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Women in Science, Engineering and Technology (SET) in Korea: Improving Retention and Building Capacity.

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ABSTRACT

In 2002, the Korean government legislated to strengthen the capacity of women in SET and to improve the retention within SET of qualified women scientists and engineers. The National Institute for Supporting Women in Science and Technology (NIS-WIST), commissioned by the former Ministry of Science and Technology, was established in 2004. Kong-Ju-Bock Lee was in charge of the Steering Committee of the NIS-WIST and also a chief researcher of the NIS-WIST Strategic Report, *Women in S&T, Why and How Must They Be Supported?* Now, she is a Director General of the NIS-WIST. With her personal interpretation, this article includes an overview of the statistical figures of the education/training and employment of women in SET (referred to in Korean policy as 'fosterage' and 'utilization'), an introduction of important policies to resolve the key issues that Korea is facing and the outcome of each policy. The future prospects based on the 2nd Basic Plan for Fostering and Supporting Women in Science and Technology (2009 - 2013) will also be shared.

KEYWORDS

Public policy; women in SET; training; retention.



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Women in Science, Engineering and Technology (SET) in Korea: Improving Retention and Building Capacity.

Korea's lack of natural resources has meant that human resources have provided the key driving force of economic growth. However, the main players in human resources have been men in all fields, and this male-dominant tendency has been more remarkable in SET.

In the 1970s, the Korean government launched a program called *Stop at Two and Raise Them Well* to encourage newly-weds to regulate the size of their families. As a result, Korea has the world's second lowest birthrate (United Nations Populations Fund [UNFPA], 2009). The implications of this low birthrate and the shift towards an 'aging society', both of which may lead to a decrease in economically active human resources, have become a key issue within Korean society. In this context, the fact that only about half of women are participating in economic activity has become a focus of concern. Hence the importance of full capitalization of women's resources cannot be overemphasized in Korea. At the same time, this focus could provide a positive solution to the under-representation of women in SET.

In Korea it is accepted that the competitiveness of SET-based industries is crucial in terms of the nation's overall competitiveness in global markets. In the past 10 years, Korea's competitiveness in SET-based industries has grown remarkably (IMD, 2009). Interestingly, this increasing trend in SET competitiveness is almost parallel to the increasing ratio of women scientists and engineers within the SET workforce, even though women are still less than 20% of the SET workforce. It is also noticeable that the Organisation of Economic Co-operation and Development [OECD] [Reviews of Innovation Policy in Korea](#) recommends encouraging more women into science and engineering careers (OECD, 2009).

From the mid 1990's, a series of policies¹ were enacted that focused on providing equal opportunities for women within the workplace, emphasizing the importance of 'gender mainstreaming' as a key aspect of national policy. The Act on Fostering and Supporting Women Scientists and Technicians (2002) provided the basis for the 1st Basic Plan for Fostering and Supporting

Women in Science and Technology, which was implemented between 2004 and 2008. Now the 2nd Basic Plan for the next five years, between 2009 and 2013, is being implemented. The implementation of these Basic Plans has included establishing one national organization and four regional organizations called Institute for Supporting Women in Science and Technology. Following the publication of the Report on Economic Activity Status and Participation Rate (Statistics Korea, 2008), which noted that the participation rate of women in economic activity is very low in all ages over 30, the Act on the Promotion of the Economic Activities of Career-Break Women was enacted.

