplied to the RSE for this study

Parliament/Public bodies

- 63** In the 2011 Scottish Election, women were elected to just 45 out of 129 seats in Holyrood (34.8%), an increase of 1.5% from 2007, but significantly lower than the previous highs of 39.5% in the 2003 election and 37.2% in 1999. Overall, the proportion of female candidates fell from 36.1% in 2007 to 29.5% in 2011. A report into the election results found that there were clear gendered patterns of candidate placement in the 2011 election, with women candidates generally placed in lower positions on party lists and less likely to be selected to contest safe or winnable constituency seats⁴¹. Of the 129 MSPs, currently only three women (2.3% of all MSPs) and 12 men (9.3% of all MSPs) hold a STEM degree (including medicine).
- 64** Following the UK General Election in 2010, women accounted for just 21.9% of all MPs representing the three major UK parties. Of the 604 MPs with known qualification/work backgrounds, there were only 10 women (1.7% of all MPs) and 77 men (12.7% of all MPs) with a STEM qualification and/or work experience⁴².
- 65** The total membership of STEM public bodies⁴³ has declined in recent years, with the number of women falling at a faster rate than that of men. In 2008, women were only 23.7% (179 women) of all members of STEM public bodies in the UK; a decline of 2.0 percentage points and a loss of 30 women since 2006⁴⁴. In part, the low representation of women members on public bodies reflects the general under-representation of women in STEM. However, the data show that women were also under-represented in STEM public bodies belonging to those STEM sectors with a high participation of women. For example, although women comprised 46.3% of health professionals in 2008, female membership of public bodies in the Department of Health was only 35% in the same year.

Box 1 Women in STEM in Europe

The under-representation of women in the highest academic ranks and in decision-making positions in scientific organisations is common to all countries in the EU and its associated countries, even if this under-representation varies somewhat from country to country, as demonstrated by the EU Women and Science reports during the past decade⁴⁵.

On average, throughout the EU-27, 7% of women and 18% of men working in the academic sector are at Grade A (Full Professors). Women are thus relatively more present at the lower levels of the academic career.

⁴¹ <http://www.engender.org.uk/UserFiles/File/news/Election%20Report%20%28Scottish%20Parliament%202011%29.pdf>

⁴² The UKRC 2010

⁴³ Cabinet Office. Public Bodies 2009. http://www.civilservice.gov.uk/wp-content/uploads/2011/09/PublicBodies2009_tcm6-35808.pdf

⁴⁴ The UKRC 2010

⁴⁵ EC 2000; EC 2003; EC 2008a; EC 2008b; EC 2009a

Box 1 *continued*

The latest EU statistics and indicators on gender equality in science⁴⁶ show an improvement in the proportion of women at all academic grades, but strong vertical segregation remains. Female representation at Grade A (Full Professors) is on average higher in the new EU member states, than in the EU-15, where there are 17% women at Grade A compared with 19% in the EU-27. The five EU countries with the highest proportion of Grade A women across all disciplines are Romania, Latvia, Bulgaria, Finland and Portugal. Portugal greatly exceeds the EU-27 average of 13.4% female Grade A staff in the natural sciences, with 27.5%. In engineering and technology, Croatia (an EU-associated country) has 23.6% female Grade A staff compared with 7.2% in the EU-27. The UK falls below the EU-27 average in the natural sciences, with only 10.1% female Grade A staff, but is comparable in engineering in technology with 7%.

B Barriers to the participation of women in STEM

The nature and organisation of science and technology

- 66** While the under-representation of women is not unique to the STEM field, the nature and organisation of science and technology creates obstacles to the participation and progression of women, which are not necessarily found in other fields. As stated in a European Commission working document on women and science “scientists have the longest period of qualification, high levels of career insecurity and international mobility as a key element of their careers.”⁴⁷
- 67** A subsequent report on policy measures for gender equality in science identified further obstacles to women’s participation: “In certain fields of science, experiments often have to be run and supervised during long and/or outside normal working hours, which can interfere with the scientists’ other outside responsibilities. Secondly, science and technology are changing at ever-increasing speed, which makes it difficult for scientists to re-enter these fields after taking time out for their families, as their knowledge may become out of date after even short periods away from work⁴⁸.”

⁴⁶ EC 2009a

⁴⁷ EC 2008b, p.18

⁴⁸ Ibid.



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

- 68** The data presented in Figure 5 show the concentration of women in less senior academic posts which tend to be characterised by less pay and security. The insecurity of being on a fixed-term contract is one of the main barriers to successful academic careers faced by women researchers⁴⁹. Data from the Athena Forum ASSET survey show that women at all STEM academic grades were more likely than their male counterparts to be employed on fixed-term contracts.⁵⁰
- 69** When women become mothers, many seek part-time positions in order to maintain their careers while at the same time spending significant time with their families. Hart and Roberts⁵¹ note high demand for part-time work opportunities from women, especially in the two decades following their early 20s, with child-rearing being the most important contributory factor. However, they argue that the engineering and scientific communities “do not appear to be willing or able or to see the necessity to cater for this demand.” While they consider that the reasons require more detailed research, they suggest that: the nature of engineering and scientific job tasks may not lend themselves to shorter-period work spells; and such jobs are performed in relatively small-scale companies and academic departments that may not have the same working time flexibility as larger organisations.
- 70** Hart and Roberts provide data showing the dearth of opportunities for part-time working in engineering and science, contrasting this with professions such as teaching, where greater opportunities exist. They flag up the serious efforts made by the National Health Service to retain female doctors and consultants by promoting part-time employment contracts, with the result that a much higher percentage of medical-related professionals switch to part-time employment than in engineering or scientific professions.

Implicit bias

- 71** A recent EU report highlighted “a lack of awareness of how systems and structures, policies, processes and procedures can be discriminatory, even where the employers have the very best of intentions on fairness and equality.”⁵² For example, while there is general agreement that appointments should be based on ‘merit’ and the ‘best person for the job’, concepts of what constitutes ‘merit’ are socially constructed and can be influenced by preconceived views of men and women. They can also value some qualities or attributes more than others. Women can be significantly disadvantaged by a gendered conception of merit, especially one that values a full-time, uninterrupted career trajectory and research success.

⁴⁹ Zalevski *et al.* 2009

⁵⁰ Athena Forum 2010

⁵¹ Hart and Roberts 2011

⁵² EC 2011, p.19



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

- 72** Trix and Psenka found systematic differences in letters of recommendation for academic faculty positions for female and male applicants⁵³. Letters written for women are more likely to refer to their compassion, teaching and effort, as opposed to their achievements, research and ability, which are the characteristics highlighted for male applicants.
- 73** Research profiled in a report from the American Association of University Women shows that people not only associate maths and science with ‘male’ but also often hold negative opinions of women in ‘masculine’ positions, such as scientists or engineers. This research shows that people judge women to be less competent than men in ‘male’ jobs unless women are clearly successful in their work. When a woman is clearly competent in a ‘masculine’ job, she is considered to be less likable. Because both likability and competence are needed for success in the workplace, women in STEM fields can find themselves in a double bind.⁵⁴
- 74** Small imbalances add up to disadvantage women. Computer simulations have shown the importance of very small amounts of bias on the progression of women. For example, Martell, Lane and Emrich⁵⁵ simulated a hierarchical institution with a pyramidal structure, staffed with equal numbers of men and women at each level. The model assumed a tiny bias in favour of promoting men, a bias accounting for only 1% of the variability in promotion. After repeated iterations, the top level was 65% male. Even very small amounts of disadvantage accumulate over time. “The small but systematic undervaluation of women culminates in women’s smaller salaries compared to men’s, and slower rates of promotion.”⁵⁶

Family responsibility and career breaks

- 75** A large American study found that family formation – most importantly marriage and childbirth – accounts for the largest leaks in the pipeline between PhD receipt and the acquisition of tenure for women in the sciences (including the social sciences)⁵⁷. The findings indicate that women in the sciences who are married with children are 35% less likely to enter a tenure track position after receiving a PhD than married men with children. Upon entering a tenure-track job, they are 27% less likely than their male counterparts to achieve tenure. It is worth noting here that single women without children are only 2% less likely than married men with children to enter a tenure track position, but 23% less likely to achieve tenure.

