

Strengthening innovation-driven inclusive and sustainable development

Asia-Pacific

Tech Monitor

Vol. 37 No. 4 Oct - Dec 2020

**Sustainable energy development
Innovative business models and best practices**



Plus

- Technology News and Events
- Tech Ventures & Opportunities
- Business Coach



*The shaded areas of the map indicate ESCAP members and associate members.**

The Economic and Social Commission for Asia and the Pacific (ESCAP) serves as the United Nations' regional hub promoting cooperation among countries to achieve inclusive and sustainable development. The largest regional intergovernmental platform with 53 Member States and 9 associate members, ESCAP has emerged as a strong regional think-tank offering countries sound analytical products that shed insight into the evolving economic, social and environmental dynamics of the region. The Commission's strategic focus is to deliver on the 2030 Agenda for Sustainable Development, which is reinforced and deepened by promoting regional cooperation and integration to advance responses to shared vulnerabilities, connectivity, financial cooperation and market integration. ESCAP's research and analysis coupled with its policy advisory services, capacity building and technical assistance to governments aims to support countries' sustainable and inclusive development ambitions.

**The designations employed and the presentation of material on this map do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries*

Asia-Pacific Tech Monitor

Vol. 37 No. 4 ❖ Oct-Dec 2020

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.

Web: www.techmonitor.net

Editorial Board

Ms. Michiko Enomoto

Dr. Satyabrata Sahu

ASIAN AND PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY

C-2, Qutab Institutional Area

Post Box No. 4575

New Delhi 110 016, India

Tel: +91-11-3097 3700

Fax: +91-11-2685 6274

E-mail: postmaster.apctt@un.org

Website: <http://www.apctt.org>

Opinions expressed by the authors are not necessarily those of APCTT.

The designation employed and the presentation of material in the publication do not imply the endorsement of any product, process or manufacturer by APCTT.

*The contents of the **Tech Monitor** may be reproduced in part or whole without change, provided that the **Tech Monitor** and the authors concerned are credited as the source and a voucher copy of the publication that contains the quoted material is sent to APCTT.*

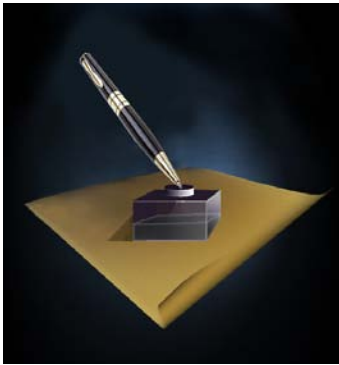
This publication has been issued without formal editing.

ISSN: 0256-9957



CONTENTS

Introductory Note	2
Technology Market Scan	3
Technology Scan: Sustainable energy technologies	8
Special Theme: Sustainable Energy Development – Innovative business models and best practices	
• Sustainable energy development Technology trend, innovative business models and best practices <i>Mohammad Golam Sarware Kainat</i>	13
• The need for sustainable energy development and the path to creating sustainable business models <i>Pamli Deka and Tirthankar Mandal</i>	20
• Generating Energy from Waste Public private partnership approach in Nepal <i>Narayan Prasad Adhikari, Sushim Man Amatya, Anusuya Joshi</i>	25
Tech Events	31
Tech Ventures & Opportunities	32
Business Coach	
• Start-up Venture Creation	33
• Technology Transfer	35
• Venture Financing	39
• Managing Innovation	41
• Green Productivity	43
Tech Opportunities	
• Technology Offers	45



Introductory note

According to the Intergovernmental Panel on Climate Change (IPCC), global average temperature has already surpassed the mark of one degree Celsius rise compared to pre-industrial levels since 1880¹. This highlights the urgency to strengthen and expedite the actions towards low carbon growth. Responding to this urgency, countries are starting to commit to net zero emissions in the next few decades. Towards this objective, it is imperative for countries to transit from fossil fuels to clean and renewable energy. With technological advancements, renewable power now costs less than keeping many existing coal plants in operation. For example, replacing

the costliest 500 gigawatts of coal capacity with solar and wind can potentially reduce annual system costs by up to USD 23 billion per year². Additionally, it can curb the growth in greenhouse gas (GHG) emissions to reduce the impacts of climate change.

Apart from environmental benefits, accessibility and affordability of clean and renewable energy are also crucial factors to achieve the Sustainable Development Goals (SDGs). Also, the COVID-19 pandemic has re-emphasized the need for energy access in key development sectors, such as healthcare and education.

Innovative business models are required to bring sustainable energy development at the forefront. Achieving SDGs will be determined by the success of merging public financing and private investments through such models. Decentralized sustainable energy interventions offer an opportunity for investment for the private sector for achieving the development targets. For instance, Pay As You Go (PAYG) microgrids have been commissioned in a few districts in Bihar, Uttar Pradesh, and Jharkhand states of India. This model allows the beneficiary to pay for the energy consumed on a periodic basis.

The rapidly surging energy demand in the Asia-Pacific region opens up a plethora of opportunities for transition to clean energy. Countries are already adopting modern renewable energy sources and innovative technologies for clean energy such as solar photovoltaics, wind and biomass. For example, in Nepal, anaerobic digestion has been adopted to convert organic solid waste to compressed natural gas and electricity, and organic fertilizer as by-product. The project highlighted that communities can benefit even with limited government investment and public budget.

This issue of *Asia-Pacific Tech Monitor* discusses innovative business models and best practices for sustainable energy development in the Asia-Pacific region. Case studies from the Nepal and India are presented in this issue of Tech Monitor.

Michiko Enomoto
Head, APCTT-ESCAP

¹ The Intergovernmental Panel on Climate Change (IPCC), 2018. Special Report: Global Warming of 1.5 °C. Accessed at <https://www.ipcc.ch/sr15/chapter/spm/>

² <https://www.irena.org/publications/2020/Jun/Renewable-Power-Costs-in-2019>

INTERNATIONAL

Agreement to unlock potential of emerging tech

The COVID-19 pandemic has wrought economic and social disruption worldwide. As people and businesses focus on recovery, governments must ensure that innovation that will power economic growth and solve the world's most pressing social and environmental challenges is not held back by outdated regulations.

At a panel organized by the World Economic Forum and the Organization for Economic Co-operation and Development (OECD), ministers from Canada, Denmark, Italy, Japan, Singapore, United Arab Emirates and United Kingdom announced their plan to lead the world in fostering responsible innovation and entrepreneurship. The Agile Nations Charter sets out each country's commitment to creating a regulatory environment in which new ideas can thrive.

In a world first, the agreement paves the way for the nations to cooperate in helping innovators navigate each country's rules, test new ideas with regulators and scale them across the seven markets. Priority areas for cooperation include the green economy, mobility, data, financial and professional services, and medical diagnosis and treatment.

The collaboration is a result of the World Economic Forum's project on Agile Regulation for the Fourth Industrial Revolution, which supports regulators around the globe respond to technological innovation. In conjunction with this project:

- The World Economic Forum published its guide to better regulation of emerging technologies, developed in partnership with the Global Future Council on Agile Governance
- The OECD launched the development of principles on effective and innovation-friendly rule-making in the Fourth Industrial Revolution for its 37 member states, to be adopted in 2021

<https://moderndiplomacy.eu/>

ASIA-PACIFIC

CHINA

New amendment of the China patent law

On 17 October 2020, the Standing Committee of the National People's Congress of the People's Republic of China (PRC) passed the decision to amend the Patent Law of the PRC. The amended patent law will come into effect on 1 June 2021.

Some of the important changes in the China Patent Law are highlighted below:

Design patent

1. A design patent will no longer limit to protect the entire design of a product. Protection of a portion of the product design will be possible.
2. Protection term of a design patent will be extended from 10 years to 15 years.

Anti-competition

New Article 20 is added to prohibit anti-competitive practices in relation to patent rights. Abuse of patent right and actions constitute of monopolization would be handled in accordance with the PRC Anti-Monopoly Law.

Patent term extension

(i) In case an invention patent is only granted after 4 years or more from its filing date or 3 years or more after a request for substantive examination was filed, the patentee can request for an extension of patent term for any unreasonable delay.

(ii) Patent term extension will also be available for pharmaceutical-related patents, similar to a supplementary protection certificate in other jurisdictions, to compensate the time spent in obtaining marketing authorization for a drug. The maximum extension for drug-related patents shall be 5 years with a total effective patent term not exceeding 14 years after the authorization is obtained.

Public Open License System

(i) A brand new public open license system is introduced in the amended law. At the request of a patentee who wishes to license the patent to the public, China Na-

tional Intellectual Property Administration (CNIPA) will publish such open license information, including the relevant fee and payment means as requested by the patentee.

(ii) Annuity fee is reduced for any patents under the open license system.

Patent infringement

(i) Damages for willful infringement has been increased to no more than five times of the profits made from the patent infringement in line with the PRC Trademark Law and PRC Anti-Monopoly Law.

(ii) Statutory damages of patent infringement has also been raised from RMB30,000 to RMB5,000,000.

(iii) Legal proceedings in relation to patent infringement may be filed up to 3 years from the date of such infringement act and infringer are known or ought to know by the patentee. This is in line with the new statutory time limit under the PRC Civil Procedure Law.

The amended law has made significant changes in enhancing patent protection generally, curing some pain points under the old law and aligning with other jurisdictions' patent practices. The concept of Public Open License System is an innovative one which encourages patent licensing to the wider public. It is envisaged that the amended law will be widely welcomed.

<https://www.mondaq.com>

Patent filings down 14% in October 2020

According to statistics released 17 November 2020, October 2020 Chinese invention patent applications filing dropped 14.5% versus September 2020. Similarly, utility model patent applications filings dropped almost 15%. While a drop was expected due to the mid-Autumn Festival and National Day holidays, the drop was much steeper than last year's drop of 6.3% and 5.8%, respectively. The CNIPA did not provide a reason for the drop. Cumulative filings though are significantly higher than last year, especially for utility model patent applications.

Cumulative filings for invention patents applications through October 2020 was 1,231,706 versus 1,110,183 filings through October 2019. Cumulative filings for utility model applications through October was 2,393,222 versus 1,793,919 filings through October 2019. Cumulatively, foreigners filed 11.7% of invention patent applications so far this year and 0.4% of utility model applications, an often overlooked intellectual property right.

Cumulatively through October 2020, there were 412,830 invention patents granted, with foreigners receiving 17.6% of the granted patents. Cumulatively, there were 1,949,236 utility models granted, with foreigners receiving 0.4% of the grants.

<https://www.natlawreview.com>

INDIA

Reinforcing position as innovation hub

Clarivate Plc, a global leader in providing trusted information and insights to accelerate the pace of innovation, has announced the release of a new report on Innovation in South and South East Asia. The report revealed that 64% of the 235 leading innovators are Indian organizations, reinforcing India's position as a regional research and innovation hub. Governments and academic institutions in the region are pivotal to enabling innovation. They constitute 57% of the top innovators in the report.

Science, technology and innovation are at the forefront of South and South East Asian countries' national agendas. The Association of South East Asian Nations (ASEAN) Plan of Action on Science, Technology and Innovation (2016 to 2025) and ASEAN IPR Action Plan (2016 to 2025) show why and how science, technology and intellectual property (IP) can contribute to national and regional socio-economic development goals. At a national level, the Indian government has identified innovation as a priority, with initiatives such as Innovate India, a platform for showcasing innovation. The concerted policy push by governments and new initiatives from IP

offices in the region to encourage IP investment and make IP protection more affordable are encouraging a culture of innovation and IP.

South and South East Asian innovators identified in the report saw their inventions rise by 10% year on year between 2014 and 2018.

Research for the report was conducted using patents filed between 2014 and 2018 by organizations that originate from the region. From analysis of over 75,000 inventions across the region, 235 organizations made the final list of key innovators in the region. These organizations were based in 9 countries – Brunei Darussalam, India, Sri Lanka, Singapore, Malaysia, Thailand, Indonesia, Philippines and Vietnam – and included government research institutions, academia and corporations.

<https://www.marketscreener.com>

INDONESIA

Key changes to Indonesian patent and trademark laws

Indonesia officially enacted Law No.11 of year 2020, commonly known as the Omnibus Law, on 2 November 2020. The Omnibus Law contains revisions to multiple laws, including patent and trademark laws.

The major changes to the Indonesian patent law are as follows.

“Simple patent” – commonly known as a utility model, petty patent or innovation patent in other jurisdictions. The law has been amended to explicitly define a simple patent. Previously, a simple patent could be granted to every new invention or development of an existing product/process which is industrially applicable. There is now a further definition in that the development of the existing product/process can include “a simple product, a simple process, or a simple method.” At this juncture, it is unclear how the further definition will materially affect prosecution of simple patents. It appears that the further definition might suggest that it is easier for simple patents to be granted when compared with before.

“Working requirement” – Specifically, acts of using, manufacturing, importing or licensing will be considered working the invention. Previously, only acts of using or manufacturing was considered working the invention.

Furthermore, patent owners can submit a written request to postpone fulfilment of the working requirement. If approved, a postponement period of a maximum of 5 years may be granted. Seeking further postponement (i.e., beyond the maximum period of 5 years) may also be possible, citing valid reason(s). The request for postponement has to be filed within 3 years from grant of the patent. There are transition provisions which allow patent owners with patents granted before 9 December 2019 to file a request for postponement by 8 December 2022.

“Compulsory licensing” – Consistent with the changes to the working requirement provisions mentioned above, if an invention is not worked (i.e., the patent owner does not use, manufacture, import, or license a product/process covered by the patent) within 36 months after grant, a third party can file an application for a compulsory license. In the past, a third party could file an application for a compulsory license if the patent owner does not manufacture products or use processes covered by the patent within 36 months after grant. In other words, it is now possible to avoid compulsory licensing by importing a product or licensing a product/process.

There are *two major changes* to the *trademark law* – (i) a trademark cannot be registered if it contains shapes/forms that relate to a functional purpose and (ii) the substantive examination period has been significantly reduced from 150 days to 30 days, which should result in faster prosecution and grant of trademarks.

<https://www.mondaq.com>

Fund for Indonesian tech startups

MDI Ventures, the corporate venture arm of state-owned Telkom Indonesia, has partnered with fintech-focused VC firm Finch Capital to launch a new early-stage

investment fund called Arise. The two firms will run the fund under a joint venture and invest in Indonesia-focused tech startups in Southeast Asia. Arise, which has a target of US\$40 million in assets under management, will invest in startups in the post-seed to series A stage with an average ticket size between US\$250,000 to US\$3 million. The team will use a variety of playbooks to make these investments, which are tailored to different tech ecosystems in Europe, Asia and Silicon Valley.

A recent report by Cento Ventures shows that local tech investing fell to US\$5.6 billion in 2020, a 13% drop compared to the same period in 2019. MDI Ventures and Finch Capital believe that this fund may generate optimism for early-stage tech companies in the region.

