

Strengthening innovation-driven inclusive and sustainable development

Asia-Pacific

Tech Monitor

Vol. 35 No. 4 Oct - Dec 2018

Biotechnology commercialization and transfer in Asia and the Pacific



Plus

- Technology News and Events
- Tech Ventures & Opportunities
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Asian and Pacific Centre
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The Centre will achieve the above objectives by undertaking such functions as:

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- Networking and partnership with international organizations and key stakeholders; and
- Training of national personnel, particularly national scientists and policy analysts.



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Asia-Pacific Tech Monitor

Vol. 35 No. 4 ❖ Oct-Dec 2018

The **Asia-Pacific Tech Monitor** is a quarterly periodical of the Asian and Pacific Centre for Transfer of Technology (APCTT) that brings you up-to-date information on trends in technology transfer and development, technology policies, and new products and processes. The Yellow Pages feature the Business Coach for innovative firms, as well as technology offers and requests.

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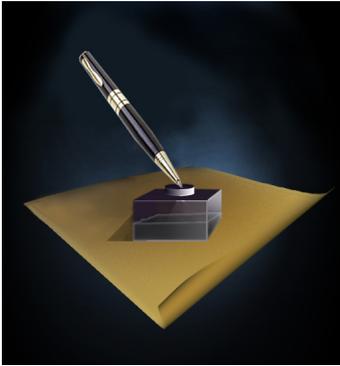
This publication has been issued without formal editing.

ISSN: 0256-9957



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Introductory note

Modern biotechnology offers innovative technologies and applications in some key sectors of development - medicine & healthcare, agriculture and environmental protection. Through supporting these sectors, biotechnology contributes to achieving the 2030 Sustainable Development Goals. Biotechnology innovations now provide technically and commercially viable solutions to the challenges in these sectors.

Favourable policy environment is essential for promoting innovation and commercialization of biotechnologies. Some countries in the Asia-Pacific have established focused policy and institutional frameworks to support their biotechnology sectors. Prominent examples are Malaysia's Bioeconomy Transformation Programme to promote specific bio-based industries; China's strategic focus on commercialization of agriculture biotechnology; and the National Biotechnology Strategy of Japan. Biotechnology is also considered as a capital- and knowledge-intensive sector. For acquiring these critical resources, enterprises need to establish strong collaboration and networking with domestic and international partners. According to Korea Biotechnology Industry Organization, 29.6% of biotechnology companies of the country have cooperative relationships with other organizations as of 2016. The most common cooperative relationships were found to be 'joint R&D contract', followed by 'technical tie-up and licensing', and 'technical manpower exchange'.

Venture capital financing has been a key driving factor for commercialization of innovations by biotechnology small and medium enterprises in some countries of the Asia-Pacific. For example, due to enabling public policies in the Republic of Korea, venture capital financing had been growing rapidly with about 18% in 2017, according to Korea Venture Capital Association. Other financing tools considered important for the biotech startups and small and medium enterprises in the Republic of Korea are credit guarantee system and intellectual property based finance. According to the global consulting firm ChinaBio, the Chinese venture capitals and private equity funds raised US\$ 45 billion for investments in life sciences in the two and a half years prior to June 2017.

Biotechnology provides immense opportunities for enterprises to become part of the global value chain. A strong biotechnology sector in the Asia-Pacific would require countries to establish robust policy and institutional frameworks as well as financing support systems and instruments. It is also important to leverage on collaborations and partnerships with domestic and international players for successful commercialization of biotechnology innovations.

This issue of the Asia-Pacific Tech Monitor discusses pertinent issues, challenges and opportunities that are being faced by biotech stakeholders in countries of the Asia-Pacific region.

Michiko Enomoto
Head, APCTT-ESCAP

ASIA-PACIFIC CHINA

Policies to boost innovation

The Chinese government decided to implement a new set of reform policies and measures to boost innovation and creativity, according to a statement released after a State Council executive meeting presided over by Premier Li Keqiang. Reform measures in boosting innovation have been piloted in eight Chinese cities and regions including the Beijing-Tianjin-Hebei region, Shanghai and Guangdong. The first pilot program covering 13 policy measures were rolled out nationwide in 2017. It was decided during a meeting that another batch of 23 reform measures will be rolled out to mobilize innovation resources, incentivize innovation activities and nurture new drivers of growth.

More efforts will be made to incentivize the commercialization of R&D findings. Commercialization professionals will participate in the whole process. Universities and research institutes will be encouraged to participate, through commercial deals, in business research on technological breakthroughs. New fin-tech services will be introduced to explore more financing channels for small- and medium-sized tech companies, including asset-light firms and firms yet to make profits. Local government equity funds will be channeled to support seed and early stage high-tech startups. Insurance companies will be encouraged to develop products that cover patent enforcement and patent infringement to forestall patent holders' losses from IPR violations.

Market-based operation of state-owned scientific research instrument and equipment will be promoted. Mechanisms will be established to allow for innovation-related decision-making on a trial-and-error basis. It was also decided at the meeting that the three reform measures, which have so far been piloted in one or two places, will be extended to all the above-mentioned eight cities and regions. Such measures include granting scientists and researchers a certain share

of ownership of their findings proportionate to their job positions, setting up science and technology innovation sections in regional equity markets, and allowing greater autonomy for universities administered by local governments to attract talents and confer academic titles.

The draft amendment, in learning from international practice, substantially raised penalties for patent infringements. It stipulated that Internet service providers should take on joint responsibilities when they fail to stop the infringements on a timely basis. It also specified the incentive mechanism that would allow inventors or designers to reasonably profit from yields out of their service invention and creation. The amendment will be submitted to the Standing Committee of the National People's Congress for review. A draft regulation on emergency response to work safety accidents was also passed at the meeting, according to the statement.

<http://www.globaltimes.cn>

Draft amendments to patent law

A new draft amendment to China's patent law aimed at enhancing protection of intellectual property rights (IPR) will likely be passed in the country's legislative body next year, as part of China's broader efforts to boost IPR protection, officials revealed at a press briefing. The new draft amendment has been submitted to the National People's Congress (NPC) for review and is likely to be approved next year, Yin Xintian, an official with the National Intellectual Property Administration said at the briefing. The new amendment is aimed at stepping up efforts to crack down on IPR infringement and adopt international practices, the *Xinhua News Agency* reported.

To discourage entities from violating IPR, the new amendment also seeks to significantly increase punishments for violators based on their intentions, according to the report. Another major change in the new amendment is that once adopted, internet service providers would be required by law to stop activities on their sites that

infringe on others' IPR or they will face punishment. The draft amendment was passed by an executive meeting of the State Council, China's cabinet, on December 6 before being submitted to the NPC for final review.

China has in recent years stepped up its efforts to enhance protection of IPR, as the country shifts focus to an innovation-driven economy and faces growing concerns from foreign governments over its IPR protection. China has become a leader in new patent filings in recent years. In 2017, there were 1.38 million new patent applications in China, according to *Xinhua*.

<http://www.globaltimes.cn>

INDIA

Increment in patent applicants granted

The UN's World Intellectual Property Organization (WIPO) reported that the number of patents which are granted by India has reached up 50 percent in the year 2017, simultaneously keeping steep increase trend. According to the WIPO's reports released on Monday, increment of the patent from 8,248 in 2016 to 12,387 in 2017 has been seen. 2017 year's number of patent granted by India was approximately double than the 6,022 patents granted in 2015.

According to WIPO's statistics, among the patents granted last year, 1,712 was reserved to the individuals and entities based in India and other 10,675 accounted to foreigners. WIPO states the increment in the steep was made through the patents which were granted to foreigners, which holds around 85 percent of the total increase steep.

WIPO reported, in 2016, domestic entities and individuals held 1,115 and 7,133 accounted to foreigners, and in 2015, domestics held 822 and 5,200 belongs to foreigners. The estimated reports stated that 1.4 million patents were globally granted in the year 2017.

Reports states that among 46,582 patents granted by India last year, 9,222 has come from the country US. US generated 606,956

patents last year, among which 10,309 came from the country India. Though, India has ranked 10th in the world for the patents, none of Indian company or university has come under top 50 patent applicants.

According to WIPO reports released, India has 1.6 million active trademarks, from which 339,692 has been registered last year (2017), 52,553 for foreigners and 287,139 from domestics. India, increment in patent applicants, has shown their sign of growing entrepreneurship, Gurry said.

<https://www.theindianwire.com>

Patents filed by Indian Startups

Three years back, India had whopping 2,46,495 pending applications for patents, which was due to in-capabilities of government departments to handle patent applications. In year 2015, between April to October, government rejected 605 patent applications and 6,543 trademark registrations due to number of reasons where insufficient staffing was one of them.

In 2017 however, the things seem to have changed a little bit as according to the data from the Department of Industrial Policy & Promotion (DIPP) reveals that Indian startups filed 909 patent applications last year, as compared to a mere 61 in 2016. One of the key reasons that resulted the rapid increase in filing patents from Indian startup ecosystem is the way investors look at startup with one or more patents. A startup with a patent even if it is pending tag it with 'innovation' label.

Venture Capitalists (VCs), who are increasingly investing in startups, are preferring to pump money into startups that have filed patents. If a patent has been filed, it means that the project has some innovation, which will result in increased market value. Further, getting a patent would also put these companies in the elite club of startups. Also, a tweak made by government in the definition of startups allowed startups to become eligible for various benefits being handed over to startups in India, including 80% rebate on patent filing, under the latest patent framework introduced by the authorities last year.

Additionally, the Indian government's Startup India initiative has also created

awareness towards minimizing legal risk against IP infringement. This resulted in a positive impact and now more startups are investing in on-boarding IP lawyers at initial stages of commercialization of their product. Last year, the government had also introduced mechanisms for speedier process of filing patent applications, which then allowed companies to acquire a patent in India within a year of its filing.

<https://www.inventiva.co.in>

INDONESIA

SMEs R&D spending

According to the Organization for Economic Co-operation and Development (OECD), less than 0.1 percent of research and development (R&D) spending is conducted by small and medium enterprises (SMEs) in Indonesia, far behind the OECD average of 2.3 percent. That figure was presented in a press statement for an OECD report on SMEs and entrepreneurship in Indonesia, presented by OECD secretary-general Angel Gurría in Nusa Dua, Bali.

"In Indonesia, small companies employing fewer than 20 people account for more than three-quarters of national employment, more than in any OECD country," said Gurría. "This is why policies to boost SME development should remain a priority for the Indonesian government." Co-operatives and Small and Medium Enterprises Minister Anak Agung Gede Ngurah Puspayoga and National Development Planning Minister Bambang Brodjonegoro spoke at the same event.

The OECD suggested that the government increase spending on skills upgrading and innovation at SMEs to strengthen productivity growth. The OECD also suggested scaling back some large programs, such as the people's business credit (KUR) – a loan program with subsidized interest rates, while increasing the focus on targeted groups, such as first-time borrowers and SMEs from regions lagging behind in terms of development.

"To improve the overall coherence of Indonesia's SME policy, the review recommends the integration and merger of

programs that offer very similar services but are operated by different ministries, for example in the field of business development services and business incubators," the statement says.

<https://www.thejakartapost.com>

MALAYSIA

GDP contribution of SMEs in manufacturing

The Ministry of Entrepreneur Development (MED) aims to increase the contribution of small and medium enterprises (SMEs) in the manufacturing sector to 7.0 per cent of the country's gross domestic product (GDP) from the current 5.8 per cent by 2020. Its minister, Datuk Seri Mohd Redzuan Yusof, said the improvement was achievable by creating a conducive environment for SMEs to thrive.

During the tabling of the mid-term review of the 11th Malaysia Plan 2016-2020 in Parliament, the government said it aimed to increase GDP contribution of SMEs to 41 per cent in 2020. As at 2017, SME contribution to Malaysia's GDP rose to 37.1 per cent from 36.6 per cent in 2016.

Mohd Redzuan said the development of a strong and dynamic SME sector was vital for a vibrant and sustainable economy. "However, the policy space to foster SME contribution requires, to a great degree, a conducive framework and access to strategic resources. "As such, the MED is committed to ensure that the government's effort towards entrepreneur and SME development will be holistic, integrated and targeted in order to pave the path for new opportunities and grow our capital market," he said. Meanwhile, Mohd Redzuan said grants for research and development, as well as, the prototype for the proposed national car would be announced early next year.

<https://www.malaymail.com>

Promoting local SME products

The Domestic Trade and Consumer Affairs Ministry (KPDNHEP) has allocated RM20 million for the promotion of local small and medium enterprise (SME) products.

KPDNHEP Business Development Division Director Ismainur Hadi Amat Bakeron said the allocation would also fund its "Buy Malaysian Products" campaigns nationwide, which will create greater awareness among consumers on local brands.

"The ministry will act as 'SMEs Custodian' and facilitator for SME entrepreneurs in developing their products," he told reporters after closing the ministry's annual "Program Citarasa Malaysia" event. He said the ministry had doubled its efforts to rid the negative perception among Malaysians on the low quality of local products.

"Our SME Product Development Programme aims to develop SME entrepreneurs' products to increase their ability to compete with international products as well as increase sales revenue through attractive and trendy packaging. Through this programme, we will identify products that have the potential for permanent listing in the hypermarkets, but do not meet the standard set by the hypermarkets," he added.

The Ministry's 15th Series of Program Citarasa Malaysia, in collaboration with Labuan's 24-Hour Supermarket D' One Mart, introduced new local products from 13 SME entrepreneurs.

<http://www.dailyexpress.com.my>

PHILIPPINES

"Technology can grow Philippine economy 10% faster"

The Philippine economy could grow faster by an estimated 10 percent, provided that emerging technologies, knowledge and the Fourth Industrial Revolution can be utilized to accelerate productivity, according to a research fellow of the Philippine Institute of Development Studies (PIDS). "Right now, we are growing at about 6 percent. We have not fully utilized the existing technology. How much more if we are going to be able to overcome these barriers to the adoption and adaptation of current technology and knowledge to improve our productivity and then some more with the new technologies.

We should be growing fast," PIDS distinguished visiting research fellow Dr. Vicente Paqueo said in an interview.

To take full advantage of the Fourth Industrial Revolution, Paqueo underscored the need for the country to hop into the bandwagon headed for the knowledge and technological frontier, where the United States and advanced European countries belong. Technologies commonly identified as "frontier" and are tagged as being part of Industry 4.0 include, 3D printing, the Internet of Things, AI, robotics, big data and cloud computing. For his part, PIDS senior research fellow Dr. Jose Ramon Albert underscored the need for the country to invest more in research and development (R&D).

Albert cited the benchmark of United Nations Educational, Scientific and Cultural Organization (UNESCO) suggesting that R&D spending should amount to about 1 percent of a country's gross domestic product (GDP). "We are (only) spending 0.2 percent, it's one-fifth of 1 percent of GDP. That's just R&D, we think also of the complementaries for education. We are still relatively underspending for education," he said in the same interview.

Albert pointed out that hard and soft infrastructure, as well as capacity development of human resources and institutions, are complementary factors to R&D investments that need to be addressed in improving readiness to the Fourth Industrial Revolution. "It must be a whole package. That's the problem sometimes we tend to be focused too much on one thing and we forget that they are all connected. We have to like to put all of these together," he said.

Albert also cited as an example Estonia, a former Soviet republic, which has managed to use technology considerably across government. "They use many kinds technologies and they are the forefront now of trying to use and harness technology. They are fast growing economy so potentials can actually become realized if you invest properly in certain areas. And part of it will be ICT (information communications technology), technical areas, but part of it will also be in other skills, soft skills where

potentially these will not be replaced by automation," he added.

<http://www.pna.gov.ph>

Technology boosting Philippine SMEs' competitiveness

Adaptation by Philippine-based small and medium enterprises (SMEs) is high and this gives them a big advantage to be at par with the best in the world. Results of the survey "Global is the New Local: The Changing International Trade Patterns of Small Businesses in Asia Pacific" commissioned by FedEx Express in nine Asia Pacific (APAC) countries and conducted from March to April 2018 showed that 81 percent of around 500 domestic SME players use emerging technology to improve supply chains and distribution channels.

In a briefing, FedEd Express Philippines Managing Director John Peterson said the survey indicated that software automation and mobile payments are the widely used technologies in the country. Use of these innovations allows small businesses that are part of the study to increase their revenues as they improve their products, among others. On average, exports account for 89 percent of the surveyed small enterprises' total annual revenue. Bulk or 56 percent of these exports are within the APAC region while 44 percent is accounted for by those outside APAC. Outside APAC, Philippine SMEs' major export destinations are the US and India, the survey showed.

Asked for their outlook on revenues, 56 percent of the exporter-respondents said they expect their revenues to increase for trade within APAC while 67 percent are optimistic of higher revenues from outside APAC. For those that are into importation, the survey showed that 59 percent prefer to source their materials locally while those that buy overseas source it primarily from China, Japan, Singapore and India.

Raw materials and finished products registered the highest rating, at 46 percent each, in terms of the types of goods that local SME import. Components came in third at 30 percent, followed by professional services, 28 percent; designs, 21 percent;

and others, three percent. Asked for reasons for importing goods, the respondents said better materials allow them to increase the quality of their products. Survey results showed that 95 percent of the respondents use social commerce, with 76 percent using this to find customers overseas.

<http://www.pna.gov.ph>

REPUBLIC OF KOREA

R&D spending to GDP ratio

Republic of Korea has reclaimed the number one spot in terms of the ratio of research and development (R&D) spending to gross domestic product (GDP). Republic of Korea's ratio was 4.55 percent last year, higher than Israel's 4.25 percent. The total amount of Republic of Korea's R&D investment reached 78.8 trillion won (US\$69.73 billion) last year, up more than 13.5 percent from a year earlier and the fifth largest in the world.

The Ministry of Science and ICT released on Nov. 27 the results of its survey on R&D activities carried out in the government, public and private sectors in Republic of Korea last year. The survey was conducted on 59,603 domestic companies from April to September based on the OECD standards for international comparison of material and human resource injected into R&D. Out of the 59,603 firms, 50,619 responded to the survey, showing a collection rate of 84.9 percent, and those not responded the survey were so small that they wouldn't actually affect the results, according to the government.

Republic of Korea's total R&D investment recorded 78.8 trillion won (US\$69.73 billion) last year, up 9.38 trillion won (US\$8.3 billion) from a year ago. Republic of Korea ranked fifth among OECD member countries after the United States, China, Japan and Germany. The R&D investment of the private sector grew 14.7 percent, or 7.72 trillion won (US\$6.83 billion) to 60.06 trillion won (US\$53.15 billion) compared to the previous year, while that of the government and public sector rose 8.1 percent, or 1.33 trillion won (US\$1.17 billion).

Corporations spent 62.56 trillion won (US\$55.37 billion) on R&D activity, accounting for 79.4 percent of the total R&D

investments, followed by public research institutes 9.54 trillion won (US\$8.45 billion) for 12.1 percent and universities 6.68 trillion won (US\$5.91 billion) for 8.5 percent. Corporate investment included part of the government's R&D activity worth 20 trillion won (US\$17.7 billion) a year.

Republic of Korea also showed the highest ratio of R&D spending to GDP in the world with 4.55 percent, up 0.32 percentage points from a year earlier and higher than Israel's 4.25 percent. By R&D stage, development research for commercialization accounted for 63.6 percent of the total R&D investments with 50.08 trillion won (US\$44.32 billion), followed by application research with 17.31 trillion won (US\$15.32 billion) and basic research with 11.39 trillion won (US\$10.08 billion).

The total number of researchers in R&D activity gained 4.8 percent, or 22,027, to 482,796 last year, and that of full time equivalent (FTE) increased 21,808 to 383,100, coming in sixth place in the world. The number of researchers for per 1,000 of the economically active population stood at 13.9 and per 1,000 people at 7.4. The number of researchers at corporations came to 343,367, accounting for 71.1 percent, followed by universities 102,877 for 21.3 percent and public research institutes 36,552 for 7.6 percent.

The country's R&D costs per 1,000 researchers rose 7.1 percent, or 33.56 million won (US\$29,699), to 205.66 million won (US\$182,000) compared to a year ago but the figure fell short of the US with US\$359,850 (406.63 million won), Germany with US\$254,373 (287.44 million won) and Japan with US\$233,556 (263.92 million won).

<http://www.businesskorea.co.kr>

IP infringers to face punitive damages

Those who intentionally infringe patents and trade secrets of others will be subject to punitive damages starting June next year, Republic of Korea's intellectual property office said. The National Assembly approved bills to revise the Patent Act and the Unfair Competition Prevention and Trade

Secret Prevention Act, which included reinforced penalties for violations, according to the Korean Intellectual Property Office.

The median value of damages in patent infringement lawsuits here stood at 60 million (\$53,452) as of the end of last year, the IP office's data showed. The corresponding figure in the United States as of end-2016 was 6.6 billion won. "Even considering the respective size of the two economies, this gap shows that IP infringement victim companies have so far received insufficient compensation," KIPO said in a press release.

The relatively light punishment has also led to prevalent market sentiment that it is more profitable to take advantage of IP assets and pay the damages, if necessary, than to pay the legitimate royalty, according to KIPO.

To curb such violations, the latest revision bill has adopted a punitive damages system that allows maximum compensation of threefold the amount of acknowledged damages. The bill also alleviates the burden of proof for patent holders and trade secret holders.

<http://www.koreaherald.com>

SRI LANKA

Tax exemptions to agriculture sector SMEs

The government has decided to relieve Small and Medium Enterprises (SME) in Agriculture sector from income tax for 5 years to boost the local production for exports and consumption. Accordingly, the income received from any agro sector such as tea, coconut, rubber, spices, rice, fruits, vegetables, etc., especially by the small-scale entrepreneurs, produced for both exporting and local consumption as food and industrial raw material, will be exempted from income tax for five years, the Ministry of Finance said in a statement.

Additionally, the annual income tax rate on processing industries using local agricultural commodities will be reduced from 28 percent to 14 percent. The measure is expected to benefit farmers as well as consumers. Further, as a further measure to ease hardships on small business operations, a proposal has been made to raise

the threshold for the application of Economic Service Charge from Rs.12.5 million per quarter to Rs.50 million per quarter.

The Finance Ministry said the relief measures were taken on the instruction of the President and the Minister of Finance and Economic Affairs aiming to provide the highest priority to agricultural development. The Ministry said the government is of the view that every effort should be made to make use of the 2018/19 Maha cultivation season as a new beginning and a number of relief measures will be provided in the future.

<http://www.colombopage.com>

THAILAND

First business accelerator for SMEs

In collaboration with United Overseas Bank, The Finlab launched its Smart Business Transformation in Thailand to help SMEs transform their businesses through digital solutions. Thailand is the first market outside of Singapore where The Finlab will offer its SME business transformation programme, Felix Tan, Managing Director of The Finlab, said at a media event on Thursday in Singapore. The Thai launch follows the success of the Singapore programme in August 2018 where 11 Singapore-based SMEs deepened their digital capabilities by piloting the use of technologies such as artificial intelligence and robotics process automation.

The Finlab is a fintech and innovation accelerator under the United Overseas Bank (UOB). Since its inception in 2015, The Finlab has run two acceleration cycles for fintech companies chosen from more than 700 applications from 44 countries. The programme is supported by UOB in Thailand and the Digital Economy Promotion Agency (depa) of Thailand. To support Thai SMEs drive their business performance, The Finlab's three-month Smart Business Transformation Programme will help participating SMEs refine their business models and adopt digital solutions particularly those in online sales and marketing.