⁵³ Trix and Psenka 2003

⁵⁴ American Association of University Women 2010

⁵⁵ Martell *et al.* 1996

⁵⁶ Valian 2005, p.204

⁵⁷ Goulden *et al.* 2009

- 76** The EU *Women in Science & Technology: Creating sustainable careers* report found that the underlying culture in STEM tends to marginalise both men and women who use work–life balance policies, stating that “too often it seems that we do not manage the transition into career breaks – or the transition back to work – with a sincere desire to protect the individual’s career, or indeed the investment made by the company in that person’s professional development. We are also concerned that work–life balance policies are not designed with the most promising, talented individuals in mind – the ones we want to keep. Instead, the high performers are encouraged to avoid these tracks.”⁵⁸
- 77** This is supported by the analysis of the responses to the 2007 ERA Green Paper which found that “an overwhelming majority (88%) of female researchers agreed that providing for working and funding conditions that foster a better work-life balance will positively affect the number of women in research careers.”⁵⁹ Box 2 gives examples of good practice.

Box 2 Good Practice

Guidance on good practice can be found in the following places (amongst others):

Royal Society of Chemistry

Planning for Success: Good Practice in University Science Departments

<http://www.rsc.org/ScienceAndTechnology/Policy/Documents/PlanningforSuccess.asp>

Institute of Physics Project Juno

www.iop.org/publications/iop/2009/page_42647.html

Athena SWAN Factsheets

<http://www.athenaswan.org.uk/html/athena-swan/good-practice/swan-factsheets/>

Good practice includes work–life balance policies:

“Work–life balance is about people having a measure of control over when, where and how they work. It is achieved when an individual’s right to a fulfilled life inside and outside paid work is accepted and respected as the norm, to the mutual benefit of the individual, business and society.”⁶⁰

Several STEM employers have introduced creative solutions to address the particular challenges in STEM so that working practices can be made more inclusive, to the benefit of both men and women. These include:

Flexible work practices such as working from home, flexible hours, compressed hours, job sharing, and time off in lieu (TOIL) for extra hours worked;

Flexible leave arrangements above the statutory level, such as parental leave, carer’s leave, and the ability to purchase extra holidays;

Health and information programmes such as managing stress workshops and resources, employee advisory services childcare referral services, and keeping-in-touch programmes.

⁵⁸ EC 2009b, p.5

⁵⁹ EC 2008a, p.32

⁶⁰ The Work Foundation <http://www.theworkfoundation.com/>

- 78** One of the biggest factors for many women in deciding whether to remain in or return to a STEM career is the provision of good quality, affordable childcare.⁶¹ In many places, suitable childcare is not available near the place of work and does not match the hours that the parents work. Where such facilities exist, the places are often over-subscribed and prohibitively expensive.

Access to research resources

- 79** Access to research resources is a major key to success in a scientific career. A 2002 report from the Wellcome Trust⁶² and a more recent EC report on gender and access to research funding⁶³ reveal gendered differences in grant application behaviour. Even where grant-awarding processes are considered to be gender-neutral, women are less likely to apply for funding and request smaller amounts of money for a shorter duration.
- 80** Despite efforts to eliminate bias against women in the 2008 Research Assessment Exercise (RAE), inequalities remained, with only a 48% chance of a permanent female academic being selected compared with 67% for men^{64 65}. A Universities UK survey⁶⁶ found that during term time women academics on average spent more hours per week teaching and less hours conducting research than male academics. Men spent more of their teaching time concentrating on doctoral instruction, whilst women spent more of their time at the undergraduate and Masters level. According to the report men appeared to be more involved in the types of research activities that are highly valued by research councils and within the RAE. The report concludes in its findings that women had less time to research and were less involved in the types of research activities valued by assessment and promotion frameworks, which “may be evidence of prominent obstacles to women in reaching top university positions.”

C Initiatives and policies

- 81** A range of initiatives to promote gender equality specifically in STEM have been developed in Europe and the US over the last three decades, the sheer number of which is an indication of the level of concern held on this issue. The measurable impact of these initiatives is less clear. Indeed, a Scottish Government Social Research study carried out in 2010⁶⁷ found “little detailed work evaluating the impact of different policies on women in science in the UK.”

⁶¹ Daphne Jackson Trust 2009

⁶² Wellcome Trust 2002

⁶³ EC 2009c

⁶⁴ Higher Education Funding Council of England 2009

⁶⁵ Equality Challenge Unit 2009

⁶⁶ Universities UK 2010, p.32

⁶⁷ Whyte 2010, p.23



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

- 82** Although the range of past and current initiatives is diverse, they share common themes, focusing on changing girls' and women's perceptions of STEM and giving them the skills and support they need to survive and achieve in STEM careers. In the UK the initiatives have frequently been led by women, often on a voluntary basis, and have also tended to be *ad hoc*, short-term and uncoordinated with other such initiatives. Nonetheless, these contributions have helped to bring us to today's improved position. Current UK initiatives are listed in Appendix D.
- 83** Until relatively recently, there has been little focus on addressing the structural transformation of institutions and organisations necessary for women's full and equal participation in STEM, particularly in senior positions. The US has led the way via the ADVANCE programme, funded by the National Science Foundation (Box 3). Some initiatives have also been taken at a European level, but a recent report finds that the scale of these needs to be increased⁶⁸.

Box 3 National Science Foundation ADVANCE program

The ADVANCE program aims to increase the representation and advancement of women in science, technology, engineering and mathematics (STEM) careers by encouraging higher education institutions (HEIs), professional societies and other charitable organisations to address various aspects of STEM academic culture and institutional structure that may differentially affect women. Since 2001, the NSF has invested over \$135M to support ADVANCE projects at more than 100 institutions of higher education and charitable organisations in 41 States, the District of Columbia, and Puerto Rico. Further information is available at <http://www.nsf.gov/advance>

The ADVANCE Program at the University of Michigan:

This began as a five-year project promoting institutional transformation with respect to women faculty in science and engineering fields in four general areas: equitable recruiting practices; retention of valued faculty; improvement of departmental climate; and development of leadership skills to encourage supportive climates.

In the colleges that employ the largest number of scientists and engineers, in the two years before the ADVANCE programme started 13% of all new hires were women (nine women out of 71). Eight years after the start of the programme the fraction was 29% (95 women out of 327). The fraction of female academics increased from 16% to 23% and 14 women were appointed to be dean or departmental chair.

With the University's commitment to continue funding through June 2016, the program is gradually expanding to promote other kinds of diversity among faculty and students in all fields.

- 84** In Scotland and the UK, both the UK Resource Centre for Women in Science, Engineering and Technology and its Scottish equivalent, the SRC, have combined training and support of women with guidance and best practice solutions for employers. Scotland's ability to build effectively on the good work done by the SRC and others depends on the availability of long-term funding, together with the force of connected and co-ordinated actions. Chapter 3 details our recommendations to individual partners in developing a strategy for change.