<https://www.techinasia.com>

JAPAN

Stimulus package focusing on green, digital innovation

Japan's Prime Minister Yoshihide Suga pledged to compile a stimulus package focused on pulling the economy out of a pandemic-induced slump through green investment and digital innovation. "We are looking into a package sufficient to underpin an economic recovery while achieving a digitalized, carbon-neutral post-pandemic society," Suga said during a meeting of the government's top economic council.

Members of the private sector participating in the meeting called for spending big enough to prevent economic conditions from worsening further. "The government shouldn't be bound by precedents. It must deploy all budgetary, tax and deregulation means available to boost growth," the members said in a written proposal presented to the council's meeting. They also expressed hope that the Bank of Japan would take appropriate action to cushion the economy from the impact of the pandemic.

The members proposed creating a large-scale fund to help firms that invest in digitalization and carbon-neutral technology. The private members' proposals tend

to lay the groundwork for discussions on the government's economic policy.

<https://www.reuters.com>

MALAYSIA

New policy to transform from user to developer of technologies

The National Policy on Science, Technology and Innovation (DSTIN) 2021–2030 will intensify local technology development and application efforts to transform the country from being technology users to technology developers. Minister of Science, Technology and Innovation, Khairy Jamaluddin said that, by setting a target of becoming a high-technology country, the efforts would be able to reduce dependence on foreign technology and labour. He said experimental development research efforts would be empowered by setting aside 50% from the allocation for research and development (R&D). The government through this ministry has formulated the new policy, which will also address the issue of innovation inefficiency, where the concept of Science, Technology, Innovation and Economy (STIE) is introduced in this policy.

"An integrated approach combining the two major sectors of the country, namely 'STI' and 'Economy' as one sector, to ensure all programmes are implemented to complement each other and have a high impact, thus making STI as an enabler in addressing national issues and challenges," he said when launching the policy and the 10-10 Framework of Science, Technology, Innovation and Economy (MySTIE) which was streamed live on the ministry's Facebook page today.

He said the new policy outlined six cores, along with 20 strategies and 46 initiatives, covering all sectors and living spaces of people from all walks of life. Khairy said that the six cores emphasized responsive STI governance, empowerment of research, development, commercialization and innovation (R&D&C&I), as well as the use of local technology by the industry, STI talent development, embracing and

application of STIE, as well as bringing STI to the global stage. "We are aware that STI-based economic growth efforts require the cooperation of various parties, therefore this policy emphasizes strategic collaboration between government, industry, academia and society, particularly in the development of local technologies through R&D&C&I.

"This is to ensure that STI benefits all parties inclusively without marginalising any quarter ... STI talent which is the backbone of national development is also the main focus of the new DSTIN," he said. Therefore, he said, Science, Technology, Engineering and Mathematics (STEM)-based education, as well as Technical Education and Vocational Training (TVET), will be fortified to ensure that talents can meet the needs of the industry in a rapidly changing global economy and technology.

Khairy said in the efforts to make Malaysia a high-technology country with a GERD (Gross Domestic Expenditure on Research and Development) of 3.5% by 2030, 10 STIE leap programmes have been formulated. Among them are the creation of Technology Commercialisation Accelerator (TCA), Malaysia Science Endowment (MSE), National Technology Innovation Sandbox (NTIS) and the establishment of the National Vaccine Centre, which will drive local technology development and commercialization of R&D products.

Meanwhile, Khairy said Malaysia was ranked 33rd out of 131 innovative countries in the 2020 Global Innovation Index (GII), compared with 35th last year.

<https://www.theedgemarkets.com>

REPUBLIC OF KOREA

R&D spending

The Republic of Korea invested almost 90 trillion won (US\$83 billion) in research and development (R&D) last year, making it the fifth largest spender among members of the Organization for Economic Cooperation and Development (OECD). The Republic of Korean government and the private sector's total R&D spending in 2019 amounted to 89.05 trillion won, up

3.9% from the previous year, according to the Ministry of Science and ICT.

The total R&D spending translates to 4.64% of the Republic of Korea's gross domestic product (GDP) last year. The ministry said the latest figures place the Republic of Korea as the fifth largest R&D spender and second in terms of R&D spending to GDP ratio among OECD countries, although figures for other countries are based on the results from 2018.

The United States was the largest R&D spender that year at a total of \$581.6 billion. The ministry said Republic of Korea's private sector spent 68.5 trillion won in R&D last year, accounting for 76.9% of the total, while public R&D spending amounted to 19.1 trillion won or 21.4% of the total.

Companies' R&D spending in manufacturing amounted to 62.6 trillion won in 2019, up 2.3% from the previous year, while R&D in the service sector rose 21.6% to 7.6 trillion won over the same period. The number of researchers in the country also increased 4.7% to 538,136 in 2019. Female researchers took up 21% of the total last year, lower than other major countries. The ministry said the United Kingdom's share of female researchers stood at 38.6% in 2018 and Germany at 27.9% in 2017.

<http://koreabizwire.com>

SINGAPORE

Innovation Awards 2020

TechNode Global, a Pan-Asia tech platform, has announced the winners for the first edition of ORIGIN Innovation Awards. 2020 winners include early-stage startups, venture capital firms, corporates, community builders and influential individuals. Close to 400 contenders from 18 countries across the Asia Pacific region participated. Southeast Asia continued to be the most-represented region, with 67% of the applications, while East Asia emerged in the second spot with 23%, ahead of South Asia with 10%.

TechNode Global presented the ORIGIN Innovation Awards to outstanding startups, corporates, ecosystem enablers, and movers and shakers in Asia who are poised for

growth. Nominations were evaluated based on criteria such as value proposition, strength of technology product, company growth potential and the leadership capability.

Dr. Gang Lu, founder and CEO of TechNode Global, said, "We're thrilled to offer recognition to the winners as they continue their journey on a technology revolution. TechNode Global remains committed to continue building a community of tech innovation in Asia. We look forward to meeting more outstanding solutions, engaging new partners, and connecting tech businesses across the region."

<https://technode.com>

SRI LANKA

Angel Fund shortlists five startups for investment

The Angel Fund, the first of its kind in Sri Lanka, has shortlisted its five early-stage startups for potential investment; Niftron, Traccular, Medica, Soulboner Clothing and Ophir. This follows an intense application and selection process, spanning September, October and November 2020, which initially attracted 80 applications.

The Angel Fund, launched earlier this year by the Lankan Angel Network (LAN), was established with the support of ecosystem development partner Ford Foundation to catalyze the growth of Sri Lanka's startup ecosystem. Comprising 100 angel investors, including many high-profile entrepreneurs and corporate leaders, who represent more than a dozen sectors with proven competencies in over 20 functional domains, the Angel Fund is also distinct in that it features 20% of its investment from members based out of Canada, Dubai, Hongkong, Qatar, the UK and the United States.

The process was guided by the Fund's high-profile Investment Committee (IC) consisting of Angel Fund members Dumith Fernando, Chairman of Colombo Stock Exchange/Chairman of Asia Securities, Dumintra Ratnayaka, Chairman/Senior Consultant at Martin & George. The IC also comprises Nathan Sivagananathan, Co-Founder of Hatch Works; Anarkali Moonesinghe, former CEO of CIMB Sri Lanka; Mangala Karunaratne,

Founder/CEO of Calcey Technologies; and Imal Kalutotage, Founder/CEO of NCINGA. Joining them as Independent IC Member is Shiluka Goonewardene, Principal – Deal Advisory – KPMG.

Angel Fund IC member Dumith Fernando stated, "The investment approval process for the Angel Fund was quite robust with seasoned experts from varied backgrounds participating in the Investment Committee. We were encouraged by the quality of the shortlisted startups that presented to us. We set a high bar for investment selection this time. And even among those founders who did not gain funding this quarter, we found several who would be investable with some tweaks to their business models and plan."

The top five shortlisted startups were:

1. Niftron – A Blockchain-as-a-Service platform that allows for easy and efficient integration of blockchain with products or projects, enhancing ownership, transparency and security.
2. Traccular – A cloud-based IoT-enabled visitor management system that provides a scalable solution for companies looking for an efficient check-in and verification process to improve efficiency and security.
3. Medica – A cloud-based patient and prescription management platform for doctors. From when a patient registers, to when they walk out with their medicines from the pharmacy, the entire process is managed within Medica, which aims to build a digital ecosystem for primary health care for Sri Lanka.
4. Soulboner Clothing – A fun, casual Sri-Lankan streetwear line made for GenZ and the young Millennial. The brand focuses on creating a lifestyle and a community and boasts a customer base in many countries.
5. Ophir – A brand focusing on a range of chemical and synthetic-free, all-natural body care and spa products, which deliver the rich benefits of Camellia Sinensis, Ceylon Tea. Ophir taps into the skyrocketing global demand for natural skincare products, with the added advantage of Sri Lanka's millennia-old fame resulting from its cornucopia of botanicals, spices, and herbs, as well as Ayurveda.

The Rs. 100 million Angel Fund has plans to eventually invest in 6–10 high potential

startups in total, gearing them up to scale domestically, and even internationally. It is managed by LAN's fund management team, which continues to identify and evaluate opportunities for investment across the island, including in traditionally underserved regions. The fund is dedicated to investing in, and mentoring and supporting, early-stage startups across multiple sectors; from making investments at the early stages, to even helping startups identify sources for future funding.

The Angel Fund also periodically evaluates early-stage startups. Held every three months, these evaluation cycles are announced by the Fund via the Lankan Angel Network pages on Facebook and LinkedIn.

<http://www.colombopage.com>

THAILAND

Scaling up robotics innovation

State-run Electricity Generating Authority of Thailand (Egat) plans to scale up its development of innovations in energy and robotics for commercial purposes within five years, says assistant governor Venus Longsomboon. Egat is working on many projects to reduce dependence on imports of machinery and increase efficiency of power generation and transmission systems.

A move toward commercial development is in line with economic policymakers who want Thailand to build technology in the country, said Ms Venus, who oversees research, innovation and business development for Egat. Egat started developing innovations more than five years ago.

- Waste-to-energy projects see official support, villager resistance
- Hit by pandemic
- BECIS-Symbior secures UOB green loan

Now it is emphasizing various technologies, including a predictive maintenance analytics system, a weed-removing barge, a robot that can repair transmission lines and a smart power balance system for electricity generated by fossil fuel and renewable sources. Most projects aim to save operation costs, replace technology imports and maintain security of the power supply.

To develop commercial innovations, Egat recently teamed up with Spain-based Wallbox Chargers SL, the world's first start-up successfully developing and manufacturing small bi-directional chargers for home use. They signed a memorandum of understanding in October, with an aim to jointly develop a smart electric vehicle (EV) charger enabling vehicles to give power to the grid. Wallbox also plans to help Egat develop a suitable EV charger business for Thailand.

<https://www.bangkokpost.com>

Online intellectual property dispute platform

The Thai Department of Intellectual Property has introduced its online dispute settlement services covering intellectual property cases that it developed with the Thai Arbitration Institute. This brand new service will be officially in operation from January next year. The online dispute settlement platform for intellectual property cases will assist with cases related to copyright, patents and trademark infringements using digital technology.

The new system will allow cases to be filed online, enabling settlement sessions via online chats and video conferences, and allowing fully online formal settlement processes to achieve faster, more convenient agreements with less chance of confrontation between the two sides, and at a lower cost. When settling disputes on the online system, the parties involved will have to agree to a mutual confidentiality agreement that forbids facts and evidence being shared during the process and from being used in a court filing.

This new online settlement service will be available from January 2021 on the website www.thac.or.th/.

<https://en.vietnamplus.vn>

VIET NAM

New regulations on document signing

The Intellectual Property Office of Vietnam (VNIPO) recently issued Notice 13822, which tightens the requirements for legal

representatives of IP applicants to sign documents on their behalf.

- The government hopes this will ensure greater quality and validity in the type of IP applications in addition to its efforts in developing a more comprehensive IP system.
- The new regulation is set to impact both local and foreign IP applicants pursuing IP registration in Vietnam.

The VNIPO recently issued *Notice No. 13822/TB-SHTT* (Notice 13822), which tightens the requirements for legal representatives of IP applicants or owners to sign documents on their behalf.

This latest notification is part of the government's efforts to improve the country's IP system. In August 2019, the government issued the Intellectual Property Strategy 2030, which aims to develop a comprehensive IP system to not only provide protection but to foster innovation, and thus utilizing IP as a tool to enhance economic development and national competitiveness.

The strategy covers five main objectives, namely

1. Place Vietnam among the leaders of creation and protection of IP rights in ASEAN by 2030;
2. The establishment of industrial property laws as well as plant variety rights to ensure greater transparency for applicants;
3. To improve IP laws and to significantly reduce the number of IP infringement cases;
4. To increase the quantity and quality of IP of Vietnamese individuals and organizations with indicators from the GI; and
5. To enhance the effectiveness of IP utilization, such as increasing the number of commercially exploitable patents as well as the number of enterprises using IP tools in their production, among others.

<https://www.vietnam-briefing.com>

Technology Scan

Sustainable energy technologies

INTERNATIONAL

Improved water treatment technique

In recent years, “direct solar steam generation” (DSSG) has emerged as a viable technique for water purification, which utilizes “photothermal” materials that can absorb high amounts of solar energy. These materials are then made to float in water, which helps to maintain localized heating and generate water vapor that is subsequently condensed to obtain clean water. Current DSSG methods have reached the limits of solar thermal efficiency and evaporation rate; however, given the demand for high-flux clean water in large-scale commercialization, further enhancement in evaporation rate is necessary. Previous studies have tried to do this by exploring different absorbers to manipulate the “input” (IE) and “required” energy (RE) needed for evaporation, but the relationship between IE and RE has not been studied yet.

To this end, Prof Lei Miao from Shibaura Institute of Technology, Japan, along with co-authors Xiaojiang Mu and Jianhua Zhou from Guilin University of Electronic Technology, China, aimed to find a balance between IE and RE to optimize evaporation performance in DSSG. According to them, the trick to this was to reduce the RE to match the IE, a unique concept called “energy matching.” For this, they came up with an innovative evaporation system based on bilayer structures of carbon nanotube aerogel-coated wood (CACW). The design provided three layers of thermal insulation, which (1) minimized heat loss and prevented a sudden temperature drop in the absorber and (2) regulated water transport to the evaporation surface. Prof Miao explains, “Water speed regulation is key to the ‘energy matching’ strategy employed in our design. By controlling the speed of water transport, we ensure that the RE for evaporation is balanced with the IE to the absorber.” The findings of their study are published in *Solar RRL*.

To test the water transport speed in the CACW system, the scientists evaluated the

evaporation rates for different concentrations of carbon nanotubes and for wood sheets of different thicknesses. In addition, they used the system to treat liquid samples emulating sewage and estimated their quality post treatment in terms of ion concentration, oil content, and bacterial levels. Finally, they estimated the IE and evaporation rates under varying water transport speeds.