Mentors from The Finlab, UOB (Thai) and depa will also guide participating SMEs to identify the unique issues they face in their

business and equip them with the tools and knowledge needed to innovate. The SMEs will then be matched with a suitable technology solution provider to address their concerns and to pilot the implementation of the solution. The Finlab is now accepting applications from SMEs in Thailand for the Smart Business Transformation Programme until January 2019. It is also calling for global technology companies and start-ups to participate in the programme as solution providers. The Smart Business Transformation Programme will commence in April 2019.

<https://www.finews.asia>

VIET NAM

FDI policy to support domestic firms

Việt Nam will institute new policies designed to attract foreign direct investment (FDI) by boosting the development of local companies and setting up value chains driven by advanced technologies. FDI has been a major factor in Việt Nam's rapid socio-economic development; however, some key metrics remain below their expected levels. These include the involvement of local companies in the value chain and the development of the part supply industry. Transfer pricing, outdated technologies and environmental pollution are also significant problems.

Minister of Planning and Investment Nguyễn Chí Dũng said it is time for Việt Nam to consider changes in how it seeks to attract FDI. Changing global investment flow trends such as the US - China trade war, the rise of protectionism, opposition to multi-lateral free trade and the Fourth Industrial Revolution mean the country's methods of attracting investments are outdated.

The country has taken lessons from its efforts to attract FDI over the last three decades, and the Government has recently stated that Việt Nam would not make too many sacrifices to attract investments. Dũng said FDI should be associated with sustainable development, green growth, economic restructuring, boosting domestic industry and the Industry 4.0. Dũng was quoted in a note on the ministry's e-portal saying that while FDI is an important

resource, it still accounts for just 25 per cent of total investment in the country. Domestic businesses still play a decisive role.

"We have to focus on developing and supporting domestic enterprises to unlock their production capacity," Dũng said. The note also emphasised the importance of the link between FDI and domestic businesses. He said the developmental gap between FDI companies and domestic industry makes it hard for them to connect. To remedy this, Dũng suggested focusing on boosting technology transfer in FDI attraction by selecting projects with advanced, environmentally friendly technologies.

Ministry statistics show that Việt Nam has attracted US \$334 billion of FDI into 26,500 projects with a disbursed capital of around \$184 billion. FDI has contributed to 52.8 per cent of the processing and manufacturing industry, created 50 per cent of the country's industrial value and provided jobs for 3.6 million labourers.

<https://vietnamnews.vn>

Global innovation centre coming up

The Ministry of Science and Technology and Xinoa signed a Memorandum of Understanding on Wednesday to establish a global innovation centre in Việt Nam to connect Vietnamese innovators with the global innovative network for greater creative ideas. The centre, according to Minister of Science and Technology Chu Ngọc Anh, will serve as a bridge connecting local groups and businesses with a network of more than 12,000 global scientists and innovators. It will also create conditions for Vietnamese scientists and engineers to join the network. Technology management officers and those working in the innovation sector in Việt Nam will have opportunities to learn from the world's newest solutions aiming to boost innovation.

Xinoa, a corporation with a network of 12,000 innovators and experts, is operating in nine countries worldwide. It partners with customers and inventors to think beyond the confines of their organisations and solve big problems.

<https://vietnamnews.vn>

Technology Scan

Focus: Biotechnology

INTERNATIONAL

'Climate proof' crops

New rice and green bean plants are now being rolled out to help farmers grow more of these staple foods despite higher temperatures caused by climate change. These new 'climate proof' crop varieties were developed as part of a five-year project aimed at helping countries to improve food security and adapt to changing climate conditions. The project specifically addressed the improvement of tolerance of rice and bean plants to high temperatures in drought-prone areas.

To help protect crop-based food sources, a group of plant breeders, plant physiologists, agronomists and plant biotechnologists and experts from the IAEA, in cooperation with the Food and Agriculture Organization of the United Nations (FAO), teamed up to develop new 'climate proof' crop varieties through a five-year IAEA coordinated research project.

The team began by studying how rice and common bean plants react to normal and aberrant – meaning any climate condition to which a variety of crop is not normally adapted to – climate conditions, and identifying genes related to heat tolerance and higher yields. With this information, they targeted plants with desired traits and bred for these traits using irradiation to speed up the natural process of mutation in plants. This breeding process increases diversity of plants' traits, allowing scientists to more quickly test and select plants with the desired characteristics. The result was a series of 'climate proof' rice and common bean plants that can tolerate high temperature conditions better while producing higher yields compared to local varieties.

One of these new rice varieties called 'Guillemar', which is drought tolerant, is now being used in Cuba and has boosted crop yields by 10 per cent. Other countries such as India, Pakistan, the Philippines, Tanzania and Senegal, are also preparing to release new, high-yielding rice varieties suited to each countries' temperature conditions, while experts in Colombia and Cuba have

had success with new varieties of heat-tolerant, higher yielding common bean and tepary bean plants, which they expect to release to farmers by 2020-2021.

Over the course of this five-year project, the team created methods for screening the physiological, genetic and molecular components of plants as well as for accurately assessing the plants' genetic makeup to identify, select and breed plants with desired traits. A pre-field screening technique, for example, was refined to help plant breeders accelerate the evaluation of plant varieties in controlled conditions such as a greenhouse or growth chamber. This approach allows them to effectively narrow down the number of possible plants for further field tests from a few thousand to less than 100. By slimming down the options, it can reduce research and development time from around three to five years to one year, which means new plant varieties can reach farmers more quickly to help them stay ahead of climate change and prevent food insecurity.

Many of the team's methods and techniques are now being made accessible to other researchers to research further. They are being made available through IAEA coordinated research and technical cooperation projects with other teams of scientists, as well as through more than 40 publications, including a recently published open-access guidebook on Pre-Field Screening Protocols for Heat Tolerant Mutants in Rice.

<https://www.iaea.org>

ASIA-PACIFIC AUSTRALIA

Test to detect all types of cancer

Researchers from the University of Queensland have developed an inexpensive test that can detect traces of cancer in the bloodstream in as few as 10 minutes. "This new discovery could be a game-changer in the field of point of care cancer diagnostics," Dr. Abu Sina, a member of research team, said. The Queensland scientists discovered that the DNA released

by cancer cells sticks to metal differently than DNA from healthy cells, according to a report by the Guardian. The research results were published in the journal Nature Communications.

The DNA is put into water with gold nanoparticles. Even though it's gold, the water looks pink. If cancer DNA is added, the water remains pink. If it's healthy DNA, the water turns blue. "This happens in one drop of fluid," said chemistry professor Matt Trau, who led the research team. "You can detect it by eye, it's as simple as that."

The test has been used to detect breast, prostate and colon cancer and lymphoma. According to a news release from the university, the technology has been up to 90 percent accurate in tests involving 200 human cancer samples and normal DNA. "Virtually every piece of cancerous DNA we examined had this highly predictable pattern," Trau said. "It seems to be a general feature for all cancer. It's a startling discovery."

<https://weather.com>

CHINA

Decoding cell-specific DNA methylation

Scientists in China have developed an algorithm that can link epigenetic modifications to specific cell types with 90 percent sensitivity. In a study published in Nature Methods, researchers in China have developed a statistical algorithm for identifying sites of DNA methylation (DNAm) in genomes. DNAm is a covalent modification of DNA which can regulate gene activity, with implications on health and disease. Identifying changes in DNAm that correlate with disease risk is the main aim of epigenome-wide association studies (EWAS) in large numbers of individuals.

However, tissues profiled in EWAS are complex mixtures of many different cell types, each with its own characteristic DNAm profile, which can confound analyses. In the present study, researchers led by Professor Andrew Teschendorff at the Shanghai Institute of Nutrition and Health, Chinese Academy of Sciences, developed

a statistical algorithm called 'CellDMC,' which allows researchers to pinpoint not only the specific genomic sites that have undergone DNAm, but also the cell types in which these DNAm alterations occur. They demonstrated that their algorithm can identify DNAm changes with over 90 percent sensitivity.

Using CellDMC, the researchers were able to show that many DNAm changes associated with rheumatoid arthritis occur in one particular subtype of immune cells, the B-cells. Applied to the analysis of samples from patients who smoked tobacco, their algorithm could identify epigenetic pathways linking smoking to lung cancer. The researchers propose that CellDMC will allow researchers in the EWAS community to identify the relevant cell types altered in disease, without the need for laborious cell sorting or generating single-cell methylomes, both of which are expensive and time-consuming procedures. Their technology could facilitate the identification and development of epigenetic disease risk biomarker assays, paving the way for personalized medicine.

<https://www.asianscientist.com>

INDIA

Transgenic rice with reduced arsenic accumulation

Arsenic accumulation in rice grains is one of the serious agricultural issues in India. To address this, researchers at Lucknow-based CSIR-National Botanical Research Institute have developed transgenic rice by inserting a novel fungal gene, which results in reduced arsenic accumulation in rice grain.

In their latest study, researchers have cloned Arsenic methyltransferase (WaarsM) gene from a soil fungus, *Westdykellaaurantiaca*, and inserted the same into the rice genome with the help of *Agrobacterium tumefaciens*, a soil bacterium which has natural ability to alter the plant's genetic makeup. The newly developed transgenic rice along with normal rice was then treated with arsenic. Comparison of transgenic and non-transgenic

rice showed that transgenic plants accumulated less arsenic in root as well as shoot as compared to non-transgenic lines.

Researchers found that the resulting transgenic plant acquired the potential for methylating inorganic arsenic to a variety of harmless organic species, including volatile arsenicals. This could be potential strategy for developing transgenic rice capable of low arsenic accumulation not only in grain but also in straw and feed which are used for livestock.

Now the team is focusing on food safety test and field trials, subject to regulatory approvals. In addition, researchers are also looking for gaps in arsenic metabolism in rice which will ultimately lead to understand arsenic uptake and metabolism in rice. The recent research results have been published in *Journal of Hazardous Materials*.

<https://www.downtoearth.org.in>

Fighting drug-resistant bacteria in biofilms

Researchers at Indian Institute of Technology, Roorkee (IIT-Roorkee) have developed a new eco-friendly nanocomposite that promises to help fight the problem of such antibiotic resistance more effectively. The newly synthesized nanocomposite is capable of penetrating these biofilms and kill microbes. The new compound has been developed by combining silver particles with κ -Carrageenan, a polymer derived from red sea weed. The polymer is conventionally used in food products as a gelling, thickening and emulsifying agent.

Silver nanoparticles are already known to have the ability to kill microbes but they are instable and have a short shelf life. Researchers used κ -Carrageenan to increase stability and shelf life of silver nanoparticles. They made a solution of κ -Carrageenan with silver nitrate and irradiated it in a microwave synthesizer. The nanocomposite thus obtained was found to be very stable and having a long shelf life, while being effective against both Gram-positive and Gram-negative bacteria.

"Capping of silver nanocomposites with κ -carrageenan imparts it stability and shelf

life up to six 6months, which is one of the essential features of therapeutic formulations. The nanocomposite shows excellent antimicrobial activity against *S.aureus* and *Paeruginosa* bacterial biofilms," researchers said. As carrageenan has been widely studied for its antifungal, anti-viral, anti-cancerous and immunomodulatory properties, the nanocomposite based on it can have huge potential in biomedical applications.

The new nanocomposite also has potential applications in food packaging industry as microbial films spoil food products. "We are currently devising cost-effective anti-bacterial wound dressing materials and food packaging materials using the new nanocomposite. We plan to study its efficacy as potent anti-fungal and anti-viral agents too," said Dr. Krishna Mohan Poluri, a member of the research team, while speaking to India Science Wire. The research results have been published in *Journal Carbohydrate Polymers*.

<https://www.downtoearth.org.in>

Transgenic rice for high salinity and drought conditions

A group of researchers from Jawaharlal Nehru University (JNU), International Centre for Genetic Engineering and Biotechnology (ICGEB) and University of Illinois have developed transgenic rice that promises to generate high yields even under conditions of high salinity, high temperature and drought. The scientists hit upon the idea while studying a wild rice variety, Pokkali, grown in coastal regions of Kerala. When they tried to figure out its ability to survive and thrive in highly saline environment, it emerged that it had very high level of a gene, OsIF.

Tests showed that the plant expressed the gene four times more than in traditional plants. Using this insight, researchers raised another rice plant, IR 64, with OsIF over-expressed in it. They did so by using a promoter derived from cauliflower mosaic virus (CaMV). It was found that over-expression of OsIF improved the growth and yield of this plant significantly in adverse conditions of high salinity, high tempera-

ture and drought. This plant had a yield of 20 per cent more than a normal one.

Further studies showed that over-expression helped by stabilising the process of photosynthesis in the plant. The OsIF gene encodes a protein in rice for cell components called intermediate filaments (IFs). These filaments protect cells from external forces, besides participating in cell adhesion and tissue integrity. They also act as a molecular scaffold that controls intracellular organisation and contribute to signalling events in response to cell stress. The research results have been published *Journal Scientific Reports*.

<https://www.thehindubusinessline.com>

Hybrid corn variety high in vitamin A

Researchers at the Indian Agricultural Research Institute (IARI) have developed a maize variety which is rich in both Vitamin A and essential amino acids through the process of plant breeding. ... The hybrid varieties of maize currently grown in India, though rich in essential amino acids – lysine and tryptophan – are poor in vitamin A. Scientists have developed a new hybrid variety of maize by crossing. It contains natural variations of three genes – beta-Carotene Hydroxylase, Lycopene-eta-Cyclase and Opaque2 – required for production of high amount of vitamin A and the two essential amino acids. The new hybrids, thus produced, have 4.5 folds more vitamin A content and similar amounts of lysine and tryptophan as earlier varieties.

In addition, the grain yield of new hybrids has been found to be similar to existing varieties, as evaluated by growing both varieties at two different locations in India. Researchers believe that bio-fortified high-yielding maize hybrid could help address micronutrient malnutrition.

<https://geneticliteracyproject.org>

ISRAEL

Bacteria to cure fungal infections

Researchers in the Technion-Israel Institute of Technology's Faculty of Biotechnology

and Food Engineering have cured fungal infections using a soil-dwelling bacteria. The findings of the research led by Assistant Professor Boaz Mizrahi and conducted by his student Maayan Lupton and Dr. Ayelet Orbach were published recently in *Advanced Functional Materials*.

Fungal infections are common among various animals, including humans. One of the primary sources of such infections is *Candida* – a yeast regularly found in our bodies. *Candida* exploits abnormal functioning in the organism to spread and harm the host. Most people will experience a fungal infection at least once in their lifetime, in some part of their body – on the skin, in the digestive system or genitals.

The frequency of fungal infections is constantly on the rise due to the aging population and possibly global warming. Additional reasons include use of drugs, which suppress the immune system, and the increased use of broad-spectrum antibiotics, which indirectly enhance the proliferation of *Candida* by disrupting the bacteria balance in the body.

The researchers assessed the possibility of treating *Candida* via the bacillus subtilis bacterium, which naturally produces and secretes substances that inhibit *Candida* growth. This mechanism evolved in the bacteria as part of its competition with *Candida* over common growth substrates.

"Our first challenge," said Assistant Professor Mizrahi, "was to develop a transport system that would enable application of the live bacteria on the infected lesion without impairing their ability to proliferate and secrete their therapeutic substances in the target site."

To do so, the researchers developed a unique gel that is in liquid form in the refrigerator and at room temperature (enabling easy application on the skin), but which hardens within seconds after being applied to the skin. Beside the thermo-responsive polymers, the gel contains food substances, which ensure maintained bacterial viability on the skin, where they can "treat" the infection. The researchers applied the gel on the skin of mice suffering from a fungal infection,

after marking it (the gel) with a fluorescent substance that would allow for monitoring. The formulation penetrated deep into the skin but not into the underlying blood vessels, implying that the effect of the formula is limited to the diseased area. Later, the clinical efficacy of the bacterial formulation was demonstrated on mice suffering from *Candida* infection. In the control groups – treated with bacteria-free gel or not treated at all – the infection continued to develop, but the group treated with the Technion-developed bacterial gel showed rapid skin healing. Moreover, comparison of the novel treatment to the commonly used ketoconazole demonstrated the superiority of the Technion gel both from the clinically and the safety point of views.

The researchers noted that aside from development of the unique gel, a new therapeutic treatment model was demonstrated here: a miniscale factory, which after its penetration into the target, begins to produce the active substance. This is in contrast to the standard pharmaceutical model, in which the drug passes through the entire body and portions of it may be broken down in the process. The researchers hope that their novel model will be used in the future to treat a range of diseases, including psoriasis, acne, various inflammations and even cancer.

<https://phys.org>

REPUBLIC OF KOREA

Antimalarial substance

Republic of Korean scientists have discovered a substance that could be used as a new malaria treatment in a rare native microorganism found on the East Sea island of Ulleung, a state-run research center said. The Korea Research Institute of Bioscience and Biotechnology (KRIBB) said its scientists found the anti-malaria substance in actinomycete, a rare microorganism that lives in the soil of Ulleung Island. Actinomycetes are bacteria that live in various environments such as soil, plants, animals, rivers and seawater. They have been used as important biological resources for the development of new drugs

for decades.

KRIBB researchers selectively isolated very slowly growing bacteria from Ulleung Island soil and then examined liquid extracted from them. They discovered four kinds of new compounds that showed inhibitory activity against *Plasmodium falciparum*, one of the protozoans that cause malaria, without cytotoxicity.

“The successful isolation of the rare microorganism and secondary substances indicates the possibility of utilizing Ulleung Island soil as an important domestic resource,” said a researcher at the KRIBB. The KRIBB’s paper on the Ulleung Island achievements was published in the November issue of *Organic Letters*.

<https://en.yna.co.kr>

Biosensor to produce microbial cell factories

A research group at Korea Advanced Institute of Science and Technology (KAIST) presented a novel biosensor which can produce diverse, high-level microbial cell factories. The biosensor monitors the concentration of products and even intermediates when new strains are being developed. This strategy provides a new platform for manufacturing diverse natural products from renewable resources. The team succeeded in creating four natural products of high-level pharmaceutical importance with this strategy.

Malonyl-CoA is a major building block for many value-added chemicals including diverse natural products with pharmaceutical importance. However, due to the low availability of malonyl-CoA in bacteria, many malonyl-CoA-derived natural products have been produced by chemical synthesis or extraction from natural resources that are harmful to the environment and are unsustainable. For the sustainable biological production of malonyl-CoA-derived natural products, increasing the intracellular malonyl-CoA pool is necessary. To this end, the development of a robust and efficient malonyl-CoA biosensor was required to monitor the concentration of intracellular malonyl-CoA abundance as new strains are developed.

Metabolic engineering researchers at KAIST addressed this issue. This research reports the development of a simple and robust malonyl-CoA biosensor by repurposing a type III polyketide synthase (also known as RppA), which produces flaviolin, a colorimetric indicator of malonyl-CoA. Subsequently, the RppA biosensor was used for the rapid and efficient colorimetric screening of gene manipulation targets enabling enhanced malonyl-CoA abundance. The screened beneficial gene targets were employed for the high-level production of four representative natural products derived from malonyl-CoA. Compared with the previous strategies, which were expensive and time-consuming, the new biosensor could be easily applied to industrially relevant bacteria including *Escherichia coli*, *Pseudomonas putida*, and *Corynebacterium glutamicum* to enable a one-step process.

The study employs synthetic small regulatory RNA (sRNA) technology to rapidly and efficiently reduce endogenous target gene expression for improved malonyl-CoA production. The researchers constructed an *E. coli* genome-scale synthetic sRNA library targeting 1,858 genes covering all major metabolic genes in *E. coli*. This library was employed with the RppA biosensor to screen for gene targets which are believed to be beneficial for enhancing malonyl-CoA accumulation upon their expression knockdown.

From this colorimetric screening, 14 gene targets were selected, all of which were successful at significantly increasing the production of four natural products (6-methylsalicylic acid, aloesone, resveratrol, and naringenin). Although specific examples are demonstrated in *E. coli* as a host, the researchers showed that the biosensor is also functional in *P. putida* and *C. glutamicum*, industrially important representative gram-negative and gram-positive bacteria, respectively. The malonyl-CoA biosensor developed in this research will serve as an efficient platform for the rapid development of strains capable of producing natural products crucial for the pharmaceutical, chemical, cosmetics, and food industries.

An important aspect of this work is that the high-performance strains constructed in this research were developed rapidly and easily by utilizing the simple approach of colorimetric screening, without involving extensive metabolic engineering approaches. 6-Methylsalicylic acid (an antibiotic) could be produced to the highest titer reported for *E. coli*, and the microbial production of aloesone (a precursor of aloesin, an anti-inflammatory agent/whitening agent) was achieved for the first time.

<https://www.eurekalert.org>

EUROPE FINLAND

Turning skin cells into pluripotent stem cells

Professor Timo Otonkoski at the University of Helsinki and Professor Juha Kere at Karolinska Institutet and King’s College London, with their teams of researchers, have now for the first time succeeded in converting skin cells into pluripotent stem cells by activating the cell’s own genes. This was achieved by using gene editing technology - called CRISPRa - that can be directed to activate genes. The method utilizes a blunted version of the Cas9 ‘gene scissors’ that does not cut DNA and can therefore be used to activate gene expression without mutating the genome.

“CRISPR/Cas9 can be used to activate genes. This is an attractive possibility for cellular reprogramming because multiple genes can be targeted at the same time. Reprogramming based on activation of endogenous genes rather than overexpression of transgenes is also theoretically a more physiological way of controlling cell fate and may result in more normal cells. In this study, we show that it is possible to engineer a CRISPR activator system that allows robust reprogramming of iPSC”, tells Professor Otonkoski.

An important key for the success was also activating a critical genetic element that was earlier found to regulate the earliest steps of human embryo development after fertilization. “Using this technology, pluripotent stem cells were obtained that

resembled very closely typical early embryonic cells”, Professor Kere says.

The discovery also suggests that it might be possible to improve many other reprogramming tasks by addressing genetic elements typical of the intended target cell type.

“The technology may find practical use in bio banking and many other tissue technology applications”, says PhD student, MSc Jere Weltner, the first author of the article published in *Nature Communications*. “In addition, the study opens up new insights into the mechanisms controlling early embryonic gene activation.”

<https://www.eurekalert.org>

SPAIN

Antifungal proteins in plants

Researchers from the Spanish Research Council (CSIC) at the Centre for Research in Agricultural Genomics (CRAG) and the Institute for Plant Molecular and Cellular Biology (IBMCP), in collaboration with the IATA, have developed a biotechnological tool to produce, in a very efficient manner, antifungal proteins in plants. The results of this research, that could impact the agri-food and pharmaceutical sectors, have been published this week in the *Plant Biotechnology Journal*.

Disease-causing fungi that infect plants, animals and humans pose a serious threat to human and animal health, food security and ecosystem resilience. More people die every year from fungal infections than from malaria. Furthermore, fungal infections can have fatal consequences for at-risk immunocompromised patients with HIV/AIDS and organ transplantation, among others. In addition, fungi are a challenge to food security because they destroy major crops globally and contaminate food and feed with mycotoxins that are detrimental to animal and human health.

