

## Korea

The rapid development of Korea's ICT and electronics sectors has made it one of the fastest-growing OECD economies over the past decade. Korea weathered the global crisis better than most OECD and non-OECD economies, and it is the world's most R&D intensive country, with GERD at 4.29% of GDP in 2014.

Korea does nevertheless face some challenges: slowing growth, rising inequality and unemployment, a rapidly ageing society and emerging environmental problems. The 3rd S&T Basic Plan (2013-17) sets out the new government's road to economic prosperity and public well-being with the High Five Strategy to address long-term challenges. Its action plan was established in 2015.

Furthermore, the Creative Economy Initiative introduced a major STI policy governance reform and new policy initiatives. Creative Economy is a strategy to shift Korea's growth paradigm from an industrial economy to a knowledge economy by unlocking the productive potential of national STI and cultural ecosystems. In particular, the highest priority is given to advancing the S&T and ICT sectors and to refocusing Korea's research and innovation system on entrepreneurship and the innovative application of technology.

### **Hot Issues: Promoting structural adjustment and new approaches to growth**

As part of the new Creative Economy Initiative, Korea has renewed its bio- and nanotechnology strategies. Korea shows a relatively weak but growing specialisation in biotechnology. In 2016, regional specialised bio-centres have been built with state-of-the-art facilities in order to boost the national biotechnology industry and infrastructure (see the section below on clusters and regional policy). The government also aims to develop future leading technologies in drugs based on natural substances by increasing investment in R&D for new drugs. In 2015, Korea released its Strategy for the Industrialisation of Nanotechnology. The related budget goes to seven techniques for industrial applications, including 3D printing, nano-electronic devices used in intelligent robots and wearable smart devices, as well as components of industrial infrastructure aimed at improving the evaluation of production performance. Likewise, strategic items have been selected so that small firms, which account for 90% of the business sector, can better compete in the global market.

### **Fostering sustainable/green growth**

Korea has been at the forefront of green growth initiatives and aims to be a hub for global green growth. The Green Climate Fund (GCF) was established in 2013 to limit or reduce greenhouse gas emissions in developing countries through investing in low-emission and climate-resilient development. The government approved the 2nd National Energy Plan in 2014, which provides a long-term strategy that will determine the direction of the country's energy policy. The plan shifts the focus for the energy management system from a centralised, supply-side orientation to a distributed, demand-side approach. The 10 Year Energy Technology Development Plan (2014-23) has a budget of USD 20 billion PPP to assist in the creation of a new energy industry and innovation ecosystem. Part of this is establishing a new R&D system in terms of supply-demand convergence, encouraging the commercialisation of technology through a more strategic alignment of research with the market, and building capacity and an ecosystem for collaboration between central government, regional government, state-owned enterprises and government-funded research institutes. The related Transition Strategy (2015-17) has been allocated USD 500 million PPP from public budgets, with matching USD 1 billion PPP from private and state-owned enterprises, to promote a new, sustainable energy industry ecosystem that could create 14 000 new jobs by 2017. This action plan will support the creation of a USD 100 million PPP energy industry fund and also includes a detailed R&D and globalisation strategy. For instance, the government is promoting international technological collaboration to cope with climate change and the international standardisation of smart grid and package-type official development assistance (ODA) for developing

countries.

### **Strengthening the public research system**

While Korea's public R&D expenditure is high, it still has few world-class universities and produces few high-impact publications by OECD standards. One reason is that the public research system has historically been skewed towards applied and development-oriented research, much of which is performed in the public research institutes (known as Government Research Institutes, GRIs, in Korea) that supply technology for industrial R&D. The government has increased investment in basic research, from 30% of total government R&D investment in 2008 to 36% in 2015, with a target of 40% by 2017. Since 2014, the two previous S&T research councils (Korea Research Council of Fundamental Science and Technology and Korea Research Council for Industrial Science & Technology) have been consolidated into the National Research Council for S&T, marking a shift from a "management-focused" to a "support-focused" organisation and greater integration between different stages of knowledge creation. To improve efficiency, the government changed the formula for funding research, implementing an actual real cost method in order to recover indirect costs, and promoted an open S&T infrastructure approach through the strategic acquisition and joint utilisation of R&D facilities and equipment for national R&D. At the same time, the government is encouraging the PRIs to leverage funds from collaboration with the private sector and to develop industrial technology research contracts.