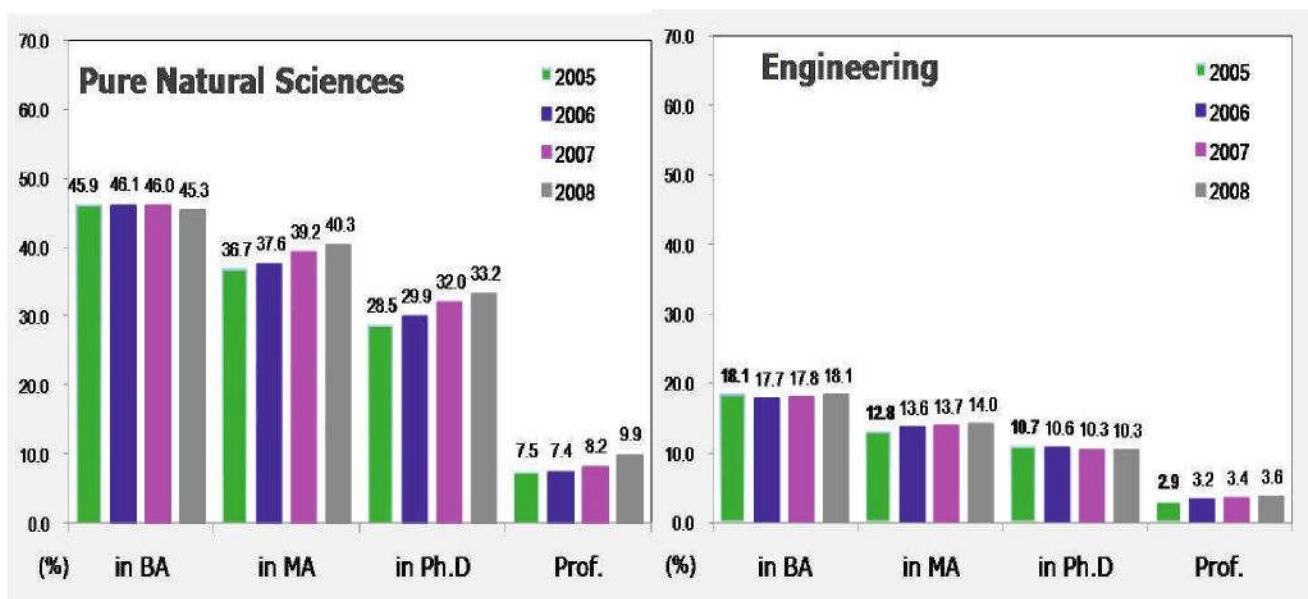
In the next section, I will provide a statistical overview of the current status of women in science and engineering fields.

HOW MANY WOMEN IN SET?

Before analyzing the situation in SET fields, I will outline the gender gaps in economy, education, health, and politics in Korea. [The Global Gender Gap Report 2009](#), produced by the World Economic Forum [WEF], states that the gender gap index of Korea is the 115th among 134 countries, indicating severe gender-inequality². Data produced in the report shows that female-to-male ratios (where 1.00 = equality) are 0.71 in labour force participation; 0.67 in enrolment in tertiary education; 0.66 in professional and technical workers; 0.52 in estimated earned income; 0.16 in parliament; 0.10 in legislators, senior officials, and managers; and, 0.05 in ministerial positions.

Now, let me focus on the situation with regards to fostering and utilizing women in SET in Korea. Educational Statistics published by the Korean Educational Development Institute in 2008 show that 115, 707 high-school girls (28% of the total number of high-school girls) are studying SET subjects. Girls represent about 35% of the total number of high-school students studying SET subjects, which in turn represents 38% of the total number of high-school students

Figure 1 shows the percentages of women students in programs for Bachelor's, Master's, or Doctoral degrees in pure natural sciences and engineering. It is encouraging that the percentage of women students in natural science graduate programs has increased. On the other hand, the percentage of women students majoring in engineering continues to be very low. Figure 1 also shows the percentage of women professors in science and engineering. Although increasing slightly in recent years, the figure still remains very low. The increasing trend in percentage of woman professors is strongly correlated to one of the governmental policies which will be introduced later.