Chapter 3

Tapping all our Talents

- 85** The previous chapter examined the high attrition rates and poor representation of women in STEM, and looked at earlier initiatives and policies aimed at addressing the problem. These initiatives and policies, including the UKRC and the Scottish Resource Centre for Women in SET, have by and large been project-funded, ad hoc or short-term. It is our judgement that improved co-ordination among initiatives is required, along with clear lines of responsibility and accountability for delivery of the policies.
- 86** In order to tap all our talents, the issue must be addressed through an integrated, comprehensive and co-ordinated strategy in Scotland – a model Action Plan that involves all the key stakeholders taking responsibility for working together to ensure its success.

A Recommendations to the Scottish Government

- 87 A National Strategy for Scotland:** The Scottish Government should demonstrate political leadership by committing itself to a national strategy, led by the appropriate Cabinet Secretary, aimed at addressing occupational segregation and the particular impact on women in STEM. It should seek support for this strategy from all the key stakeholders and organisations that have a role to play in partnership with the government. Systematic follow-up is essential, and it is important that such a strategy in the form of an Action Plan should include appropriate monitoring and feedback arrangements.
- 88 Public Sector Equality Duty:** The Scottish Government should pursue its aim of improving the operation of the Public Sector Equality Duty, which came into force on 5 April 2011, through the introduction of Specific Duties. We recommend that the government should lead by example in fully implementing the Public Sector Equality Duty in its own departments and agencies.



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

- 89 Procurement:** The Scottish Government should use its position as the purchaser of goods and services to ensure that contractors and suppliers meet the public sector equality duty. A gender perspective should be included in the monitoring and evaluation systems for such contracts.
- 90 Gender Pay Gap:** The Scottish Government should reaffirm its commitment to closing the gender pay gap by the introduction of statutory pay audits, and a requirement on public bodies and agencies to demonstrate their plans and actions for closing the gender pay gap within an agreed timescale.
- 91 Childcare:** The Scottish Government should ensure the availability of affordable high quality childcare both for pre-school children, to encourage and allow parents to return to work after the birth of their children, and for school-age children, to allow parents to balance work and parenting.⁶⁹
- 92 Data:** The Scottish Government should improve the availability and dissemination of gender disaggregated statistics covering women in STEM.
- 93 Resourcing:** The Scottish Government should ensure there is adequate resourcing and development for initiatives that have demonstrated success in tackling occupational segregation in general and in the STEM sector specifically.
- 94 Athena SWAN:** The Scottish Government, through the Scottish Funding Council and the Chief Scientist's Office, should: expect its universities to develop a strategy within a two-year period to bring all their STEM departments up to the Athena SWAN Silver award, or equivalent, level; monitor their progress in achieving this level of performance; and ensure that there is adequate funding for the programme to be developed.
- 95 Legislation on gender equality in STEM:** Box 4 outlines the new Spanish Law on Science, Technology and Innovation. Similar legislation should be considered by both the Scottish and UK Governments.

⁶⁹ A report from the Institute of Public Policy Research (2011) shows that there is a net return to the government of £20,050 over four years in terms of tax revenue minus the cost of childcare for every woman who returns to full-time employment after one year of maternity leave.

Box 4 New Spanish legislation

In 2011 Spain introduced a new Law on Science, Technology and Innovation which includes articles relating to gender equality. These articles reinforce and expand upon existing provisions in the Law of Equality and the Law of Universities, both enacted in 2007. The articles require:

- > Balanced gender composition of all bodies, councils and committees
- > Gender relevance to be considered in all aspects of the research process, including the definition of the priorities of scientific and technological research, research problems, theoretical and explanatory frameworks, methods, collection and interpretation of data, findings, applications and technological developments, and proposals for future studies
- > The promotion of gender and women studies, as well as concrete measures to encourage and give recognition to the presence of women in research teams
- > Information systems to collect, process and disseminate gender-disaggregated data and include indicators of the presence and productivity of women researchers
- > Research institutions and universities to adopt a gender equality plan
- > Universities to create gender equality units and to integrate gender into the curricula

B Recommendations to the UK Government

- 96 Employment Law:** The UK Government implemented a limited paternity leave scheme from April 2011. It should extend the legislation to recognise the equal responsibility of mothers and fathers in parenting – e.g., as in Finland, which provides nine months leave for parents following the birth of a child (three months to be taken by the mother, three months by the father, and the other three months by either parent).
- 97 Champion:** The UK Government should appoint a ‘Gender and STEM’ government champion at ministerial level to drive a cross-governmental, cross-departmental and integrated strategy to tackle gender segregation in education and the workplace, with particular responsibility for the STEM sector. The champion should ensure that there are adequate funding, monitoring and feedback arrangements in place so that the effectiveness of the strategy can be assured.
- 98 Recruitment:** In employing headhunters to fill vacancies for top positions, the UK Government should ensure that the headhunters offer up an equal number of male and female candidates.

C Recommendations to business and industry

- 99** In the last decade, business and industry have taken important steps to address life-stage issues for their employees. As a result, both women and men may be able to arrange for shortened work weeks, condensed hours, shared positions, part-time work or work-at-home arrangements. When the workplace is hospitable in this way, these companies are well-placed to realise past investment in their staff (see Box 5).

Box 5 Case Study: ClinTec International

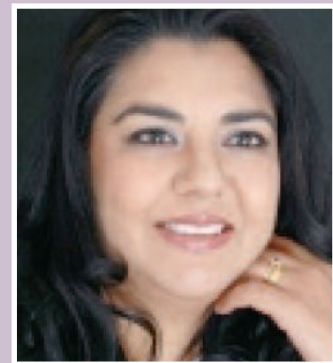
ClinTec International, a leading global clinical research organisation has an enviable record on employing and training female staff.

Approximately 80% of the staff is female and, although 30% have taken maternity leave at some stage in their careers, all have returned to continue working.

ClinTec bucks the sector trend at senior level too. Of nine Senior Managers three are women, in a sector that often struggles for even one. The story is even better at Regional level where 12 of 15 regional managers are women.

The company was originally set up in 1997 by Founder, President and CEO, Dr Rabinder Buttar, working from home while looking after her children, a toddler and a newborn. Now the company has a presence in over 40 countries in five continents and ClinTec was ranked by Deloitte as number 27 of the top 100 fastest growing privately-owned technology companies in Britain in 2010.

Dr Buttar has a flexible and open approach to management, born from first-hand experience of balancing home and working life. Judging from the balance sheet and the awards cabinet, flexibility is no barrier to success.



- 100** The majority of people employed in business in Scotland work in small and medium-sized enterprises (SMEs), which often do not have the stretch in staff numbers to allow them to attempt flexible staff arrangements, nor the HR teams to manage programmes and understand complex regulation and reporting. It is therefore imperative that feasible alternatives are developed for SMEs to help them address the needs of their employees, in order that as many Scottish companies as possible leverage the full strength of the available workforce.