The analysis revealed that the best evaporation performance and highest solar-to-vapor energy conversion efficiency achieved with this system were 2.22 kg m⁻²h⁻¹ and 93.2%, respectively, which are higher than other carbon-based materials. Moreover, the evaporator showed sufficient self-cleaning ability along with excellent stability after ten cycles. The treated water exhibited significantly reduced metal ion concentrations, bacterial level, and oil content compared to the input samples, suggesting that it was suitable for drinking.

With such encouraging results, Prof Miao considers it a triumph for the “energy-matching” strategy and believes it has broken new ground. She concludes, “Our strategy yielded a 40% improvement in the evaporation rate along with a high solar-to-vapor conversion efficiency of 93%. We now look forward to the practical implementation of DSSG in desalination of seawater and sewage treatment. In the future, we hope to come up with new ideas to develop this technology further until we have eradicated water scarcity.”

https://www.eurekalert.org/pub_releases/2020-12/siot-aba120920.php

ASIA-PACIFIC

AUSTRALIA

Efficient process to convert water into hydrogen

University of Sydney researchers have developed an efficient process to convert water into hydrogen – a breakthrough in the development of this clean energy resource. A team of engineers led by FH Loxton Research Fellow Dr Shenlong

Zhao from the School of Chemical and Biomolecular Engineering have created an efficient water-splitting catalyst that requires less energy to produce pure hydrogen than earlier catalysts. Catalysts are materials that speed up or slow down chemical reactions. They are critical for managing energy conversion.

The water-splitting process – which rips hydrogen away from oxygen, turning “H₂O” into “H₂” – has not been widely adopted, mainly because of the prohibitive cost of precious metals, like platinum or ruthenium, normally used as catalysts. Methods to split water are also often unfeasibly energy intensive, and the required catalyst materials can break down too quickly before the necessary change occurs. “Improvements in energy conversion and storage are absolutely essential for a successful and sustainable energy economy. Because energy from solar and wind sources is intermittent, our research sought to discover an efficient way of storing renewable-sourced power,” said Dr Zhao.

<https://indiaeducationdiary.in>

CHINA

Hydrogen solar project

In China, researchers have demonstrated a use case for using the hydrogen to make methanol, and if convert it back, a promising area, as methanol does have wide readily available industrial uses. In fact, rather than releasing carbon dioxide into the air, it can be used to produce methanol – an excellent fuel for cars and airplanes, using solar energy. In this case, Hydrogen is just an intermediary step.

Researchers led by professor Li Can at the Dalian Institute of Chemical Physics (DICP), an institute under the government recently claimed to have industrialized the liquid solar fuel production via the “Liquid Solar Fuel Production Demonstration Project.” Or the “liquid sunshine” project, as they called it.

For carbon dioxide hydrogenation, the catalyst used was zinc oxide/zirconium oxide bimetallic oxide solid solution catalyst,

which the researchers claim has been a cost-effective, high-stability, and high-selectivity option for methanol production. The selectivity of methanol increased to 98%, while the methanol content in the produced fuel increased to 99.5%. Furthermore, the catalyst was found to be highly resistant to sintering and poisoning.

The "Liquid Solar Fuel Production Demonstration Project" was made at a plant with three basic units: A solar plant to supply renewable electricity, alkaline water electrolyzer to synthesize green hydrogen, and carbon dioxide hydrogenation to produce methanol. This methanol can be supplied to the chemical industry, or stored and used to produce hydrogen again.

With a total power of 10 MW, the solar plant supplied the electricity needed for the alkaline water electrolyzer to produce hydrogen, which was then used in the end station for hydrogenation of carbon dioxide to finally synthesize methanol. Upto 1000 tons per annum, according to the researchers. They believe this could be scaled upto over 1000 tonnes, or even 100,000 tonnes, building a strong case for the use of solar power in more energy intensive industrial processes. At the time of filing, details were not provided on whether the solar power used was a set off on grid power, or used in combination with storage to ensure steady supply.

<https://www.saurenergy.com>

INDIA

Method to control voltage fluctuations in solar systems

Researchers at the National Institute of Technology Kurukshetra have claimed to have developed a new method to regulate direct current (DC) voltage for grid-connected solar photovoltaic plus battery energy storage (SPV-BES) systems. The researchers explained that power system engineers faced several technical challenges due to the high-penetration of renewable energy into the distributed generations. The voltage level increases due to the active power supply from solar to the distribution system. The issue becomes

severe when solar power generation is at its peak during the day time.

The researchers developed a new technique for the coordinated regulation of active and reactive power compensation of grid-connected solar plus battery storage. They utilized a curve fitting toolbox in Simulink (graphical programming for simulation) to derive the controller equation for the new DC voltage regulator. To verify the proposed system's effectiveness, the researchers simulated variations in solar irradiance and load changes.

The researchers integrated the maximum power point tracking (MPPT) algorithm in the control setup to take out the peak power output from solar at any instance under the variable operating conditions. The battery will be charged when the solar irradiance is higher than a particular value decided by the voltage measurement of SPV. It will be discharged when the solar system cannot supply the load due to reduced solar irradiance as the converter allows the energy to flow in both directions.

The researchers connected the solar system with the DC link capacitor through DC to DC converter and coupled BES to the DC link capacitor through buck-boost DC to DC converter to develop the control structure. They also used DC to AC converter to connect the DC side of the structure with the AC side and coupled variable AC loads at the point of common coupling (PCC).

<https://mercomindia.com>

Catalytic systems for biofuel, lactic acid production

Indian Institute of Technology (IIT) Guwahati researchers have developed efficient "pincer" catalytic systems that transform industrial/biomass wastes into valuable chemicals. Tiny amounts of these "pincer catalysts" repeatedly convert large amounts of industrial waste such as glycerol into lactic acid and hydrogen. "Such catalysts also efficiently convert bioethanol, a low-energy density fuel into high-energy density butanol," IIT Guwahati said in a statement.

The conversion of valuable intermediates such as glycerol and ethanol, produced

during the processing of biomass, into industrially useful chemicals has elicited much interest worldwide. "Glycerol, for example, which is a by-product in biodiesel production, can be transformed into lactic acid and hydrogen, the former used extensively in food, pharmaceutical, cosmetic and polymer industries, and the latter in the energy sector," IIT-G said. "Likewise, ethanol obtained from biomass can be converted into high quality fuel. While bioethanol has lower energy density than gasoline and corrodes engine parts when used directly, it can be transformed into higher energy butanol that is immiscible in water and noncorrosive in nature," it added. The conversion of glycerol and ethanol into such useful products hinges on the development of efficient catalysts that can bring about these transformations.

Dr. Akshai Kumar and Dr. Hemant Kumar Srivastava work towards the development of catalysts that can bring about such industrially important transformations. They have recently developed efficient 'pincer catalysts' that selectively convert glycerol to lactic acid and bio-ethanol to butanol. "Pincer catalysts are complex molecules in which, an organic moiety holds on tightly to a metal core, much like the claws of a crab," said Dr. Akshai Kumar adding that such an arrangement not only confers stability to the catalyst, but also selectivity to bring about the intended transformations.

The research team rationally designed and tested a large library of "pincer catalysts" to be used for these transformations. The experiments were carried out under environmentally benign conditions without the use of hazardous reagents and solvents. The most efficient "pincer catalyst" was found to be one that had least crowding around the metal centre. Such an arrangement enabled easy removal of hydrogen from the starting materials, glycerol and ethanol, and their selective conversion into lactic acid and butanol, respectively. The results of the experiments have been validated by theoretical studies.

<https://nenow.in>

REPUBLIC OF KOREA

Record efficiency for flexible perovskite solar cells

Scientists have developed a material for flexible perovskite solar cells that uses sunlight-generated electrons more effectively, obtaining a new record efficiency of 20.7%. The material includes a porous planar electron transport layer that improves the interaction between its electrodes and perovskite layer, increasing performance to nudge the concept closer to real-world applications.

The most efficient perovskite solar cells are often rigid so typically contain materials that need to be processed at temperatures over 250°C. Flexible solar cells have the advantage of a high power-to-weight ratio, flexibility and low manufacturing costs but trail behind rigid modules in terms of performance. Now, a team led by Jangwon Seo from Korea Research Institute of Chemical Technology (KRICT) in South Korea has found a way to combine the principles of flexible and rigid photovoltaics, overcoming the previous performance limitations and producing large-scale devices.

'Highly efficient rigid perovskite solar cells usually employ a bilayered architecture for the electron transport layer and motivated us to introduce this approach to flexible solar cells,' explains Seo. The new flexible device uses an electron transport layer that is processed at 180°C then spin coated onto a substrate before being treated with 100°C heat. A similar electron transport layer could also form the basis of thinner, lighter and more flexible solar cells using polymer substrates.

'This new low-temperature fabrication methodology for mesoporous electrodes based on Zn₂SnO₄ thin films is a clear step towards the imminent commercialisation of highly efficient flexible perovskite solar cells,' comments Mónica Lira-Cantú who researches flexible perovskite solar cells at the Catalan Institute of Nanoscience and Nanotechnology in Spain.

The bilayered structure is comprised of a porous layer made using 20nm-sized

Zn₂SnO₄ nanoparticles and a planar layer made of 2nm-sized SnO₂ nanoparticles, giving an energy band structure that allows effective extraction of electrons that are excited by light shining on the perovskite active layer, minimising recombination of electron-hole pairs formed in the process.

<https://www.chemistryworld.com>

Perovskite solar cell via new photoactive layer

Researchers at the Republic of Korea's Ulsan National Institute of Science and Technology (UNIST) claim to have achieved a conversion efficiency of 25.17% in a perovskite solar cell by minimizing the deformation for the microstructure of photoactive layers in the device. The scientists explained that the microstructure of these layers, which generate an electric charge and send it to electrodes, can be deformed, which affects the efficiency of the charge transfer itself. 'This is because the extracted electric charges disappear when defects are formed,' they explained. They claim to have succeeded in minimizing the internal defects of the photoactive layers by changing the type and ratio of ions embedded in the layers. These changes were responsible for increasing the solar cell's open-circuit voltage, 'Encapsulated devices retained 90% of their initial efficiency after 400 hours of maximal power point operating conditions,' the researchers stated, adding that the certified efficiency of the device is 24.4%.

The Korean team also explained that the cell maintained over 80% of its initial efficiency after 1,300 hours in the dark at 85 degrees Celsius. The process to prevent the deformation of the photoactive layers is described in the paper *Impact of strain relaxation on performance of a-formamidinium lead iodide perovskite solar cells*, published in *Science*.

<https://www.pv-magazine.com>

Biodiesel from discarded cardboard

Development of a microorganism that doubles the yield of biodiesel precursor

production using genetic scissors and based on the principles of evolution; expected to reduce fine dust release and reduce greenhouse gas emissions.

Dr. Sun-Mi Lee and her team at the Clean Energy Research Center of the Korea Institute of Science and Technology (KIST) have announced that they have developed a novel microorganism capable of producing biodiesel precursors from lignocellulosic biomass such as discarded agricultural by-products, waste paper, and cardboard boxes. This microorganism has achieved the product yield twice of what was obtainable from its predecessors.

This novel microorganism can produce biodiesel precursors during the process of metabolizing sugars contained in the lignocellulosic biomass that it feeds on. The sugar contained in lignocellulosic biomass is generally composed of 65-70% glucose and 30-35% xylose. While microorganisms that exist in nature are effective in producing diesel precursors by metabolizing glucose, they do not feed on xylose, thus limiting the yield of the raw materials.

To solve this problem, the KIST research team developed a new microorganism that can produce diesel precursors by effectively metabolizing xylose as well as glucose. In particular, the metabolic pathway of the microorganism was redesigned using genetic scissors to prevent interference with the supply of coenzymes essential for producing diesel precursors. The ability to metabolize xylose was improved by effectively controlling the process of evolution in a laboratory, for instance, by selecting and cultivating only those microorganisms that delivered excellent performance.

<https://scitechdaily.com>

EUROPE

GERMANY

Renewable energy from biomass

Siemens Energy has helped drive power generation trend through long-standing production and research on technologies

and equipment. A key objective has been to improve the efficiency and bring down the cost of recovering biomass. Additionally, every single industrial steam turbine manufactured is tailor-made for individual customer's needs. This highly customised modular design capability enable Siemens Energy to insert design elements needed by individual customers into each steam turbine. As a market leader for industrial steam turbines, Siemens Energy offers a comprehensive range of reliable and versatile steam turbines for the power output range from <1 to 250MW.

With this technology, its steam turbines can convert not only sugar, but a wide range of biomass products and waste into useful heat and power.

As demand for renewable energy grows, many of these owners are utilising bagasse in high-performance, biomass-to-energy plants in order to help drive profitability and build a sustainable, 'sweet', self-supplying energy production industry.

<https://biomarketinsights.com>

SWEDEN

Biofuel jet

Several successful test flights have been conducted with the Swedish air force's JAS 39 Gripen using a mixture of fossil-free fuel. Ongoing tests have shown good aircraft performance with the biofuel when compared to traditional jet fuel.

Testing continues and the Swedish Armed Forces is closely following the biofuel project that the Swedish Defence Materiel Administration (FMV) is conducting together with GKN Aerospace Engine Systems Sweden in Trollhättan. Engine tests have been performed in order to study possible differences in performance and engine function when using a 50/50 mix of biofuel compared to performance in engines using only jet fuel. The tests showed that the engine using biofuel had unchanged performance both regarding thrust power and fuel consumption.

"This is an important project for the Swedish Armed Forces' development activity as Sweden aims to become climate neutral

by 2045. The conducted tests are very positive and we look forward to the next step with confidence," says Brigadier General Gabor Nagy, fighter pilot and head of the Swedish Armed Forces' Total Defence Department.

<https://biofuels-news.com>

Electricity from tidal power

A tidal power project located in the Faroe Islands has started to send electricity to the grid, in the latest example of how marine based technologies are being deployed and used around the world. The small 100 kilowatt tidal kite system, known as DG100, was installed back in October, with commissioning activities starting at the same time.

In an announcement earlier this week, Minesto – a firm headquartered in Gothenburg, Sweden – said electricity was being sent to the grid as part of a power purchase agreement with Faroese utility SEV. The development is located in the Vestmannasund strait, in the northwest of the Faroe Islands, an archipelago situated in the northeast Atlantic Ocean between Iceland and Scotland.

Minesto's technology takes the concept of flying a stunt kite and transfers it to water in order to produce electricity. It does this by harnessing underwater current, which creates a hydrodynamic lift force on the wings of the "kite," generating movement. An onboard control system and rudders steer the kite in a figure of eight trajectory. As it moves, water flows through the system's turbine, generating electricity.