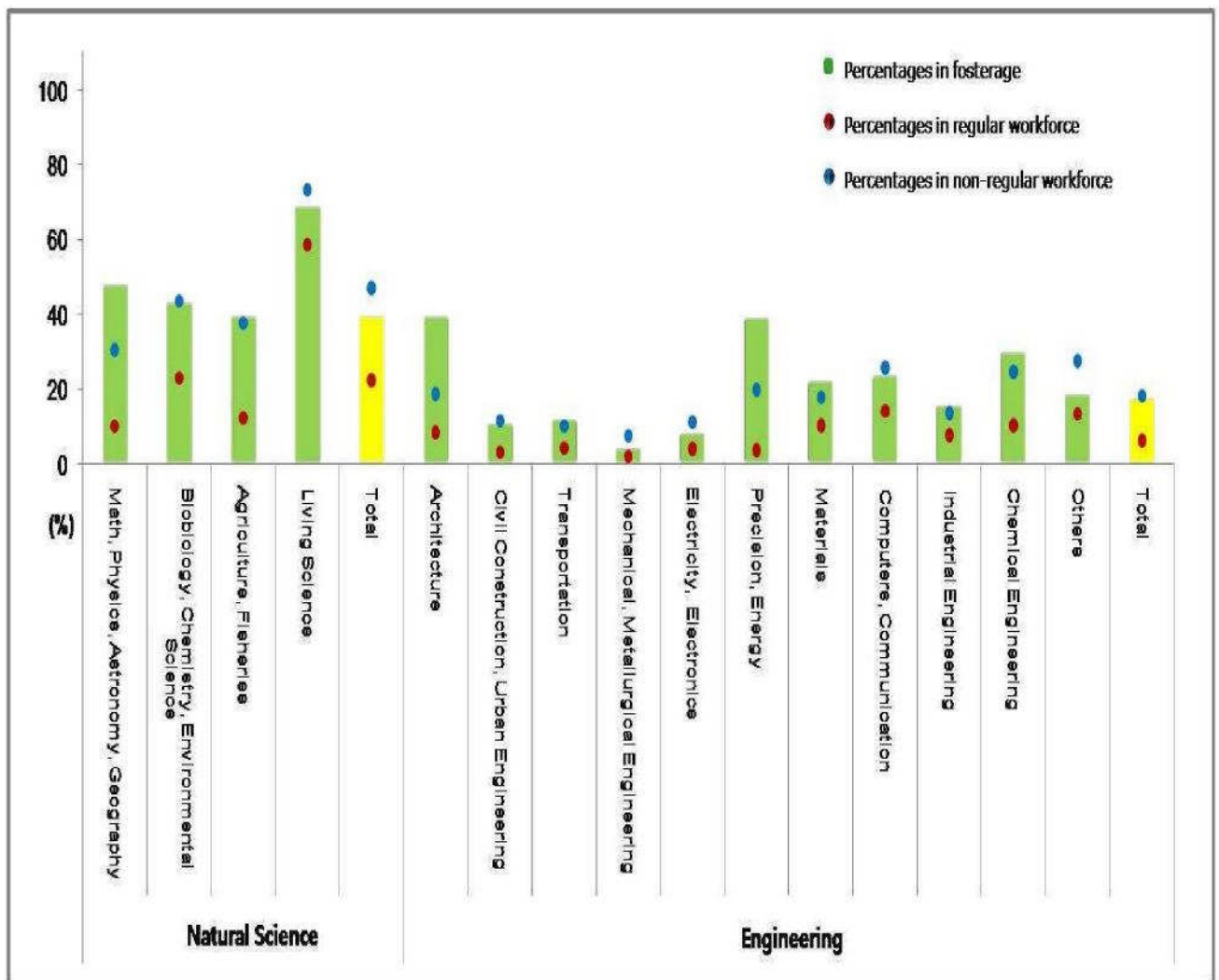


Source : Educational Statistics, Korean Educational Development Institute (2005-2008)

Fig.1: Percentages of women in each academic program and in faculty positions

of pure natural sciences and engineering

The percentage of women in tertiary education studying SET subjects is 30.3%, and this is quite close to the OECD average (OECD, 2008). However, the percentages of women PhDs and researchers in SET are only 16.4% and 14.9%, respectively, which are much below the values in other OECD countries. This indicates a waste of human resources in SET in Korea. This point can be seen clearly in Figure 2. Figure 2 indicates the percentages of women with degrees in SET subjects, working in regular and non-regular positions in SET³. It clearly shows that the employment (denoted by red dots) of women within the regular or stable workforce is significantly less than the total of SET qualified women (denoted by green or yellow bars).