We recommend the following actions:

- 101 SME Taskforce:** Programmes which already operate in larger companies can be tailored to smaller businesses. A taskforce comprising SMEs should consider what specific remedies can be created for that segment of business and industry. It should be that all of business and industry demonstrate respect for all their staff and an understanding of the confluence of their business needs, with the evolving needs of their employees.
- 102 Fast-track career paths:** Businesses, of any size, should examine paths of career progression and the age at which up-and-coming members of staff typically gain certain types of experience. Where expansive, career-enhancing roles typically come at the time when working women consider having children, businesses should re-shape the way careers are designed, so that women will benefit from these expansive opportunities, and develop profile and networks at an earlier stage.
- 103 Part-time Employment:** Organisations should introduce quality part-time employment for men and women at all levels. There should be a greater presumption in favour of creating part-time posts and more flexible working arrangements.
- 104 Culture Change:** In order to reap the business benefits of a diverse workforce, employers should encourage culture change within the organisation. The Managing Director or CEO should be given overall responsibility for promoting culture change.
- 105 Equality Audits:** An Equality Audit (including pay) should be done to provide a baseline for action, and a senior management champion should be appointed to support gender equality. This champion should ensure that data are collected and monitored so that the impact of initiatives can be assessed.
- 106 Data:** STEM businesses and industry should improve the collection and availability of gender disaggregated employment data.
- 107 Recruitment and Selection:** In order to attract high calibre, qualified staff, employers should seek to widen the pool of applicants. This should include advertising vacancies more widely and highlighting family-friendly policies. Employers should consider using competency-based selection processes to assist applicants who have taken career breaks. When employing headhunters to fill vacancies for top positions in business and industry, headhunters should be required to produce short lists with equal numbers of suitable male and female candidates.
- 108 Progression and Support:** Many employers already recognise the benefits of investing in their staff and this should be encouraged further. Improving staff development helps reduce turnover. In turn this retains knowledge and experience, as well as reducing the costs of selecting and training of new recruits. The criteria and processes for promotion should be disseminated to all staff. Job-shadowing and secondments should be encouraged.

- 109 Progressive Policies and Practice:** More employers should adopt policies that encourage a motivated and productive workforce and ensure that such policies are put into practice. Employee performance should be measured on outputs rather than ‘presenteeism’. Better work-life balance should be encouraged for all staff by reducing expectations to work long hours. Maternity, paternity and family leave should be improved for all staff, with well-managed re-entry arrangements after such a break. Employers should consider all options for childcare support, including voucher schemes or the provision of high quality, on-site, affordable childcare with a sufficient number of places to cater for all. Featuring women in internal communications creates a more inclusive workplace, and in external communications it promotes women’s employment in the industry.
- 110 New business development:** In planning for the development of new STEM businesses, attention should be given to the role that women could play, through fostering the proposals set out in this report.
- 111 Sector-Wide Initiatives:** Businesses committed to diversity in the workforce should take a key role in building capacity on gender awareness across their sectors and highlighting good practice examples. Industry Advisory Boards and Sector Skills Councils should promote the benefits of diversity and work to increase the participation of women in STEM employment, exploring opportunities for joint working within their sector.

D Recommendations to funders and investors

- 112** There has been a rise in the direct interventions by funders and investors that target the development of systematic processes to support the careers of women in STEM. Examples are given in Box 6. However, more could be done to develop incentive schemes and embed minimum standards as conditions of research funding.

Box 6 Direct interventions by funders and investors

The Swiss Federal University Funding Act (2000) introduced:

- An incentive scheme where individual universities are paid a bonus per newly-appointed full or associate female professor.
- A provision for the creation of new facilities and the extension of existing childcare facilities at all universities.

In July 2011, the Chief Medical Officer (CMO) for England outlined her intention that all medical schools who wish to apply for National Institute of Health Research funding for Biomedical Research Centres and Units must have achieved an Athena SWAN Charter for women in science Silver Award. This is the first time that a criterion for major funding has been explicitly linked to gender equality.



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

- 113 Athena SWAN:** Research Councils should follow the Chief Medical Officer for England in making the achievement of an Athena SWAN Silver Award (or equivalent) a condition of research grants. We recommend that funders require Universities to develop strategies, within the next two years, to bring their STEM departments up to Athena SWAN Silver (or equivalent) award level, and that within three to five years the majority of departments should have achieved that level. Box 7 describes the Athena SWAN programme and shows those departments and universities in Scotland that have achieved the award.

Box 7 Athena SWAN Charter

Founded in 2005, the Athena SWAN Charter is a scheme that recognises excellence in STEM employment for women in higher education. Any university or research institute embedded within a university that is committed to the advancement of the careers of women in STEM can become a member of the Charter by accepting and promoting the Charter principles.

Once Charter signatories, universities and their STEM departments are encouraged to submit for Athena SWAN Charter recognition awards. There are three levels of award: Bronze, Silver, and Gold. Universities must achieve a Bronze award before individual STEM departments can submit for Bronze, Silver, or Gold awards. Once a number and range of STEM departments at an institution hold awards, universities can then submit for a Silver award, and so on. Awards are only valid for a period of three years, after which institutions and departments must submit a renewal award application, or submit for the next level award.

Bronze university awards recognise that the university overall has a solid foundation for eliminating gender bias and developing an inclusive culture that values all staff.

Bronze department awards recognise that in addition to university-wide policies, the department has identified particular challenges and is planning activities to address these for the future.

Silver department awards recognise that in addition to university-wide policies, the department has a significant record of activity and achievement and has identified particular challenges, has implemented activities and can demonstrate the impact of these activities so far.

Silver university awards recognise a significant record of activity and achievement by the university in promoting gender equality and in addressing challenges across the full range of SET departments within the university. Universities should demonstrate that Athena SWAN is well embedded, with strong leadership in promoting the Charter principles and evidence of the impact of Athena SWAN activities.

Gold department awards recognise a significant sustained progression and achievement by the department in promoting gender equality and to address challenges particular to the discipline. Gold departments should be beacons of achievement in gender equality and should champion and promote good practice to the wider community.

www.athenaswan.org.uk

Currently there are 87 award-holding institutions and departments in the UK.

Those in Scotland holding Silver awards are:

Silver departments: University of Edinburgh Biomedical Sciences, and University of Edinburgh Chemistry.

Silver universities: no UK or Scottish University has yet reached Silver standard but Edinburgh, Strathclyde and Heriot-Watt have Bronze status.



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

- 114 Universal minimum level of performance:** the Scottish Funding Council (SFC) and Universities Scotland should discuss how best to achieve a universal minimum level of performance equivalent to the Athena SWAN Silver Award, as a condition of the funds provided by SFC toward the infrastructural component of HEI research (see Box 8).

Box 8 The Scottish Funding Council

The Scottish Funding Council (SFC) is the largest single source of HEI funding, providing 39% of the total income of Scottish universities. The SFC contributes towards HEI research infrastructure as well as towards the costs of teaching. Under these circumstances, setting a minimum level of performance equivalent to the Athena SWAN Silver Award as a condition of grant would be an order to implement the standard, rather than merely an incentive.

- 115 Minimum performance standards:** The UK Research Base Funders Forum, representing the mosaic of research funders in Scotland, including charities, industry and government departments, in addition to funding councils and research councils, should agree on minimum standards of performance, again analogous to the Athena SWAN Silver Award, to be used as a condition of research funding from any member of the Forum. Such a concerted approach by this diverse group would create an overarching strategy that set prescriptive targets for achievement.
- 116 Impact assessment:** Research Councils and other funders undertake equality impact assessments and reviews of gender distribution of their appointment boards, strategy panels, peer review panels and research committees. However, currently these reviews vary in formality and it is often unclear what reporting chains or mechanisms to deal with issues identified are in place. Research funders should ensure that there is clarity on the outcomes of assessments, how results are fed into governance committees and appropriate monitoring mechanisms to evaluate actions taken.
- 117 Research Excellence Framework:** It has been demonstrated (see paragraph 80) that in the 2008 RAE permanent female academics had a lower chance of being selected than their male counterparts. Funding bodies should carry out a retrospective analysis of the Research Excellence Framework (REF) submissions to investigate whether such discrimination continues.