<https://www.cnn.com>

UK

Tidal power to create hydrogen

In November, the European Marine Energy Centre (EMEC) in Scotland announced it would be installing a 1.8-MWh flow battery at the organization's tidal energy pilot site on the Scottish island of Eday. This novel blend of tidal power technology and flow battery technology powers EMEC's on-site hydrogen production

facility. The setup will allow for continuous green hydrogen production from a variable renewable energy source. Produced by the UK-based Invinity Energy Systems, the flow battery system to be utilized at the EMEC tidal facility will be assembled from eight separate modules. The project is expected to go live by the end of 2021.

Dependent upon rising or falling tides, tidal power is predictable yet highly variable. There are four inherent cycles to tidal energy each day. By comparison, solar energy has just one charge and discharge cycle per day. Due to this variability, power storage is necessary to properly regulate tidal power technology as an energy source. With conventional lithium-ion batteries degrading significantly over time, flow battery technology has emerged as a promising alternative. After a technical review of its system, the EMEC established that flow batteries would be ideal for its use of tidal power for hydrogen production.

At the EMEC's facility, the flow battery will capture electricity generated during periods of high-power generation so it can be discharged during low power periods, creating on-demand electricity to make hydrogen through the use of a 670-kW electrolyzer.

<https://www.azocleantech.com>

Membrane-based system for cheap, efficiently made biofuels

Researchers at Imperial College London have developed a membrane-based extraction system for the production of biofuels which uses less than 25% of the energy of current processes and produces ten times more biofuel with more than 99.5% purity.

In their labs at Imperial, researchers investigated the performance of several thin-film composite membranes and settled on one which can block the transport of extractant and water, allowing only the biofuel to travel through. They found that this protected the microorganisms and enabled continuous production, resulting in a ten-fold increase in productivity compared with conventional techniques.

They tested the membrane with three different extractant solvents to further fine-tune the best operating conditions. They found that the 2-ethyl-1-hexanol extractant exhibited a five times faster recovery rate, which reduced the energy consumption of the process to less than one quarter of conventional recovery systems.

<https://www.greencarcongress.com>

New system uses wind turbines

The system uses the variable speed of the rotors in wind turbine systems to more closely regulate the supply of power to the grid. This means that when electricity demand is high, stored kinetic energy in the turbines can be used intelligently to keep the grid stable. University of

Lead researcher Professor Xiao-Ping Zhang, Director of Smart Grid in the Birmingham Energy Institute, comments: "By 2030 wind is expected to provide half the UK's power, so it's important that we can use the wind farms provide a vital safety mechanism of controlling frequency dips of UK's national power grid. Our proposed frequency control system for wind turbines could revolutionise the UK's power grid's frequency control and, importantly, uses our existing infrastructure of wind turbines and it will not need additional devices and investments."

The most recent severe power cut, in August 2019, caused blackouts across the Midlands, South East, South West, North West and North East of England, and Wales. The incident was triggered by two almost simultaneous unexpected power losses at Hornsea and Little Barford due to lightning strikes.

The method proposed by the Birmingham team harnesses the potential of wind turbines to operate at variable speeds to provide the flexibility required to respond to fluctuations in supply and demand. Their results are published in IEEE Open Access Journal of Power and Energy. The team has already validated their approach in an industry-standard power grid simulator and is seeking industrial partners to explore commercial opportunities for the technology.

<https://www.birmingham.ac.uk>

NORTH AMERICA

USA

Hydrogen fuel cells for hot, dry conditions

A research team formed in collaboration with Los Alamos National Laboratory, USA; University of Stuttgart, Germany; University of New Mexico, USA; and Sandia National Laboratories, USA have developed a proton conductor for fuel cells based on polystyrene phosphonic acids that maintain high protonic conductivity up to 200° C without water.

The project leader Dr. Yu Seung Kim from Los Alamos highlighted the need for regular technical innovations for next generation fuel cell platform towards heavy duty applications as one of the key technical challenges of current fuel cells is heat rejection from the exothermic electrochemical reactions of fuel cells.

He added that his team has already developed an ion-pair coordinated membrane in 2016 and now they have the challenge to improve the performance of high-temperature membrane fuel cells. The ion-pair polymers are good for use in the membrane, but the high content of phosphoric acid dopants caused electrode poisoning and acid flooding when we used the polymer as an electrode binder. Later after rigorous research and brainstorming the current fuel cells is developed by the researchers whose heat rejection requirement is met by operating the fuel cell at a high cell voltage. To achieve an efficient fuel-cell-powered engine, the operating temperature of fuel cell stacks must increase at least to the engine coolant temperature (100° C).

The team has developed a new synthesis for a phosphonated poly (pentafluorostyrene). And, this polymer showed a good proton conductivity being higher than Nafion in the temperature range >100°C, and an unexpected excellent chemical and thermal stability of >300°C. And later in the group have developed high-temperature fuel cells to use with the phosphonated polymers.

<https://www.saurenergy.com>

Innovation in hybrid energy systems

Researchers from the U.S. Department of Energy's (DOE's) three applied energy laboratories—Idaho National Laboratory (INL), the National Renewable Energy Laboratory (NREL), and the National Energy Technology Laboratory (NETL)—co-authored the paper describing such integrated energy systems.

"The design of integrated energy systems is a significant challenge—and opportunity," INL Director Mark Peters said. "The collaboration by the three applied national laboratories, and the setup and operation of real-world experiments at their testing facilities, represents a comprehensive and focused effort that is transparent and objective. This work will help realize future advanced energy systems that should help our nation expand affordable energy options and significantly contribute to wide-scale decarbonization efforts."

The paper describes one example of the multi-input, multi-output nature of these systems: a hypothetical, tightly coupled industrial energy park that uses heat and electricity from highly flexible advanced nuclear reactors, small-scale fossil generators, and renewable energy technologies to produce electricity and hydrogen from electrolysis.

"In this scenario, depending on market pricing, electricity and or heat could be sold into the grid, used on-site, or stored for later distribution and use," said David C. Miller, NETL's senior fellow for Strategic Systems Analysis & Engineering and co-author of the article. "Furthermore, the output streams could also be used to produce hydrogen or other valuable chemicals and products."

This flexibility could provide an abundant supply of clean energy for a larger net-zero-emission energy system. Such systems could support sectors of the economy that are more difficult to decarbonize, such as industry and transportation.

<https://www.globenewswire.com>

SUSTAINABLE ENERGY DEVELOPMENT

TECHNOLOGY TREND, INNOVATIVE BUSINESS MODELS AND BEST PRACTICES

Mohammad Golam Sarware Kainat

Director (Joint Secretary), Renewable Energy Development Sustainable and Renewable Energy Development Authority (SREDA) Power Division, Ministry of Power, Energy and Mineral Resources Government of Bangladesh 9-10th Floor, IEB Bhaban, Ramna, Dhaka-1000, Bangladesh E-mail: dir.re@sreda.gov.bd; gskainat@gmail.com

Abstract

The green sustainable energies have significant importance as the planet earth is suffering from global warming and it has got links with all the sectors of energy such as energy production, conservation, decrease of pollution and to implement techniques that are eco-friendly. Women can bring a unique value proposition as entrepreneurs in green energy businesses. This is good for the women, for their families, and for the business as entrepreneurs and employees—particularly in nontraditional roles—is a win-win situation. Here, women get an opportunity of income which can enhance welfare for them and their families in education, healthcare, skills, services to their communities, and performance as like as men. In this article, the available sources, their trends including related technologies, market development, sustainable innovation models, best practices, and gender issues will be focused based on the available data and brief analysis.

Introduction

The major energy resources were wood, timber, and waste product in ancient time of human era and later on biomass became the only energy source (Hannah Ritchie, <https://ourworldindata.org/renewable-energy>). Due to the technology development, fossil fuels like coal, oil, and natural gas were come in the scene. At that time the benefits of fossil fuels were wide and due to huge availability, it was very easy to harness. But the environment started to degrade as the usages of these fossil fuels increased heavily across the world. Result is an increase in global warming. Some of the countries across the globe have detained fossil fuels products, result to the upsurge in prices of these fuels. So, it was necessary to search for some other sources of energy source to mitigate the situation with rising prices, increasing air pollution and risk of getting finished soon. Already human experienced that energy sources should be available plenty, widely, and cheap across the globe, cause no pollution and create no damage to environment and are renewable in nature (World Energy Council, 2018). Therefore, sustainable energy comes into the

scene as it could meet increasing demand for energy, provides no harm to environment, everywhere available in the world in plenty, and can be used them in the future without depletion.

The renewable energy sources are solar, wind, hydro, ocean, geothermal, biomass, and hydrogen. Some of them are variable in nature such as wind and solar. Solar is a good sustainable energy source and available almost everywhere in the world. It includes both light and heat. Wind is a sustainable energy source. It is also available everywhere in the world. Both onshore and offshore of wind energy are useful (USAID, 2020). Perhaps, wind power will be a big industry and it will stop the use of fossil fuel in near future. Hydro power is one of the biggest forms of sustainable energy. Countries having enough hydro resources are exporting hydroelectricity to other countries after their consumptions. Ocean energy can be harnessed via wave and tidal version mainly, though it has other sources like ocean current, energy based on temperature differences at various depths etc. This energy source has some demerits with

aquatic creatures' life (IRENA, 2015). Geothermal energy needs to be raised from beneath the earth. It is only available at the high seismic area and is prone to volcanoes thus, restrict the use on a much wider scale. Biomass energy is produced by burning biomasses like wood, timber, landfills, municipal and agricultural waste etc. Hydrogen is a clean fuel that can store and deliver usable energy.

Technology trends

Solar

Utility-scale solar park, mono passive emitter rear contact (PERC) solar module, rooftop solar, green building solar, floating solar, and solar hybrid generation are the new technology trends of solar photovoltaic (SPV) systems. Utility-scale solar parks are installed for more power generation (Liza and Islam, 2020).

Solar roadways are special design of modular solar panel system on which one can walk and drive and produce electricity. Space distributed solar plant is connected to grid for stability. SPV is combined with other technology to increase cost-effectiveness and higher power generation. Mono PERC solar modules are an advanced form of regular monocrystalline cells in terms of efficiency and are getting popularity as mainstream solar modules (Noh et al. 2015). Rooftop and green building solar power minimize bill to pay to utility and can be installed both in CAPEX and OPEX model. Floating solar is specially designed for PV installation on water body and its usage increases commercially day by day.

Wind

The new wind turbines use the wind in the best manner and can provide high yields with better capacity factors therefore, replacing older wind turbines systems with new ones within lifetime for higher efficiency, more power, and less cost. There has been a lot of merging in the wind power industry among the original equipment manufacturers since 2017 and Siemens Gamesa is a noteworthy example of Siemens and Gamesa to form a single large

Sustainable energy development

company (World Energy Council, 2018). Larger turbines are being manufactured and more developers are opting to install the same as the technological competence increases and per megawatt basis costs decreases. Though, onshore and offshore wind contributes more energy generation but,

tendency of more growth is seen particularly on offshore wind (Noh et al., 2015). GE has recently built the world's longest wind turbine blade based 12 MW offshore wind turbine which has a 107-m long blade and 220-m rotor. Currently, operation and maintenance activities of wind farms include new technologies such as drones with high-

definition thermal cameras because of the taken images, video footages and thermal images of each wind turbine help to detect any damages and internal abnormalities on real-time basis. To tap higher wind speeds, developers are installing much larger turbines farther into deeper sea.

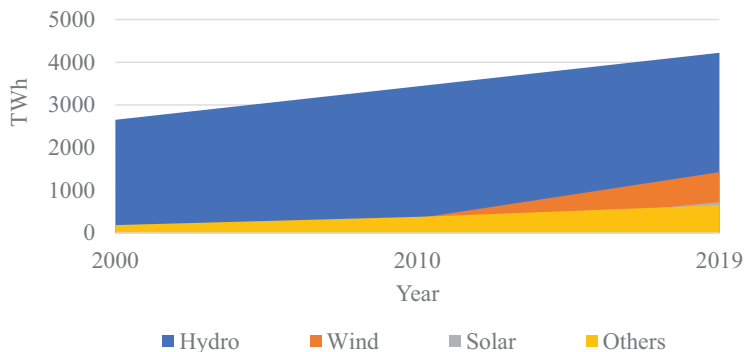


Figure 1: Renewable energy generation by source (Hannah Ritchie, <https://ourworldindata.org/renewable-energy>)

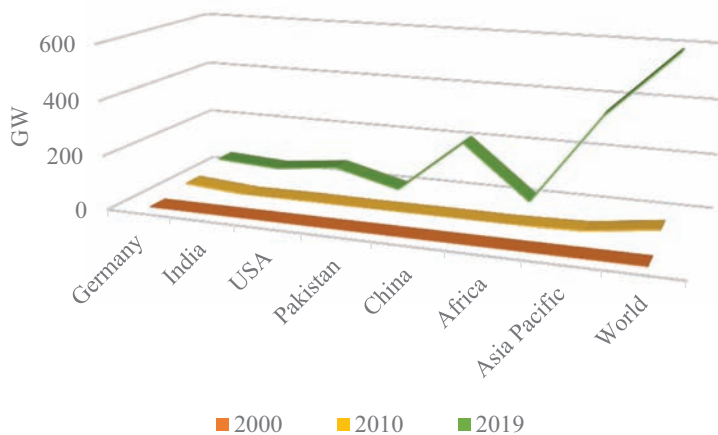


Figure 2: Solar installed capacity (Hannah Ritchie, <https://ourworldindata.org/renewable-energy>)

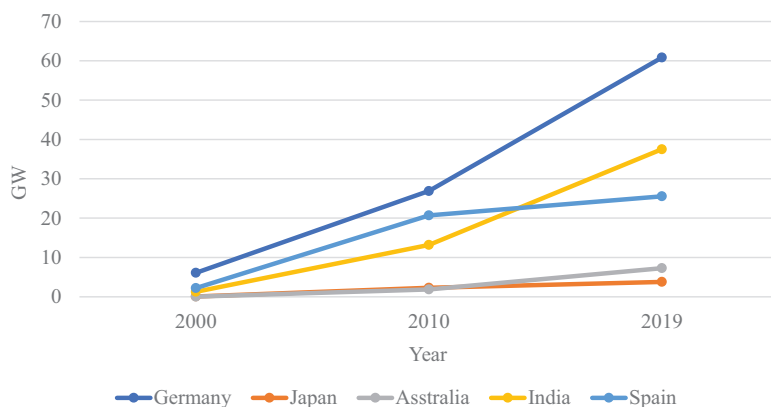


Figure 3: Wind installed capacity (Hannah Ritchie, <https://ourworldindata.org/renewable-energy>)

Battery storage

The increasing share of renewable energy sources has demanded the need for adoption of battery energy storage systems (BESS) technology as the variable renewable energy (VRE) sources like wind and solar power with substantial peaks and troughs require energy storage for smooth output and to reduce ramp rates for medium and large power plants.