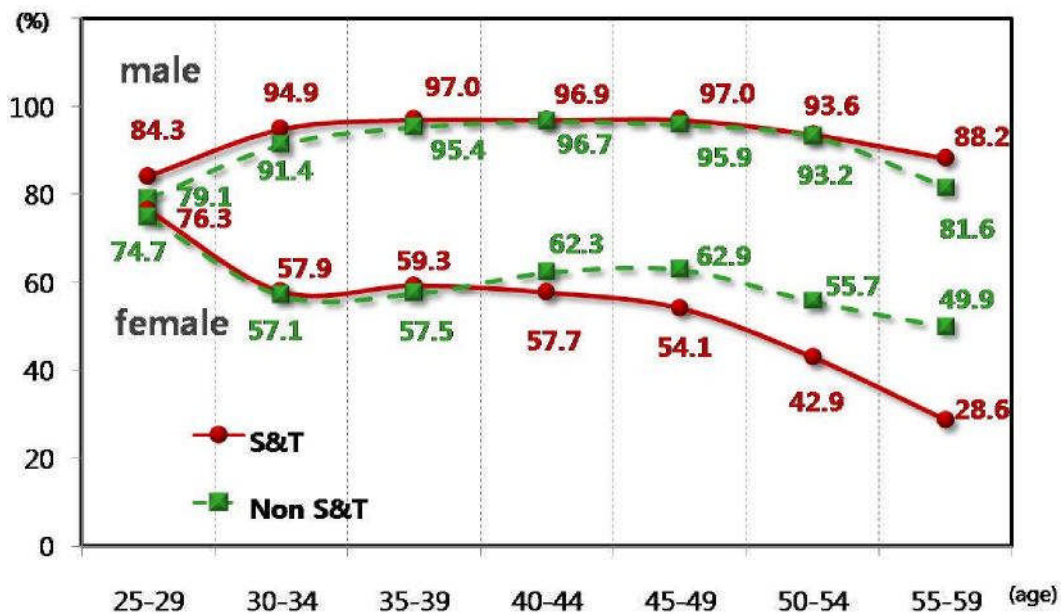


Source : Report on the Status of Women in Science and Engineering, NISWIST-MEST (2009)
Educational Statistics, Korean Educational Development Institute (2008)

Fig.2: Percentages of SET qualified women (bar), in the regular workforce (red dot), and in the non-regular workforce (blue dot) in pure natural sciences and engineering.

Figure.3 shows that the economic activity rates of women at ages over 30 who have achieved SET degrees are never more than 60%, and that the rates decline sharply between the ages of 25 – 30. The activity rates for men, however, match more closely the patterns found in advanced countries. This pattern of the economic activity rates of women in Korea is strongly related to the social customs such that wives should take care of children, housekeeping and the elderly. The activity rate of women at age 25-29 in 1998 was almost same as the rate at age 35-39 in 2008.

The increase of activity rate at age 25-29 in 2008 could be a positive sign, however, the increase of the rate at 25-29 seems to be due to a trend of late marriage. Considering that marriage, childbirth, and childcare are likely to contribute to the decline of the numbers of women in the labour force, special efforts are needed to sustain the activity rate of women at 25-29 onwards.



Source : STATISTICS KOREA, Report on Economic Activity Status and Rate (2008)

Fig.3: Economic activity rates in age

The new employment rate of women with SET degrees in 2008 is 75.1% which is lower than that of men (81.8%)⁴.

Table 1 shows new and total employments in R&D sectors in 2008. Respondents to the survey, carried out by the National Institute for Supporting Women in Science and Technology, included 277 universities, 172 governmental R&D institutes, and 1,603 private businesses with more than 100 employees and running affiliated R&D institutes. It is worthwhile to point out that 19,623 out of 33,066 women employees are taking non-regular positions. In other words, about 60% of women employees in the R&D sectors are temporary. This is further evidence for the under-utilization of women in SET. As a comparison, only 27% of male employees are taking

non-regular positions.