E Recommendations to universities and research institutes

- 118** Women are under-represented at all levels within universities and research institutes, with the representation of women in senior academic positions (Reader/Professor) and in university/research institute management positions being particularly poor. Universities and institutes need to put in place positive measures to redress this gender imbalance (see Box 9) and, in particular, to create senior role models for young female researchers.

Box 9 Massachusetts Institute of Technology (MIT)

In the 1990s, a group of MIT's women faculty perceived patterns of inequitable resource allocation between them and their male colleagues. They collected data that demonstrated and quantified the problem, and they alerted the Institute's leadership, in search of practical remedies. Compelled by the evidence, MIT responded. In 2011 MIT published an update report on the status of its women faculty in STEM⁷⁰ which demonstrated a positive difference for women faculty in terms of equity, status and numbers.

Actions taken over the past decade, together with future plans include:

- Monitoring service commitments and ensuring that these are fairly distributed, such that women do not carry a greater burden than men. To consider compensation for time spent on Committees.
- Establishment of equity Committees within university schools to review equity data with deans, and serve as a network of women faculty with knowledge of and access to the administration.
- Provision of on-site childcare with sufficient number of places and financial support.
- Training for search committees to recognise bias in letters of recommendation and the interview process.
- Overseeing the hiring of women faculty, at the level of the Deans and Associate Provost.
- Improving the mentoring of junior faculty. Departments should have a clear mentoring plan in place prior to making new hires.
- Disseminating reference information regarding policies relevant to women, including maternity leave, family leave (that encompass caring for aging parents, as well as other family members, including children), tenure clock extension and other benefits.
- Continuing and improving tracking of faculty salaries, retirement packages and resources for equity.
- Developing ways to support dual-career couples, particularly with searching for jobs

119 Athena SWAN: All Scottish Universities should, within two years, have in place a strategy to bring all their STEM departments to the minimum standard of an Athena SWAN Silver award (or equivalent); within three to five years the majority of departments should have achieved this level.

⁷⁰ Massachusetts Institute of Technology 2011

- 120** The following commitments are typical of the requirements for an Athena SWAN Silver award:
- **Monitoring and publishing data:** Institutions should collect data and publish statistics on female representation at all levels of employment, disaggregated by academic subject area. It is particularly important that these data are disaggregated for individual STEM subjects (e.g. physical sciences, engineering) as well as by level of seniority within the institution. Universities should also publish recruitment data on the percentage of female applicants versus the number of those appointed to both new and internal positions.
 - **The gender pay gap:** Faculty salaries should be tracked and published by gender to ensure equity.
 - **Redressing the gender balance in senior management:** For positions where head-hunting firms are employed, this should be on the condition that they provide equal numbers of potential female and male candidates.
 - **Establishment of equity committees:** Universities and research institutes should establish equity committees that review the published equality data and that report at the highest level to senior management.
 - **Work–life balance:** Institutions should consider work–life balance for both men and women. Examples of good practice can be found in the Athena SWAN *Best Practice Factsheet on Work–life balance* and the Royal Society of Chemistry’s *Planning for Success: Good Practice in University Science Departments*. See also Box 2.
 - **Equality training:** Equality training should be mandatory for senior managers, heads of department, heads of large research groups, members of appointment committees and members of promotion committees.
 - **Childcare:** Institutes and universities should provide high quality, on-site, affordable childcare with a sufficient number of places to cater for all (Box 10).

Box 10 **Queens University Belfast**

Queens University Belfast has developed a childcare package that includes after-school and summer holiday provision, a voucher scheme and a salary sacrifice scheme, alongside a list of registered childminders. They also implement a maternity leave cover scheme that automatically provides departments with funding for a replacement position.

Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

- **Departmental provision to cover maternity/paternity leave:** Sufficient funding should be automatically transferred to departments to cover the teaching and administrative load of staff on maternity or paternity leave, so that departments that employ a high percentage of staff that are starting families are not financially penalised.
- **Policy dissemination:** In the 2010 Athena ASSET survey, women academics and postdocs reported that they had little or no knowledge of the departmental promotion criteria or process⁷¹. Reference information about policies should be clearly disseminated to all staff, including promotion criteria, parental leave, family leave and provision for part-time employment.
- **Mitigate effects on long-term research performance:** Universities should provide support to departments to fund at least one term of sabbatical leave for parents returning from maternity/paternity leave to enable rapid research recovery (Box 11).

Box 11 University College London

University College London gives all staff returning from a period of long-term leave (either sickness or maternity) a sabbatical term to rapidly re-establish their research activity.

- **Staff mentoring:** Mentoring schemes should be in place for all early-career staff. Such schemes should ensure that mentors of female staff are appropriate and have a high level of awareness of gender equality issues, particularly with reference to career progression.
- **Ensuring future progression of career researchers:** As part of promotion and development reviews, individual staff should be obliged to report on the training, advice and opportunities for career progression they have provided to postgraduate research students and staff under their personal line management.
- **Representation on key decision-making bodies:** All key decision-making bodies should strive to ultimately achieve gender balance. Whilst it is extremely important that women are fully represented on university committees, this should not result in a greater committee burden on the fewer women than on men, unless this load is compensated elsewhere.
- **Promotion:** Academic Development Reviews should account fairly for periods of maternity/paternity leave and part-time employment. An individual's research trajectory and success rate should be noted and other indicators (research income, publications) adjusted. NB: The loss of output recently agreed for the Research Excellence Framework is equivalent to 18 months per pregnancy (one output from four over a six-year period per pregnancy).

71 Athena ASSET Survey 2010



F Recommendations to academies, and learned and professional bodies

- 121 Setting standards:** All these bodies (hereafter called Learned Bodies) set standards and can help in changing culture. Learned Bodies must be models of good practice, recognising that women, being often more cautious and less confident, provide a useful counterbalance in scientific research, and that they introduce diversity through their distinctive values and ambitions. Consequently, a body or practice established on male norms may not well serve well a diverse community of scientists and engineers. Learned Bodies must also ensure that their own house is in order, by providing fair and inclusive working environments for their own staff as well as balanced and transparent processes for their elections and awards.
- 122 Commitment by those in leadership positions:** The governors of each Learned Body should publicise a statement welcoming and encouraging the full participation of women in that Body and its academic discipline. An inspiring statement along these lines has been produced by the London Mathematical Society (a society that is neither large nor rich) – see Box 12. There is an alternate statement, recommended by the InterAcademy Council Panel on Women for Science⁷².
- 123 Gender issues:** Learned Bodies should allocate responsibility for gender issues and consider whether this has to be led by women or whether leadership by a sympathetic male might send a stronger message. Learned Bodies should consider whether this is sufficiently significant that reporting should be direct to President and Council, and be clear as to who is responsible for formulating plans to remedy gender imbalances.

⁷² InterAcademy Council 2006, Box 6.1

Box 12 London Mathematical Society

The LMS is concerned about the loss of women from mathematics, particularly at the higher levels of research and teaching, and at the disadvantages and missed opportunities that this represents for the advancement of mathematics. This can occur for several reasons:

Women are more likely to have had broken career patterns or worked part-time on account of child-rearing and family responsibilities.

The fact that there are fewer women in the mathematics community means that they are often overlooked when names are sought, for speakers or for prizes, for instance.

Those few women who reach the higher levels are disproportionately called on to sit on committees etc., to the detriment of their own careers.

Women are often called on to take part in 'people-based' activities rather than 'research-based' activities, to the detriment of their own careers.