Hydrogen as energy storage

Hydrogen can be one of the principal substitutes for energy storage from renewables and seems to be ideal as the lowest-cost alternative for storing huge quantities of electricity over days, weeks, and months. The storage of hydrogen fuel can take place for long periods and in quantities restricted only by the size of storage facilities.

Use of data and technology

Artificial intelligence, machine learning, and blockchain are modern technologies and are adopted by the power industry as these technologies can enhance demand and generation predictions from VRE sources. They are also able to provide wholesale price predictions. Utilities are using blockchain to create and maintain peer-to-peer electricity trading platforms in the current time.

Market and industry trends

Hydropower

An assessed 15.6 GW new capacity led the global installed capacity to about 1150 GW in last year. Hydropower generation increased 2.3% during the year 2019 to an estimated 4306 TWh which is not only increased the capacity but also shifted localized variability of weather patterns and other operational conditions deliberately (Renewables 2020 Global Status Report).

Brazil led in commissioning new hydropower capacity in 2019, followed by four Asian countries China, Lao PDR, Bhutan, and

Tajikistan. Pumped storage capacity grew negligibly in 2019 with most of the increase being a single 300-MW facility completed in China and total installed capacity at the end of year was 158 GW. The hydropower industry continued to face extensive, consistent, and growing challenges and opportunities. Some are specific to the technical works and economic considerations of the industry itself such as the need for modernization and climate resilience, while others relate to hydropower's relationship with other renewable energy sources such as integration of VRE as well as other environmental, social, climate, and sustainability necessities (Shamshad, 2017).

Wind power

The global wind power market saw its second largest annual increase with offshore wind accounting for a record 10% of new installations. It expanded 19% in 2019 to 60 GW, the second largest annual increase, for a total of 650 GW (621 GW onshore and the rest offshore) (Renewables 2020 Global Status Report).

The rapid large growth was happened due to the surges in China and USA in advance of policy changes and to a significant increase in Europe. New wind farms reached full operation in at least 55 countries and by year's end at least 102 countries had some level of commercial wind power capacity. While falling prices are opening new markets, the global transition to auctions and tenders has occurred as a result of powerful price competition. Poorly designed tenders, permitting delays and lack of available land and grid access are challenging for wind developers in many countries and causing censored among turbine manufacturers. The industry is working to meet new challenges with improved technologies and other advances to further reduce costs and better integration of wind energy into existing energy systems.

Combining wind power with solar and energy storage reduce energy prices while justifying impacts of variability and expanding revenue opportunities (IRENA, 2015). Wind energy accounted for an estimated in Denmark 57%, Ireland 32%, Uruguay 29.5%, Portugal 26.4% electricity generation and continue in many other

countries also. Worldwide capacity operation at the end of 2019 estimated 5.9% of global generation and significant new

capacity was being planned or under construction to support growth in VRE by SPV and wind power.

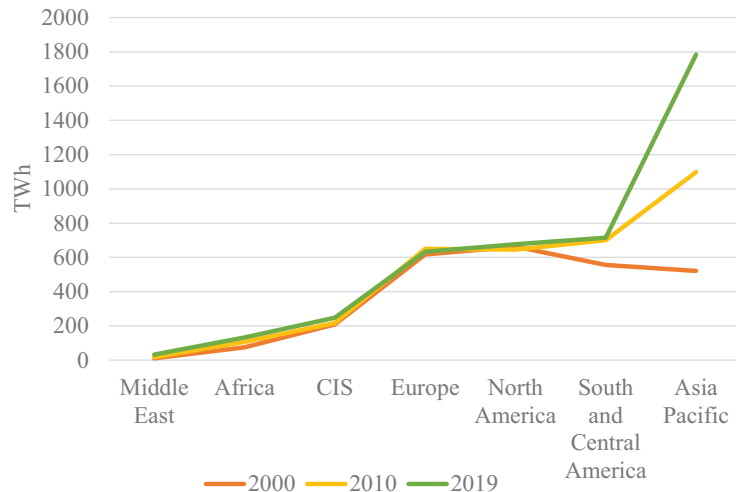


Figure 4: Hydro energy generation by region (Hannah Ritchie, <https://ourworldindata.org/renewable-energy>)

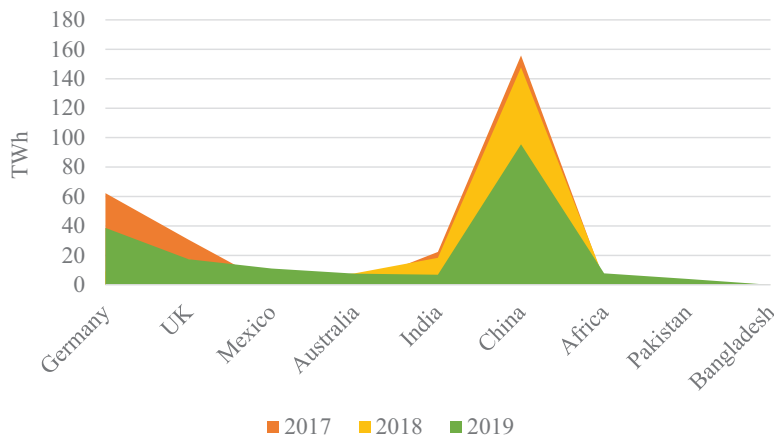


Figure 5: Annual change in wind energy generation (Hannah Ritchie, <https://ourworldindata.org/renewable-energy>)

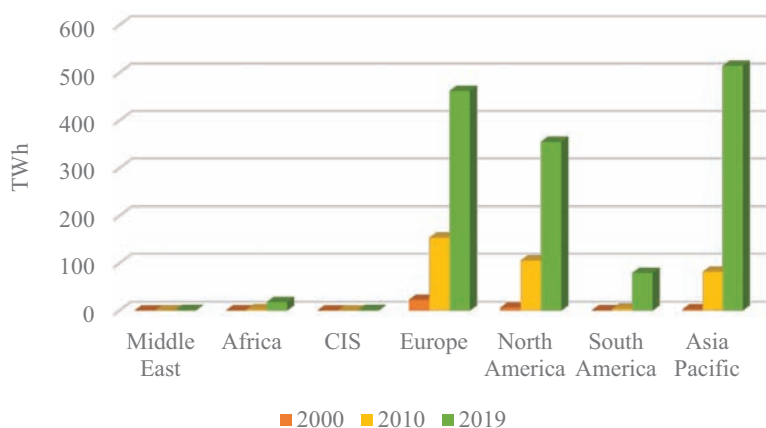


Figure 6: Wind energy generation by region (Hannah Ritchie, <https://ourworldindata.org/renewable-energy>)

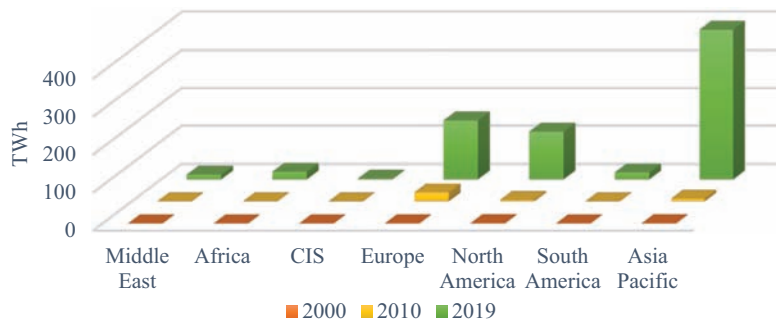


Figure 7: Solar energy generation by region (Hannah Ritchie, <https://ourworldindata.org/renewable-energy>)

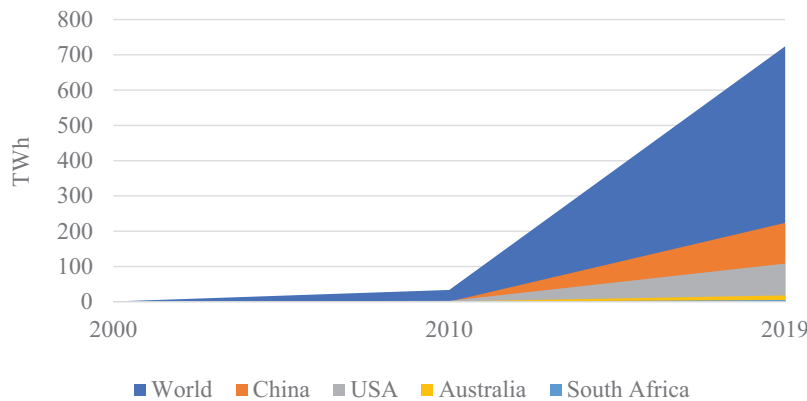


Figure 8: Solar electricity generation in different countries (Hannah Ritchie, <https://ourworldindata.org/renewable-energy>)

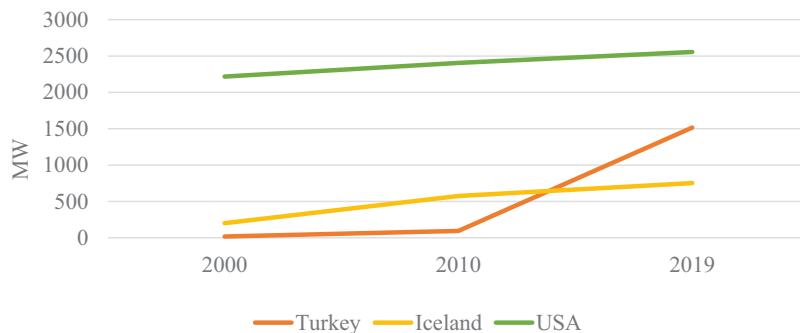


Figure 9: Geothermal capacity across globe (Hannah Ritchie, <https://ourworldindata.org/renewable-energy>)

Solar photovoltaic

The curiosity of large-scale SPV systems is growing fast trailed by a number of projects which are under construction. Corporate purchasing lengthened significantly in 2019 and self-consumption was a vital driver for new distributed systems in many countries including Australia and Germany (ADB, 2015). The global market raised around 44% and SPV accounted for around 10.7% of total generation in Honduras and significant

shares in Italy (8.6%), Greece (8.3%), Germany (8.2%), Chile (8.1%) during the year 2019 (Renewables 2020 Global Status Report). By year's end, enough capacity was in process worldwide to yield an assessed 2.8% of global electricity generation. Following a year of constant demand, the SPV market enlarged 12% in 2019 to a record 115 GWp for a total of 627 GWp. The industry continuously faced existing competition that attached with policy

moods including uncertainty and motivated unsparing bids at some auctions which result a tinny margin in the effort for some developers and manufacturers contributions. On the other side, this competition drove price decreasing and opening new markets (Shamshad, 2017). Due to low price and high global demand, efficient manufacturing and markets expansion are being happened and new companies are entered into the market and develop the innovation continuously.

Concentrated solar thermal power

Global concentrated solar thermal power (CSP) capacity grew 11% in 2019 to 6.2 GW with 600 MW from online capacity. An estimated 21 GWh of thermal energy storage (TES) was operating in aggregation with CSP plants across five continents. Nearly all commercial CSP under construction are located in Asia, Middle East, and Latin America comprising TES. CSP industries are more geographically diverse, both in the locations of commercial plants and in the origins of developers, investors, and contractors. Levelized costs of CSP energy continued to decline on last two years with increasingly being built with both SPV and wind power to lower the costs and increase capacity value (Renewables 2020 Global Status Report).

Solar thermal heating and cooling

Solar thermal installed capacity reached to 479 gigawatt-thermal (GWth) in 2019. China developed the major portion (69%) of the total. A noteworthy growth in Brazil, Cyprus, Denmark, Greece, South Africa, and Tunisia balanced the declines in Australia, Austria, Germany, Israel, Italy, Poland, and Switzerland and thus, additions in the largest markets for solar heating and cooling remained stable. The 24 new commissioned systems raised 196 megawatt-thermal (MWth) heating in Denmark, China and Germany during the year. 251 MWth from solar heat for industrial processes occurred led by Oman, China, and Mexico. A cumulative total of 700 MWth from parabolic trough were supplied to the factories worldwide by the year's end (USAID, 2020).

Geothermal power and heat

In 2019, electricity production from geothermal renewable energy source was 95 TWh and direct thermal output was 117 TWh.

Three countries such as Turkey, Indonesia, and Kenya together led new installations and Germany, USA, Japan, Mexico, and Costa Rica supplemented new geothermal power facilities. Thermal applications have increased on average 8% from direct use and space heating has annual growth around 13% of geothermal source (Shamshad, 2017).

Bioenergy

The contribution of bioenergy is almost half of all renewable energy in final energy consumption and around 5% of total global final energy demand was in 2018. Industry share of modern bioenergy to heat has increased about 2% in recent years. Global biofuel production increased 5% in 2019 and ethanol and biodiesel delivered 3% of the transport energy (Renewables 2020 Global Status Report).

Ethanol production grew in USA around 2% in 2019. Indonesia has become the world's largest biodiesel producer and received a decrease of 7% production last year. Bioenergy industry has significant rise in wood pellet production and assisted in raising markets in Japan and the Republic of Korea (IRENA, 2015). Production of hydrotreated vegetable oil and hydroprocessed esters and fatty acids was improved to 12% at the year end.

Ocean power

Ocean power contributed a miniature portion of the renewable energy market and most placements to date have been small-scale demonstration and pilot projects. The ocean power industry reformed in 2019 and continued its gradual advance towards commercialization and an estimated operational capacity of 535 MW was achieved with a net addition around 3 MW at the end of 2019. Noteworthy investments and distributions were deliberated for 2020 and beyond. Ocean power development has been concentrated mainly in Europe, where tidal stream devices generated 15 gigawatt-hours in 2019 which is an increment of 50% from 2018. However,

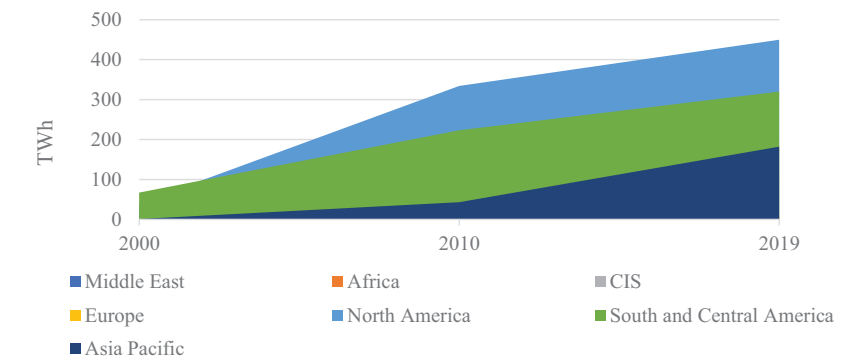


Figure 10: Biofuel production by region (Hannah Ritchie, <https://ourworldindata.org/renewable-energy>)

ocean power was gaining momentum in Canada, USA and China (USAID, 2020).