Table1. Employment of the SET graduates in R&D sectors (2008)

2008	Type	Total (A+B)		Regular/Stable (A)		Non-regular/Unstable (B)	
		W+M	W (Rate%)	W+M	W (Rate%)	W+M	W (Rate%)
New employment	Univ.	4,074	912 (22.4)	1,340	307 (22.9)	2,734	605 (22.1)
	Gov. R&D Inst.	3,316	1,173 (35.4)	688	148 (21.5)	2,628	1,025 (39.0)
	Priv. R&D Inst.	8,809	1,395 (15.8)	8,710	1,366 (15.7)	99	29 (29.3)
	Sum	16,199	3,480 (21.5)	10,738	1,821 (17.0)	5,461	1,659 (30.4)
Total employment	Univ.	78,406	19,156 (24.4)	24,967	2,939 (11.8)	53,439	16,217 (30.3)
	Gov. R&D Inst.	29,506	23,665 (19.8)	22,094	2,658 (12.0)	7,412	3,183 (42.9)
	Priv. R&D Inst.	82,389	8,069 (9.8)	81,844	7,846 (9.6)	545	223 (40.9)
	Sum	190,301	33,066 (17.4)	128,905	13,443 (10.4)	61,396	19,623 (32.0)

Source: Report on the Status of Women in Science and Engineering, NISWIST-MEST (2009)

KEY POLICIES OF KOREAN GOVERNMENT FOR WOMEN IN SET

Following the Act on Fostering and Supporting Women Scientists and Technicians, the Korean government implemented several strategies to promote women in SET. The major policies or projects commissioned by various ministries are listed and classified by fostering, utilizing, and supporting in Table 2.

Table 2. Policies for Fostering, Utilizing, and Supporting Women in SET

Objective	Policy/Project	Ministry in charge
Fostering	WISE WIE WATCH21 Scholarship for female students in SET	MEST ^{*1}
Utilizing	Recruitment Target System Promotion Target System Women Rate in Committees Affirmative Action for Employment Improvement	MEST MEST MoGE ^{*2} MoL ^{*3}
Supporting	ISWIST Designation of Officer for Women Point Award System Research Funds only for Women Childcare Center in Daedeok Research Complex	MEST

^{*1} Ministry of Education, Science and Technology

^{*2} Ministry of Gender Equality

^{*3} Ministry of Labor

The WISE (Women Into Science and Engineering) program was started in 2001 with a mentoring program to encourage young women to major in science and engineering. To promote women engineers and technicians, the WIE (Women in Engineering) project developed a gender recognized education system in engineering schools. The WATCH21 (Women’s Academy for Technology Changer in the 21st Century) program provided high-school girls with experience in engineering research laboratories. The ISWIST (Institute for Supporting Women in Science and Technology) was established by the Act on Fostering and Supporting Women Scientists and Technicians to maximize the utilization of women in SET.

These policies were more or less successfully implemented under the 1st Basic Plan for Fostering and Supporting Women in S&T (2004 - 2008). The main outcomes of the 1st Basic Plan can be summarized as following:

1. The percentage of women with doctoral degrees in SET was increased from 16.3% to 20.8%.
2. The rate of women recruits in 99 public R&D institutes was

increased from 20.0% to 22.1%.

3. The percentage of women researchers in R&D projects was increased from 12% to 15.6%.

4. The childcare center (nursery school) in Daedeok Research Complex was built for women scientists and engineers, not by the Ministry of Gender, but by the former Ministry of Science and Technology. The nursery school can accommodate about 550 babies and children.

Recruitment Target System, Promotion Target System, Research Funds only for Women Scientists, and the action center, NIS-WIST will be introduced briefly below.

Recruitment Target System

The Recruitment Target System (RTS) for women in SET was promoted by the National Science and Technology Council (NSTC) under the presidential instruction, and applied to 25 government-funded S&T institutes in 2001. Since 2003 this policy has applied to all 99 national and governmental S&T institutes. The RTS is under the supervision of the Ministry of Education, Science and Technology, and the aim is to increase the average rate of women recruits of 99 institutes to 30% by 2013. Some of target institutes have set their own target rates for women recruits, taking into consideration the numbers of women working in relevant SET fields.