Maria Coca, researcher at CRAG and one of the senior authors of the study, explains that “only a few classes of antifungal agents are available today, and even these are not fully effective due to the development of resistance, host toxicity, and undesirable

side effects. Many of these compounds do not even comply with the regulations, and therefore they cannot be used. Thus, there is an urgent need to develop novel antifungals, whose properties and mechanisms of action represent improvements on the existing ones, and which can be applied in diverse fields, including crop and postharvest protection, preservation in cosmetics, materials and food, and animal and human health.” Coca’s research group, in collaboration with the IATA’s researcher Jose F. Marcos, aims to develop new antifungal compounds based on the antifungal proteins (AFPs) secreted by filamentous fungi. The problem is that the synthesis of these compounds is extremely complex; hence their exploitation requires efficient, sustainable and safe production systems.

The CSIC researcher at the IBMCP José Antonio Daros is an expert in viruses that infect plants. Through genetic engineering, Daros and his team in Valencia managed to modify the tobacco mosaic virus (TMV) so that, instead of producing its own pathogenic proteins, it produced other proteins of interest. In Barcelona, the team led by Maria Coca implemented this tool to produce antifungal proteins in leaves of the *Nicotiana benthamiana* plant - a plant from the tobacco family widely used in research - discovering that these leaves produced large quantities of these new antifungals.

In addition, the researchers demonstrated that extracts recovered from the *N. benthamiana* plants are active against pathogenic fungi, being able to protect the tomato plant from the infection by the fungus *Botrytis cinerea*, better known as grey mould. The work of the CRAG, IBMCP and IATA researchers shows that the plants can be used as biofactories of antifungal proteins for commercial purposes.

<https://www.news-medical.net>

UK

Technology to highlight cancer area for biopsies

A research team at University College London (UCL) has developed a new technology that could pinpoint the potential

cancer area in the prostate gland, allowing better biopsies and disease detection.

The new technology, deployed through the SmartTarget system, creates a 3D model of the prostate and cancer from MRI scans of each patient by leveraging image processing and machine learning algorithms. While performing a biopsy, the 3D model can be integrated with ultrasound images to pinpoint the area of concern in order to guide surgeons in detecting the cancer quickly. The researchers said that the technology has enabled surgeons to identify clinically relevant cancers that were missed with existing visual detection techniques. They believe that a combination of both techniques would be the best approach.

During a study, the team performed two biopsies in 129 people with suspected prostate cancer using the SmartTarget system and visual MRI scan review. The combination of the two methods identified 93 clinically significant prostate cancers, while each of them detected 80 and missed 13 that the other technique picked up.

UCL Medical Physics & Biomedical Engineering researcher Dr Dean Barratt said: “We developed the SmartTarget system to equip surgeons with vital information about the size, shape and location of prostate tumours during a biopsy that is otherwise invisible on ultrasound images.” The software provides them with a clear target. As MRI-targeted biopsies require a very high degree of expertise and experience, we hope that the imagery displayed by SmartTarget will help to bring high accuracy prostate cancer diagnosis to a much wider range of patients and hospitals.”

Findings from the research have been published in *European Urology*.

<https://www.medicaldevice-network.com>

NORTH AMERICA

USA

New cancer treatment

Researchers at The University of Texas at Austin have developed a new approach to treating cancer using enzyme therapy. The enzyme, PEG-KYNase, does not directly kill cancer cells but instead empowers the

immune system to eradicate unwanted cells on its own. PEG-KYNase is designed to degrade kynurenine, a metabolite produced by numerous tumors that suppresses the immune system. The UT team's findings were published in a recent issue of *Nature Biotechnology*.

"Our immune system constantly polices the body and normally recognizes and eliminates cancerous cells," said Everett Stone, research assistant professor in the College of Natural Sciences, Department of Molecular Biosciences and co-author of the study. "Kynurenine acts as a roadblock to immune cells that impedes normal surveillance; our drug removes this obstacle."

Enzymes have been used in specific treatments before, to treat cancers such as leukemia for example, but this is the first time one has been designed to take on the role of immune checkpoint inhibitor. The researchers are confident this approach could prove effective in treating a variety of different cancers.

The team, led by Stone and professor George Georgiou in the Cockrell School of Engineering, developed an enzyme therapy that stimulates a human immune system abnormally suppressed by cancer cells, unleashing the body's power to fight back against the disease. Their next step is to initiate clinical trials to test the safety and efficacy of the enzyme.

<https://phys.org>

'Mutant' enzyme that eats plastic

Scientists have developed an enzyme which is able to "digest" some of the planet's most commonly polluting plastics. Undertaken by teams at the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) and the U.K.'s University of Portsmouth, the research could potentially lead to a "recycling solution" for plastic bottles made from polyethylene terephthalate (PET), which lingers in the environment for hundreds of years.

The researchers were initially examining the crystal structure of PETase, an enzyme that can digest PET, in order to understand how it works. But during their research, the

scientists managed to engineer an enzyme that was more effective at "degrading" the plastic than the naturally occurring one, which was recently discovered in the soil of a Japanese recycling plant.

The University of Portsmouth said that the "mutant" enzyme was also able to degrade polyethylene furandicarboxylate, which is a bio-based substitute for PET plastics. The research was published in the *Proceedings of the National Academy of Sciences*.

<https://www.cnbc.com>

Methods to control bacterial factories

Michigan State University scientists have announced a breakthrough in manipulating miniature factories, found in bacteria, that hold much promise in the biotech field. The factories, or bacterial microcompartments, are widespread in nature and do different things depending on the host. For example, in cyanobacteria that harvest energy from the sun, they help to construct high-energy compounds. In our own guts, pathogenic bacteria use the factories – because the processes they perform are inefficient outside of them and sometimes use toxic materials – to outcompete our good bacteria.

Scientists want to retrofit the factories with new machines to perform designed functions. The synthetic versions could sustainably make biofuels, industrial materials and nanoscale medical devices.

In a *Nature Communications* publication, the lab of Cheryl Kerfeld announces new methods to manipulate factories:

- Complementation-based Affinity Purification, or CAP, which quickly screens for the assembly and extraction of the factories
- Encapsulation via Covalent-linkage, or EnCo, which helps to predictably insert custom machinery in the factories
- "Current technologies require many days to prepare and extract a synthetic factory shell," Andrew Hagen, a post-doc in the Kerfeld lab, said. "We also have had limited options to insert custom machinery in it. I wanted to develop better ways to do those two things."

The factory walls are made of protein tiles, shaped like hexagons and pentagons, that snap together to form an enclosure that looks like a soccer ball.

In the lab, scientists rely on chemical mixtures to make synthetic factories. And it is challenging to fish them out once they're completed. The new method shows an easier way to extract the factories:

- The team creates a factory that lacks one of the wall protein tiles.
- They add a tag to the missing tile.
- They add the tile back to the mixture, where it snaps into place when it finds the factories;
- The team extracts the factory with the help of the tagged tile. The team attracts that tag with a system that works like Velcro.

The scientists also report a method to insert custom enzymes inside the factories. It relies on a new technology that works like protein super glue.

"The technology has two entities, SpyTag and SpyCatcher, that are attracted to each other," Andrew said. "We insert a SpyCatcher 'docking site' on the inside of a factory wall. We then add a SpyTag on the machinery. Once in the same environment, the SPY system comes together like glue."

Once 'glued' to a factory, the machinery can't get out. So far, the team has managed to insert 60 copies of a single enzyme into a factory. The team aims to increase that number, as one factory could ideally fit around 200 copies.

The current proof of concept is looking promising. Next is to realize some of the technology's promise. One such application is to produce chemicals that are used in industry. For example, another team member is working on producing the molecule that gets turned into rubber, a process that usually needs fossil fuels. Other ideas include biofuels and medical tools. "We also think other scientists can use these methods with different bacteria and their factories," Andrew said. "There is a good chance they will adopt these new methods widely."

<https://msutoday.msu.edu>

A REVIEW OF BIOTECHNOLOGY COMMERCIALISATION IN SELECTED COUNTRIES

APPROACHES, CHALLENGES AND STRATEGIES IN ASIA

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Abstract

Biotechnology commercialisation is seen as the economic driver that could trigger extensive national growth while at the same time it provides solutions that will improve the quality of life for human. While the attempts to commercialise various research outputs have been done for many years, the results still vary with many countries experiencing various hurdles and researchers experiencing unexpected difficulties. This article focuses on biotechnology commercialisation in four selected countries namely China, Japan, Singapore and Malaysia. A review was done on the challenges faced by these countries as well as their approaches and strategies to achieve success in biotechnology commercialisation. All four countries face different predicaments and approaches. In conclusion, the main issues that seemed to hamper efforts of biotechnology commercialization were found to be lack of local scientific talent, lack of entrepreneurial skills among the academics and financial assistance from government. These very same issues if tackled strategically will also be the key factors which could ensure commercialisation success of biotechnology processes and products.

Introduction

Biotechnology commercialisation is now viewed as one of the main economic drivers in numerous countries in Asia. Biotechnology commercialisation entails commercialising research and development (R&D) outputs from universities, research institutes and companies into products or processes that have a significant commercial value. However, the commercialisation of life science technologies involves long and bumpy processes, with highly uncertain outcomes and high chances of failure.

The characteristics and the range of issues related to the commercialisation of biotechnology research differ between developing and industrialised countries. In industrialised countries, biotechnology is viewed as an all-pervasive profit-generating technology and a strategic component of industrial competitiveness (Othman, et al., 2014), whereas in developing countries, revenue generation from biotechnology commercialisation is still far from being ideal and rarely meets the expected

return from its huge investment. However, despite facing various challenges, several countries in Asia have notably put up the necessary framework which are followed with concrete strategic approaches to harness the benefits of biotechnology commercialisation. China, for example, has shown its commitment and mettle in ensuring that it will be at par with countries like the United States in terms of biotechnology research, innovation and commercialisation of its bioproducts. This paper will review the biotechnology sector of four different countries, namely China, Japan, Singapore and Malaysia in order to understand the current trend and the associated strategic approaches as well as the shortcomings in realising the commercialisation of biotechnology products in Asia.

Tales of four countries

Biotechnology in China

Since 2007, China has collaborated with various main players in the biotechnology industry, particularly from the US and UK. These collaborations resulted in an in-

crease in investments, and joint ventures and alliances with various multinational corporations (MNCs), particularly in the drug producing sectors. Such moves indicated China's intention in pushing towards a bigger and wider strategic approach in biotechnology commercialisation. At that point, the total Chinese biotech market, though still small compared to most Western countries, has attracted the attention of MNCs with its robust growth. It remained focus on the commercialisation of biologics, reagents and new drugs. However, at the end of 2017, President Xi Jinping, while clearly and publicly expressing the Chinese government support for biotechnology research, had also stressed the importance of a more cautious approach towards involving foreign companies especially in the commercialisation of agriculture biotechnology products in China. Foreign investments were to be allowed only in conventional or hybrid seed production, and would be restricted to minority shareholdings in joint ventures with Chinese companies (Global Agriculture Information Network, 2018). China has strategically moved towards becoming its own producer of biotechnology products without relying on foreign investments or foreign technological expertise. The strategy is consistent with *The 13th Five-Year Plan for National Science and Technology Innovation (13th FYP)* issued by the State Council in August 2016, which revealed how China was going to push forward with the commercialisation of key products, including the new generation Bt cotton, Bt corn, and herbicide-tolerant soybeans, and commensurate the central government's pledge to invest heavily in its local biotechnology sector.

The rise of biotechnology research in China could also be observed through the huge number of genetic related patents filed by its scientists. A remarkable 1,599 applications for invention patents on genetic engineering were filed between 1985

and 1999 alone (Huang & Wang, 2003). China has also shown the importance of nurturing and hosting world class scientists through the launch of the *Thousand Talents Plan* in 2008, a scheme that orchestrated the return of leading Chinese life science scientists, academics and entrepreneurs living abroad to China. These returnees have made a huge impact, seen especially in the increased number of new drugs approvals in China. It was estimated that out of 2 million returnees to China over the past 6 years, 250,000 of them worked in the life sciences related sectors (Hepeng, 2018).

Despite the slowing down of biotech commercialisation and start-up in the west due to the global financial crisis, financing for biotech in China is actually increasing. Chinese venture capitals and private equity funds raised USD45 billion for investments in life sciences in the two and a half years prior to June 2017, according to ChinaBio (Hepeng, 2018). Beside capital investments, various grants are made available to life science scientists in universities in order to aide them in bolstering the accelerating momentum and to further produce scientists with world class aptitude. The strengthening of human capital in life sciences was also complemented by the building of high quality support infrastructure including more than 100 life sciences parks, aiming to push the biotechnology sector pass the 4% of gross domestic products by 2020. These systematic, aggressive and well-timed strategies are set to propel China to be a major biotechnology forerunner in the world, helming the technical and financial aspects of biotechnological commercialisation, without any signs of slowing down. China's deep pocket will continue to enable and sustain the development of its local biotechnology industry without having to rely on foreign investments. Additionally, the homegrown life science scientists will help the country to further explore the vast potential of the biotechnology development and commercialisation well into the future.

Biotechnology in the land of the rising sun

Japan's capability in biotechnology and life science research is outstandingly at par with

the US and Europe. The level of commercialisation of the research outcomes is evident in the rising number of biotech start-up companies in Japan as well as the increase in the number of patents being filed. Japan's biotech start-ups involved an enormous capital investment of Japanese Yen (JPY) 445.8 million, with an operating income of JPY47.6 million, and research and development (R&D) expenses totaling up to JPY80.9 million. By 2013, these start-up companies were generating sales of up to JPY668.0 million. As of 2010, Japan's biotechnology industry's worth was estimated to be around JPY2.4 trillion. The Japanese government had earlier introduced the National BT Strategy to ensure that the industry met its full financial prospects. However, the growth of the biotech industry in Japan before 2010 faltered, attributed to the conservative Japanese culture, the country's poor science policy, the massive gap between academic and industry, the abysmal venture capital financing activity, as well as poor public acceptance towards biotechnology products such as GMO (Miyata, 2012). Perhaps the biggest difference between Japan and China is their treatment of foreign investors and partners. China made it clear that foreign involvement was to be limited in terms of shareholding through its tight governance of biotechnology research and commercialisation activities. Japan, on the other hand, welcomes foreign collaborations, which resulted in giant pharmaceutical companies moving their operation from China to Japan. Amidst concerns about China's regulatory efficiency and various impediments faced during bioproducts registration, the acquisition of American pharmaceutical companies such as Althea by Ajinomoto, Plexikon by Daiichi Sankyo and several others, proved Japan's compelling intention to become a biopharma hub in Asia, and this in turn encouraged foreign companies to work closer with Japan to penetrate Asian markets faster and effectively. Nevertheless, Japan faces a specific and special issue that needs urgent attention in the form of its aging society. The political and socio-economic aspects of Japan's aging population must be taken into account in its quest to develop a sustainable biotechnology sector, the impacts of which cannot be understated. This factor also raises another

challenge in the form of a declining labour force, which at the same time also results in rising health demands that need to be addressed. This challenge will inadvertently necessitate efforts for a strong and long term codependency relationship with foreign partners in order to ensure that the biotechnology sector is sustainable in the long run.

Singapore as the new biotechnology hub?

Singapore has indicated its intention to extend biotechnology and innovation as its economic drivers with various strategic moves by the government, which resulted in the increased number of biotech firms in the island state. Between 2015 and 2017 alone, 32 local biotech start-up firms were set up, two times more than the previous 2 years. By the end of 2017, nearly a quarter of the 79 home-grown biotech firms in Singapore were actually spin-offs from the Agency for Science, Technology and Research (A*Star), an agency that was initiated by the government to propel mission-oriented research which then encouraged scientific discoveries and technological innovations. The agency provides a coordinated platform for research, innovation and commercialisation to Singapore's scientists and technologists. The road to a successful biotechnology sector took almost 15 years for the pioneering start-ups and the nation is now enjoying its fruit of labour as the sector is drawing in a steady influx of venture capital financing and producing more biotechnology products which are viable for commercialisation. Singapore's biotech hub largely comprises medical related (medtech) sub industry and by 2016, the medtech industry was reported to be worth about USD3 billion (Hynes, 2017). Singapore's research infrastructure with various world class research facilities, together with the country's foreign investment friendly environment, acted as the main catalyst in attracting local start-ups as well as global multinationals. The government's efforts have resulted in the participation of biotech heavyweights such as GlaxoSmithKline, Sanofi and Novartis; a clear indication of its strategic acumen in ensuring Singapore continues to prosper in leaps and bounds in its biotechnology

innovation and commercialisation activities in the future.

Malaysia biotechnology aspiration

Malaysia launched the National Biotechnology Policy (NBP) in 2005, in an attempt to jump start the biotechnology sector. NBP provided a comprehensive framework to guide biotechnology development efforts in the country as well as a more integrated framework for industry development, outlining a comprehensive set of goals, priorities and strategies. This strategy was affirmed in 2006 via the Ninth Malaysia Plan (2006–2010) with a substantial fund allocation of MYR2 billion (USD0.58 billion) for biotechnology-related activities. In support of the strategy, local universities have also been producing more than 4,000 graduates with Bachelor, Masters and PhD degrees since then. The graduates were equipped with a wide spectrum of life sciences and biotechnology based specialisation such as molecular biology, plant biotechnology, bioprocess engineering, bioinformatics and marine biotechnology. The Ninth Malaysia Plan also outlined how the country must focus on implementing the NBP to develop Malaysia's niches in agriculture biotechnology, healthcare-related biotechnology, industrial biotechnology and bioinformatics, intensifying the need to promote local and foreign investments in the sector. However, more than 10 years after the launch of NBP, the intended outcomes have yet to be significantly realised. Stakeholders in the sector cited lack of skilled human capital and industrial bases, and many research products having no commercialisation value (Mokhtar & Mahalingam, 2010) as the main reasons for the underwhelming growth of the biotechnology sector in Malaysia. In 2012, the then government of Malaysia put forward the Bioeconomy Transformation Programme (BTP), aiming to accelerate the industry and maintaining the focus on specific bio-based industries that had been identified as potential key strengths of the nation. Several biotechnology parks were established to act as an economic accelerator for the biotechnology sector. One such park is in the Iskandar Malaysia develop-

ment area, strategically located in Johor state, just across the causeway from the bustling Singapore. The park is home to several foreign biotechnology companies such as Biocon from India, Amore Pacific from South Korea, Hydromission and BioAyzia from Singapore, together occupying about 50% of the park. However, stakeholders in the industry are saying that the development of the biotechnology sector is still not at par with neighbouring countries mainly due to lack of skilled and knowledgeable workers. Despite such setbacks, the government of Malaysia through its government-linked companies and agencies continue to push forward the innovation and commercialisation activities to support biotechnology companies. Based on data from MyIPO, the number of patents issued has steadily increased since 2005 (Figure 1). This goes to show that, while there are still various hurdles to overcome, Malaysia's biotechnology sector is catching up with the rest of the Asian countries.

Key challenges in biotech commercialisation

Lack of local talents

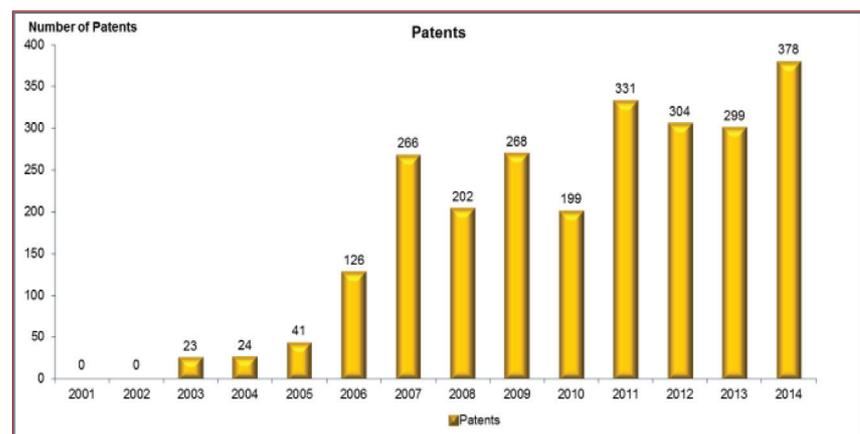
In all the countries reviewed above, the main source of knowledge and innovations in biotechnology is the local researchers and the local universities. This pattern shows that it is crucial that Asian countries develop their own biotechnologists and life science scientists in order to propel the growth of the sector. Malaysia's case clearly

reflects how a lack of local talents can derail even the most immaculately developed strategy. China's strategy to lure back its life science scientists fortified the importance of having adequate and highly skilled workers to helm the biotechnology industry. The nation honed its own talents while, at the same time, luring foreign scientists with huge R&D funding. Through having a significant number of scientists, China has become the main producer of patents from their research works (Figures 2 and 3). Thus, any countries with a similar aspiration should look into developing a structured academic approach in order to produce highly capable scientists and innovators.

Malaysia's biotechnology sector evidently suffers from lack of talents as capable researchers remain the most important part of biotechnology commercialisation, regardless of demographic, social and cultural aspects. High quality life science scientists are the core element which ensure continuous production of novel ideas, innovations and bioproducts. The lack of such important element has severely impeded Malaysia biotechnology research and the subsequent commercialisation efforts compared to Singapore.

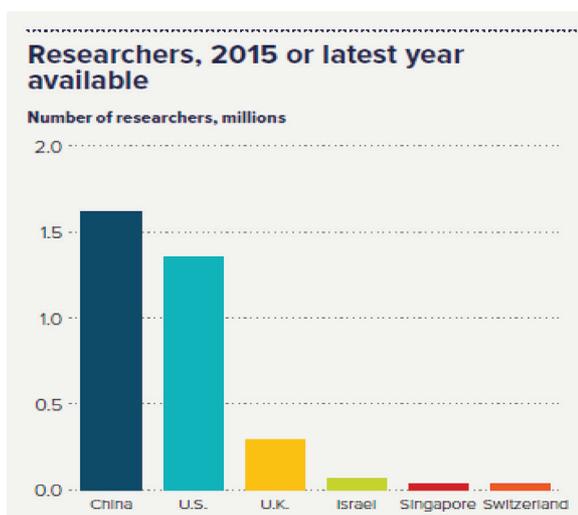
Entrepreneurial acumen

Commercialisation of any type of innovations, especially involving academics, is not for the weak-hearted. Multi-dimensional aspects of commercialisation include such elements as business acumen, critical soft



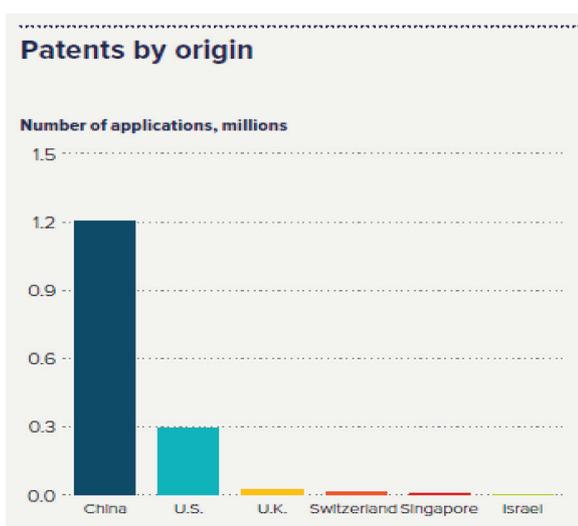
Source: Bibliometric Study 2015, MASTIC

Figure 1: Number of patents filed in Malaysia from 2001-2014



Source: World Intellectual Property: The Global World Innovation Index 2018

Figure 2: Number of researchers (in millions) by countries



Source: World Intellectual Property: The Global World Innovation Index 2018

Figure 3: Number of patents applications (in millions) by countries

skills; e.g. in negotiation, legal aspects of licensing and many other business related dexterities, which are not exactly the forte of most academics. Biotechnology commercialisation focuses on revenue generation by bringing the products to the market. However, for this to be successfully done, there are various pre-market processes that the scientists as the owner of the technology must undergo. Such activities include filing for patents, the technology licensing procedure, assessing the potential of establishing spin-off companies, determining the

amount of royalty payments, as well as deciding on the most suitable business plan. All these could be very overwhelming to academicians, especially when they have not been exposed to any business knowhow before undertaking the commercialisation related activities. To some researchers, especially the newly minted entrepreneurs, they might be reluctant to leave behind their role as a scientist and may experience hesitancy in delving wholeheartedly into becoming a full time entrepreneur. Having to perform a dual role, both as a researcher as well as

an entrepreneur, may prove to be burdensome, especially when there is a serious lack in commercialisation knowledge and business knowhow. Therefore, it is crucial for support agencies, either the university itself or the commercialisation agency, to understand this problem and provide adequate training and support to the scientist-turned-entrepreneur in order to ensure the commercialisation process is successful and start-ups are sustained.