Innovative models

SREDA model

Sustainable and Renewable Energy Development Authority (SREDA) of Bangladesh has initiated a plug & play business model for utility-scale renewable energy park. In Kushtia district, around 120 acres government land is selected to prepare a model solar park which will be first in Bangladesh to reduce the per unit generation cost of electricity from renewable sources. All types of infrastructure support needed for a solar power plant like available grid line, developed land, road communication etc. will be provided by government. This model will be a game changer as scarcity of land has hindered the development of solar energy (Sustainable and Renewable Energy Development Authority). Moreover, wind is going to play a vital role in upcoming days in Bangladesh where land will be another issue. Besides wind power plant needs some special infrastructure support from government. SREDA will take a piloting for a plug & play model Wind Park to see the impact of wind energy generation cost comparing with unsolicited based wind power plants.

Benefits of this model:

1. As renewable energy highly depends on regions, this model ensures the resource utilization of renewable energy. Investors will invest in a specified ready zone selected by government. This will decrease the risk factor for the investors as well.

2. Plug & play system eases the business for the investors. Land dispute will also be reduced drastically.
3. Per unit generation cost of renewable energy will be reduced.
4. Site selection by the government will increase grid stability because location of integration of renewable energy plays a vital role for grid stability. Study shows that it works well if RE is injected near to the center of load circle.
5. This type of project will increase the scope of local female employment as well.

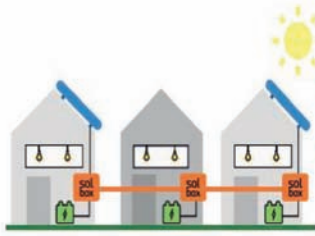
SOLshare model

This model approaches in bringing solar energy to rural off-grid communities. SOLshare interconnects installed solar home systems (SHS) into smart peer-to-peer microgrids, monetizing solar energy with mobile money in real time and empowering rural communities to earn a direct income from the sun (D. S. Groh, SOLshare, www.me-solshare.com). The energy trading platform has helped increase economic returns, improve livelihoods, increase resilience, and create alternative income generating opportunities specially for women and ensured empowering communities to control their future through decentralization, decarbonization, democratization, digitalization, and disruption.

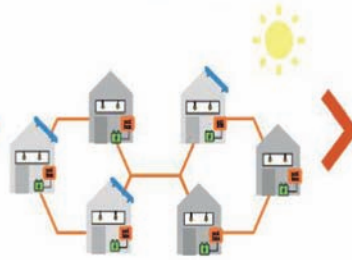
“The platform is aligned with the community. As the community grows, so does the revenue.”

Sustainable energy development

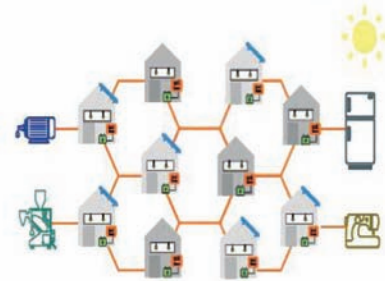
Connect to your neighbors & gain better use of access to energy



Grow within the network, use more energy & appliance



Develop own community and make market linkages



Voice from the field:



Tara Miya checks patients at his clinic. The clinic's light, fan and nebulizer are powered by SOLshare SOLbox. The solar-powered nebulizer is vital for small children suffering from pneumonia.



Maya is now a "solar entrepreneur". She sells energy to her neighbors, and in return have a constant source of income. The image was taken after her first cash-out.

This model is fully aligned with the community and as the community grows, so does the revenue. The model constitutes a 3-step approach:

- I Access to Energy: the last mile of electricity distribution solved with clean, reliable, and affordable energy.
- II Economic Mobility & Livelihoods/Market Development:
 - a. Skills training, including entrepreneurship.
 - b. Access to financial products and services.
 - c. Market linkages: access to new products, buyers, and suppliers.
- III Community Driven Development: with communities/community-centered organizations owning the SOLgrid, the income share earned from trading electricity is reinvested into improving healthcare and education services.

Benefits of the model:

- a. People become electricity producers, thereby democratizing the concept of energy.
- b. People shift towards energy efficient appliances to increase productivity and revenue, thereby decarbonizing their future.
- c. People engage with digital financial services as entrepreneurs, thereby digitalizing their market experience.

Best practices

Energy efficiency and conservation

Energy efficiency and conservation is reducing energy use to avoid waste, save money, and reduce the environmental impact. Conservation has a behavioral aspect such as turning off lights when not needed, lowering thermostats in the winter etc. Many countries use motion detectors to control lights or programmable thermostats to ad-

just temperature and overcome behavioral issues. Energy efficiency is a subset of conservation and saves energy by using more efficient energy-consuming equipment.

Lights

Replacing traditional incandescent light bulbs with compact fluorescent light (CFL) bulbs can save energy up to 75%. Light-emitting diode (LED) uses less than 25% energy of an incandescent light and lasts at least 15 times longer with energy star rating. If CFLs were used in all homes, office buildings, commercial outlets, factories and LEDs in traffic lights would reduce the percentage of electricity used equivalent to many large-scale coal-fired powers plants.

Efficient equipment and appliances

Energy can be saved by using energy efficiency equipment. Policies and financial incentives encourage people to buy more

energy efficient products. Refrigeration makes up 9% of household energy use. Star labeled new refrigerators can be a large energy saving appliance. Laptops and flat screens use considerably less electricity than desktops and CRT monitors. Many vampire power appliances such as chargers for cell phones, digital cameras, computers etc. even if turned off, draw power from the grid. Although it is a small amount, it can comprise up to 10% of home electricity use. Plugging everything into a strip control by one master device can replace the behavior of manually turning off and unplugging all the devices when they are not in use.

Tighten up building envelope

Insulation in walls and seals around windows, doors, gas-fills insulating spacers, frames, double-pane insulated glass windows etc. can significantly reduce energy demand of a building. Heating, ventilation, and air-conditioning systems in commercial and industrial buildings need to be maintained for the most efficient function. Old or inefficient motors, fans, boilers, and chillers are to be replaced or retrofitted with more energy efficient equipment.

Combining heat and power

Heat produced by electricity generation system is captured and used to provide space heating, hot water heating, humidification, cooling via absorption chillers as well as other uses, thus eliminating the added expense of burning fuels for space heating.

Design new energy efficient buildings

Energy efficiency aspects of building construction include site selection, energy and water efficiency, materials used, proximity to public transit and provision of biking amenities, and renewable energy. Green building certification and recognition systems need to promote design for the environment where the structure of the building itself provides the energy needed to heat, cool, or illuminate the building thus, energy savings can be achieved more readily.

Renewable energy technologies

When buildings have been retrofitted to be more energy efficient and combined heat

and power systems are used more broadly, then energy demand will be reduced significantly. This will be cost-effective, create more jobs domestically and can be able to deploy mass renewable energy technologies.

Energy savings in transportation

Energy can be saved through innovative alternative vehicle technologies, improved internal combustion engines, exhaust gas recycling, variable valve timing, vehicle downsizing, light weighting, and behavior. Bicycling and walking are two forms of alternate transit that have no environmental impact on energy demand. Carpooling and car sharing are also options that lower the number of cars on the road and provide opportunities to travel by car when needed.

Conclusion

In recent year installed capacity of renewable energy grew more than 200 gigawatts (GWh) mostly from SPV. Capacity installations and investment continued to spread to all corners of the world. Private sector signed power purchase agreements (PPAs) for a record amount of renewable power capacity, driven in large part by ongoing cost reductions in some technologies specially SPV, wind etc. Wind and solar energy have become mainstream electricity sources and are increasingly cost-competitive compare to fossil fuel plants. Electricity generation from new renewables becomes more cost-effective than new coal-fired plants almost everywhere. Even it is cheaper to build new wind or solar PV plants than to operate existing coal-fired power plants in many countries. Now a days, renewables are outcompeting new natural gas-fired power plants on cost basis in many locations across the globe. Amid the pandemic, renewables were the only source of electricity to record demand growth over this period. The carbon intensity of electricity systems also dropped and cities are being benefited from unusually high air quality. Electricity networks in major markets were able to accommodate huge changes in the energy mix as of mid-2020 despite the challenges of maintaining operations amid social distancing rules. Corporate sourcing of renewable power set a record in 2019 with nearly 20 GW of PPAs signed in 23 countries during the year

and Google became the world's largest corporate buyer of renewable power, adding 2.7 GW throughout the year. Side by side, job markets are also being created where the engagement of both male and female employees is continuously increasing. This improving situation of environment and social aspects are happening mainly owing to declines in emissions from the power sector and growing industrialization across the globe which are related mostly with the growths in cost reduction of renewable products, energy efficiency, and growing shares of renewable energy.

References

- ✓ ADB. (2015), "Business Models to Realize the Potential of Renewable Energy and Energy Efficiency in the Greater Mekong Subregion. Mandaluyong City, Philippines".
- ✓ Groh, D.S. SOLshare, www.me-solshare.com.
- ✓ Hannah Ritchie, "Renewable energy," *Our World in Data*. <https://ourworldindata.org/renewable-energy>.
- ✓ IRENA. (2015), "Renewable Energy Technology Innovation Policy," *IRENA*, vol. A Process Development Guide, January 2015.
- ✓ Liza, Z.A., & Islam, M. R. (2020), "Solar Park: The Next Generation Energy Source in Bangladesh", *Journal of Energy Research and Reviews*, 4:9–19.
- ✓ Noh, C.-H., Kim, I., Jang, W.-H., Kim, C.-H. (2015), "Recent Trends in Renewable Energy Resources for Power Generation in the Republic of Korea". *Resources*, 4:751–764.
- ✓ Renewables 2020 Global Status Report. <https://www.ren21.net/gsr-2020/>.
- ✓ Shamshad, A. (2017), *ESCAP*, 73rd Commission Session.
- ✓ Sustainable and Renewable Energy Development Authority (SREDA), Power Division, MPEMR, Bangladesh Web, www.sreda.gov.bd.
- ✓ USAID. (2020), "Challenges in the Development of Variable Renewable Energy in Bangladesh, Scaling up Renewable energy.", June 2020.
- ✓ World Energy Council. (2018), "Perspective on the Grand Energy Transition," *World Energy Issues Monitor*, 2018. ■

THE NEED FOR SUSTAINABLE ENERGY DEVELOPMENT AND THE PATH TO CREATING SUSTAINABLE BUSINESS MODELS

Pamli Deka^a and Tirthankar Mandal^b

^aAssociate Director

World Resources Institute (WRI) India
Aadi Building, Lower Ground Floor, 2, Balbir Saxena Marg
New Delhi 110016, India
E-mail: Pamli.deka@wri.org

^bSenior Manager

World Resources Institute (WRI) India
Aadi Building, Lower Ground Floor, 2, Balbir Saxena Marg
New Delhi 110016, India
E-mail: tirthankar.mandal@wri.org

Abstract

The article attempts to analyze the role of energy as an intervention to achieve sustainable development outcomes. It starts off with the assumption that energy interventions are important to achieve various Sustainable Development Goals (SDGs). In that context the article analyzes how the businesses can invest in achieving these goals using energy interventions. The article summarizes various successful business models that are developed with energy as an intervention to achieve health, education, and livelihood outcomes. The article also briefly touches upon the issues faced by businesses in investing in the development sector.

Introduction

As we mark the fifth year of adoption of the 2030 SDG goals, and fight a global pandemic, there are growing concerns regarding the achievement of the goals. There is an acknowledgement that to achieve the goals we need active participation from the private sector players along with the Government and development agencies.

Globally, it is increasingly observed that organizations are adopting sustainable practices. It is also estimated that business models for sustainability will add to 12 trillion USD and 380 million jobs worldwide in the next decade¹. The Responsible Business Trends report 2019 states, to meet the SDG goals, an investment to the tune of 5–7 trillion USD is required every year. With private sector accounting for 70% of the global GDP, it is expected that a sizeable volume of investment for achieving the SDG goals will come from the businesses.

While the processes to attract private investments for the sectors with surety of financial returns are established, the difficulty arises where the returns on investment focus on social and environmental development. Typically, these are the sectors which are associated with health, education, and livelihood activities in rural areas. The operating models for these sectors vary from the traditional businesses. In most countries, these sectors are driven by the Government. For improving health and education services or to enhance livelihoods in rural areas, key support has come in the form of Government budgetary allocations, multilateral development banks offering long-term soft loans to Government and Official Development Assistance (ODA) from the developed countries. However, with the SDG goals, there is an opportunity for private sector to play its role even in the developmental sectors.

To enable participation of private players, public financing can crowd in private investments. There are different modes of these investments including philanthropic support, remittances, and investments to the projects and programs (OECD 2019)². Such investments by the private sector are popularly called as Social Impact Investments (SII) (OECD 2019)³. These investments bring in both financial returns and positive social outcomes, often measured in the form of betterment of development indicators.

The impact of social impact investments is not limited to economic growth and relies on developing alternative measures to measure returns. They operate on three important features, namely (a) financing in a manner so that no one is left behind, (b) engaging with the local financing community to develop sustainable financing markets, and finally, (c) ensuring commercial sustainability. To be able to achieve these returns, there is a need to undertake an integrated approach to development and to invest in innovative thinking around business models which will attract investments for achieving good health, education, and livelihood outcomes.

In this article we will be assessing the need for sustainable energy development across health, education and livelihood sectors and the models that can be deployed for development—in the context of India. A similar approach can be adopted in other developing countries faced with the twin challenge—of achieving SDG goals while developing sustainable energy development models for growth.

Sustainable energy development

Development of rural infrastructure is key to supporting rural communities. There is

¹ <https://www.weforum.org/agenda/2019/01/a-business-model-for-sustainability/>

² <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/Social-Impact-Investment-2019.pdf>

³ <https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/Social-Impact-Investment-2019.pdf>

Table 1: Government of India targets for improving maternal and childcare

Indicator ⁶	India	World	National Health Policy Target ⁷	SDG 2030 target
Maternal Mortality Rate (MMR) ⁸ 2017	145	211	100 by 2020	<70
Neonatal Mortality Rate (NMR) ⁹ 2018	22.7	18	16 by 2025	<12
Infant Mortality Rate (IMR) ¹⁰ 2018	29.9	28.9	28 by 2019	-
Under 5 Mortality Rate ¹¹ 2018	36	38	23 by 2035	≤ 25 (less than or equal to)

Source: <https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=794&lid=168>

an urgent need to focus on identifying and closing the gaps in rural infrastructure—COVID-19 has highlighted this.

With rebuilding in progress, rural India must ensure access to basic services like health and education to sustain the economy. Livelihood opportunities without health and education facilities will fail to support growth in rural areas and the country will continue to see an increasing urban–rural divide.

With 66%⁴ of the population residing in rural areas, it is now the right time to focus on strengthening the existing facilities and building new facilities in a sustainable manner. And a key element to support the sustainable development is access to reliable, affordable, and sustainable electricity. According to the World Bank’s “Status of Electricity Access Report 2017-18” of the 169 SDG targets, energy is interconnected with 125 of them. This reiterates the relevance of access to electricity as a critical

input to achieving crucial development outcomes.