Compared with men, women tend not to press their case but to understate their skills.

The Society recognises the need to give active consideration to ensuring that men and women are treated equally in their prospects, recognition and progression. Such disadvantages as do occur are often the unintentional outcome of the formulation of regulations and procedures which do not give adequate attention to the needs of people in such positions.

Accordingly, the Society will:

- > be aware of and seek to ensure an appropriate gender balance on its committees and working groups, and encourage the Nominating Committee to give similar attention in its proposals for election;
- > keep under review the regulations governing its membership, prizes, awards and grants to ensure that they do not inadvertently deter or fail to recognize people with non-standard career patterns;
- > actively encourage and facilitate the nomination of women for its prizes and awards, and ensure that it considers women when it is proposing nominees for external prizes and positions;
- > actively seek to include women speakers in its meetings and workshops;
- > expect that the organisers of conferences and activities who are seeking grants from the Society will: invite both male and female speakers, or explain why this is not appropriate or possible; and give consideration to the provision of mechanisms to enable participation by people with children or family responsibilities;
- > collect data and thereby monitor trends in the above.

http://www.lms.ac.uk/sites/default/files/Mathematics/wim_statement.pdf.



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

- 124 Elections and awards:** Membership for life in Learned Bodies can lead to a preponderance of (older) male members. If this is the case, the Learned Body should consider ways to correct it.
- Learned Bodies should consider why there might be a shortage of women in the nomination pool. If only existing members can make nominations, this may inadvertently discriminate against women, against new (sub)-fields and against talented scientists or engineers in establishments where there is no member of the Learned Body. The definition of eligibility may need to be updated or broadened. A search committee (possibly going beyond the Body's membership) might be convened to identify people who should be nominated and to start that process.
 - The qualities expected of successful candidates should be made clearly and publicly available, perhaps by listing in rank-order the criteria to be used in the selection. These qualities should be stated in gender-neutral language, in terms not normally associated with one gender or the other. There is evidence that the more transparent the process, the more likely women are to consider themselves good candidates.
 - The criteria and the deadline for awards nominations should all be publicised in good time. This is particularly important as women generally have less access to informal networks. Selection criteria should be determined in advance, before any cases are reviewed.
 - Selection committees for membership, awards, etc. should be sufficiently diverse as to give an adequate breadth of perspective. Committee members (male and female) should have had recent training in fair selection, unconscious bias, indirect discrimination etc.
 - If places are limited and candidates are equally strong, a policy of favouring female and minority candidate should be considered, in order to increase diversity.
 - Learned Bodies may have to be more proactive in encouraging applications. Eligibility criteria should be reviewed, remembering that women are more often in part-time, fixed-term positions. Applications from people returning after career breaks should also be considered.

- 125 Funding:** Learned Bodies should follow the CMO for England in making the achievement of an Athena SWAN Silver (or equivalent) award a condition for allocating resources to organisations. We recommend that organisations receiving funding should be given two years to develop a strategy for bringing all its STEM departments up to this standard and that within three to five years most departments should have achieved the standard. See Box 7 for details of Athena SWAN. To assist departments reach an appropriate standard Learned Bodies should consider offering ‘climate surveys’ to university departments (as the Institute of Physics has done)⁷³. If women are submitting proportionally fewer applications than men for research fellowships or awards for research, travel, conferences, etc, and/or for smaller amounts, Learned Bodies should consider how to remove the imbalance. The terms of any funding should not discriminate against women – e.g. funding should be flexible enough that a successful candidate could work part-time and draw down the funds at a slower pace, include childcare and/or eldercare as allowable costs, and when necessary, move the funding to another institution.
- 126 Institutional sexism:** Learned Bodies should be alert to institutional sexism. While individuals may not be discriminatory, the systems they operate may be. The best of intentions on fairness and equality are necessary but not sufficient. An understanding of institutional sexism and unconscious bias is necessary, and it is often very subtle. An example of institutional sexism is when the attributes of a good leader, as identified by an organisation, are all stereotypically male attributes.
- 127 Visibility of women:** Learned Bodies should take steps to heighten the visibility of women by:
- including women in delegations and sending them as representatives;
 - increasing their presence on platforms at meetings, both those the Learned Body sponsors and those they organise;
 - ensuring both men and women feature in publications and educational material;
 - naming buildings, rooms, awards, etc after female as well as male scientists and engineers;
 - providing visible female role models, as this will affect the aspirations of younger women;
 - commissioning portraits of female members to improve the gender balance of pictures hung in the learned body’s premises
 - expanding the involvement of women in the body’s activities;
 - considering inviting women to deposit materials relating to their life and science with the Learned Body so that they are not lost to posterity.

⁷³ Institute of Physics 2006

- 128 Committee membership:** As diversity improves the decision-making of committees and boards, there should be adequate representation of women, especially on powerful or significant committees – a minimum of **three** on a large committee or board. Learned Bodies should, however, avoid using the same few women over and over again.
- 129 Statistics:** Learned Bodies should ensure that appropriate data are being collected, analysed and reported regularly and that trends are examined. This should be done both for a Learned Body's own employees and for those admitted into membership, given awards etc. Learned bodies should establish why women are dropping out or falling behind.
- 130 Working with Social Scientists:** Learned Bodies should consider working with social scientists who have been down this path in their own profession. Learned Bodies could make use of the knowledge and experience of sociologists to view their working practices in a new light and to develop and implement appropriate changes.

G Recommendations to women and women's organisations

- 131** Our recommendations have been directed at government, business, universities and others. But women themselves have an active role to play in effecting change. They need to be aware of the cultural and other factors that may inhibit their progression in STEM careers. For example, there are well-studied differences in the way women and men behave both within and outside the work place, such as the way in which language is used⁷⁴; these differences make for diversity, which is a strength, but they can also unexpectedly cause problems.
- 132** Further, women's own aspirations and ambitions can also be set too low. A decision to put a career 'on-hold' for many years may be a personal choice resulting from the significant challenges of combining career and family. Yet societal norms also have a major influence on this choice, signalling to a woman that her career expectations (and not her male partner's) are secondary to her caring responsibilities. An additional challenge can be the common perception that being a successful career woman somehow reflects poorly on the performance of the male partner, particularly if the woman is the more senior or the higher earner. These norms and expectations can impact on women even when do not have caring responsibilities or do not have partners.
- 133** To reach their full potential in STEM careers, women should be aware of current behavioural norms and aspire to achieve at the highest levels.



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

134 The recommendations in previous sections of this document will serve to provide supportive workplace structures and enabling policies; however, for women to fulfil their full potential, they also require a supportive culture. Achieving cultural change is challenging and may be enabled by the support of women's organisations in raising organisational awareness, and through the targeted training of all senior staff. Further, as society moves forward, more senior women will reach secure positions and can, therefore, speak out for change with less risk than those nearer the beginning of their careers. They can be effective too in mentoring and encouraging younger female colleagues.

We recommend that:

- 135 Fulfilling potential:** Women should be proactive, be prepared to take control, in seeking out opportunities and seizing those offered. Women should be prepared to step outside their comfort zone and to take risks – often, when they do so, they surprise themselves with what they achieve.
- 136 Raising awareness:** Women's organisations should support female STEM graduates and help raise organisational awareness, and the awareness of both women and men, of cultural differences and attitudes that discriminate against female progression within the workplace; and what can be done to effect positive change.