Financial assistance

Funding is deemed critical for the enrichment of biotechnology research (grants to universities and third party research companies) as well as to support the commercialisation process itself (seed money, start-up grants etc.). It might be a surprise to many that even Apple Inc. was once the receiver of US government funding (Mazzucato, 2013). China's deep pocket has proven to be its strength as, funded heavily by the central government, China's biotechnology sector boasts of world class research and commercialisation infrastructures and enormous financial support that do not only lure its citizens, but are able to entice even the Western researchers. Free of financial worries, these researchers are able to focus solely on conducting high quality research that eventually lead to equally high quality bioproducts. Financial assistance not only will ensure more uptake of life sciences related research, but will also provide a sense of security for researchers-turned-entrepreneurs into embarking into the uncertain world of commerce. Apart from that, strong support from the government is also perceived as the country's commitment in ensuring continuous promotion of the biotechnology sector, just as Singapore is being perceived by foreign investors from the US and UK. Biotechnology related investment is deemed as high risk with high uncertainty, thus a compounded effort by the host country can be the deal breaker to attract foreign investors and collaborators into to the local biotechnology scene.

Conclusion

Biotechnology commercialisation could become the new significant source of

national income for various developing countries in Asia as it is in the developed nations. However, it is important that each element of the commercialisation process be strongly supported in order for the products to successfully reach the market. The commercialisation process, starting from the laboratory until the end consumers, needs to be within a tested framework that can be regulated. At the same time, the implementation and execution of the commercialisation process involving technology transfers needs to be carried out effectively in order to mitigate any risks of failure. Government support, strategically through proper commercialisation system and human capital development, and financially through various funding of commercialisation

activities, is the main catalyst in ensuring that the commercialisation process of biotechnology in Asia will achieve its desired outcomes.

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Guide to tackling issues in access & benefit-sharing agreements

The World Intellectual Property Organization (WIPO) and ABS Capacity Development Initiative have jointly published "A Guide to Intellectual Property Issues in Access and Benefit-sharing Agreements". The guide, which is complementary and mutually supportive of the WIPO database of biodiversity-related access and benefit-sharing agreements, covers the conceptual and practical aspects of dealing with intellectual property in the context of access and benefit-sharing agreements.

Genetic resources are subject to access and benefit-sharing regulations, in particular within the international legal and policy framework defined by the Convention on Biological Diversity and its Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization, the International Treaty on Plant Genetic Resources for Food and Agriculture of the United Nations Food and Agriculture Organization and the Pandemic Influenza Preparedness Framework of the World Health Organization. Intellectual property issues are one of the elements of the broader framework on access and equitable benefit-sharing. The strategic management of intellectual property issues in an access and benefit-sharing agreement can influence the degree to which providers and users of genetic resources and associated traditional knowledge can achieve their goals and serve their mutual interests.

The Guide's objective is to support providers and users of genetic resources and associated traditional knowledge when managing intellectual property issues in access and benefit-sharing agreements. It does so by explaining how intellectual property clauses may influence the approach and results of the utilization of genetic resources and associated traditional knowledge, providing an overview of the types of intellectual property related issues that providers and users of genetic resources and associated traditional knowledge are likely to face when negotiating an agreement, and outlining the options available in managing those issues, thereby enhancing the information available to stakeholders. The guide draws on a number of practical experiences across a range of economic sectors, including pharmaceuticals, industrial biotechnology, agriculture, cosmetics, and food and beverages, and describes issues that have arisen in practice in those sectors and the various approaches taken to resolving them.

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BIOTECHNOLOGY COMMERCIALIZATION IN THE REPUBLIC OF KOREA

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Abstract

In a knowledge-based economy, biotechnology industry is considered as one of the key industry whose development is important for national competitive advantage. In the era of globalization, many national and local governments are eager to develop the biotechnology industry to build up the capabilities for the future of their economies. Based on a firm survey of the Korea Biotechnology Industry Organization in the biotechnology industry, recent trends in the industry were studied. Intellectual property-based finance were introduced to promote commercialization of biotechnology. Findings showed that SMEs participate actively in the Korean biotechnology industry and the venture capital investment in the biotech sector had been growing rapidly. Using intellectual property-based finance, SMEs could monetize their intellectual property more easily. This study provides meaningful information for decision makers in the biotechnology industry.

Biotechnology industry

Biotechnology is recognized as one of the most important industries in a knowledge-based economy (Kang and Park, 2012). Since Karl Ereky created the word 'biotechnology' in 1919 to refer to 'methods and techniques that allow the production of substances from raw materials with the aid of living organisms', biotechnology has been defined in many different ways (Kang 2009, OECD 1999). In OECD, biotechnology was defined as 'the application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services' (Kang 2009, OECD 2005).

Biotechnologies give rise to biotechnology industry when they are applied at industrial and commercial scale (Kang 2009, Sasson 2004). Because the scope of the industry is determined by biotechnology itself and is extended in accordance with technological development, biotechnology firms are not classified within a single industry in

industrial classification systems (Kang 2009, KIET 2004). In Republic of Korea, a biotechnology industry classification system of eight categories has been used (KBIO 2017). Table 1 presents the structure of the biotechnology industry classification system in the Republic of Korea.

In the Republic of Korea, biotechnology initially began to develop in academia such as universities and research institutes in the early 1980s (Kang 2009, KIET 2003). The Republic of Korean government actively invested in the biotechnology industry during the 1990s and

SMEs and large established firms began to actively participate in the biotechnology industry around the year 2000 (Kang 2009, KIET 2003). Biotechnology industry in the Republic of Korea had been growing rapidly with 21.52% CAGR (Compound Annual Growth Rate) during 1999~2004 (KIET 2007).

According to the report from KBIO, the domestic biotechnology industry has steadily progressed. The survey data on the biotechnology industry in the Republic of Korea showed that the Korean biotechnology industry had been steadily growing with 4.8% CAGR during 2012~2016 (KBIO 2017) (Table 2). Total size of domestic supply in 2016 was 8.9 trillion won and total size of domestic demand was 5.9 trillion won (KBIO 2017). The biopharmaceutical industry is the largest sector and the biofood industry is the next largest one (Table 3).

Biotech SMEs

In the biotechnology industry, one of high-tech industries, start-ups and small firms play a crucial role in the advancement of the industry (Audretsch 2001, Giesecke 2000, Kang and Park 2012). The size of the firm is what is most contrasted in many literatures since Schumpeter's contrast results. Schumpeter (1934) argued the small-scale entrepreneur was the key of capitalism's vitality (Schumpeter I) but later he saw the large-scale enterprise as the principal innovator (Schumpeter II)

Table 1: Structure of the biotechnology industry classification system in Republic of Korea

Categories	Name of industrial classification
Goods	Biopharmaceutical industry Biochemical and bioenergy industry Biofood industry Bioenvironmental industry Biomedical equipment industry Bioinstrument and bioequipment industry Bioresource industry
Services	Bioservice industry

Source: KBIO 2017

Table 2. Size of production and domestic demand in biotechnology industry (2012-2016) (Unit: billion won, %)

Classification		2012	2013	2014	2015	2016	Annual average rate of change
Supply and Demand (Production + Import)	Investment amount	8,575.6	8,898.0	9,007.6	9,912.6	10,338.2	4.8
	Distribution ratio	10.6	3.8	1.2	10.0	4.3	
Production (Domestic sales + Export)	Investment amount	7,144.5	7,510.8	7,607.0	8,503.9	8,877.5	5.6
	Distribution ratio	10.5	5.1	1.3	11.8	4.4	
Domestic Demand (Domestic sales + Import)	Investment amount	5,528.1	5,733.7	5,602.4	5,626.6	5,892.6	1.6
	Distribution ratio	9.6	3.7	-2.3	0.4	4.7	

Source: KBIO 2017

Table 3: Size of production and domestic demand in biotechnology industry (Unit: million won, %)

Industrial category	Production		Domestic demand	
	Total	Distribution ratio	Total	Distribution ratio
Total	8,877,520	100.0	5,892,591	100.0
Biopharmaceutical industry	3,350,668	37.7	2,930,875	49.7
Biochemical and bioenergy industry	1,112,534	12.5	1,064,450	18.1
Biofood industry	2,918,164	32.9	1,229,242	20.9
Bioenvironmental industry	29,479	0.3	29,272	0.5
Biomedical equipment industry	587,645	6.6	120,689	2.0
Bioinstrument and bioequipment industry	124,582	1.4	118,713	2.0
Bioresource industry	170,241	1.9	154,081	2.6
Bioservice industry	584,207	6.6	245,269	4.2

Source: KBIO 2017

(Schumpeter 1942, requoted from Cohen and Klepper 1992, Kang 2009). Arguments exist both supporting a large size and a small size with regard to its effect on innovation performance (Galende and de la Fuente 2003, Kang 2009). Scholars studying small firms argued that they have a merit of 'greater flexibility, better communication, greater specialization possibilities, informal and strategic controls' and have the relative advantage in highly innovative industries (Acs and Audretsch 1987, Galende and de la Fuente 2003, Kang 2009).

In 2016, 57.7% of companies in Republic of Korean biotechnology industries belonged to 'less than 50 workers' and 29.1% of companies belonged to 'from 50 to 299' among total size of workers (KBIO, 2017) (Figure 1).

On the other hand, the biotechnology industries are 'comprised of a value chain of highly interrelated but distinguish-

able activities' including R&D, clinical trials, evaluation, manufacturing and sales (Kang 2009, Szuhaj 2008).

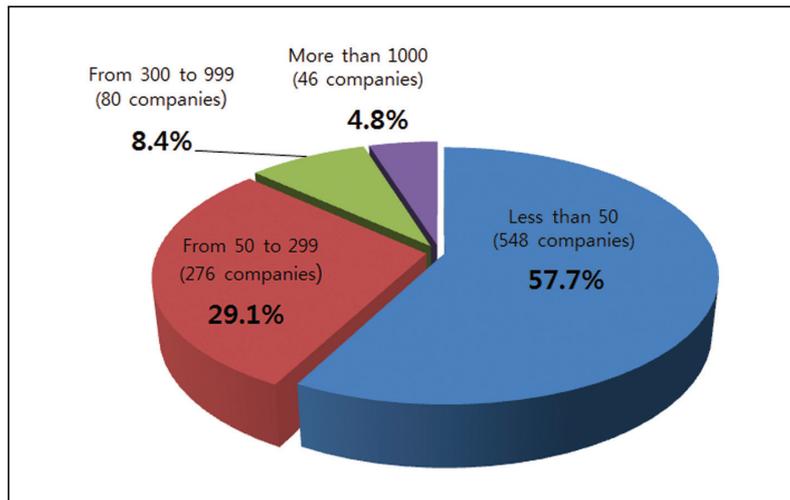
When considering the main actors in each process, biotech SMEs are located at the hub of a network of upstream and downstream relationships (Table 4, Figure 2). Therefore, biotech SMEs serve as 'value-added intermediaries' between upstream partners (e.g. universities) and downstream partners (e.g. established enterprises), taking on 'a dual role of knowledge transformation and commercialization' (Kang 2009, Rothaermel and Deeds 2004, 2006, Stuart et al. 2007).

Collaboration (Networking)

In high-tech industries, where rapid scientific or technological developments have occurred, knowledge is broadly distributed that 'no single firm has all the internal capabilities necessary for success' (Kang 2009, Powell et al 1996). Many previous studies

revealed that the correlation between innovation and interaction with other actors is positive (Baum et al. 2000, George et al. 2002, Hagedoorn 1993, Kang 2009, Romijn and Albaladejo 2002, Rothaermel and Deeds 2006, Shan et al. 1994). There are two groups of literatures to study effects of inter-firm partners in particular (Kang 2009, Stuart et al. 2007). One has been focused on connections between biotechnology firms and universities including public research institutes (Kang 2009). The other has been focused on collaboration between biotechnology firms and established firms such as big pharmaceutical companies (Kang 2009). These interactions help firms to overcome deficiencies in their information, scientific knowledge, resources and competencies (Becheikh et al. 2006, Kang 2009, Kang and Lee 2008, Romijn and Albaladejo 2002).

Biotechnology firms maintain broad and deep interaction with universities



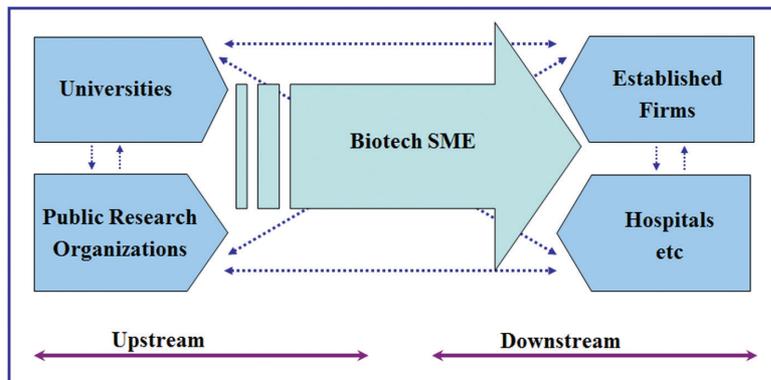
Source: KBIO, 2017

Figure 1: Korean biotechnology industries' distribution per size of workers

Table 4: Main actors in each value-chain in biotechnology industry

Value chains	Main actors
R&D (Basic)	University, Research institutes
R&D (Application)	Biotech SMEs, Large established firms
Clinical trials/evaluation	Research hospitals, Firms specializing in clinics
Manufacturing	Large established firms
Marketing	Large established firms

Source: Powell et al. 1996, Kang 2009



Source: Kang 2009, modified by author

Figure 2: Inter-firm networks of biotech SMEs

(Stuart et al. 2007). Zucker et al. (Zucker et al. 1998; Zucker et al. 2002; Zucker and Darby 2001) investigated co-authorships and argued that the dependence of new biotechnology firms on university science, in particular human capital like star scientists, ran so deep (Kang 2009, Stuart et al., 2007). George et al. (2002) found that

companies with university linkages had higher levels of innovative output and Baum et al.'s study revealed that biotech startups which formed upstream alliances generally exhibited stronger performance (Baum et al. 2000, Kang 2009).

The strong complementary nature of biotechnology firms and established

firms makes collaboration between established firms and biotechnology firms quite positive and supportive (Audretsch and Feldman 2003, Kang 2009). While new biotechnology firms are specialized in the certain types of knowledge, products and applications, large established firms 'have experience in large-scale production, marketing and distribution and the regulatory process required to bring products to the market' (Audretsch and Feldman 2003, Kang 2009). And procuring complementary assets through market exchange is apparently more efficient than the internal transaction (Audretsch 2001, Kang 2009). For these reasons, networks between biotechnology firms and established companies blew up in the mid-1980s (Cullen and Dibner 1993 quoted from Audretsch 2001 and Audretsch and Feldman 2003, Kang 2009). Baum et al. (2000) found that downstream alliances generally exhibited strong initial performance (Baum et al 2000, Kang 2009).

In Republic of Korean biotechnology industries, 29.6% of 980 companies have cooperative relationships with other organizations as of 2016 (KBIO 2017). The most frequently found type of cooperative relationship was 'joint R&D contract' (83.4%), followed by 'technical tie-up and licensing' (22.1%) and domestic and international technical manpower exchange (11.4%) (KBIO 2017, Multiple responses accepted).

By cooperating organization, the number of cooperation cases with Universities was frequently found (36.0%), followed by cooperation cases with business entities (35.6%), research institutes (21.9%) and medical institutes (6.5%) (KBIO 2017). The number of cooperation cases between a bioindustrial company with 1 - less than 50 workers and a university is large at 174 (KBIO 2017) (Table 5).

Kang (2009) examined the effects of domestic and international networks on firm's innovation and found that not domestic partnerships but foreign partnerships positively affected both domestic and global innovation performance. Physical proximity is less important and ICTs act as the material devices to help firms to communicate with partners in the distance (Kang, 2009). OECD's study also suggested that

Table 5: Cooperating organizations by scale of workers (Unit: Count)

Classification		Cooperative relationships in total	Business entities	Research institutes	Universities	Medical institutes
Total	Total	1,157	412	253	417	75
	1 – less than 50 workers	468	162	110	174	22
	50 – 299	392	131	72	155	34
	300 - 999	94	27	15	40	12
	1,000 or more	203	92	56	48	7

※ 1-less than 50 workers: 548 companies; 50-299: 276 companies; 300–999: 80 companies; 1,000 or more: 46 companies.

Source: KBIO, 2017

collaboration with foreign customers can help firms to develop new products, processes or other innovations (Kang, 2009, OECD 2008). It is needed to be linked with foreign entities to promote biotechnology industry in the Republic of Korea. However, firms must realize the many obstacles they are likely to confront before initiating international collaboration and try to obtain skill and sensitivity toward resolving the managerial challenges (Hergert and Morris 2002, Kang 2009).

Intellectual Property-Based Finance

Biotechnology industry is a science-intensive sector and innovative activities in biotechnology require strong R&D efforts to explore and explicit knowledge (Kang 2009, Mangematin *et al.* 2003, Orsenigo 1989). The intellectual property system provides incentives for R&D, particularly in fields where innovations have long gestation periods. Inventions and technological advances are the important source of economic growth and the legal systems for IP are needed to motivate inventors. The protection of research results becomes important in such research-based industry (Burron 2006). The legal systems enable innovative entities to earn financial benefit from what they invent by using intellectual property-based finance. Intellectual Property-based finance refers to any kind of financing on Intellectual property (Kang 2017). Venture capital investments, the credit guarantee system, and IP trust are major parts of IP finance (Kang 2017).

Venture capital investment

Venture capital financing is generally considered as the most suitable external financing mode for new technology based SMEs,

such as biotech SMEs (Sohn and Kang 2015). Previous studies highlighted the roles of venture capital investment such as the relaxation of financial constraints, coaching, and networking in leading nations (Bertoni *et al.*, 2010).

Previous studies examined the effects of patents on venture capital investment and the results showed positive relationship between patents and venture capital financing (Kang 2017).

According to empirical studies, venture capital investors perform a key coaching function to the benefit of investee firms (Bertoni *et al.*, 2010). They provide companies, which typically lack internal resources, with advising services in fields such as strategic planning, marketing, finance and budgeting, and human resource management (Bertoni *et al.*, 2010). Furthermore, firms which received venture capital investment can take advantage of the network of social contacts of their VC investors with potential customers, suppliers, and alliance partners (Bertoni *et al.*, 2010). The relaxation of financial constraints, coaching, and networking are all likely to increase R&D productivity (Bertoni *et al.*, 2010). Baum and Silverman (2004) directly address the causality issue between VC investments and firms' patenting activity using 204 biotechnology start-ups located in Canada (Bertoni *et al.*, 2010). Relying on time series regression techniques, they found that the amount of pre-IPO financing is positively affected by patent applications and patents granted in the year before the receipt of VC finance. Sohn and Kang's study showed the mechanism of venture capital investment influencing innovation via promoting downstream collaborations (Sohn and Kang 2015). Amounts

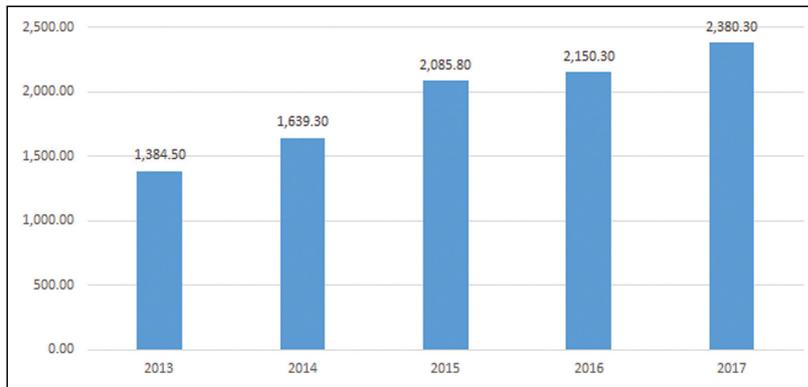
of venture capital investment had been growing rapidly with 14.5% CAGR during 2013~2017 and reached 2,380 billion won in 2017 (Figure 3).

The investment in the biotech sector took the largest portion in 2018 3Q (KVCA, 2018) (Figure 4). Venture capital investment would be influencing innovation via coaching function and promoting collaborations.

The credit guarantee system and technology trust

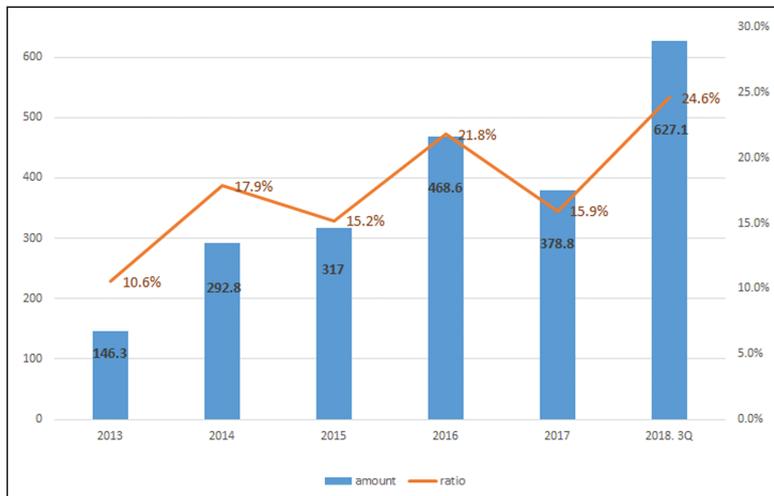
Under the government's drive, Intellectual property holders can monetize their IP more easily in the Republic of Korea (Jung and Kwack 2013). 'The credit guarantee system' has played important role in the SMEs sector. 'The credit guarantee system' has focused on the firm's future potential such as the technology excellence. The system used a quantitative analysis of a firm's business prospects based on the technology that it possesses and provide guarantee services for technology SMEs based on their IP value (Ha 2016, KIBO 2017). It has lessened the SMEs' problem of lack of financial resources (KIBO homepage).