Electricity for ensuring uninterrupted health services

The Economic Survey of India, 2020 stresses on the SDG nexus approach for achieving developmental outcomes in the health sector. Emerging literature has proven time and again the essential role of electricity access in ensuring improving health outcomes (Chen et al⁵ share about the role of reliable electricity in improving health services).

The COVID-19 pandemic has affected regular health services and India’s efforts to achieve the SDG 3 health outcomes. In particular, it poses a serious threat to Government of India’s efforts to improve maternal health and childcare services by 2030.

The Gol declared 2012 as the “Year of Intensification of Routine Immunization.”

But even today, India continues to be one of the 10 countries where children are not receiving routine immunization services¹² to protect them against preventable diseases¹³. WHO reports that approximately 50% of the vaccines are wasted globally. Heat exposure and freezing due to improper temperature control are two of the causes for wastage of the unopened vaccine vials. The Global Alliance for Vaccines and Immunization (GAVI) has shared their concerns about how healthcare facilities without electricity or without reliable electricity face challenge in maintaining the cold chain storage systems¹⁴.

Along with trained manpower and medical equipment, a key element for ensuring access to such services is the access to reliable, affordable, and sustainable source of electricity. Without electricity, it becomes difficult to maintain the potency of the vaccines which have already spent several days in transit and changed locations to reach the last cold chain point. The Ice-Lined Refrigerators (ILRs) have to ensure the temperatures are maintained within the range of 2–8°C for routine vaccines. For COVID-19, temperatures of up to –70°C¹⁵ may be required to preserve some vaccines. The need for reliable electricity connections is even more now, than ever before. On an on-going basis, electricity is required for diagnosis and treatment, for sanitization of facilities and equipment, for lighting and cooling and to ensure safety of patients and attendants.

To build sustainable health infrastructure that can operate through extreme climatic

⁴ World Bank Data

⁵ Chen, Y.J., Chindarkar, N. & Xiao, Y. Effect of reliable electricity on health facilities, health information, and child and maternal health services utilization: evidence from rural Gujarat, India. *J Health Popul Nutr* 38, 7 (2019). <https://doi.org/10.1186/s41043-019-0164-6> (<https://jhpn.biomedcentral.com/articles/10.1186/s41043-019-0164-6#citeas>)

⁶ MMR is calculated as number of deaths per 100,000 live births. NMR is number of deaths per 1,000 live births; Under 5 mortality rate is number of deaths per 1,000 live births. Neonatal refers to the first 28 days of life in a child. Infants refer to children under the age of 1.

⁷ National Health Policy target and SDG 2030 target data – National Health Mission, Ministry of Health and Family Welfare, Government of India - <https://nhm.gov.in/index1.php?lang=1&level=1&sublinkid=794&lid=168>

⁸ MMR data - <https://data.unicef.org/resources/dataset/maternal-mortality-data/>

⁹ NMR data - UNICEF - <https://data.unicef.org/topic/child-survival/neonatal-mortality/>

¹⁰ IMR data - UNICEF - <https://data.unicef.org/topic/child-survival/under-five-mortality/>

¹¹ Under 5 mortality rate data - UNICEF - <https://data.unicef.org/topic/child-survival/under-five-mortality/>

¹² WHO immunization coverage report. Other countries are Angola, Brazil, DRC, Ethiopia, Indonesia, Nigeria, Pakistan, Philippines, and Vietnam - <https://www.who.int/news-room/fact-sheets/detail/immunization-coverage>

¹³ WHO vaccine preventable diseases: monitoring system. 2019 global summary - https://apps.who.int/immunization_monitoring/globalsummary/estimates?c=IND

¹⁴ https://www.msf.org/sites/msf.org/files/msf_access_issuebrief_thermostability_en.pdf

¹⁵ <https://www.npr.org/sections/health-shots/2020/11/17/935563377/why-does-pfizers-covid-19-vaccine-need-to-be-kept-colder-than-antarctica>

events and pandemics, access to reliable, affordable, and sustainable sources of electricity is crucial.

Electricity for imparting education in a changing world

The use case for electricity in the education sector has been seen as the provision of lights and fans for comfortable ambient conditions in the classrooms. But the absence of electricity also affects the ability of the school to provide for clean drinking water and water for sanitation facilities. With 23% of adolescent girls dropping out of school due to lack of toilets¹⁶, literature shows that there is a direct link between absence of sanitation facilities and school dropout rates.

Along with lights, fans, and water—to run the Digital India program and to support uninterrupted broadband connections for the 250,000 secondary and higher secondary schools¹⁷, electricity is a key input. And the COVID-19 pandemic further emphasizes on the need for robust systems to enable online education. To create the digital education content for learning online and to deliver the same—electricity is a necessary condition for systems to function. Digital initiatives under the responsibility of the Ministry for Human Resource Development like SWAYAM, SWAYAM Prabha, National Academic Depository, and National Digital Library can ensure access to education to the remotest corner of the country with closure of schools. The OLABs (Online Labs) for lab experiments provide students with the ease and convenience of conducting experiments over the internet during such times. The National Mission on Education through Information and Communication Technology (NMEICT) leverages the potential of ICT, in teaching and learning process for the benefit of all the learners in Higher Education Institutions. Continuing on this journey, during the pandemic, Government has launched the NROER (National Repository of Open

Educational Resources) which has more than 17,000 pieces of e-content along with the e-Pathshala for 1–12 grades and DIKSHA platform to promote one nation—one platform concept.

Government and private institutions have come together to continue imparting education while schools and colleges are physically inaccessible to majority of the students. To be able to do so, the country requires access to basic internet infrastructure—for which reliable electricity is key.

Electricity for supporting livelihood activities

In India, youth travel out from villages in search of better livelihood opportunities to urban areas. The intensity of the challenge for youth from rural India has been brought to focus during the COVID-19 pandemic. As per statistics, 10 million¹⁸ people have returned to their home states after the country wide lockdown. Along with healthcare services, the state governments are faced with the challenge of providing for livelihood opportunities. Return of the youth population also implies loss of remittances with millions of people employed outside.

To be able to continue on the path of economic recovery and to make it possible for India to achieve the SDG 8 goals around decent work and economic growth, it is of utmost importance to skill the youth and create livelihood opportunities in rural India.

The government has taken up various initiatives under Skill Development Mission to support the youth of the country. Under the Pradhan Mantri Kaushal Vikas Yojana (PMKVY) 2.0 scheme, 20 sectors have been identified. In addition, there are Advanced Training Institutes (ASTIs) across multiple states. For imparting training across these sectors—telecom, electronics and IT hardware, apparel making, healthcare, construction, and automotive—electricity

access is critical for the success of these programs.

For supporting the agriculture sector, along with seeds, fertilizers, and pesticides, water is a key input. Irrigation facilities along with rainwater harvesting techniques can help marginalized farmers who are dependent on rain fed monocropping practices. In addition to irrigation facilities, farmers require access to cold chain storage systems to reduce post-harvest losses. The COVID-19 pandemic saw increase in food losses due to inability of farmers to preserve their produce. Further, for processing the food produce, community centers in villages have to be connected to a reliable electricity source. Along with agriculture, farming communities depend on the incomes from poultry, fishery, and dairy produce, where one of the key inputs is access to reliable electricity connections.

Across the sectors, electricity access is key to support delivery of services. Sustainable energy development models can accelerate this path to development while ensuring reliability of services and increasing benefits to the rural communities.

Sustainable energy development—the inputs for developing a business model

Clean energy sources which are decentralized in nature can support development across the sectors. To develop sustainable energy solutions, data from the ground can feed into the design of technology, policies, and programs which are developed through collaboration between multiple stakeholders and customized for the end beneficiary. And to sustain these solutions, there is a need to build capacity at the local level.

Data for decision making

Data on the status of electricity connections, quality of power, and reliance on diesel generators is crucial for identifying

¹⁶ <https://timesofindia.indiatimes.com/city/udaipur/23-girls-drop-out-due-to-lack-of-toilets-in-school-of-the-country-reveals-study/articleshow/56490444.cms>; <https://www.safetykart.com/blog/girls-forced-drop-schools-due-lack-sanitation-facilities/>

¹⁷ NCERT, NSDC, NUEPA are some of the education-related public agencies enabling DI Initiatives.

¹⁸ <https://qz.com/india/1903018/indias-covid-19-lockdown-displaced-at-least-10-million-migrants/>

business models for sustainable energy development. This has to be complemented by the demand side data from livelihood, health, and education loads.

When overlaid with livelihood, health and education indicators—funders and policy makers can identify focus areas. The linkages and impact of improved electricity access on development outcomes can be monitored on an on-going basis to identify return on investments in energy solutions—not only in terms of the income generated with reliable electricity source but also for tracking impact on development.

There are multiple on-going data collection efforts supported by the government and international development agencies. These programs can add further value by considering efforts to collect data related to electricity access. For example, the Electronic Vaccine Intelligence Network (eVIN¹⁹) program launched by Government of India in collaboration with UNDP has temperature profiles of 27,000 vaccine storage centers across 29 states and 7 union territories. The data from the 50,000 temperature loggers installed in the vaccine storage centers can provide insights into quality of electricity connections across these health centers and play a crucial role in strengthening the cold chain storage systems for vaccines.

Customization and collaboration

It is critical to understand the requirements of the end-user/beneficiary to design a solution that can support the existing loads and cater to the increased demand in the future. The demand profile has to be considered while customizing the solution and identifying the business model to scale up such efforts.

Along with the load profile, climatic events and socio-economic vulnerabilities, remoteness of the locations have to be considered as the other critical inputs. The energy solutions have to operate in extreme heat, heavy rains, thunderstorms, and high wind speeds. In doing so, customized

energy solutions in unserved and underserved areas can complement the efforts to extend and intensify the grid.

The collaboration between energy enterprises, DISCOMs, and the end-users of technology is key to develop such sustainable solutions. From the very onset—the inputs of the end-user should be solicited and be used for customizing the system and for scaling up efforts to integrate decentralized energy systems into the main electricity supply system.

Capacity to build and sustain solutions

System failures are very often attributed to the lack of Operations and Maintenance (O&M) planning beyond the initial 5 years with AMC (Annual Maintenance Contract) support. RMS (remote monitoring systems) has become an integral part of energy solutions—helping the service provider to monitor the health of the system. But local capacity has to be available to support O&M to ensure uninterrupted services. Particularly in the context of sectors like livelihood and health where 24X7 uptime is needed—it is critical to have local support for O&M.

To be able to do so, there is an urgent need to develop capacity at the community level by building in the requisite technology knowledge and skill sets. This can create an avenue for generating jobs in addition to ensuring continued services. The gaps existing in the ecosystem to create and provide access to such jobs have been further detailed out in the report on “Can Renewable Energy Jobs Help Reduce Poverty in India” by Bharath et al.

Identifying the right model for sustainable energy development

One of the key challenges around sustainable energy development is lack of sustainable business models. This section explores some of the models piloted in India across the sectors.

Sustainable development models

In India, majority of the rural healthcare and educational facilities are run by the Government. Apart from Government, not-for-profit charity organizations have been seen to play an important role in provision of services which are subsidized. Due to absence of a model to support upfront capital investments, adoption of decentralized clean energy solutions has been a challenge for such institutions.

Government budgets are the key source of funds to run the healthcare institutions that cater to the last mile. While the health department is responsible for financing the health programs and for maintaining the existing facilities, the electricity agencies oversee the electrification aspect. There are limited examples of innovative models for implementing and operating decentralized clean energy solutions for government health centers—the solarization of PHCs (Primary Health Centre) in Chhattisgarh state is such an effort.

Government funding for health and education

900 health centers have been electrified by solar resulting in installation of 3 MW of solar PV systems which is estimated to benefit 80,000 patients every day. The nodal agency for renewable energy—Chhattisgarh State Renewable Energy Agency (CREDA) has worked with the Department of Health & Family Welfare & Medical Education in Chhattisgarh to implement and operate the project. The state budget of the health department takes care of the regular O&M expenses of the system while CREDA has supported the installation of the 900 health centers. CREDA works with health department to identify the health centers and manages the system design, installation, tendering, and monitoring of the systems.

This collaborative approach has helped in scaling up the program since 2012 and resulted in reduction of energy costs while improving health services in Chhattisgarh²⁰. Learning from this experience, the collaborative approach

¹⁹ <https://www.in.undp.org/content/india/en/home/projects/gavi1.html>

²⁰ Powering Primary Healthcare through Solar in India Lessons from Chhattisgarh – CEEW and Oxfam India

can be used to develop budgets and plans that draw support from both the health and energy departments.

Grant driven model for funding not-for-profit social loads

Financing for decentralized clean energy solutions suited to the requirements of non-government, not-for-profit healthcare and education institutions have been driven by grants. In India, Corporate Social Responsibility (CSR) funds or grants made by corporates added up to INR 18,655 crore²¹ in 2018–2019 alone. However, as per the report on “Energizing Development” by Samhita Social Ventures, only 6% of the total CSR funding has been spent on clean energy solutions.

With limited spending in this sector and with most of the funds going into street-lights, solar lamps, minigrids for communities, there are a very few health and education facilities that have benefited from CSR funds. Further, to make such models successful in the long run, one must ensure availability of O&M costs on an on-going basis. At a facility level, financing should include components of O&M and battery replacement for off-grid solutions. While at the institutional level, funds for capacity building and M&E are key to ensure long-term sustainability of such systems. With the volumes and reach, the corporate sector has a significant role to play in supporting the development of funding models and to catalyze private-sector investments for clean energy solutions to electrify social loads.

A pure grant-based model supporting CAPEX has faced challenges due to lack of accountability. A revolving fund which receives contribution from the community/facilities, and which is replenished using the savings in fuel expenses and electricity bills can support the grants for CAPEX.

Blended financing for Public Private Partnership

Under the blended financing model, public sector can work in tandem with the

private sector to fund sustainable energy projects, where public-sector funding can catalyze flow of funds from private sector. By reducing the risk associated with the investment, public funds can make the project more attractive for a private investor or a bank.

As an example, in India, the Viability Gap Funding (VGF) model has been operational since 2004. While the focus of this has been larger utility scale projects where Government supports private players who invest in utility scale projects—the same model can be explored in the context of decentralized energy sector. This Public Private Partnership (PPP) model can set the path for electrifying the last mile institutions in India. To make this possible—demand across sectors has to be aggregated and clear governance mechanisms have to be institutionalized. A collaborative approach between different sectors and departments is key to the success of such a model.

Pay As You Go for productive loads

Livelihood activities powered by decentralized clean energy solutions can trigger additional incomes and diversify livelihoods. To support such activities, Pay As You Go (PAYG) microgrids have been commissioned in a few districts in Bihar, Uttar Pradesh, and Jharkhand. The PAYG model allows the beneficiary to pay for the energy consumed on a periodic basis. In addition to microgrids used for productive loads, this model has been deployed to run solar water pumps where marginal farmers benefit from the solar-powered water pumps.