Chapter 4

Concluding Remarks

- 137** In this report we have drawn attention to the serious loss of talent caused by the attrition of women in STEM careers and their under-representation in leadership positions. But it is possible to alter this situation and for Scotland to tap all of its talents to the benefit of its society and economy. This will require a major change of culture.
- 138** While we recognise that effecting and measuring cultural change can be difficult, there are parameters that can be quantified and which give some indication of progress. We strongly recommend the monitoring of data collected on measurable outcomes to ascertain that change is taking place, and to evaluate the impact of initiatives and new strategies. Only this way can further appropriate policies and strategies be developed, and a sustained approach maintained.
- 139** Our Programme for Action contains key recommendations and sets out the timescales within which initiatives should take place. By adopting such an approach, Scotland has the potential to make a real difference.
- 140** We do not pretend that the road ahead will be easy. Above all, it depends on the Scottish Government recognising the importance and urgency of the situation and showing leadership and commitment to a strategy to improve opportunities for women, to make better use of their talents and to become a smart economy.
- 141** The Scottish Government's National Outcomes describe what they want to achieve over the next ten years⁷⁵. The implementation of the key recommendations in this report will contribute to the achievement of many of these.
- 142** Gender equality is on the agenda across the world and Scotland now has an opportunity to take a lead in ensuring the full participation of women in STEM and, in doing so, to put itself on this world map as a model of progress.

⁷⁵ <http://www.scotland.gov.uk/About/scotPerforms/outcome>



Chapter 5 Appendices

A Women in STEM Working Group

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Professor Alice Brown CBE FRSE FRSA AcSS Cipfa (Hon) (Deputy Chair)

Professor Geoffrey Boulton OBE FRS FRSE FGS

Professor Anne Glover CBE FRSE FAAM

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Dr Susan Rice CBE FCIBS FRSE

Professor Wilson Sibbett CBE FRS FRSE

Ms Linda Somerville

Professor Bonnie Webber FRSE FAAAAI

Dr Caroline Wallace MSB (Secretariat; seconded from the Society of Biology)



B Membership of the RSE Review Group

Professor Ian Halliday CBE FRSE FInstP (Chair)

Professor Janet Allen MRCP FRSE

Professor Jean Beggs CBE FRS FRSE

Professor Patricia Connolly FRSE

Professor Ian Diamond AcSS FBA FRSE

Professor Hector MacQueen FBA FRSE

Professor Sheila Rowan MBE FInstP FRAS FRSE

C Women in STEM consultation – evidence and assistance received

We have complemented a literature review with **interviews**, including a discussion dinner with Dr Bonnie Dunbar and guests; **discussion fora** involving representatives from different stakeholder groups including academia, trade unions and business and other representative organisations; and a **formal written consultation** as follows:

- 1 What do you see as the opportunities and challenges facing the STEM workforce in Scotland today?
- 2 What do you see as the current barriers to the recruitment, retention and progression of women in the STEM workforce?
- 3 What steps are being taken within your organisation and/or sector to enhance the career options and progression routes for female staff members?
- 4 What further steps could/should be taken within your organisation and/or sector, including any specific policies and practices?
- 5 More generally, how could the potential of women in the STEM workforce be more effectively and efficiently realised? Who would be responsible for implementation and what support would be required?
- 6 Do you think there needs to be any changes to existing employment law? If so, in what areas?
- 7 Are you aware of any existing resource that is effective in addressing the under-representation of women in STEM?

In addition, we conducted a **survey** of academies, and learned and professional bodies on their membership as follows:

Inclusion of women:

- a) Does your organisation feel that it would benefit from increased inclusion of women in its Fellowship? If so, in what ways would the organisations benefit?
- b) What mechanisms, procedures or actions, if any, are in place to move towards achieving an appropriately gender-balanced membership? Examples may include positive action, gender-balanced panels, attention to the pipeline.
- c) Are there any further mechanisms or actions that the organisation could initiate by which the gender balance could be improved?

Election of Fellows:

- d) What criteria are used in selecting new Fellows?
- e) Has your organisation done a gender impact analysis on the selection criteria to assess if they are equally appropriate for both genders?
- f) How transparent is the selection process? Are the criteria published and do those outside the Council and Selection Committees understand how the selection is done?
- g) How are interdisciplinary nominations handled?

Statistics:

- h) Is the % of females in the candidate pool the same as/lower than/higher than the % of females in the pool candidates are drawn from? (We suggest taking professors as the best approximation to the pool candidates are drawn from).
- i) Are there trends in these percentages? Does the trend match that of the pool?
- j) Once in the candidate pool, do women get elected more often/quickly than men?
- k) Is the number of women in the candidate pool growing, static, decreasing? (Are they being elected faster than they are being nominated?)

If there are several categories of Fellowship (e.g. Honorary Fellows and Ordinary Fellows) it would be useful to have figures for each category.

Related areas:

Similar questions may be raised about the gender balance in the award of prizes and grants, in the membership of its most powerful committees and in the slates of speakers and chairs of meetings it promotes. We welcome any information you can provide us in this regard.



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

Oral Evidence

Zillah Doyle, Business Unit Managing Director, Downstream Oil, ClydeUnion Pumps

Dr Bonnie Dunbar, President and CEO, Seattle Museum of Flight

Dr Stuart Fancey, Assistant Director Research and Innovation, Scottish Funding Council

Dr Janet Halliday, Director of Research and Development, Controlled Therapeutics (Scotland)

Ann Henderson, Assistant Secretary (Policy & Campaigns), STUC

Katie Hutton, Head of Local and National Government, Skills Development Scotland

Allison Johnstone, Project Officer, Scottish Resource Centre for Women in SET

Hugh Lightbody, Team Leader National Business Gateway Unit

Muriel Mackenzie, Research & Policy Officer, ESEP Ltd

Dr Judith Masthoff, Department of Computing Science, University of Aberdeen

Stephen McCrossan, National Officer (Education and Equality), EIS

Dr David McLean, Global Technology Manager UK, Syngenta Crop Protection

Professor Alan Miller, Deputy Principal (Research & Knowledge Transfer), Heriot-Watt University

Professor Alan Murray, Head of School of Engineering, University of Edinburgh

Dr Jo Oliver, Chief Executive Officer, AvantiCell Science Ltd

Dr Emma Perfect, Chief Scientific Officer and Managing Director, LUX Assure

Professor Sue Scott, Vice-Principal and Pro Vice-Chancellor (Research), Glasgow Caledonian University

Scott Reid-Skinner, Equal Opportunities Manager, Scottish Enterprise

David Watt, Director of Institute of Directors Scotland

Professor Lesley Yellowlees, Vice-Principal & Head of the College of Science and Engineering, University of Edinburgh



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

Written Evidence

Organisations:

AMEC plc

BAE Systems Surface Ships

British Pharmacological Society
'Women in Pharmacology' Committee

Chevron Women's Network,
Aberdeen Chapter

Close The Gap

Edinburgh Mathematical Society and
London Mathematical Society Women
in Mathematics Committee

e-skills UK

Heriot-Watt University

Highlands and Islands Enterprise

Institute of Physics

Institution of Civil Engineers – Scotland

OPITO

Research Councils UK

Royal Society of Chemistry

Scottish Agricultural College

Scottish Association for Marine Science

Scottish Funding Council

SELEX Galileo

SEMTA, the Sector Skills Council for
Science, Engineering and Manufacturing
Technologies

Skills Development Scotland Ltd

Skillset

Society for Endocrinology

Society of Petroleum Engineers
(Aberdeen) Another Perspective
Committee

The Institution of Engineering
and Technology

The James Hutton Institute

The Open University in Scotland

The Royal Academy of Engineering

The Science Council

The UKRC

Transport Scotland

Universities Scotland

University of Aberdeen

University of Abertay Dundee

University of Dundee

University of Glasgow

University of Strathclyde

Wellcome Trust



Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

Individuals:

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Dr Emilie Combet
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Dr Janet Moxley

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Allison Johnstone, Scottish Resource Centre for Women in SET
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Jackie Waring, Managing Director, Blue Horizons (Scotland) Ltd.
Mark Wild and Pauline Ward, Universities Scotland
Charlie Woods, Core Solutions

We would like to thank all those who participated in our study and who gave so generously of their time and ideas.