In addition, 'technology trust' has important parts of IP financing (Kang *et al.*, 2016). "The term 'technology trust management business' means business engaging in, under a trust agreement with a technology holder on his/her technology and right to use, the management specified by Presidential Decree, such as the settlement or transfer of technology, etc., the collection and distribution of royalties, further development of technology, and technology and asset-backed securitization" (TECHNOLOGY TRANSFER AND COMMERCIALIZATION PROMOTION ACT, Article 2, 8). In Korean, number of organizations which



Source: KVCA 2018

Figure 3: Venture capital investment in Republic of Korea (Unit: billion won)



Source: KVCA 2018, modified by author

Figure 4: VC investment in biotechnology sector (Unit : billion won, %)

obtained technology trust management business via TECHNOLOGY TRANSFER AND COMMERCIALIZATION PROMOTION ACT is only six. More active discussion is needed to revitalize the system.

Conclusion

In Republic of Korea, SMEs participate actively in the biotechnology industry and the biotech SMEs enter into networks with external entities to acquire resources. Previous studies showed that there were significant relationships among networks: Upstream and downstream partnerships were positively associated with innovation performances. In the era of globalization, physical proximity is less important and biotech SMEs needed to be linked with foreign enti-

ties. In particular downstream partnerships with foreign entities help firms to generate cash cow or access new markets. Therefore, firms have to try to obtain skill and sensitivity toward resolving the managerial challenges of international collaborations

The Republic of Korean government has considered venture capital investment as one of the important financing instruments and established several public policies encouraging venture capital. As a result, venture capital financing had been growing rapidly with 18.5% CAGR. Venture capital investment would be influencing innovation via coaching function and promoting collaborations.

The credit guarantee system and technology trust have also played important

role in the biotechnology industry, which is the most science-intensive sectors. Using intellectual property-based finance, biotechnology SMEs could monetize their Intellectual property more easily and overcome financial difficulties.

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Biotechnology Networks and Databases

ASEAN Network on Microbial Utilization

<http://www.anmicro.org/>

The ASEAN Network on Microbial Utilization serves as a platform for capacity building, resource and knowledge sharing in the area of microbial utilization. It can further catalyze bilateral or multilateral research collaboration among member institutes. This Network creates visibility of ASEAN and attracts collaboration from other regional and international bodies such as the World Data Centre for Microorganisms (WDCM), World Federation for Culture Collections (WFCC) and the Asian Consortium for the Conservation and Sustainable Use of Microbial Resources (ACM).

International Agri-Food Network

<https://agrifood.net/>

The International Agri-Food Network (IAFN) is an informal coalition of international trade associations involved in the agri-food sector at the global level. The network facilitates liaison among the member organizations and engages international organizations in the agri-food chain at a global level.

ASEAN South American German (ASAG) Biotech Network

<http://www.asag-biotech.net/>

The ASEAN South American German (ASAG) Biotech Network is a global web portal designed to facilitate and enable the ASAG Biotech Network event alumni and its associates of scientists, technicians, governmental organisations and policy makers, to easily access information and work groups in the fields of infection research and biotechnology.

GM Approval Database

<http://www.isaaa.org/gmapprovaldatabase/>

International Service for the Acquisition of Agri-biotech Applications (ISAAA) presents an easy to use database of Biotech/GM crop approvals for various biotechnology stakeholders. It features the Biotech/GM crop events and traits that have been approved for commercialization and planting and/or for import for food and feed use with a short description of the crop and the trait. Entries in the database were sourced principally from Biosafety Clearing House of approving countries and from country regulatory websites. We invite corrections, additions/deletions, and suggestions for the improvement of the database.

BIOTECHNOLOGY PARKS AND INCUBATORS IN INDIA

The Government of India and State Governments are making efforts to promote biotechnology activities in the country by setting up biotechnology parks, incubators as well as pilot projects through public private partnership. The Department of biotechnology (DBT) of Government of India has supported the following biotechnology parks and incubation centres located in different States for the promotion of biotech start-up companies and the promotion of public private partnerships.

The following biotech parks and incubation centres have been supported by the Government of India and are fully operational:

Lucknow Biotechnology Park, Uttar Pradesh

The Biotechnology Park, Lucknow, has been set up jointly by the Department of Biotechnology of Govt. of India & Department of Science and Technology, Government of Uttar Pradesh. The Park is a futuristic state of the art facility for biotechnology-led enterprises.

- It is the only functional Biotechnology Park in North India, serving the State of Uttar Pradesh to bring biotechnology as the way of cultivating crops, living a healthy life and enriching the skills for boosting biotech industry.
- The park has changed the paradigm of transferring biotechnology advancements from laboratory to field and made humble contribution in initiating biotechnology related policy changes in the state.
- The Park has Department of Scientific and Industrial Research (DSIR) of the Government of India recognition and is registered under National Science and Technology Entrepreneurship Development Board (NSTEDB), New Delhi that accords approval for exemption of Service Tax to Park and its incubatees. The Incubators – I & II of Biotech Park are ISO 14001:2015 certified and offer state of the art facilities to startups for incubation and development of innovation led, high growth and knowledge based bio-business and infrastructure facilities for setting biotech industries.
- There are 18 common facilities and 27 instrumentation facilities. 27 incubatees graduated and 11 are presently housed from Bio-Pharma, Agri-biotech and health area (diagnostics, herbal cosmetics & nutraceutical).

- The Biotech Park facilities include accredited analytical & quality assurance laboratory, molecular & microbiology laboratories; certified plant tissue culture unit, biopesticides & biofertilizers units and GLP compliant solvent extraction pilot plant with downstream process facility.
- The Park has attracted investment of more than INR 300 million through its 36 incubatee companies and is a showcase of innovation industries and a model of active collaboration between industries, research institutes and academia.

Biotechnology Incubation Centre, Genome Valley, Hyderabad, Andhra Pradesh

The Park has been established by Indian Institute of Chemical Technology of Council of Scientific and Industrial Research (CSIR-IICT) and Govt. of Andhra Pradesh (now Govt. of Telangana) with support from Department of Biotechnology. A Biotech Incubation Centre has been set up at Alexandria Knowledge Park, Genome Valley, Hyderabad. The Park started operations from 2009.

- World class facilities have been created for use by entrepreneurs on use and pay basis. There are 12 labs of 350 sq. ft each which are given out to companies. Business centre approach is being used in this Park and 9 companies are operating, and 74 scientists are working there.
- DBT has provided support for current good manufacturing practices (cGMP) compliance for pilot plant facilities, required for quality manufacturing and for minimizing contamination. The biotechnology incubator facility would have research laboratories, knowledge based service centres and utility generation facilities. It is mainly designed for development and scale up of bio processes and technologies.
- The incubator has 14 pilot plants and 8 analytical facilities and 9 common facilities. 6 incubatees were graduated out of 11. One of the incubates (Tergene Biotech) established proof of concept of Pneumococcal vaccine and awarded Best Innovator by the Government.

- An Advanced Analytical and Characterization Resource (AACR) facility has been established in July 2016.

Biotechnology Core Instrumentation Facility (BTCIF) at TIDCO Centre for Life Sciences (TICEL), Chennai

The Tamil Nadu Government established TICEL – I and II in 8 Lakh sq.ft., a state-of-the-art Wet Lab Infrastructure in 5 acres in Chennai. TICEL offers Lab Modules conforming to BSL-II, to various companies on 3 years/ 10 years term for R&D / CRD activities. The lab infrastructure being offered by TICEL includes A/C, Compressed Air, Vacuum, RO Water, Power Back-up, ETP / STP, etc. TICEL has offered Lab Space to more than 30 International / National companies.

- TICEL has established BTCIF, jointly with Department of Biotechnology (DBT), Government of India, in 21,000 sq.ft. at First Floor of TICEL – II for providing Analytical, Technical and Scientific Support with High-end equipment towards performing Research / Analysis by Industries/ Entrepreneurs for commercialization.
- BTCIF layout contains facility with ISO 7 clean rooms for Purification, Microbiology, Molecular Biology, Tissue Culture and all labs conforming to ISO 8. Clean rooms are equipped with dynamic pass boxes for sterile material transfer. The labs are designed for uni-flow direction separation of clean and dirty corridors suitable for microbial process with dedicated AHUs for clean room zones. The facility includes Microbial Fermentation & Downstream Processing Zone with Microbiology and Molecular Biology / labs. It also includes Analytical wing and Tissue Culture Zone for Cell Cultures with independent wash rooms.
- TICEL has installed Fomenters (5, 40, 100 L), Continuous High Throughput Centrifuge, High Pressure Homogenizer, TFF Systems, Chromatography System, etc. as Pilot Scale equipment and Genetic Analyzer, Flow Cytometer, MALDI TOF / TOF, Real Time PCR, etc. as Analytical equipment. Gel Electrophoresis System, Thermal Cycler, Refrigerated Centrifuge, Incubators, Autoclaves, etc. as basic equipment and utility equipment are available.
- TICEL is offering the equipment for utilization by Companies / Scientists / Entrepreneurs on non-exclusive basis for their scientific activities / process & product development / sample analysis. The consumables and chemicals / reagents for the operation

of the equipment are being sourced by the clients as per their specifications and requirements. The charges for utilizing equipment will be collected from the clients. TICEL clients and external Companies / Scientists are using the equipment at BTCIF for their scientific activities.

The Golden Jubilee Biotech Park for Women, Siruseri, Kanchipuram District, Tamilnadu

The Park was established by Government of Tamilnadu at Siruseri, Kanchipuram District with support from DBT and is fully functional since 2001. It was registered as a Society under the Tamil Nadu Society's Registration Act 1975. It is a joint project of the Government of Tamil Nadu and DBT.

The Park has a lab facility for providing quality testing and training programs for providing hands-on experience and to generate revenue streams for the Park. It is an entrepreneurial facility for women Scientists aided with managerial skills and capable of making small-scale investment, to independently take up the functioning of the lab.

- At present the park is fully occupied. 80% comprises of 1st generation entrepreneurs. All entrepreneurs are women. In all there are 150 workers which includes 50-60% of women both skilled/unskilled.
- The production units that have been set up are for herbal cosmetics, bio-pesticides, bio-fertilizers, spice fortified with herbs, and essential oil, ready to eat snacks etc.

Guwahati Technology Incubation Centre (GBPIC) at Biotech Park, Assam

The project of setting up of Guwahati Biotech Park Technology Incubation Centre has been sanctioned by the DBT, Government of India.

- Government of Assam (GoA) has recently allotted a land measuring 17 acres to Guwahati Biotech Park in proximity to Indian Institute of Technology (IIT) Guwahati for setting up of GBPIC. Another 7.5 acres of land near the allotted land has been identified and likely to be allotted soon to GBP.
- Existing building of IITG has been renovated to make it suitable for housing the sophisticated instruments (purchased with the funding from GBPIC project). Facilities include 8 Modular Laboratories, Specialized & Support Facilities. The progress of the park is regularly

monitored by GBPIC Management Committee and Technical Advisory Committee.

- 9 incubatees are currently associated and 6 are graduated. The Incubator has 94 common facilities.

Bangalore Biotech Park, Karnataka

The project was sanctioned in 2005 for a period of 3 years.

- Civil Construction (Nirmithi Kendra) is 80% (appx.) complete with 25 Incubation suites ranging from 200 sq.ft to 700 sq.ft. Also includes Common Instrumentation facility, Mammalian and Plant tissue culture, Dark room/Cold room/Utilities, Animal house/Chemical store, Cafeteria/Meeting rooms/Conference rooms etc.
- Process has started for separate Entity (section 25 Co) to be formed. To operationalize within 6 months' time. Project Management Committee (PMC) and Technical Advisory and Resource group formed (TARG).
- Services include plug-and-play, infrastructure lab space and common equipments, high end equipments and facilities, mentorship, funding, networking, branding, legal, finance and accounting.
- Role in Cluster Development
 - Facilitate Bio Helix Park Development by attracting big and medium sized companies
 - Linkages with Public R&D and academic Institutions- IBAB, CHG
 - Advocacy and policy research
 - Creation of value networks
- The centre has 21 common instrumentation facilities. Also have 18 resident incubatees and 3 incubatees graduated.

KRIBS BioNest, Kochi, Kerala (previously called KINFRA Biotech Park)

The proposal for setting up of a Biotechnology Incubator at Kerala Biotechnology Park was sanctioned in March 2005 for a period of 3 years.

- Civil works of the Biotechnology Incubation Centre have been completed. Building infrastructure has been constructed to house various facilities such as Analytical lab, Bio-processing and Molecular facilities. This includes clean room standards ISO 7 and 8 labs for various purposes. A total space of more than 10,000 sq. feet is available for rental to incubatees.

Besides these spaces, there is provision for setting up a central instrumentation facility, medicinal plant extraction facility, micro propagation facility and fermentation facility. 20 acres land is available for lease to industries.

- Under the BioNest there are three major divisions: Analytical, Molecular and Bio-processing. Each division is under scientific mentorship by an experienced scientist from RGCB and a post doctoral scientist is in charge of each of these facilities. They are assisted by 5 technical personnel at various levels and 2 administrative personnel. Two staff members with business administration qualifications are involved in marketing the facility.
- The Biotech Park functions on the model of mentorship and nurture by trained scientific personnel. All interested applicants are encouraged to make a detailed presentation in front of an experienced, friendly technical committee which consists of technical personnel from pharmaceutical and biotechnology industry as well as scientific and administrative personnel.
- The KRIBS BioNest functions on the model of revenue generated based on rental receipts and equipment usage charges. But this amount is insufficient to fund the ongoing activities in the Centre. Earlier, KINFRA had charged a small rental of INR 8 to 13 a square feet and actual for utilities with a small amount for common facilities. KRIBS BioNest increased the rental to an amount of INR 40 per square feet, but this has been greatly resisted by the companies approaching us for space.
- BIONEST is a facility (a) to accelerate the commercialization of new technologies based on life and medical sciences (b) to nurture emerging ventures and (c) to assist new enterprises to forge appropriate link with other biotech companies, academia and government. It aims to provide a viable mechanism for licensing new technologies to upcoming biotech companies, to start new local ventures and to achieve early state value enhancement of the technology with minimum financial inputs. The deliverables of BioNest are technology packages, new product portfolios, techno economic feasibility and project reports for new products, process/product patents, prototypes of new equipment and rich management experience. BioNest will serve as a platform for creation of new jobs in technology development and scale-up.
- The progress of the BioNest facility has been reviewed recently by DBT in March, 2017 and based on the visit report of the committee, the project is likely to be extended till 2019 to fulfil the objectives of the project.

Punjab Biotechnology Incubator, Mohali, Punjab

Punjab Biotechnology Incubator (PBTI) was established jointly by Department of Biotechnology (DBT), Govt. of India (GoI) and Department of Science, Technology and Environment, Govt. of Punjab (GoP) on 70:30 sharing basis in the year 2005. PBTI, the first Biotechnology Incubator funded in Punjab, started its operations as a registered society. The State-of-the-art analytical facilities were made operational in 2007 from transit premises in SAS Nagar (Mohali). The project was initially sanctioned for a period of three (03) years which was extended for another two (02) years till March, 2010. Thereafter, Govt. of Punjab is providing financial support and has allocated 1 acre land to PBTI in Knowledge City, Sector 81, SAS Nagar (Mohali) in 2014 to build up its own infrastructure. In Knowledge city, PBTI is a part of Agri-Food Biotechnology cluster with National Agri-Food Biotechnology Institute (NABI), Center of Innovative and Applied Bioprocessing (CIAB) and Biotechnology Park as the sister components. The other National level institutes located in the Knowledge City include Indian Institute of Science Education and Research (IISER), Institute of Nano Science and Technology (INST) and Indian School of Business (ISB).

Starting its operations from mere 3500 sq.ft. area in 2007, with continuous efforts of its dedicated team of scientists, the incubator could expand 4-folds. In own building expansion of existing activities & setting up of new facilities is planned in an area of approx 60,000 sq.ft. The upcoming set-up includes the provision for plug & play kind of incubation area for entrepreneurs/start-ups; in addition to analytical facilities, trainings infrastructure & contractual research facilities.

Over the period of time, PBTI, due to its credibility in Food & Environment sectors could attract funding from different Ministries of Govt. of India for strengthening of its facilities

from time to time. PBTI took the lead in the country by setting up independent Honey Authenticity testing facilities, as a part of comprehensive Analytical facilities for Agri-Food & Environment sectors under one roof. Looking at the biotechnological strengths of PBTI Ministry of Agriculture and Farmers Welfare, GoI Notified it as National Referral Laboratory (NRL) for LMO/GMO detection under Seeds Act PBTI's world class facilities in transit premises include the following services for Agri-Food & Environment sectors.

- Analytical Services
- Contractual Research Services
- Capacity Building Services
- Project Management Consultancy/Advisory Services

At present, more than 1200 users including Multinational Companies, State Cooperatives, Govt. organizations, Entrepreneurs, Exporters and Marketers from Agri, Food, and Environment biotechnology sector are using the services of PBTI. Hands on trainings are being conducted for International as well as National participants in collaboration with concerned Ministries. PBTI has executed various consultancy projects including technical, advisory and research consultancy projects in Agri, food & Environment sectors. PBTI has also started providing services to Pharma sector.

The location of PBTI in Mohali with excellent rail, road and air connectivity with other parts of the country has made it the choicest destination for Stakeholders in Northern region of India to meet their analytical & Research requirements. With the construction of its own building which is likely to start shortly, PBTI shall be able to provide its services in more efficient & comprehensive manner.

For more information, access: <http://www.dbtindia.nic.in/schemes-2/biotechnology-parksincubators-in-india/> ■

WHO list of essential diagnostic tests

The World Health Organization (WHO) has published its first Essential Diagnostics List, a catalogue of the tests needed to diagnose the most common conditions as well as a number of global priority diseases. The list concentrates on *in vitro* tests - i.e. tests of human specimens like blood and urine. It contains 113 products: 58 tests are listed for detection and diagnosis of a wide range of common conditions, providing an essential package that can form the basis for screening and management of patients. The remaining 55 tests are designed for the detection, diagnosis and monitoring of "priority" diseases such as HIV, tuberculosis, malaria, hepatitis B and C, human papillomavirus and syphilis.

For more information, access:

https://www.who.int/medical_devices/diagnostics/WHO_EDL_2018.pdf

Tech Events

2019

**Feb 11–13
New Delhi,
India**

World Sustainable Development Summit

Contact: DSDS Secretariat
Tel: +91 11 24682100
Fax: +91 11 24682144
E-mail: dsds@teri.res.in

**Mar 5–6
Tokyo,
Japan**

BIO Asia International Conference

Contact: Biotechnology Innovation Organization
1201 Maryland Avenue, SW
Suite 900, Washington, DC 20024
Tel: 202.962.9200, Fax: 202.488.6301
E-mail: info@bio.org
Web: <https://www.bio.org>

**Mar 11–12
Singapore**

9th World Convention on Waste Recycling and Reuse

Contact: Conference Series LLC Ltd
Tel: 1-650-889-4686
E-mail: recyclingsummit@conferenceint.org
Web: <https://recyclingsummit.conferenceseries.com>

**Mar 13–14
Shanghai,
China**

Asia Pharma R&D Innovation 2019

Contact: Marketing Department
Tel: 86 21 31602153
E-mail: Marketing@wbfgroup.com
Web: <http://www.aprdic.com>

**Mar 19–21
Kuala Lumpur,
Malaysia**

GREEN ENERGY Expo & Forum 2019

Contact: Mr Ridzuan
Tel: +6013 223 4881
E-mail: Ridzuan.husin@ubm.com
Web: <https://www.greenenergy.org.my>

**Mar 27–28
Singapore**

IoT Asia

Contact: SingEx Exhibitions Pte Ltd,
#01-01, 11 Tampines Concourse Singapore 528729
registration.iotasia@singex.com
Web: <https://www.internetofthingsasia.com>

**Mar 28–31
Hangzhou,
China**

International Conference on Renewable Energy and Smart Grid (ICRESG 2019)

Contact: Ms. Suzy Shih
Tel: 852-30697937 (HK)
E-mail: icresg@smehk.org
Web: <http://www.icresg.org>

**Apr 10–12
Jakarta,
Indonesia**

6th Waste Management & Waste to Energy Asia Summit 2019

Contact: INBC Shanghai Jinggao Limited
Tel: +86 21 6106 5002,
Fax: +86 21 6106 5003
E-mail: info@inbcglobal.com
Web: <http://www.wastetoenergyasia.com>

**May 21–24
Chengdu,
China**

2019 Innovative Smart Grid Technologies Asia (ISGT Asia)

Contact: Professor Qi Huang
E-mail: hwong@uestc.edu.cn
<http://sites.ieee.org/isgt-asia-2019/>

**Apr 03–05
Daegu,
Republic of Korea**

GREEN ENERGY EXPO 2019

Contact: Energy EXPO Secretariat
(702-712) 90, Yutongdanji-ro(St.)
Buk-gu, Daegu, Republic of Korea
Tel: +82 53 601-5371
Fax: +82 53 601-5372
E-mail: energy@excodaegu.co.kr

**June 5–8
Bangkok,
Thailand**

ASEAN Sustainable Energy Week (ASE)

Contact: Ms. Jidakarn Jarhatchaititikhun
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Ari Hill 18th Floor, 428 Phahonyothin Road.
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Mobile: +66 91 874 6776
E-mail: Jidakarn.j@ubm.com
Web: <http://www.asew-expo.com>

**Jun 19–21
Seoul,
Republic of Korea**

EXPO SOLAR 2019

Contact: Infothe Co. Ltd.
13th floor Shinhan DM building
33-1 Mapo-dong
Mapo-gu
Seoul, 121-708
Republic of Korea
Tel: +82 2-719-6931, Fax: +82 2-715-8245
E-mail: interexpo@infothe.com

**Jul 7–9
Bangkok,
Thailand**

7th Annual Sustainable Development Conference 2019

Contact: Tomorrow People Organization
Address: Dusana Vukasovica 73,
11000 Belgrade, Serbia
Tel/Fax: + 381 62 680 683
Web: <http://www.sdconference.org>

**Jun 17–21
Manila,
Philippines**

Asia Clean Energy Forum (ACEF) 2019

Contact: Asia Clean Energy Forum
E-mail: acef@adb.org
Web: <http://www.asiacleanenergyforum.org>

**Aug 16–18
Guangzhou,
China**

GUANGZHOU INTERNATIONAL SOLAR PHOTOVOLTAIC EXHIBITION 2019

Contact: Guangzhou Grandeur Exhibition Services Co., Ltd
Room 2303-2305, The 4th Tower
Dong Jun Plaza, No.836 of Dong Feng Dong Road
Yuexiu District
Guangzhou, 510080
China
Tel: +86 2022074185, Fax: +86 20-82579220
E-mail: grand.ad@grahw.com

**Sept 03–05
Kuala Lumpur,
Malaysia**

RENEWABLE ENERGY WORLD ASIA 2019

Contact: PennWell Conferences & Exhibitions
1421 S. Sheridan Road, Tulsa, Oklahoma 74112
USA
Tel: +1 (918) 835-3161, Fax: +1 (918) 831-9497
E-mail: Headquarters@PennWell.com

**31 Oct to 2 Nov
Hong Kong,
China**

IWA-ASPIRE 2019

Contact: IWA-ASPIRE 2019 Conference Secretariat, c/o International Conference Consultants Ltd., Unit C-D, 17/F, Max Share Centre, 373 King's Road, North Point, Hong Kong, Tel: (852) 2559 9973
Fax: (852) 2547 9528
E-mail: info@iwaaspire2019.org
<http://www.iwaaspire2019.org>

**Nov 21–29
Bangalore,
India**

Intersolar India

Contact: Brijesh Nair
Project Director, India
Tel: +91 22 4255-4707
Fax: +91 22 4255-4719
Web: <https://www.intersolar.in>

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Startups promotion in Thailand

Startup Thailand Center, National Innovation Agency, Thailand

<https://www.startupthailand.org>

Founded as a national agency to support the startup businesses and its ecosystem based on the policy of the National Startup Committee (NSC), Startup Thailand operates under the Ministry of Science and Technology in collaboration with related organizations, helping startups to utilize local resources for their product and service development, and local employment and revenue distribution, leading to new target industries in driving the country forward.