### **Encouraging business innovation and innovative entrepreneurship**

Korea's BERD was 3.36% of GDP in 2014, at the top of the OECD ranking. Large manufacturing conglomerates are the main performers of business R&D, with SMEs and young firms playing much smaller roles. The government is therefore committed to promote SMEs' R&D and to improve the system for managing R&D investment. The Creative Economy initiative focuses on supporting start-ups and building SMEs' innovative capacity by consolidating existing schemes, and the share of R&D investment going to SMEs increased from 12.4% in 2011 to 18.0% in 2015. The government has created a dedicated fund through participation in the "Growth Ladder Fund" and the "Korea Fund of Funds", and large companies collaborate with the Centres for Creative Economy and Innovation (CCEIs) to meet funding needs tailored to each stage for startups and SMEs. In terms of innovative entrepreneurship, Korea performs modestly, with a performance level similar to that of other OECD nations, and the intensity of VC investment slightly surpasses that of the OECD median. The regulatory and administrative framework is also not much different from the OECD median. In 2015, the government launched a support programme for matching business angel and venture capital investments in R&D, with public investment of up to six times as much. In addition, Korea has a large portfolio of support programmes that target SMEs and young firms. A new accelerator programme aims to attract start-ups from around the world.

### **Targeting priority areas/sectors**

R&D policy for new technologies has recently begun to be planned in a more strategic way in preparation for Industrial Revolution 4.0, including by setting up the National Strategy Project to deal with an era of global low growth. The National Strategy Project is a government-wide project that selects and fosters priority areas, with the aim of developing new growth engines and improving the quality of life. An implementation plan was established in August 2016 and five areas (artificial intelligence [AI], virtual reality, autonomous vehicles, light-weight materials and the smart city) were selected as the new growth engines, and four areas (precision medicine, carbon recycling, fine dust and biomedicine) were selected for improving national happiness and the quality of life. In order to promote AI technology in particular, the government plans to invest approximately USD 1.8 billion PPP (KRW 1.6 trillion) for the next 10 years. The National Strategy Project focuses especially on encouraging public-private partnerships, investing massively, and reforming the regulatory system to create an ecosystem that can proactively respond to future needs. Recognising that intelligent information technology will bring structural changes in the future economy and society as a whole, the Ministry of Science, ICT and Future Planning (MSIP) launched a special cross-agency, Intelligent Information Society Bureau in September 2016 to develop mid- to long-term national strategies, foreseeing and responding proactively to the future that intelligent information technologies will bring in. The MSIP is also planning to establish an AI research institute focusing on core AI

technologies. This institute will implement a “flagship project” to develop core AI technologies and transfer them widely to firms and other research institutes.

### **Selected Highlights: STI policy governance**

A ministerial overhaul and major changes in STI policy co-ordination arrangements were carried out in 2013. Most STI policy functions have been consolidated into the Ministry of Science, ICT and Future Planning (MSIP). The government’s R&D innovation initiative and its action plan, established in 2015, aim to strengthen its role as the country’s R&D control tower. An independent Science and Technology Strategy Office (STSO) was set up within the MSIP to strengthen the national R&D system, including for S&T planning, budget allocation and co ordination, and R&D evaluation. The MSIP introduced an open evaluation system for STI policy and R&D that underlines outcomes and impacts rather than immediate outputs. The new national R&D assessment standards now give greater emphasis to qualitative performance and peer reviews.

### **ICT and Internet infrastructures**

Korea has a strong revealed technology advantage (RTA) in ICT, with almost half of business R&D performed by the computer, electronics and optical industries. The government is planning to further increase R&D investment in software industry and to create a software ecology by establishing a software bank, nurturing talents and cultivating an environment for technology proliferation. In addition, keeping pace with the accelerating market growth of new ICT industries, the size of the industry covering the Internet of Things, cloud computing and big data has kept pace with the acceleration in the market growth of new ICT industries in general, and has increased, respectively, from USD 4.3 billion PPP (KRW 3.8 trillion, 2014) to USD 5.4 billion PPP (KRW 4.8 trillion, 2015), from USD 594 million PPP (KRW 523.9 billion, 2014) to USD 860 million PPP (KRW 766.4 billion, 2015), and from USD 228 million PPP (KRW 201.3 billion, 2014) to USD 295 million PPP (KRW 262.3 billion, 2015). The government also pledged to foster convergence in ICT through the ICT Convergence Flagship Project (e.g. next-generation game, ScreenX, and Theme Park) and the Software Convergence Project (e.g. shipbuilding/marine engineering and healthcare).