NIS-WIST is monitoring the outcomes of this policy, and reporting the results to the NSTC. The rate of women recruits increased from 18.2% in 2003 to 26.6% in 2009. The 25 government-funded institutes that set their own targets performed well by increasing the rate from 10.4% in 2003 to 19.7% in 2009. Since 2009, Minister (of MEST) Awards, proposed by the NIS-WIST, are given to the institutes achieving excellent performances.

The RTS was also implemented in 23 national and public universities. The former Ministry of Education and Human Resources Development allocated 200 new faculty positions only for women in all fields from 2003 to 2005. This policy resulted in a significant increase of female faculty rate from 9.2% (5.2% in S&E, 2003) to 11.0% (6.5% in S&E, 2005) in a short period of time. In 2009, the rate of female faculty is 12.2% on average if all fields

are taken in account, but only 7.4% in SET fields. Terminating the policy has resulted in a slower increase in the rate of women faculty recruitment, even though women with doctoral degrees are increasing.

Promotion Target System

The Promotion Target System (PTS) was proposed by NIS-WIST in 2006. The target rate of the PTS is 30%, and the PTS has been recommended to 25 government-funded S&T institutes since 2007. The percentage of women promoted is not so negative if the percentage of women candidates to promote is considered, as shown in Table 3. NIS-WIST is monitoring the promotion status of 99 national and public R&D institutes every year.

Table 3. Percentages of women candidates and promotion rates.

Type\Year	2007		2008	
	Candidates	Promoted	Candidates	Promoted
To Director	6.7%	8.4%	7.5%	7.3%
To Senior	20.6%	15.2%	21.3%	22.9%
Total	11.7%	11.5%	12.7%	14.4%

Research Funds only for Women Scientists

The aim of this fund, an R&D budget is allocated only for women scientists since 2000, is to encourage women scientists and engineers to remain within SET research and to develop them into outstanding researchers. The budget started at US\$2.5M in 2000 and has increased to about US\$15.7M in 2010.

Point Award System

The decision-making process implemented by institutions awarding funding for research includes a 'point award' system. From 2003, projects that included a female project manager were awarded 3 extra points in 2003, rising to 5 extra points in 2006. A quota system was also adopted in 2007 and 2008, with a target of 14% of project managers posts for women. Since 2009, the point award system is no longer applied, however, preference is now given to returners from maternity leave.

The Action Center, NIS-WIST

Article 14 of the Act on Fostering and Supporting Women Scientists and Technicians defines the foundation, duty, and management of a working center, namely, the Institute for Supporting Women in S&T. The role of

the center is to carry out research on policy development; to educate, train, and consult women in S&T; to provide information related to employment; and, to support individuals and their organizations. There is one national institute based in Seoul (NIS-WIST) and there are four regional institutes based in Gwangju (GJIS-WIST); Busan (BIS-WIST); Daejeon (DCIS-WIST); and, Daegu (DGIS-WIST), providing nationwide coverage. NIS-WIST is responsible for the planning and steering of the policy initiatives. Approximately US\$2M is allocated to these action centers from the government each year.

The NIS-WIST is responsible for supporting women professionals in Science and Technology from the start of their employment to the final stage of being leaders. The most important project of the NIS-WIST is an annual investigation of the actual status of women in SET. The actual status report is the only survey report focused on gender recognition in SET fields, and it provides a statistical database for policy development. The report is approved as a national statistic by the Korea National Statistical Office. Through this investigation the issue of women employees in R&D sectors taking mainly unstable job-positions was first raised. The status report has also shown that 82 out of 418 SET fields in 23 national and public universities have no female faculty members, even though, in 2008, more than 10% of PhD candidates were women. NIS-WIST has recommended that the Recruitment Target System, Employment Target System and Promotion Target System should be implemented together for the best efficiency.

[The NIS-WIST](#) is offering various training and supporting programs at each stage of career - from job-training to developing research-ability; communication skills ; SET management; and leadership training to individuals. NIS-WIST also provides financial support for the activities of non-governmental organizations of women scientists and engineers. The WIST-FIT (Women in S&T - Friendly Institutional Transformation) project, benchmarked from the ADVANCE program of the NSF in USA, is offered to any SET related organizations which are willing to promote women and develop a more family-friendly work environment. 6 national universities, 4 private universities, and 14 public R&D institutes have participated in this project since 2004.