The NSC was initiated by Prime Minister General Prayut Chan-ocha, who is reorganizing the country's economic system by fostering an environment that promotes the development of startups so that they can serve as the "new economic warrior" (NEW). Thailand therefore is set to play a pivotal role in the growth of Asean. The startups promotions are as follows:

Open for talent

To increase the competitiveness of Thai startups in the global market, Thailand needs to draw talented people who have experience and capability, and who understand global business development.

Open for business growth

The promotion of innovation and entrepreneurship beginning even at the university level is crucial to creating a climate where startups can successfully develop their products and services. In

Thailand, startups can take part in an acceleration program that prepares them for international fundraising so that they can expand their business overseas and compete in the global marketplace.

Open for investment

At every stage of growth, startups require new or additional funding for their innovative products and service development and for business expansion abroad. Thailand can link startups to a host of local and international investors including individual investors, joint venture capitalists, organizations and public funding, while also offering an innovative financial sector that provides material support for the expansion of startups to the global market.

Open for ecosystem

To maintain a sustainable startup ecosystem, Thailand needs to implement the "area-based innovation economy", in where key urban areas, or "clusters", are developed and set aside as "innovation districts". These communities become a sort of one-stop shop dedicated to the development of startup businesses. These areas are focused on the well-being of the business and its talent, promoting a high quality of life and connecting startups to the resources needed for these businesses to thrive. It also should have a system of privileges supporting every related party in the startup ecosystem.

Startup Thailand

Founded as a national agency to support the startup businesses and its ecosystem based on the policy of the National Startup Committee (NSC), Startup Thailand operates under the Ministry of Science and Technology in collaboration with related organizations, helping startups to utilize local resources for their product and service development, and local employment and revenue distribution, leading to new target industries in driving the country forward.

The startups promotions in Thailand are as follows:

- **Open for talent:** To draw talented people who have experience and capability, and who understand global business development.
- **Open for business growth:** The promotion of innovation and entrepreneurship beginning even at the university level is crucial to creating a climate where startups can successfully develop their products and services.
- **Open for investment:** At every stage of growth, startups require new or additional funding for their innovative products and service development and for business expansion abroad.
- **Open for Ecosystem:** To maintain a sustainable startup ecosystem, Thailand needs to implement the "area-based innovation economy", in where key urban areas, or "clusters", are developed and set aside as "innovation districts".

For more information, access:

<https://www.startupthailand.org>

Supporting entrepreneurs in India

Small Industries Development Bank of India

<http://www.sidbi.in>

With a strong purpose to support, develop and nurture ideas of modern entrepreneurs that are instrumental in transforming the Indian economy, the Small Industries Development Bank of India (SIDBI) has been playing an important role in developing the Venture Capital (VC) eco-system in the country. Through its holistic offerings comprising of credit and support ecosystem with tailor-made initiatives, SIDBI operates thoughtfully designed initiatives that meet the requirements of a modern entrepreneur at every stage of his journey, from idea generation to venture formation to scaling up a business. SIDBI's initiatives have been instrumental in creating a vibrant entrepreneurial support ecosystem where a strong capital flow is made available along with relevant handholding to ventures. To provide financial resources for Start-ups / MSMEs, SIDBI has been contributing to corpus of various Alternative Investment Funds (AIFs) / Venture Capital Funds (VCFs) for over two decades, which in turn invest at both early & growth stages in Start-ups / MSMEs. SIDBI has committed cumulatively more than INR 3600 crores to over 110 funds under its Fund of Funds operations.

SIDBI does not invest directly in Start-ups, but participates in the capital of Alternative Investment Funds (AIF) registered with Securities and Exchange Board of India (SEBI). SIDBI, thus, contributes to the corpus of Alternative Investment Funds (AIFs) for investing in equity and equity-linked instruments of various Start-ups at early stage, seed stage and growth stage.

SIDBI has been managing the following Funds and programmes for start-ups:

Fund of Funds for Start-ups

In line with the Start-up India Action Plan unveiled by the Hon'ble Prime Minister on the January 16, 2016, the Cabinet approved the establishment of 'Fund of Funds for Start-ups (FFS) at SIDBI for contribution to various Alternative Investment Funds (AIFs) with a corpus of INR 10,000 crore. Introduced with a focussed objective of supporting development and growth of innovation driven enterprises, the Fund of Funds (FFS) facilitates funding needs for Start-ups through participation in capital of SEBI registered Venture Funds.

Aspire Fund

A Scheme for Promotion of Innovation, Rural Industry and Entrepreneurship [ASPIRE FUND]

The Hon'ble Finance Minister in his budget speech 2014-15, proposed allocation of funds of INR200 crore under 'A Scheme for Promotion of Innovation, Rural Industry and Entrepreneurship

[ASPIRE] programme which inter-alia, aims at creating technology centre network, business incubators including Fund of Funds operations for promoting start-up ventures in the agro Industry. In line with above, ASPIRE Fund was set up with SIDBI for carrying out Fund of Funds operations with a corpus of INR60 crore for investments in agri and rural focused enterprises. The Aspire fund provides support to various Angel / Venture Capital Funds (VCFs) for investing in start-ups / early stage enterprises in the areas of innovation, entrepreneurship, forward backward linkage with multiple value chain of manufacturing and service delivery, accelerator support in the agro-based Industry verticals and sectors which would galvanize the rural economy.

India Aspiration Fund

India Aspiration Fund set up SIDBI with the support of RBI pursuant to a budget announcement is an INR2000 crore fund introduced by SIDBI with a vision to promote and accelerate equity and equity linked investments in Start-ups and MSMEs. IAF contributes to the corpus of SEBI registered Alternative Investment Funds (AIFs), with sector agnostic investments specifically involving MSMEs as key strategic investment sectors.

SIDBI Startup Mitra

SIDBI Start-Up Mitra is a digital initiative that address gaps in the start-up ecosystem. The portal was launched by the Hon'ble President of India on March 17th, 2016. It acts as a virtual platform to bring together all stakeholders, start-up entrepreneurs, incubators, investors (Angel networks / Venture Capital Funds), industry bodies, mentors /advisors and banks to meet the financing and developmental needs of the early stage start-ups and enterprises.

The portal also facilitates entrepreneurs to engage with incubators, investors, mentors and spreads awareness about the government schemes for start-ups in India by becoming the knowledge partner for State and Central Governments. The portal is supported by the Department of Science and Technology [DST], Govt. of India and currently boasts of more than 10,245 start-ups, 118 incubators and 90 investors as registered members on the platform

Incubation Centres

SIDBI in collaboration with premier educational institutions in the country has set up incubators to help entrepreneurs solve the problems commonly associated with running a Start-up by providing workspace, seed funding, mentoring, and training, etc. These centres support and nurture budding

entrepreneurs by empowering them with business and technological know-how and to eventually help develop the overall SME enterprises. Currently, SIDBI supported innovation and incubation centres include the SIDBI Innovation & Incubation Centre (SIIC) at IIT Kanpur, KIIT Technology Business Incubator at Kalinga Institute of Industrial Technology (KIIT) University, Bhubaneswar and SIDBI Centre for Innovations in Financial Inclusion (Sci-FI) at IIM, Lucknow, which was set up under the Poorest States Inclusive Growth Programme being implemented by SIDBI.

The SIIC at IIT Kanpur has so far incubated 69 start-ups in diverse areas of state-of-the-art technologies, out of which 42 have graduated.

TIFAC-SRIJAN Scheme

TIFAC_SRIJAN Scheme, a collaborative programme of TIFAC & SIDBI launched on November 01, 2010, aims at facilitating development, demonstration and commercialization of technology innovation projects pertaining to new product or process development to encourage and promote development of capabilities in MSMEs to innovate and to bring high-risk innovations to the market for opening up opportunities for business linked with innovations. The programme supports MSMEs towards development, up-scaling, demonstration and commercialization of innovative technology based projects by providing developmental loans at flexible terms & interest rate to encourage / promote development / innovation of new technology / process / product and its commercialization.

Startup India

Startup India is a flagship initiative of the Government of India (launched January 2016), intended to build a strong eco-system for nurturing innovation and Startups in the country that will drive sustainable economic growth and generate large scale employment opportunities. The Government through this initiative aims to empower Startups to grow through innovation and design. In order to meet the objectives of the initiative, Government of India announced Startup India Action Plan that addresses all aspects of the Startup ecosystem.

The Action Plan is divided across the following areas:

Simplification and handholding

1. Compliance Regime based on Self-certification
2. Startup India Hub
3. Rolling out of Mobile App and Portal
4. Legal Support and Fast-tracking Patent Examination at Lower Costs
5. Relaxed Norms of Public Procurement for Startups
6. Faster Exit for Startups

Funding support and incentives

7. Providing Funding Support through a Fund of Funds with a Corpus of INR 10,000 crore
8. Credit Guarantee Fund for Startups
9. Tax Exemption on Capital Gains
10. Tax Exemption to Startups for 3 years
11. Tax Exemption on Investments above Fair Market Value
12. Organizing Startup Fests for Showcasing Innovation and Providing a Collaboration Platform

Industry-academia partnership and incubation

13. Launch of Atal Innovation Mission (AIM) with Self-Employment and Talent Utilization (SETU) Program
14. Harnessing Private Sector Expertise for Incubator Setup
15. Building Innovation Centres at National Institutes
16. Setting up of 7 New Research Parks Modeled on the Research Park Setup at IIT Madras
17. Promoting Startups in the Biotechnology Sector
18. Launching of Innovation Focused Programs for Students
19. Annual Incubator Grand Challenge

For more information, access:

<https://dipp.gov.in/programmes-and-schemes/industrial-promotion/startup-india>

IPO registration of technology transfer agreements in the Philippines

Board of Investments, Philippines

<http://boi.gov.ph>

Royalties and similar fees

Royalties and similar fees can be charged to operations provided payments for said fees are covered by a technology transfer agreement (TTA) which conforms with the mandatory and restrictive provisions of the Intellectual Property Code (IPC). Compliance of the TTA with the IPC requirements will not require the registration of the TTA with the Documentation, Information and Technology Transfer Bureau (DITTB) of the Intellectual Property Office (IPO).

The non-conformity of the TTA with the IPC shall generally render the TTA unenforceable. However, in certain exceptional and meritorious cases provided under the IPC, non-compliance with the IPC is allowed subject to prior approval of the TTA by the IPO. The IPC provides certain restrictions in the terms and conditions of the TTA particularly those that will adversely affect free competition and trade. It also prescribes certain mandatory provisions that should be included in the TTA.

Royalties and similar fees are generally subject to 30% gross income tax and 12% value added tax when payable to a non-resident foreign corporation. However, the tax rates for the royalties payable to residents of foreign countries with which the Philippines has a tax treaty vary according to the terms of the respective treaties.

Reimbursements of actual cost

Reimbursements of actual cost incurred abroad for operations such as maintaining offices, advertising, commission, etc. are allowed provided they are duly supported by documents and that these costs are incurred in connection with the regular course of trade or business of the local paying company.

Technology transfer arrangements

Technology transfer arrangements refer to contracts or agreements involving the following: transfer of systematic knowledge for the manufacture of a product or the application of a process; rendering of a service, including management contracts; and the transfer, assignment, or licensing of all forms of intellectual property rights, including licensing of computer software, except computer software developed for mass market.

Government approval

Within ten days from the filing of the request for certification of compliance, the DITTB conducts a summary evaluation of the TTA. If the TTA conforms with the Prohibited Clauses and Mandatory Provisions of the IPC, the DITTB issues a Certificate of Compliance. Otherwise, the DITTB notifies the parties of any violation and requires them to comply with the IPC if they wish to obtain a Certificate of Compliance.

Documentary support

With the liberalization of foreign exchange rules, remittance of royalties, fees, or similar payments to a foreign company, net of the applicable taxes, may be made through AABs without need of BSP approval. The following documents may be required by the AABs to prove the legitimacy of the transaction: (a) copy of contract/agreement; (b) statement/computation of the royalty/copyright/patent/licensing fee; and (c) proof of payment of withholding tax or tax exemption or entitlement to preferential tax treatment, as the case may be.

Inventor Assistance Program

The Inventor Assistance Program (IAP) is the first global program of its kind. It matches developing country inventors and small businesses with limited financial means with patent attorneys, who provide *pro bono* legal assistance to secure patent protection (free legal advice on how to file a patent to protect their inventions). The program is a joint initiative of the World Intellectual Property Organization (WIPO) and the World Economic Forum, with support and input from some of the world's leading businesses and law firms. WIPO and The Forum have developed IAP aimed at making the IP system more accessible by matching financially under-resourced inventors of promising new technologies and ideas with qualified IP counsel, to assist in securing patent protection for their innovations. IAP is designed to assist both individuals and small entities who lack the financial resources to navigate the patent system on their own. The Program helps solve the problem experienced by patent filers on unaffordable professional fees relative to filing international patents by putting eligible inventors and small businesses in touch with an expert in their country who is willing to help them free of charge.

For more information, access:

<https://www.wipo.int/iap/>

Registration of licensing agreement in Thailand

Department of Intellectual Property, Thailand

<http://www.ipthailand.go.th/en/>

Consideration criteria

Licensing Agreement to use the patent is the contract, with which the patent/petty patent owners grants the specific right to the licensee. The permission shall not exceed the protection period as prescribed by law.

- * The protection period of invention patent lasts 20 years.
- * The protection period of petty patent lasts 6 years, or upon the petty patent renewal application according to Article 65 paragraph 2 of the laws.

Conditions of application submission

1. To register a licensing agreement, the applicant shall submit the form as determined by the Director-General, together with a licensing contract to use the invention patent/petty patent.

2. Authorization

2.1 In case the applicant of the patent does not reside in the Kingdom of Thailand, he shall authorize the patent agent/patent attorney registered with the Director-General of the Department of Intellectual Property to act on his behalf. In this regard, the power of attorney shall be presented to the Director-General in accordance with the following regulations;

- (1) If the authorization is done outside the Kingdom of Thailand, the signatures in the authorization letter or power of attorney shall be certified by the authorized official of the Thai embassy or consulate or Director of the office of the Ministry of Commerce located in the country where the principal or power grantor resides, or the person authorized to act on behalf of the said officials or the person authorized to certify the signature according to the law in that country, or

- (2) In case the authorization is done in the Kingdom of Thailand, the applicant shall submit a copy of passport or temporary residence certificate of the principal or power grantor, or any evidence indicating that at the time the authorization was made, the principal or power grantor was in Thailand.

2.2 The Power of Attorney shall be attached with the revenue stamp of 30 Baht/patent agent or patent attorney/application.

Proceeding according to the official's instruction

1. In case that the official finds a correctable defect in the application, the official shall notify the applicant or his patent

agent/patent attorney for the correction. The applicant shall finish the correction within 90 days of the notification reception date. After such period, without the correction, the applicant shall be deemed to have abandoned the application, except the Director-General extends the period for correction as deemed appropriate due to any necessity.

2. After the applicant corrected the application, the applicant shall submit the correction application and the fee to the Department of Intellectual Property or the provincial office of the Ministry of Commerce. The corrected application shall enter the consideration and initial inspection processes respectively, similarly to the re-submission of the application.
3. In case of application submission via the website of the Department of Intellectual Property, the inspecting official shall check the completeness of information and details in the patent/petty patent application, request or other applications based on information and details appearing in the e-patent filing system. In this regard, the applicant shall present the application and supporting documents to the Department of Intellectual Property within 15 days of application number reception date and patent/petty patent application filing date via internet. The inspection of application submitted via internet shall be in accordance with the Notification of the Department of Intellectual Property Re: Principles and conditions for submission of patent/petty patent application, requests or other applications via internet.

Notes:

1. The working process starts after the inspection of the documents is completed, as specified in the manual of the public service.
2. In case the application or documentary evidence is not correct or incomplete, the official shall record the defect of the document or indicate the required additional documentary evidence (Record of conditions on application reception). The applicant shall correct the document and/or submit the additional document within 90 days of the application filing date. If the applicant fails to submit all additional documents within the specific period of time, the applicant shall be deemed to have abandoned the application. The official shall return the application to the applicant and inform the reason of the return and his appeal right.
3. Any person fee paid to the Department of Intellectual Property shall not be refunded in all cases, except

- (1) The law stipulates that the fee must be refunded, or
- (2) The applicant double-paid or overpaid the fee, by which the faulty payment resulted from the mistake of the state official, not the payer. In this regard, the Department of Intellectual Property shall consider the refund case by case.
4. In case the applicant is required to submit many additional documentary evidences, the applicant shall submit all additional documentary evidences in the same time.
5. In case the applicant submits the copy of the documentary evidence, the applicant shall certify the copy of the documentary evidence.
6. In case the applicant submits the document in foreign language, the applicant shall submit the document with Thai translation and the correct translation certification of the translator.
7. In case the applicant or the authorized patent agent/patent attorney does not submit the application by himself, and

granted power to the other person to submit the application, the application submitter shall present a sub power of attorney or temporary power of attorney, so that he is eligible to submit the application and sign in the record of conditions on application reception. If it appears that the application and the documentary evidence is not correct or incomplete, and the application submitter is not authorized to sign on the said record, the official shall not receive the application.

8. The working period does not include the time period when the applicant follows the official's instruction or corrects the application, or the period of temporary suspension of registration.

Relevant laws

The Ministerial Regulation No.25 (B.E. 2542) issued by virtue of the Patent Act B.E. 2522 (Dated 24 September 1999).

The Patent Act B.E. 2522 as amended by the Patent Act (No. 2) B.E. 2535 and the Patent Act (No. 3) B.E. 2542

Recent Publications from World Intellectual Property Organizations

World Intellectual Property Indicators 2018

This authoritative report analyzes IP activity around the globe. Covering the filing, registration and maintenance of patents, utility models, trademarks, industrial designs, microorganisms, and plant variety protection, and geographical indications, the 2018 edition also looks at the creative economy for the first time, making it even more comprehensive. The special theme explores how one might statistically capture patent litigation activity and presents selected statistics for the United Kingdom and the United States of America.

Global Innovation Index 2018

The Global Innovation Index 2018 provides detailed metrics about the innovation performance of 126 countries and economies around the world. Its 80 indicators explore a broad vision of innovation, including political environment, education, infrastructure and business sophistication. The GII 2018 analyses the energy innovation landscape of the next decade and identifies possible breakthroughs in fields such as energy production, storage, distribution, and consumption. It also looks at how breakthrough innovation occurs at the grassroots level and describes how small-scale renewable systems are on the rise.

A Guide to Intellectual Property Issues in Access and Benefit-sharing Agreements

An essential complement to the WIPO Database of Access and Benefit-sharing Agreements, this guide offers users and providers of genetic resources an accessible overview of intellectual property issues in access and benefit-sharing agreements.

An Introduction to Patents for Small and Medium-sized Enterprises

This is the third in the series of guides on Intellectual Property for Business. It focuses on patents, a crucial tool to enable a company to draw maximum benefit from new technological ideas.

WIPO-ASEAN Design Manual

This document is a manual which provides the technical detail of the survey questionnaire designed and implemented for the study on "Understanding the Use of Industrial Designs –the Case of Indonesia, Philippines and Thailand.

For more information, access:

<https://www.wipo.int/publications/>

Green Climate Fund

Green Climate Fund, Republic of Korea

<https://www.greenclimate.fund>

The Green Climate Fund (GCF) is a new global fund created to support the efforts of developing countries to respond to the challenge of climate change. GCF helps developing countries limit or reduce their greenhouse gas (GHG) emissions and adapt to climate change. It seeks to promote a paradigm shift to low-emission and climate-resilient development, taking into account the needs of nations that are particularly vulnerable to climate change impacts.

It was set up by the 194 countries who are parties to the United Nations Framework Convention on Climate Change (UNFCCC) in 2010, as part of the Convention's financial mechanism. It aims to deliver equal amounts of funding to mitigation and adaptation, while being guided by the Convention's principles and provisions.

When the Paris Agreement was reached in 2015, the Green Climate Fund was given an important role in serving the agreement and supporting the goal of keeping climate change well below 2 degrees Celsius.

Responding to the climate challenge requires collective action from all countries, including by both public and private sectors. Among these concerted efforts, advanced economies have agreed to jointly mobilize significant financial resources. Coming from a variety of sources, these resources address the pressing mitigation and adaptation needs of developing countries.

GCF launched its initial resource mobilization in 2014, and rapidly gathered pledges worth USD 10.3 billion. These funds come mainly from developed countries, but also from some developing countries, regions, and one city (Paris).

GCF's activities are aligned with the priorities of developing countries through the principle of country ownership, and the Fund has established a direct access modality so that national and sub-national organisations can receive funding directly, rather than only via international intermediaries.

The Fund pays particular attention to the needs of societies that are highly vulnerable to the effects of climate change, in particular Least Developed Countries (LDCs), Small Island Developing States (SIDS), and African States.

GCF aims to catalyze a flow of climate finance to invest in low-emission and climate-resilient development, driving a paradigm shift in the global response to climate change.

Our innovation is to use public investment to stimulate private finance, unlocking the power of climate-friendly investment

for low emission, climate resilient development. To achieve maximum impact, GCF seeks to catalyze funds, multiplying the effect of its initial financing by opening markets to new investments.

The Fund's investments can be in the form of grants, loans, equity or guarantees.

Key features

GCF invests in adaptation and mitigation activities in developing countries, managing a project portfolio that is implemented by its partner organisations, known as Accredited Entities.

GCF's approach is marked by several distinct features:

balanced portfolio: GCF's investments are aimed at achieving maximum impact in the developing world, supporting paradigm shifts in both mitigation and adaptation. The Fund aims for a 50:50 balance between mitigation and adaptation investments over time. It also aims for a floor of 50 percent of the adaptation allocation for particularly vulnerable countries, including Least Developed Countries (LDCs), Small Island Developing States (SIDS), and African States.