### **Technology transfers and commercialisation**

Public research is mainly conducted in the PRIs, which have strong links with industry. Universities and PRIs are also very active in patenting their research results. Korea aims to establish a new ecosystem for co operation among PRIs, universities and industry to promote greater use of public R&D results for industrial and social purposes. This includes a One-Stop Assistance Centre to help SMEs access the facilities and expertise of PRIs. The MSIP also has programmes to support exchanges of professors and students between universities and PRIs, and it plans to establish several new joint industry-university-PRI R&D centres. In addition, the 3rd S&T Basic Plan encourages greater shared use of S&T infrastructure to broaden access to S&T knowledge and information. PRIs are required to devote 15% of their total institutional funding to support SMEs by 2017 (compared to 7% in 2012) and 3% of their total budget to support and empower their special organisation in technology transfer and commercialisation for SMEs (compared to 1.76% in 2012). Korean Science and Technology Holdings and Mirae Holdings, Ltd were established to commercialise the technologies developed by PRIs.

### **Clusters and regional policies**

The main purpose of promoting clusters is to increase R&D efficiency and balanced regional growth. The government has created several Special Research and Development Zones, including Daedeok, Gwangju, Daegu, Busan and Jeonbuk, each with its own technological orientation, to promote regional industrial bases, business start-ups and local job creation through the commercialisation of R&D. The 3rd Comprehensive Plan to Promote Special Zones (2016-20) was established in January 2016, and is mainly focused on the promotion of regional industrial bases and the strategic commercialisation of public technology. Since 2015, 18 Centres for Creative Economy and Innovation (CCEI) have been created to serve as regional hubs for start-ups and SMEs to support networking and greater collaboration.

## Globalisation

Korea's levels of international co-authorship and co patenting are well below the OECD median. A traditionally strong focus on applied research and technological development that is performed largely in GRIs partly explains the low levels of international co authorship. The low level of patent applications with foreign co inventors is due in part to a big business-oriented structure, which tends to retain technology development within the company. In the past, there have been occasional instances of cross-border co operation but no comprehensive strategy for international STI co operation. The MSIP has therefore developed a Comprehensive Plan for STI Global Co operation, which includes the formation of a global network of overseas STI outposts, the expansion of S&T ODA, the reinforcement of science diplomacy, the promotion of international joint R&D and the sharing of large R&D facilities. The MSIP is also implementing measures to encourage the international mobility of highly skilled labour. The CCEI also fulfils a function in facilitating the overseas expansion and integration of start-ups and innovative SMEs into global value chains by helping them access funding from large global companies. The new global excellator programme offers them expertise services and access to resources as well.

## Skills for innovation

Korea has invested heavily in higher education and ranks third in the world in terms of the share of GDP spent on higher education. However, the Korean education system has mixed results. For example, despite a large share of tertiary-qualified adults, adults' technical problem-solving ability is just average, and while 15-year-olds perform well in science, the rate of engineering (S&E) doctorates is modest. The government has developed a Comprehensive Plan for the Scientifically Gifted and Talented (2013-17) to identify pupils with high potential and to nurture their creativity. The Five-Year Plan for University Start-ups (2013-17) aims to improve entrepreneurial education in secondary schools and universities. The National Scholarship programme and the 3rd Women S&E Promotion Basic Plan (2014-18) have been launched to increase youth participation in the field of science and engineering in higher education. On top of this, the government is implementing various initiatives to attract young scientists and engineers to SMEs, e.g. by establishing a one-stop information network for job markets and encouraging the pre-employment of students. Korea's demographic pattern points to a decline in the student population from 2018. In order to respond to this, the government introduced the Programme for Industrial needs / Matched Education (PRIME) in 2016 to promote the institutional reform of regional universities to better meet social and industrial needs for skills.

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- [8] [http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-innovation-outlook-2016/sti-country-profiles-reader-s-guide\\_sti\\_in\\_outlook-2016-44-en](http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-innovation-outlook-2016/sti-country-profiles-reader-s-guide_sti_in_outlook-2016-44-en)
- [9] [http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-innovation-outlook-2016/methodological-annex-to-the-2016-oecd-sti-outlook-country-profiles\\_sti\\_in\\_outlook-2016-95-en](http://www.oecd-ilibrary.org/science-and-technology/oecd-science-technology-and-innovation-outlook-2016/methodological-annex-to-the-2016-oecd-sti-outlook-country-profiles_sti_in_outlook-2016-95-en)
- [10] <https://innovationpolicyplatform.org/system/files/sti-outlook-2014-korea.pdf>