FUTURE PROSPECTS

Now, to share the future prospects. The 2nd Basic Plan for Fostering and Supporting Women in S&T (2009 to 2013) has been introduced. The 2nd Basic Plan is aimed at developing strategic support for women scientists and engineers by promoting the effectiveness of existing policies and projects and by developing new projects based on needs in policy. The Plan suggests 6 primary tasks within the strategic objectives of fostering, utilizing, and building infrastructure. Each primary task consists of 2 secondary tasks. Table 4 lists these tasks in detail.

Table 4. *Tasks of the 2nd Basic Plan for Women in SET (2009~2013)*

Strategic objectives	Primary Tasks	Secondary Tasks
Fostering	To encourage young girls to major in S&E	To build girl-friendly educational environment
		To promote competitiveness of female college students in S&E
	To strategically foster excellent women scientists and engineers	To systematically foster science-talented girls
		To foster excellent WiST in promising fields of S&E
Utilizing	To create women-friendly jobs in SET fields	To introduce flexible working status and to increase job positions
		To provide employment service and build statistical infrastructure
	To advance career development and to diversify the utilization of women in SET	To promote career development
		To enhance utilization of highly educated WiST
Building Infrastructure	To improve working environment	To build a safe Lab environment
		To build a family-friendly society
	To construct an action system and to increase budget	To expand budget

The 2nd Basic Plan has also set up some quantitative targets for each task, to be achieved by 2013:

1. 2,000 mentoring couples and 50,000 young girls participating in WISE program.
2. 22% of target rate of female students entering in engineering school.
3. 1,000 interns in industry every year.
4. 1,000 women PhD's and doctors in SET fields.
5. 10% of the employment rate for women scientists and engineers.
6. 30% female recruitment rate at public R&D sectors.
7. 10% of women PM rate.

Many governmental ministries are involved in this 2nd Basic Plan. The mid-process and outcome of this Basic Plan is monitored by the National Science and Technology Council every year.

In conclusion, there certainly is a move towards gender-mainstreaming in SET in Korea. The number of young women researchers is increasing, and the concept of gender equality is widely disseminated. An important matter seems to be time. Does Korea have enough time to wait for a natural transition from male-domination to gender equality in SET within Korea?

A women's university was opened with a single woman student in 1886, at a time when the role of women was limited to serving their husbands, sons and their parents-in-law. The university is the Ewha Woman's University (EWU), which is now the world's largest women's university with about 20,000 enrolled students and 170,000 alumnae. The EWU's pioneering efforts to provide educational opportunities in areas dominated by men have established the College of Medicine in 1945 (which was 3 years earlier than the year women received the right to vote) the College of Law in 1950, during the Korean War, and the College of Engineering in 1996. The EWU has produced many outstanding graduates and the first women leaders in many fields, proving the importance of a women's university. There are 14 women's universities now. Some women's universities, however, have become co-educational because a growing number of women did not prefer women's universities. This reflects a need for women's universities to re-identify their existence and vision.

As pointed out in the introduction, full capitalization of the female workforce, especially women in SET fields, is crucial for the economic growth of Korea. The women's universities could still play an important role in this mission. However, these universities alone will not do enough to promote women in SET nationwide as there are many female students in mixed gender universities. All the governmental policies to foster and utilize women in SET should be enforced for better performance, and more aggressive efforts are needed to persuade male leaders of the benefits of these policies.

ENDNOTES

¹ Since the Act on Equal Employment for Both Sexes in 1987, other key policies have included the Framework Act on Women's Development in 1995; the Act on Support of Women-Owned Business Enterprises in 1999; and, the Framework Act on Women's Development: Agriculture and Fisheries in 2001

² The gender gap subindices rank Korea 113th in economic participation and opportunity; 109th in educational attainment; 80th in health and survival; and, 104th in political empowerment.

³ It is possible that a position is non-regular but stable. In this case the job contract can be renewed every year without any short term limit. A non-regular position has normally 2-year contract in Korea.

⁴ People who go on to study higher degrees or who are in military service are not included in the estimates of the employment rate.

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