Unlocking private finance: The Fund is unique in its ability to engage directly with both the public and private sectors in transformational climate-sensitive investments. GCF engages directly with the private sector through its Private Sector Facility (PSF). As part of its innovative framework, it has the capacity to bear significant climate-related risk, allowing it to leverage and crowd in additional financing. It offers a wide range of financial products including grants, concessional loans, subordinated debt, equity, and guarantees. This enables it to match project needs and adapt to specific investment contexts, including using its funding to overcome market barriers for private finance.

Country ownership: GCF recognizes the need to ensure that developing country partners exercise ownership of climate change funding and integrate it within their own national action plans. Developing countries appoint a National Designated Authority (NDA) that acts as the interface between their government and GCF, and must approve all GCF project activities within the country. This country-driven approach ensures GCF's activities operate in harmony with national priorities.

The aim of all GCF activities is to support developing countries limit or reduce their greenhouse gas emissions and adapt to climate change impacts.

Development finance and access to finance in Sri Lanka

Central Bank of Sri Lanka

<https://www.cbsl.gov.lk>

The Central Bank of Sri Lanka (CBSL) on behalf of the Government of Sri Lanka (GOSL), contributes to enhance Access to Finance with the intention of achieving balanced growth and financial inclusiveness in the country. To achieve these objectives, the CBSL coordinates, facilitates and implements various refinance schemes, interest subsidy schemes and credit guarantee schemes while delivering credit supplementary services through Regional Development Department (RDD) of the CBSL.

The strategic objectives of the RDD include the enhancement of regional growth, reduction of poverty, creation of income generating activities and employment opportunities, provision of skills development and training, facilitation of formal financial services, strengthening economic activities in the lagging regions and enhancement of production of essential food items including organic food to ensure food security and food safety.

Financial assistance

The RDD provides affordable finance for beneficiaries in the Agriculture, Animal Husbandry and Micro, Small and Medium scale Enterprises (MSMEs) in the country through a network of Participating Financial Institutions (PFIs) which are mainly Licensed Commercial Banks and Licensed specialized Banks. The funds are made available to the needy people and business ventures at concessional terms and conditions through PFIs with a view to ensuring those beneficiaries are well geared to meet the challenges ahead. These schemes are funded by the GOSL, the CBSL, Donor Agencies and PFIs. Through these schemes, RDD serves the beneficiaries in a wide spectrum of sectors including Agriculture and Animal Husbandry, Microfinance and Micro, Small and Medium Enterprise (MSME) sectors, by providing affordable finance facilities.

Implementation of GOSL funded schemes

At present, RDD implemented 05 schemes funded by the GOSL including 4 refinance loan schemes and 1 interest subsidy schemes. "Sarushara"- New Comprehensive Rural Credit Scheme (NCRCS) which is funded by the GOSL, serves as an interest subsidy scheme and a credit guarantee scheme as well.

Implementation of CBSL funded schemes

In view of the strategic importance of regional development for balance and inclusive economic growth of the country, CBSL continues to fund two main schemes of RDD, namely, the Saubagya Loan Scheme and the Commercial Scale Dairy Development Loan Scheme (CSDDL), which is a refinance loan scheme and an interest subsidy scheme.

Implementation of donor funded schemes

International Fund for Agriculture Development (IFAD) serves as the main Donor Agency by contributing millions of rupees towards 6 refinance loan components under Smallholder Agri-business Partnership Programmes (SAPP) which has been implemented in mid 2018. SAPP is introduced in lieu of the National Agribusiness Development Programme (NADeP), another IFAD funded project which was successfully concluded at the end of 2017. RDD manages the Credit Component of SAPP which includes issuing Operating Instructions to the PFIs and providing refinance to them.

Credit guarantee

The RDD implements Credit Guarantee schemes with a view to mitigate credit risk of the loans granted by the PFIs for specific sectors. Under these schemes, loans granted by the PFIs are guaranteed in case of defaults, to a certain extent. To implement this process which supports PFIs to lower their credit risk, RDD issues Operating Instructions to the PFIs, specifying the terms and conditions applicable under each scheme, including issuance of guarantees and indemnity payments, etc. To be eligible under the scheme, PFIs are expected to pay a premium, specified in the Operating Instructions of the particular scheme.

Interest subsidy

Under the Interest Subsidy Schemes implemented by the RDD, PFIs are eligible to receive interest subsidy for the loans granted by them through a relevant interest subsidy scheme. These schemes are implemented to compensate the cost of funds of PFIs while encouraging them to grant loans to the specific priority sectors of the economy.

Public awareness

CBSL conducts a series of awareness building and skill development programmes, especially for those who have not accessed the formal financial sector, through RDD. These programmes mainly focus on financial management, entrepreneurship development, Training of Trainers (TOT) and workshops on entrepreneurs, mainly to promote financial inclusiveness of the country. In addition, RDD take efforts to enhance public awareness on Access to Finance and Financial Inclusiveness, using print and electronic media. Moreover, RDD takes necessary policy measures in line with the contemporary developments in the economy.

1-InnoCERT Certification Programme

SME Corporation Malaysia

<http://www.smecorp.gov.my>

1-InnoCERT certification programme is initiated by SME Corp. Malaysia to promote and develop innovative companies in Malaysia as endorsed by the Jawatankuasa Tindakan Penyelarasan Inovasi Negara and the National Innovation Council, chaired by the Prime Minister on 29th October 2009. It is aimed at fostering innovative enterprise through harnessing and intensifying home-grown innovations and R&D.test

The main objective of the certification is to encourage entrepreneurs to venture into high technology and innovation-driven industries. With more SMEs participating in such activities, it will eventually lead to them being more competitive and would help in Malaysia achieving its objective in becoming a high income nation by the year 2020.

The certification awarded under the Programme identifies and verifies innovative companies through an internationally-recognised innovation standard (OECD Oslo Manual V3) and the certification process is developed from similar process practised in Korea's Innobiz (Innovation SME) Certification Programme. Certified companies under the programme will be given a fast-track access when applying for incentives to fund and market their products and services as offered by the government.

Application criteria for SMEs

1. SMEs incorporated under the Companies Act 1965 / Registration of Business Act (1956) and fulfil the new definition of SMEs (Guideline on New SME Definition (click));
2. At least 60% of the equity held by Malaysians;
3. Valid business; acquire business license from the Local Authority and operating in a valid business premise;
4. At least two (2) years in business (able to provide 2 years Audited Financial Statement); and
5. Product and services must be commercialised for at least two (2) years.

1-InnoCERT certification process

The 1-InnoCERT certification process involves a two-stage assessment. Potential innovative companies are required to conduct an On-line Self-Assessment (www.1-innocert.my) to gauge on their readiness to be certified as a 1-InnoCERT company. Upon completing the self-assessment, the on-line system will generate a Technology Innovation System Evaluation Index, ranging a score from 0 to 1,000. A scoring of higher than 700 is an indication that

the company's internal innovation system and processes is ready to comply with the requirement.

Companies with difficulties in scoring higher than 700 can attend regular sessions of pre-certification training to understand the 1-InnoCERT criteria, and on how to become more innovative. Upon reaching a score of more than 700, the company can apply for an on-site innovation audit to be conducted at their premise. On-site innovation audit is compulsory to ensure that companies applying for the 1-InnoCERT certifications are indeed innovative and complies with the requirement of the 1-InnoCERT criteria.

Upon a successful passing of the on-site audit, the company can then officially apply to be certified as a 1-InnoCERT certified company. However, the approval is subject to acceptance by the 1-InnoCERT Approval Committee, which oversees the overall certification Program. Please take note that minimal fees are chargeable for the 1-InnoCERT certification (RM5,000.00 for first time certification and RM3,000.00 for renewal of certification).

1. The 1-InnoCERT Innovation assessment criteria consist of 4 criteria:
 - Innovation Ability;
 - Commercialisation of Innovation Ability;
 - Management of Innovation Ability; &
 - The Innovation Outcome.
2. 1-InnoCERT is currently available for 8 evaluation sectors:
 - Manufacturing;
 - Non-Manufacturing and services;
 - Biotech;
 - Professional Design;
 - Software / ICT;
 - Agriculture;
 - Environment (sustainable development, renewable energy, etc); &
 - Construction.
3. 1-Innocert's Innovation Assessment adapts the Korean Innobiz innovation evaluation system which is based on an internationally-recognised innovation assessment standard i.e. the Oslo Manual by OECD and the European Commission (Eurostat), 2005. The Oslo Manual provides guidelines for collecting and interpreting innovation data in an internationally comparable manner.

Terms and conditions

1. Logistic charges in addition to the standard on-site audit fee is applicable for companies located outside of the Klang Valley area, and the quantum of the additional logistic charges shall be determined on a case to case basis.
2. The standard on-site audit fee and additional logistic charges are payable to SIRIM QAS International Sdn. Bhd.
3. Both the standard on-site audit fee and additional logistic charges are not refundable.
4. SME Corp. and SIRIM Berhad reserves the rights to:
 - alter the Self-Assessment result to reflect the actual state of innovativeness of the company, as per the 1-InnoCERT certification criteria;
 - disqualify the company from applying and receiving the 1-InnoCERT certification.
5. The information provided by the company for this self-assessment is true and without prejudice.
6. The information and assessment results will not be alterable after they have been submitted for On-Site Audit.

Benefits of the programme

- Facilitate access to financial incentives and wider market opportunity.
- Complimentary arrangement for Business Matching with international companies, MNCs and GLCs
- Opportunities and invitation to local and International innovation related programmes.

Online Patent-Search to Procure Medicines

World Intellectual Property Organization (WIPO) and the research-based pharmaceutical industry today launched a new online tool designed to help procurement agencies better understand the global patent status of medicines.

The Patent Information Initiative for Medicines (Pat-INFORMED) is a unique resource where patent holders provide information about patents covering approved medicines through a free, open access database. This new public database became operational today, along with a platform where procurement agencies can make direct enquiries to companies.

Pat-INFORMED is a partnership between WIPO and the International Federation of Pharmaceutical Manufacturers and Associations, IFPMA, the global trade association representing the research-based pharmaceutical industry. Pat-INFORMED originated in the industry's efforts to add clarity to patent information about medicines. WIPO's globally recognized expertise in the organization and public dissemination of patent data will make an important contribution to the accessibility of patent information. WIPO is hosting the database and providing the resources to ensure its continued development, while IFPMA is working closely with the 20 leading research-based biopharmaceutical companies that have backed this initiative to help ensure a consistent and coordinated approach.

Pat-INFORMED also offers procurement agencies a direct communication channel for follow-on enquiries to participating companies. Each of the participating companies, currently 20, has agreed to engage in discussions with official procurement agencies that are seeking more detailed information about granted patents on specific products.

So far, Pat-INFORMED houses information on over 14,000 individual patents, for 600 patent families and 169 INNs, unique names that are globally recognized and used to identify pharmaceutical substances or active pharmaceutical ingredients within medicines that cover a wide range of conditions. Pat-INFORMED features patent information for small molecule drugs within oncology; hepatitis C, cardiovascular, HIV, diabetes, and respiratory therapy areas; and any products on the WHO Essential Medicines List that are not within these therapy areas. In a second phase, the initiative will extend to all therapeutic areas and explore the inclusion of complex therapeutics.

For more information, contact:
 Media Relations Section at WIPO
 Tel: (+41 22) 338 81 61 / 338 72 24
 Fax: (+41 22) 338 81 40
<https://www.wipo.int>

Grassroots innovation in India

National Innovation Foundation, India

<http://nif.org.in>

The National Innovation Foundation (NIF) - India was set up in March 2000 with the assistance of Department of Science and Technology, Government of India. It is India's national initiative to strengthen the grassroots technological innovations and outstanding traditional knowledge. Its mission is to help India become a creative and knowledge-based society by expanding policy and institutional space for grassroots technological innovators.

NIF scouts, supports and spawns' grassroots innovations developed by individuals and local communities in any technological field, helping in human survival without any help from formal sector. NIF helps grassroots innovators and outstanding traditional knowledge holders get due recognition, respect and reward for their innovations. It also tries to ensure that such innovations diffuse widely through commercial and/or non-commercial channels, generating material or non-material incentives for them and others involved in the value chain.

NIF has pooled a database of over 310,000 technological ideas, innovations and traditional knowledge practices (not all unique, not all distinct) from over 608 districts of the country. NIF has till date recognised 847 grassroots innovators and school students at the national level in its various National Biennial Grassroots Innovation Award Functions and annual Dr A P J Abdul Kalam Ignite Children Award functions. In collaboration with various research & development (R&D) and academic institutions, agricultural & veterinary universities and others institutions, NIF has helped in getting several hundred grassroots technologies validated and/or value added.

NIF has also set up an augmented Fabrication Laboratory (Fab Lab) with the help of Massachusetts Institute of Technology (MIT), Boston, for product development and strengthening in-house research. Pro bono arrangement with intellectual property firms has helped NIF file over 1040 patents, including eight filed in the USA and 28 Patent Cooperation Treaty (PCT) applications, on behalf of the innovators and outstanding traditional knowledge holders. Of these, 72 patents have been granted in India and 5 in the USA. In the same time period NIF has filed 21 Design registrations for innovations of the grassroots and student innovators. In addition to this 10 trade mark applications have also been filed.

NIF has also filed applications for 71 plant varieties developed by farmers at the Protection of Plant Varieties & Farmers' Rights Authority. Of these, 9 have successfully been registered.

Micro Venture Innovation Fund (MVIF) at NIF, with support from Small Industries Development Bank of India (SIDBI), has provided risk capital to 230 innovation based enterprise projects, some of which are at different stages of incubation.

NIF has received over 1500 product inquiries from 110 countries for various technologies. It has also succeeded in commercialising products across countries in six continents, apart from being successful in materialising 109 cases of technology licensing.

NIF has proved that Indian innovators can match anyone in the world when it comes to solving problems creatively. They perform better than others in generating greater sustainable alternatives by using local resources frugally. Those who see poor only as the consumers of cheap goods, miss the richness of knowledge at grassroots level and their potential as provider of ideas and innovations. The grassroots to global (G2G) model that NIF is propagating is all set to change the way the world looks at creativity and innovations at/from grassroots.

The INSPIRE Award - MANAK (Million Minds Augmenting National Aspiration and Knowledge) is being revamped and executed by Department of Science & Technology and National Innovation Foundation-India to align it with the action plan for "Start-up India" initiative launched by the Hon'ble Prime Minister of India. The scheme aims to help build a critical human resource pool for strengthening, expand science and technology system and increase the research & development base on the same by inviting students from all government and private schools throughout the country and enabling them to send their original & creative technological ideas/innovations on the same.

Initiatives

Grassroots Innovations Design Studio (GRIDS): Grassroots Innovation Design Studio (GRIDS) facilitates formal design inputs to the grassroots innovations at premier institutes viz National Institute of Design (NID) - Ahmedabad, Indian Institute of Technology (IIT) - Gandhinagar, National Institute of Technology (NIT) - Srirangar and Srishti School of Arts, Design & Technology, Bengaluru.

Students' Club for Augmenting Innovations (SCAI): A nationwide student movement, comprising students from India's best management and technology institutes, SCAI provides product development, mentoring and monitoring support to innovators and traditional knowledge holders at the grassroots.

Micro Venture Innovation Fund (MVIF): One of its kind of dedicated risk fund in the world, setup with the support of SIDBI in October 2003 and operationalised in January 2004, MVIF provides financial support to grassroots innovators. It is extended under a single signature on a simple agreement of understanding without any collateral or a guarantor.

Grassroots Technological Innovations Acquisition Fund (GTIAF): Sanctioned in 2011 and operationalised in 2012, GTIAF

obtains the rights of technologies from innovators after compensating them for the same, with the purpose of disseminating and diffusing them at low or no cost for the larger benefit of the society.

Gandhian Inclusive Innovation Challenge Awards: The Award aim towards developing new solutions for three challenges -- paddy transplanter, wood stove and tea leaf-plucking machine.

Grassroots to Global (G2G): NIF has proved that Indian innovators can match anyone in the world when it comes to solving problems creatively. They perform better than others in generating greater sustainable alternatives by using local resources frugally. Those who see poor only as the consumers of cheap goods, miss the richness of knowledge at grassroots level. The G2G model propagated by NIF is all set to change the way the world looks at creativity and innovations at grassroots.

In situ incubation: NIF provides in situ incubation of grassroots technologies to the innovator at his/her place. All incubation facilities (financial or technical support, mentoring, etc.) are extended to the innovator at his place where he continues to work on his/her ideas or innovations.

Community workshops: NIF has established community workshops in different rural areas of the country at the premises of seasoned innovators so that other grassroots innovators of the region can have access to fabrication facilities locally. Also, they could learn from the experiences of seasoned innovators. This is expected to promote the conversion of an idea into a prototype faster. map/microincubator

Inverted model of innovation: The inverted model of innovation implies that children invent, engineers & designers fabricate and companies commercialise.

Innovations' exhibition at the President House and The Festival of Innovation and Entrepreneurship (FINE): Since 2010, the RashtrapatiBhavan has been hosting an exhibition of innovations near its Mughal Garden to showcase the creativity and ingenuity of common people. Since 2015, NIF and RashtrapatiBhavan is organizing a Festival of Innovation which comprises of roundtables on various topics in relation to Innovation in addition to the Exhibition.

ASEAN Network for Drugs, Diagnostics, Vaccines and Traditional Medicines Innovation

The ASEAN Network for Drugs, Diagnostics, Vaccines and Traditional Medicines Innovation (ASEAN-NDI) oversees the discovery and development of health technologies that will not only address health problems but also propel the health industry in ASEAN Member States. The ASEAN-NDI website offers the following features:

- Quick access to data regarding Governing bodies, Research Institutions, Collaborations, and current activities on the progress of the network via an online database greatly helps in bridging the gap between the health situations of the ASEAN member states.
- Accounts on the news involving the sectors for health are updated with the use of an online blog that is accessible to everyone.
- An online forum gives each participant an avenue for communication. Upon registration, one can contribute, update, and discuss with fellow members.

The following are potential areas of collaboration of ASEAN-NDI with partner institutions, researchers, agencies, and other health R&D innovation networks.

Strengthening cooperation of ASEAN member states in health R&D

- Promote cooperation through sharing of information and experiences to prevent and control infectious diseases;
- Assist in harmonized conceptualization of ideas and projects
- Transfer of knowledge and/or technology among member states
- Facilitate collaboration in the development and actual conduct of R&D initiatives
- Consolidate regional, multisectoral cooperative arrangements in the prevention and control of emerging infectious diseases

Development of programs and projects which address public health concerns in ASEAN

- Improve surveillance of infectious, emerging, re-emerging, and neglected tropical diseases, and even non-communicable diseases, which are becoming more prevalent in the community due to changing lifestyles
- Develop research projects to prevent and/or mitigate spread of disease through innovation in drugs, diagnostics, vaccines, and traditional medicine
- Improve access to affordable healthcare

Development of strategies to strengthen ASEAN member states' capacity and competitiveness in the development and delivery of health-related products and services

- Facilitate research and cross-country exchange of experience, products, and resources
- Promote the sharing of best practices in improving access to primary healthcare
- Establish regional support system and network to narrow the gap among ASEAN member states in addressing public health concerns in ASEAN

For more information, access:

<http://www.asean-ndi.org>

Greening the Philippine manufacturing industry roadmap

Department of Trade and Industry and Board of Investments, Philippines

<http://industry.gov.ph>

The manufacturing sector of the Philippines is challenged to significantly strengthen its competitiveness in order to be prepared for the challenges lying ahead. Seeing the worldwide dynamics of industrial development and the integration process of the ASEAN Economic Community, it becomes obvious that the manufacturing industry needs to successfully position itself as a globally competitive industry on domestic, regional and global markets.

Asia's economies and their businesses are increasingly becoming main drivers for Green Economic Development (GED) worldwide. It is obvious that the manufacturing industry of the Philippines is challenged to be responsive and proactive to this worldwide trend. Already today, the business community sees in the over-use of natural resources and the impacts of climate change a key challenge to do business successfully and to ensure its long-term economic growth perspective.

In a common effort, industry and government in the Philippines have launched an initiative, in which sectoral road maps have been elaborated and submitted to the Department of Trade and Industry and the Board of Investments. The so-called Road Map Process is a unique opportunity to define a well-focused stimulation and promotion for an industry driven GED that is integral part of a modernization and innovation process of the economy of the Philippines. Within the industry sectors, each company have to elaborate and implement their own strategy to unleash the specific market potential for products and service delivery.

Public policies on regulation, subsidies, incentives and information have a central role to play for the green modernization of the industry. Green investment from both the public side and the private side is an investment for immediate returns and for the future.

Worldwide experiences show that without a forceful and coordinated set of actions that removes barriers and sets favorable framework conditions, it is unlikely that even the most economically beneficial options would overcome a short-term sighted "Buy-the-Cheapest" or "Business-as-Usual" attitude. In cooperation with other government entities, the BOI and DTI should contribute to setting framework conditions and to building up capacities that support a paradigm shift towards an innovation process that results in competitiveness, good environmental performance, climate change resilience and job creation.

Promotion of Green Economic Development (ProGED) Project

ProGED is a project of the Department of Trade and Industry (DTI) with the Federal Republic of Germany through the Deutsche

Gesellschaft für Internationale Zusammenarbeit (GIZ). It is primarily aimed at improving the competitiveness of MSMEs while coping with climate change adaptation and mitigation requirements through the adoption of environment-friendly, climate-smart, and inclusive strategies and measures.

Interventions are implemented at the operational level through the Regional and Provincial offices of DTI (to support the enterprises in greening their operations), as well as at the policy level through the Regional Operations Group (ROG), where the green perspective is integrated into the programs and projects of DTI. A Green Growth Core Group has likewise been established within ROG to steer their initiatives on greening MSMEs within the Department.

ProGED promotes a green economy strategy founded on the five pillars of mitigation, adaptation, competitiveness, green jobs, and preserving or even improving nature's capital. The project focuses initially on the tourism sector with its high potential for investment, employment, and poverty reduction due to its linkages with upstream and downstream industries in other economic sectors.

The project is implemented from 2013 to 2016, and piloted its approach in the Provinces of Cebu and Bohol. Since 2014, it has expanded to include fourteen replication provinces in seven regions, namely: Pampanga and Tarlac (Region 3) Laguna and Cavite (Region 4A), Palawan and Occidental Mindoro (Region 4B), Albay and Camarines Sur (Region 5), Negros Occidental and Capiz (Region 6), Negros Oriental and Siquijor (Region 7), and Agusan del Norte and Surigao del Norte (Region 13). Aside from tourism, additional priority sectors are taken up according to the location's competitive advantages.

In relation to its efforts to support the greening of enterprises and upon the request by DTI, ProGED also supported the Greening the Manufacturing Industry Roadmaps process, which aims at integrating green economic development elements in selected industry roadmaps and the overall manufacturing roadmap.

Started in 2014, the initiative has fielded three missions by Dr. Bernd Gutterer, an international GED consultant commissioned by GIZ to the Philippines. The first mission was held in July 2014, wherein initial consultations with various industry associations and stakeholders were conducted to assess awareness of GED concepts. The second mission was held in November 2014, wherein one-on-one discussions with six industries selected by DTI (automotive, copper, furniture, mass housing, plastics, and pulp and paper) were conducted to determine how green elements could be integrated in their respective roadmaps.