D Current UK organisations/initiatives on women in STEM

This list is not exhaustive but covers many of the organisations and initiatives for Women in STEM in the UK.

Athena Forum <http://www.athenaforum.org.uk/>
Athena Scientific Women's Academic Network <http://www.athenaswan.org.uk/>
BCS Women <http://www.bcs.org/category/8630>
Cambridge Association for Women in Science and Engineering <http://camawise.org.uk/>
Institute of Physics Women in Physics Group and Project Juno Programme
<http://www.iop.org/policy/diversity/initiatives/juno/index.html>
Interconnect: <http://www.interconnect.org.uk>
Mums in Science <http://mumsinscience.net>
Royal Astronomical Society Committee for Women in Astronomy and Geophysics
<http://www.ras.org.uk/about-the-ras/committees/863#women>
Royal Society of Chemistry Women Members' Network <http://www.rsc.org/Membership/Networking/WomenMembersNetwork/>
Scottish Resource Centre for Women in Science, Engineering and Technology (SRC)
www.napier.ac.uk/src
The Daphne Jackson Trust <http://www.daphnejackson.org>
The WISE Campaign (Women into Science, Engineering and Construction):
<http://www.theukrc.org/get-involved/wise>
UK Resource Centre for Women in Science, Engineering and Technology (The UKRC)
<http://theukrc.org>
Women's Engineering Society (WES) <http://www.wes.org.uk>
Women in Science, Engineering and Technology (WiSET) <http://www.wiset.org.uk/>
Women in Telecoms and Technology (WITT) <http://www.wittgroup.org/>
Women in Technology <http://www.womenintechnology.co.uk/>

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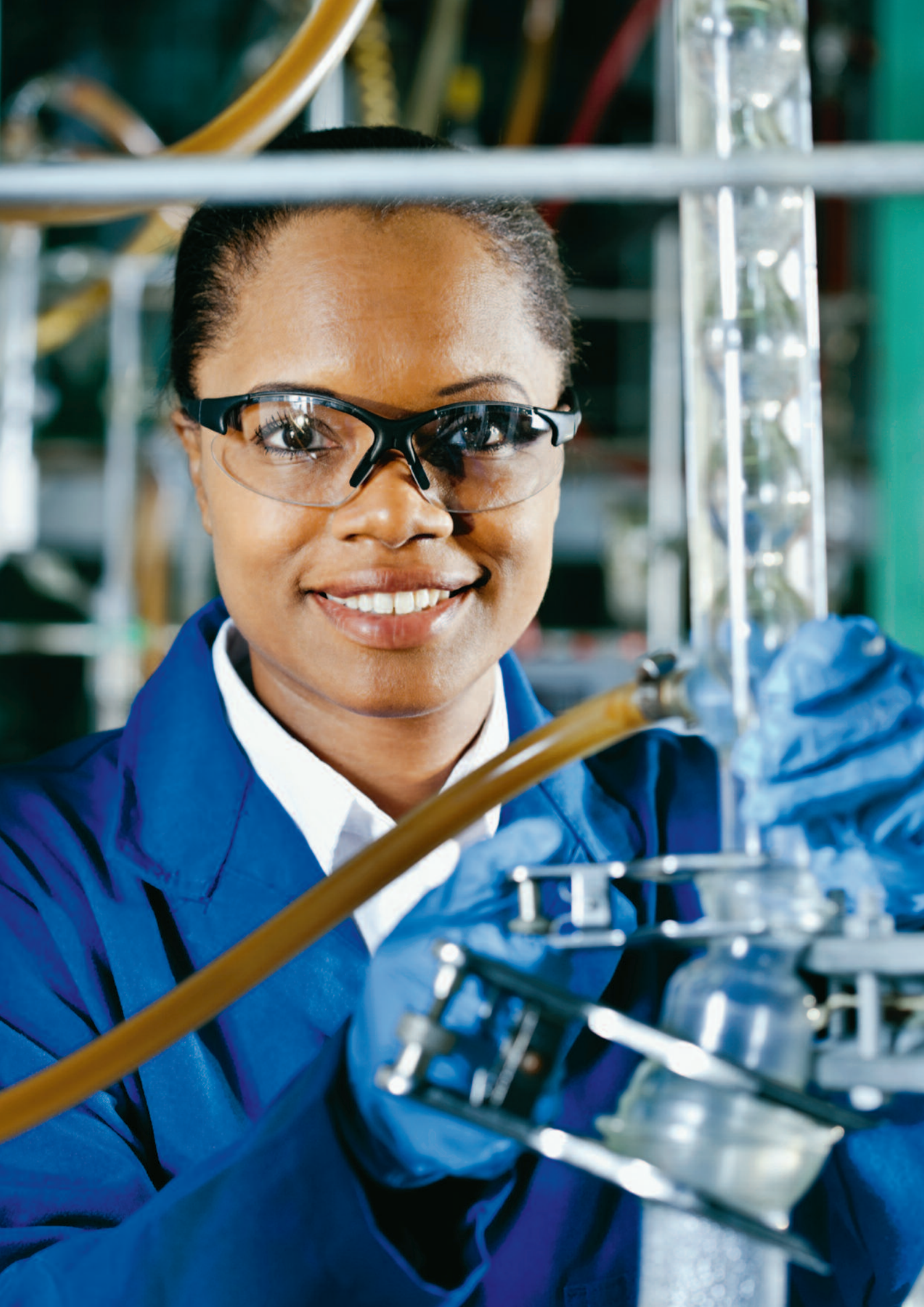


Tapping all our Talents

Women in science, technology, engineering and mathematics: a strategy for Scotland

F Abbreviations

ASSET	Athena Survey of Science, Engineering and Technology
BCS	British Computer Society
BIS	Department for Business, Innovation and Skills
CEDAW	Convention on the Elimination of All Forms of Discrimination Against Women
CEO	Chief Executive Officer
CMO	Chief Medical Officer
EC	European Commission
EIS	Educational Institute of Scotland
ERA	European Research Area
ESEP	European Structural Fund Programmes
EU	European Union
FTE	full-time equivalent
HEI	Higher Education Institute
HESA	Higher Education Statistics Agency
ICESCR	International Covenant on Economic and Social Rights
IoP	Institute of Physics
OPITO	Offshore Petroleum Industry Training Organisation (UK)
RAE	Research Assessment Exercise
RCUK	Research Councils UK
REF	Research Excellence Framework
SEMTA	Sector Skills Council for science, engineering and manufacturing technologies in the UK
SET	Science, Engineering and Technology
SFC	Scottish Funding Council
SQA	Scottish Qualifications Authority
SRC	Scottish Research Centre for Women in SET
STEM	Science, Technology, Engineering and Mathematics
STUC	Scottish Trades Union Congress
SWAN	Scientific Women's Academic Network
UKRC	UK Resource Centre for Women in SET
WES	Women's Engineering Society
WISE	Women into Science, Engineering and Construction
WiSET	Women in Science, Engineering and Technology
WITT	Women in Telecoms and Technology





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