Tax incentives for green industry in Malaysia

Malaysian Investment Development Authority (MIDA), Malaysia

<http://www.mida.gov.my>

Green Technology Incentive includes more qualifying activities

To strengthen the development of green technology, the Government will continue to provide incentives in the form of investment tax allowance for the purchase of green technology assets and income tax exemption for the use of green technology services and system.

The incentives which were announced in Budget 2014 will cover broader scope of green technology activities in the areas of energy, transportation, building, waste management, and supporting services activities. It also facilitates the transition of the expired (by 31 December 2015) tax incentives relating to renewable energy (RE) and energy efficiency (EE) projects under the Promotion of Investment Act (PIA), 1986.

A) Tax incentive for green technology project

Investment Tax Allowance (ITA) of 100% of qualifying capital expenditure incurred on a green technology project from the year of assessment 2013 (date on which the first qualifying capital expenditure incurred is not earlier than 25 October 2013) until the year of assessment 2020. The allowance can be offset against 70% of statutory income in the year of assessment. Unutilised allowances can be carried forward until they are fully absorbed.

Green technology project related to renewable energy, energy efficiency, green building, green data centre, and waste management can qualify for this tax incentive. Please refer to the Guideline for Application for Incentives and/or Expatriate Posts for Green Technology (GT) at www.mida.gov.my for more details on qualifying activities and eligibility criteria.

Applications received by 31 December 2020 are eligible for this incentive. Applications should be submitted to MIDA.

B) Tax Incentive for Green Technology Services

Income tax exemption of 100% of statutory income from the year of assessment 2013 until the year of assessment 2020.

Green technology services related to renewable energy, energy efficiency, electric vehicle (EV), green building, green data centre,

green certification and verification, and green township can qualify for this tax incentive.

Applications received by 31 December 2020 are eligible for this incentive. Applications should be submitted to MIDA.

C) Tax Incentive for Purchase of Green Technology Assets

Investment Tax Allowance (ITA) of 100% of qualifying capital expenditure incurred on green technology asset from the year of assessment 2013 (date on which the first qualifying capital expenditure incurred is not earlier than 25 October 2013) until the year of assessment 2020. The allowance can be offset against 70% of statutory income in the year of assessment. Unutilised allowances can be carried forward until they are fully absorbed.

Incentives for establishment of waste eco parks (WEPs)

Waste Eco Park (WEP) aims to promote waste recycling, recovery and treatment activities by the industries and provides a sustainable solution to waste management problem. This will encourage investments in facilities and infrastructure towards holistic waste management activities. In order to promote the activities, there are incentives available for WEP Developer, WEP Manager and WEP Operator (companies operating in the WEP).

A) WEP developers

Applications received by MIDA from 1 January 2016 until 31 December 2020, are eligible to be considered for this incentive.

B) WEP managers

Applications received by MIDA from 1 January 2016 until 31 December 2020, are eligible to be considered for this incentive.

C) WEP operators (companies operating in WEP)

Applications received by MIDA from 1 January 2016 until 31 December 2020, are eligible to be considered for this incentive.

Handbook for MSME Access to Alternative Sources of Finance in ASEAN

The Handbook is designed to provide practical information on the available alternative sources of loan and equity funding that are more suited to the financing needs and requirements of MSMEs in ASEAN.

For more information, contact:

The ASEAN Secretariat Community Relations Division (CRD)
70A Jalan Sisingamangaraja Jakarta 12110, Indonesia.

Tel: (62 21) 724-3372, 726-2991; Fax: (62 21) 739-8234, 724-3504; E-mail: public@asean.org

TECHNOLOGY OFFERS

HUNGARY

Composting of solid phase animal manures

A Hungarian SME has developed a new procedure for composting of solid and liquid phase animal manures. The aim of the company is to commute the expensive and environment pollutant chemical fertilizers to environmentally friendly compost based soil manures for plant nutrition under different soil conditions.

The offered composting technology is suitable for composting of different solid and liquid phase feedlot manures through recycling of by-products from coal or energy plant combustion. It results compost end-products which has high fertilizer value, organic matter, total N, total P, total K content and harmonious trace element content. The whole composting process is no longer than 70-90 days.

Area of Application

The offered technology can be used by all kind of animal husbandry companies.

Advantages

- The utilization of environmentally friendly by-products (essential plant oils) results significant reduction in total coliform and f. streptococcus number within 48 hours.
- The complex utilization of animal manures, water treatment residues and by-products from energy plant and coal combustion provides the reduction of environmental risk during composting and land disposal of compost product.
- The compost end-product is a potential organic source for a direct land disposal under integrated or ecological management system.
- The result of full-scale experiments demonstrated that compost product is suitable for soil improvement in acidic mine spoils or municipal solid waste landfills during recultivation.

Environmental aspects

Waste utilization

Development Status

Pilot plant

Legal Protection

Patent

Transfer Terms

- Technology licensing
- Others

Removal of arsenic from drinking water

The technology offering client is a Hungarian SME which specializes in research and development in the fields of industrial waste management, environmental protection, electrochemistry, chemistry. The technology offer of our client is able to reduce arsenic content in water with more efficiently than any of the other known processes.

The research and development work resulted in a sorbent material that has an enormous specific area and hence is able to remove the arsenic content of waters much more efficiently than any of the known technologies today. Due to its unique structure and composition the new sorbent material can remove the organic arsenic content of the waters as well. Arsenic containing adsorbent particles do not re-enter the water. The technology can be implemented easily in both industrial and domestic scales.

Area of Application

Water treatment plants

Advantages

- Easily scalable to domestic and industrial levels
- Arsenic containing adsorbent particles do not re-enter the water

Environmental aspects

Waste utilization

Development Status

Commercial prototype

Legal Protection

Patent

Transfer Terms

Technology licensing

Wireless sensor networking

A Hungarian University has developed a new wireless mesh networking technology that is suitable for an array of applications from smart metering purposes to environmental monitoring, medical sensors, or automatization. They are interested in a sales agreement, a license agreement or a joint venture opportunity.

The invention is a wireless mesh networking technology suitable for an array of applications from smart metering purposes to environmental monitoring, medical sensors, or automatization. The protocol uses industry standard secured multi-hop channels to propagate information to the server.

Compared to other standards the protocol stack remains lightweight in spite of the capabilities included. The protocol uses on-demand approach for data transmission, which minimizes management overhead. The technology has built-in guarantees for reliable information transfer. Due to the hierarchical network topology, the solution is highly scalable. Utilizing the properties of 433 MHz frequency band, the range is six times better (indoor and outdoor) than other well-known technologies like Wi-Fi or ZigBee, and has the advantage of better penetration through concrete and water. Energy efficiency is a key factor in the protocol of technology; the devices remain in sleep mode as much as possible to maximize battery life, which can be measured in years.

TECHNOLOGY OFFERS

Area of Application

- Environmental monitoring
- Medical sensor
- Automatization
- Smart metering

Advantages

- At 433 MHz, the technology is available in every major trading nation of the world. At 2.4GHz ZigBee has the benefit of being available in all nations but at the cost of using a frequency that is crowded, unreliable, short-range, and has limited ability to penetrate walls, concrete and water.
- The technology is designed to provide long battery life and low device cost for bursty, asynchronous applications that require multi-year battery life. ZigBee's focus is on applications that can benefit from high data rate and shorter battery life.
- The devices are in sleep mode for most of the time and only wake as they need to transmit and receive data, so battery life can be measured in years. ZigBee has no RF wakeup and uses a complex scheduling mechanism for communication and more energy to transmit at higher bandwidths.
- The technology has 6 times the range of ZigBee, and the ability to penetrate concrete and water as the benefits of 433 MHz.

Development Status

Commercial prototype

Legal Protection

Patent

Transfer Terms

- Technology licensing
- Research partnerships

Target Countries

World Wide

For the above three offers, Contact:

Laser Consult Ltd (Hungary)
H-6701 PO Box 1191.
Szeged
Hungary

Tea catechins as anti-aging compounds

The invention relates to the preparation of consumable composition for oral administration that contains tea catechins. The composition prepared by the process of this invention is useful in providing controlled release of catechins contained therein. In a preferred embodiment of the present invention, consumable composition containing tea catechins dispersed therein is provided.

Area of Application

Application includes antiaging agents

Environmental aspects

Environment-friendly

Development Status

Laboratory model

Legal Protection

Patent

Transfer Terms

- Consultancy
- Technical services
- Technology Licensing

Contact:

Amity University
Sector-125, Noida
Distt Gautam Buddha Nagar 201303, Uttar Pradesh
India

Nanogold-loaded carbon bullets as gene carriers

Scientists have developed a process for the preparation of carbon embedded nano gold particles with sharp edges which can be used as gene carriers. The bullets are sharp enough to penetrate hard material, with less damage (a comparatively lower force of 0.1-0.2 nN required for penetration) and can be delivered with a convenient delivery gun. Intracellular gold particles (biogenic) synthesized by a fungus in situ, embedded on a carbonaceous matrix.

Area of Application

- Gene therapy/ improved gene delivery for research and other applications
- DNA based immunization, to study gene function and its regulation, to establish various disease models, metal ion removal, fuel cells, anti-bacterial applications, catalysis

Advantages

- Preparation process is very simple and easy to implement
- The carbon matrix forms 95% of the carrier reducing the amount of gold needed and the plasmid used per transformation
- Advantages of usage of gold particles- High DNA packing density, better transformation efficiency, low nuclease degradation, being in nano scale, higher surface area is obtained- more gene cargo handled
- Advantages of usage of carbon support- Inert and less damage causing- wound caused due to penetration healed faster, better piercing capacity, for example, can effectively pierce hard plant cell walls, less force required to penetrate the plasma membrane as compared to silver nano needles

TECHNOLOGY OFFERS

Development Status

Laboratory model

Legal Protection

Patent

Transfer Terms

Technology licensing

Contact:

National Chemical Laboratory, CSIR
A208, PAML Building, National Chemical Laboratory
Dr Homi Bhabha Road,
Pune 411007, India

Microfine ginger powder

Microfine ginger powder has wide applications in pharmaceutical, brewery, soft drink, meat canning, pickle processing, curry and confectionery industries. The microfine ginger powder can be directly added in soda water for removal of certain throat irritation and similar affections. The product has high domestic and export potential. From 5 kilograms of peeled ginger, around 700 grams of microfine powder can be produced. The process of production is free from pollution.

Area of Application

- Domestic and industrial kitchen
- Food processing industries
- Brewery and confectionery industries

Advantages

- Microfine
- Free from presence of ash.
- Produced without generating temperature at the pulverizing point.
- The product maintains high drug and spice values.
- The process of production prevents evaporation of oil during pulverization.

Environmental aspects

Cleaner production

Development Status

Commercial prototype

Transfer Terms

Turnkey

Target Countries

India

Contact:

Department of Agriculture
Innova Reserach Centre Pvt Ltd
Ochanthuruth, Kochi, 682508, india
Cochin 682508, India

Nanoparticle-polymer complex for oral care

Scientists have developed a process for constructing nanoparticle-polymer complex for sustained release of active agents for oral care (for applications in toothpastes and oral rinses). Polymer multilayers are built up layer by layer on nanoparticles of 5-50 nm, consisting of a water repelling (hydrophobic) shell around a core of multiply (polyanion and polycation) charged material (the core can be of inorganics as silica, titania and/or clay) and encompassing outer layer with an affinity to the tooth enamel.

Area of Application

Oral hygiene application- sustained release of antimicrobial/ flavour compounds

Advantages

- Precisely controlled polymer multilayers can be built on nanoparticles without the requirement of the cumbersome separation step after each coating of the polymer layers
- Active compounds localised as per the requirement by fine tuning the outer layer of the complexes- retained in the complex despite extensive rinsing with water
- Enables designing systems that can anchor and retain on the surface enamel of the teeth for extended periods by adjusting the ionic strengths

Development Status

- Laboratory model
- Commercial prototype

Legal Protection

Patent

Transfer Terms

Technology licensing

Contact:

National Chemical Laboratory, CSIR
A208, PAML Building,
National Chemical Laboratory
Dr Homi Bhabha Road,
Pune 411007
India

Zero-head hydro turbine

An Indian entrepreneur has developed the zero-head water turbine which generates electric energy from moving water and simultaneously pumps the water for irrigation or other like purposes. He has designed two variants of turbine and pump models. Initially he had developed a water turbine using bamboo for harnessing the flow energy from the river to pump water to his land way back in 1998-99. And later with the assistance from GIAN-NE, a voluntary organization working in the field of development of grass root innovations, he has developed another version of the same turbine.

TECHNOLOGY OFFERS

Area of Application

Areas where electric power supply is not available

Advantages

- Novelty lies in its portability and the fact that there is no need for a dam. Economically it is a better as construction and installation cost is minimal as compared to hydro-electric, steam or any other power plant.
- The maintenance cost is also quite low compared to the conventional hydroelectric power plant.
- Its efficiency is greater than 50%. It can be set up anywhere be it plains or mountains.
- The turbine has a very high potential in rural areas where electric power supply is not available.

Environmental aspects

Energy efficiency

Development Status

Commercial prototype

Legal Protection

Patent

Transfer Terms

Consultancy

Contact:

National Innovation Foundation, India
PO Box 15051, Vastrapur, Ahmedabad 380 015, Gujarat, India
Tel: +91-79-2673 2456/2095, Fax: +91-79-2673 1903
E-mail: info@nifindia.org

Prevention system for electrical fault

The Preventive system for electrical faults (PSEF) is a device used in conjunction with an electrical system/equipment to prevent it from electrical faults resulting due to abnormal electrical parameters.

- It comprises of a "monitoring unit" to sense/measure electrical fault with the help of a sensing/measuring device.
- The said device is further connected to "signal processing and controlling unit" to receive data and thus provide output for fault identification.
- The "alarming and indication unit" gives alarm for controlling actions and command for trip signal to circuit breaking device.
- The "Data collecting and processing unit" stores the processed data at "data history storage and display unit" for back reference.

Area of Application

Useful for various equipment like:

- Circuit breakers,
- Power carrying cubicles,
- Power bus systems,
- Transformer, motor, generator, protection transformers

- Transformer/Potential Transformers/Capacitive Voltage Transformer etc.

Advantages

- Preventing the asset from leading to abnormality or failure.
- Less restoration period for attending fault.
- Damage & Repair cost of electrical system or electrical equipment is minimized.
- Damages and accidents in nearby area of electrical system or electrical equipment can be avoided.
- Less financial loss due to non-availability of electrical system or electrical equipment.

Development Status

Commercial prototype

Legal Protection

Patent

Transfer Terms

Technology licensing

Target Countries

India

Contact:

SkyQuest Technology Consulting Pvt. Ltd.
501, Krishna Complex, Opp. Devashish School,
Bodakdev, Ahmedabad 380054, India

Micro-hydro power for villages

Save the Ifugao Terraces Movement (SITMo) has worked closely with local communities to develop and install thirteen micro-hydro systems in remote villages in the Ifugao province of the Philippines. The systems provide electric light and power to 190 families, bringing a better standard of living and making it more attractive for people to stay on the farms.

Area of Application

Hydro power generation

Development Status

Commercial prototype

Transfer Terms

- Consultancy
- Technical services
- Others

Contact:

Save the Ifugao Terraces Movement (SITMo), Ifugao Heritage and
Community Education Centre
Sitio Dinapugan Tuplac, Kiangang, Ifugao, Philippines 3604
Tel: +63 9209 108253
E-mail: savetheterraces@hotmail.com

Bioethanol

A French firm is interested to acquire Bioethanol production technology. They are planning to use the bioethanol manufactured in their plant for various projects on a global scale.

Area of Application

Biotech industry, Chemical industry, Energy industry

Transfer Terms

Project Type

Start-up

Contact:

Mr. François Lecomte

BOCCARD Bureau Commercial

189 rue du Faubourg Saint Honoré - 75008 - Paris, France

Tél: +33 (0)1 45 63 50 77, Fax: +33 (0)1 45 63 84 48

E-mail: flecomte@boccard.fr

Environmentally friendly chemical technology

We need small scale environmental friendly chemical technologies that are useful in the textile sector as well as in pharmaceutical sector. The technology should be economically viable and there should be a provision for utilization of process by-product generated during the process.

Area of Application

Textile industry, Pharmaceutical industry

Studies

- Feasibility Report
- Environmental Impact Studies (EIA/EIS)
- Others

Project Type

New Idea

Target Countries

India

Contact:

Murphy Chemicals

GIDC, Ankleshwar 393002, India

Production of Vitamin E through synthetic route

We are interested in purchasing Vitamin E technology /plant based isophytol & trimethylhydroquinone (TMHQ) route. Technology with an operating reference plant will be preferred

Area of Application

Feed/food/pharma

Transfer Terms

- Turnkey plant

TECHNOLOGY REQUESTS

- Equipment supply
- Technology licensing

Project Type

Diversification

Contact:

Jubilant Organosys Ltd.

1-A, Sector 16-A

Noida 201301, India

Full cereal and health bar extrusion line

We are a company that is looking at setting up an entire cereal flakes extrusion line. At the next stage, we will be setting up the same for health bars.

Area of Application

Food processing equipment

Project Type

Start-up

Target Countries

India

Contact:

Kottaram Agro Foods

No.9 & 10, 3rd Cross, Muneshwara Block, Harlugatte Village,

Kudlu Gate, Bangalore 560068, India

Proteins and polyphenols from dried plant materials

We are looking to identify new processes or technologies which are able to effectively remove / extract proteins and/or polyphenols from dried plant materials, with the aim of using the remaining material in a consumable product. The currently used extraction process is technically difficult to scale up for commercial supply and uses large quantities of water making it unsustainable for long term use.

Area of Application

Consumable product

Transfer Terms

- Joint venture
- Technical services
- Technology licensing

Project Type

New idea

Target Countries

Worldwide

Contact:

Strategic Allies Ltd.

The Red & White House 113, High Street Berkhamsted, U.K HP4 2

DJ, Berkhamsted, United Kingdom, HP4 2DJ

Asia-Pacific Tech Monitor

Readers are requested to complete the Response Form to the best of their knowledge/opinion and return it to APCTT by fax or email. We look forward to your cooperation to serve you better.

Technology Intelligence
Asian and Pacific Centre for Transfer of Technology (APCTT)
C-2 Qutab Institutional Area, New Delhi -110016, India
Fax: +91 (11) 26856274, Email: sahus@un.org, dasm@un.org

I read Tech Monitor

Always Often Sometimes Never

1. I find the design and layout of the Tech Monitor

Excellent Very Good Good Not Good

2. I find the language used in the Tech Monitor

Easy to understand Little difficult to understand Difficult to understand

3. I find the Tech Monitor

Very valuable Generally valuable/interesting Somewhat valuable/
interesting

Little value No value

I read Tech Monitor because I appreciate

Technology Market Scan Technology Scan Special Feature (articles)
 Tech Events Technology Opportunities Business Coach

4. I find the following sections

	Very useful	Useful	Less useful	No use
Technology Market Scan	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Technology Scan	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Special Feature (articles)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tech Events	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Technology Opportunities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Business Coach	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. Tech Monitor facilitated/contributed to:

- Understand issues related to technology development and transfer
- Enhance my knowledge on latest technological developments and events
- Identity technology/business partners
- Negotiate technology/business transactions
- Establish contact with institutions/authors/experts
- Conclude a technology transfer
- Acquire a technology
- Selling a technology
- (Any other, please specify)

6. **To get similar information, I read other periodicals like:**

7. **I would like Tech Monitor to cover the following:**

About Myself

Name:

Gender: Female Male

Nationality:

Profession:

- Policy Maker Small and Medium-sized Enterprise (SME)
 Consultant Financier Researcher
 Professor/ Teacher Student Others (Please specify)

Contact details:

Organization:

Designation:

Street Address:

P.O Box:

Country:

Telephone:

Fax:

E-mail:

Website:

Note: *The survey results would be used for APCTT's internal purposes only.*

Selected Analytical Reports and Technology Platforms & Databases of APCTT

Analytical Reports (available online)

1. National Assessment Framework on Enabling Environment, Technology Innovation Ecosystem for Making Sustainable Energy Options Affordable and Accessible (For Indonesia and Lao People's Democratic Republic), January 2014
http://apctt.org/nis/sites/all/themes/nis/pdf/National-assessment-framework_-final_ESCAP.pdf
2. Report on the National Assessment Framework of Enabling Environment and Technology Innovation Eco-system for Making Sustainable Energy Options Affordable and Accessible – Indonesia, May 2014
http://apctt.org/nis/sites/all/themes/nis/pdf/Indonesia_Report-on-National-Assessment-of-Sustainable-Energy_optimized.pdf
3. Indonesia National Sustainable Energy Strategy Report on Enabling Environment and Technology Innovation Ecosystem for Affordable Sustainable Energy Options, May 2014
http://apctt.org/nis/sites/all/themes/nis/pdf/Indonesia-National-Strategy-Report_final.pdf
4. Report on the National Assessment Framework of Enabling Environment and Technology Innovation Ecosystem for Making Sustainable Energy Options Affordable and Accessible - LAO PDR, May 2014
http://apctt.org/nis/sites/all/themes/nis/pdf/Lao_Report-on-National-Assessment-of-Sustainable-Energy.pdf
5. Lao People's Democratic Republic National Sustainable Energy Strategy Report on Enabling Environment and Technology Innovation Ecosystem for Affordable Sustainable Energy Options, May 2014
http://apctt.org/nis/sites/all/themes/nis/pdf/Lao-National-Strategy-Report_final.pdf
6. National Innovation System (NIS) training manual - "NIS Diagnosis and STI Strategy Development to Achieve National Sustainable Development Goals", 2016
<http://apctt.org/nis/sites/all/themes/nis/pdf/NIS%20Training%20Manual.pdf>

Technology Platforms and Databases

1. APCTT's Technology4SME Database
The Technology4SME Database serves as an online platform for information exchange on the availability and sourcing of technologies for small and medium enterprises in countries in the Asia Pacific region.
<http://apctt.org/technology-transfer>
2. Renewable Energy Technology Bank
The primary objective of the Renewable Energy Cooperation-Network for the Asia Pacific (RECAP) established by APCTT is to facilitate technology transfer cooperation among countries in the Asia-Pacific region in the area of renewable energy. RET-Bank provides tested and proven renewable energy technologies (RETs) initially in the areas of solar, biomass, wind, mini-hydro power and geo-thermal energy.
<http://apctt.org/recap/renewable-energy-technology-bank>
3. Global Technology Databases
APCTT has compiled a list of global as well as country-wise technology databases that deal with the technology transfer related services for SMEs and entrepreneurs.
<http://apctt.org/apitude/>



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The website for YOU to

- Network with your potential technology partners

- Explore technology and business opportunities

- Know latest technological developments in

- Biotechnology
- Waste Technology
- Non-Conventional Energy
- Food Processing
- Ozone Layer Protection

- Read articles on

- Technology Trends
- Technology Markets
- Technology Transfer

- Gain knowledge on

- Start-up venture creation
- Venture financing
- Innovation management
- Technology transfer
- Green productivity

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