While in India, this model has been restricted to a few districts, in Kenya and Tanzania, energy enterprises have scaled up the PAYG model and have successfully raised funding from grant, equity, and debt finance to create sustainable business models. In the Issue brief “Stimulating Pay-As-You-Go Energy

Access in Kenya And Tanzania: The role of Development Finance,” Sanjoy et al explain how the financing agencies including local banks, international donors, and foundations have to work in tandem to support the development of this model.

Some of the business models have been tried to enhance the service of the social sectors but these models remain to be analyzed further. Public financing has an important role to play in attracting the private players to this space where public financing can de-risk some of the initial investments. Doing so can ensure, (a) the risk premiums go down, and (b) create awareness on the innovative models that can be tested for the social sectors.

The business models created in this process can help to minimize the funding gap and increase spending efficiencies for these sectors required to achieve the SDG goals. But, irrespective of the business model, for achieving the sustainable development objectives, an integrated approach has to be considered where the Government agencies work along with private players and development organizations.

Conclusion

Decentralized sustainable energy interventions could become an important area for private players to focus on to better the development outcomes. Especially in the time of the pandemic, when the rural infrastructure requires rebuilding, innovative business models to finance clean energy resources with a blend of public and private financing could be key to achieve sustainable development goals. Policy makers, development organizations, funding agencies, and the beneficiaries have to work together to identify the ideal business model that can achieve the desired outcomes of leaving no one behind and ensuring sustainability. ■

²¹ <https://www.csr.gov.in/index19.php>

GENERATING ENERGY FROM WASTE

PUBLIC PRIVATE PARTNERSHIP APPROACH IN NEPAL

Narayan Prasad Adhikari^a, Sushim Man Amatya^b, Anusuya Joshi^c

^aDirector,

^bSenior Bio-Energy Expert ,

^cSenior Environmental Expert,

Alternative Energy Promotion Center/Government of Nepal

Mid-Baneshwor, Kathmandu, Nepal.

Tel: +977-1-4498013/14

E-mail: narayan.adhikari@aepc.gov.np

Abstract

Anaerobic Digestion, among various Waste-to-Energy (W2E) technologies, has been adopted by Scaling up Renewable Energy Programme (SREP)-Extended Biogas project to convert organic portion of solid waste to energy in the form of Compressed Natural Gas and electricity, producing organic fertilizer as by-product. Though Public Private Partnership (PPP) model has been applied in many hydropower projects, it has been piloted in the SREP project with a new financial mix. A successful implementation of the project with overwhelming participation of private sector and municipalities has proven that the communities can benefit even with limited government investment and public budget. In addition, the project supports to boost the economy of the country by limiting the need to import fuel (LPG for cooking) and chemical fertilizer.

Introduction

Nepal is currently experiencing energy supply and Solid Waste Management (SWM) as two major challenges. Energy is essential for economic development of the country and SWM for ensuring health and sanitation of communities. Both can be well managed by converting organic portion of solid waste into energy with utilization of various Waste-to-Energy (W2E) technologies such as anaerobic digestion (AD) (i.e. both dry and wet, thermophilic and mesophilic), thermal conversion (i.e. rotary kiln incineration, mass burn incineration, starved air incineration, fluidized bed combustion, pyrolysis and gasification, plasma technology, thermo-chemical reduction, refuse derived fuel) and landfilling (i.e. landfill gas utilization and bioreactor landfill) (Sodari and Nakarmi, 2018). Considering the contribution of greenhouse gases leading to climate change by conventional sources of energy such as fossil fuels and firewood, the promotion of green and clean renew-

able energy is very essential. The security of energy supply and the threat of climate change can be improved by closing the loop of waste management through material recovery and using recovered energy to drive whole waste management and recovery chain (Tomić and Schneider, 2018). However the use of renewable energy is very limited in all Asian countries, financial factor being a major factor for determining the choice of the use of energy (Peimani, 2018). Usually, government investments and public budgets are insufficient to expand access to electricity and modern energy in rural areas in a sustainable manner, as the provision of energy services through renewable energy is capital intensive and requires significant upfront costs (Sovacool, 2013).

Public Private Partnership in energy sector

An innovative mechanism of partnerships and business models should be formulated to expand the reach of renewable energy, especially for poor and vulnerable,

despite deficiency in government budget. Chaurey et al. (2012) suggested the need for new forms of public and private sector partnerships based on established success, replicability, and potential for scaling up of the "Lighting a Billion Lives" project and India's National Rural Electrification Programme. Moreover, the successful completion of Public Private Partnership (PPP) projects in roads, airports, and other sectors have given an opportunity to implement it in hydropower sector to fill the gap of power shortage especially in remote and backward regions in India (Ullah, 2015). However, Nepal has taken PPP approach in hydropower sector since the 1990s guided by legal framework for PPP. Therefore, it has been adopted as a reliable approach for infrastructure development in the country, including renewable energy sector. However, Critical Success Factors (CSFs) for PPP approach identified by Ismail (2013)—good governance, commitment and responsibility of public and private sectors, favorable legal framework, sound economic policy, and available financial market should be balanced for sustainability of PPP in success of any project in renewable energy sector.

Waste-to-Energy

Generally, political factors and the decentralized waste management with multi-level governance in the country affect the efficacy of waste management practices. Moreover, waste is still taken as a nuisance rather than a resource or raw material that can be recovered/modified as a valuable good. Therefore, Malinauskaite et al. (2017) has sighted the importance of cooperation between local waste management authorities and the different ministries responsible for diverse policies, including waste management, energy, and environment, to explore the full potential of the W2E industry. Out of many technologies, AD has emerged as one of the best organic waste treatment options that substitute non-renewable electricity, heat,



Figure 1: Gandaki Urja Pvt. Ltd., Kotre, Pokhara (Waste processing capacity: 45 tons/day; Gas Output: 4000 m³ biogas /day; End Use: Bottling and sale (>200 cylinder/day); Organic Manure production: 15 tons/day)

Envipower Energy & Fertilizer Company, Rupandehi	
	<p>Daily Gas Output: 5500 m³ biogas /day</p> <p>End Use: Bottling and sale (>150 cylinder/day)</p> <p>No. of LPG to be Replaced: 43,800 annum</p>
	<p>KhilungKalika Biogas Plant, Syanja</p> 

Figure 2: Envipower Energy & Fertilizer Company, Rupandehi

and inorganic fertilizer with biogas and organic fertilizer (Evangelisti et al., 2014). In Nepal, 15th Plan of the Government of Nepal (GoN) has a target to increase 12% contribution of renewable energy in the total energy consumption by 2022/2023. To meet this target, the plan aims to install 500 large-scale biogas plants in next 5

years and replace 40 thousand metric ton of liquefied petroleum gas through installation of 500 large biogas plants annually.

Scaling-up Renewable Energy Program—Extended Biogas

The GoN has designated Alternative Energy Promotion Center (AEP) to promote

renewable energy in Nepal. AEP has been promoting biogas and other renewable energy technologies since its establishment in 1996. Though more than 400,000 domestic biogas plants have been installed in the country till date, very little had been done in W2E sector. It was only since 2015 when AEP partnered with the World Bank to implement the Scaling-up Renewable Energy Program (SREP-Extended Biogas), AEP started working in larger biogas plants as a part of its W2E initiative. A grant of USD 7.9 million was received from the Climate Investment Funds (CIF) through the World Bank for SREP with the main objectives of promoting large biogas plants ranging from 1000 to 5000 cubic meters by leveraging credit, grant, and private sector co-financing. These projects are developed by the private sector under Design-Build-Finance-Own-Operate-Transfer (DBFOOT) model. The *Public Private Partnership and Investment Act, 2019* has listed nine methods through which PPP projects can be implemented, and DBFOOT is one of them. Till date, seven large biogas plants (with capacity above 3000 cubic meters) have been completed with SREP support and are operating efficiently. In two of the commissioned plants, the biogas is compressed in high-pressure cylinders and sold commercially in the nearby market. In



Figure 3: Compressed natural gas cylinders in case



Figure 4: Dharan Sub-metropolitan City W2E Project, Dharan

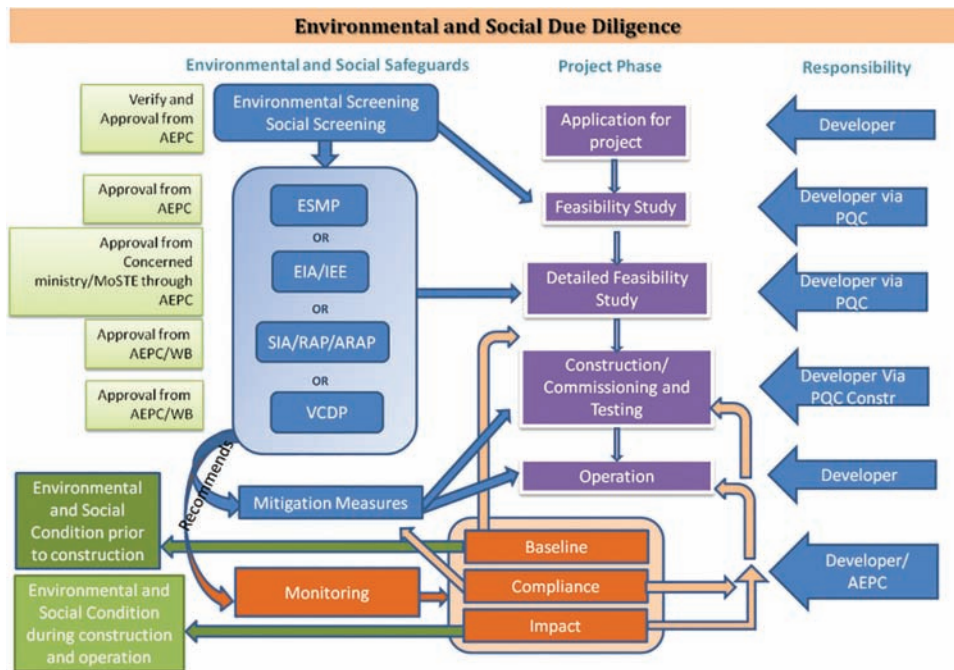


Figure 5: Environmental and social due diligence process at different phases of project cycle

Abbreviation Used: PQC: Prequalified Consulting Firm, PQC Constr: prequalified Construction Company, ESMP: Environmental and Social Management Plan, EIA: Environmental Impact Assessment, IEE: Initial Environmental Examination, SIA: Social Impact Assessment, RAP: Resettlement Action Plan, VCDP: Vulnerable Community Development Plan, AEPC: Alternative Energy promotion Centre, WB: World Bank



Figure 6: Organic Fertilizer produced from slurry

one plant, the gas is distributed to neighboring households through a biogas grid for cooking. In case of rest four plants, biogas is utilized to produce electricity, which is entirely being used for captive purposes. In Nepal, electricity produced

from biogas is not supplied to the national grid yet. However, biogas generated by these plants has replaced 250,000 LPG cylinders; one plant with 5500 cubic meters capacity producing more than 150 cylinders of Compressed Natural Gas

(CNG) per day. (Taking into reference that each LPG cylinder is loaded with 14.2 kg of liquefied petroleum gas, with the calorific value of 45.5 MJ/kg and considering the calorific value of biogas to be 22 MJ/m³@NTP). Besides biogas, these plants

produce slurry as a by-product, which is being processed as organic fertilizer and sold commercially under different brand name. This practice supports the GoN's vision of "Organic Nepal" and has potential to replace chemical fertilizer leading to reduction in its import. Moreover, carbon dioxide gas, another by-product of the plant, can be captured and traded for the use in fire extinguisher. Apart from these, 15 large-scale biogas projects, ranging from 1000 to 10,000 cubic meters capacity, are under construction phase at different locations in the country. Moreover, 25 projects are in the pipeline that has completed Detailed Project Report and will undergo construction phase soon. In addition, 67 municipalities have registered demand for initiation of waste to energy projects.

From the experience of SREP supported large biogas projects, plants above 1000 cubic meters capacity have proven to be commercially viable, with some upfront Capex support, there is a paradigm shift occurring in the sector in Nepal. Industries that produce large amount of organic wastes have indicated interest in captive generation of electricity, or direct thermal use of biogas within their premises. Similarly, energy companies in association with commercial farms have shown strong interest in bottling biogas and selling it commercially. This will minimize the import of LPG from the neighboring country, contributing to economy of the country. On the other hand, municipalities get viable alternative for waste management with utilizing waste as a resource leading to economic benefits. Therefore, with a successful demonstration of commercial viability of large biogas plants, AEPC has already signed Memorandum of Understanding with more than 40 municipalities to convert energy from waste. Even the municipalities have started to take W2E as solution for both waste management and revenue generation.

Issues and challenges in project implementation

Despite the above-mentioned benefits and a huge potential of expansion of

biogas sector in the country, few issues and challenges were experienced during the execution of the project, which might hinder the effective implementation. Firstly, most of the large-scale biogas plants are based on Continuously Stirred Tank Reactor (CSTR) technology, which has been adopted from India. Lack of technical expertise in Nepal and dependency on foreign human resources for maintenance of the plant might impede its efficient operation. Secondly, the "Not in my backyard, NIMBY" perception towards waste leads to unavailability of land at suitable location, in terms of transportation of waste (substrate) and distribution of products in the market. Thirdly, the diverse characteristic of municipal waste resulting a requirement of an extensive processing might increase the cost of the project. In addition, there is a challenge in getting market for biogas and fertilizer produced from these biogas plants. Due to its heavy weight, CNG cylinders are viable only in commercial settings such as hotels, restaurants. In case of fertilizer, lack of policy in promoting organic fertilizer and farmers' affection towards chemical fertilizer has limited its market. Therefore, to address these issues and overcome the challenges, as recommended by Patinvoh and Taherzadeh (2019), it is essential to formulate and enforce policies, and conduct technical trainings and public awareness programs. For the sustainability of the project, AEPC has followed process as depicted in Figure 5 to conduct environmental and social due diligence throughout the project cycle.

W2E and Sustainable Development Goal

With the increasing interest of private sector to invest on W2E business and municipalities to tie up with private sector, it seems that the targets of the Sustainable Development Goal 7 (SDG 7) shall be achieved before the time. SDG 7 aims to achieve, by 2030, targets (i) universal access to affordable, reliable and modern energy services, (ii) increasing substantially the share of renewable energy in the global energy mix, and (iii) doubling the global rate of improvement in

energy efficiency. In Nepal, approximately three-fourth (74.7%) of households in the country uses solid fuels as the primary source of energy for cooking, while one-fifth (18%) uses LPG for cooking. Only three-fourth (74%) of the households have access to electricity, with inadequate and unreliable electricity supply. The proposed specific targets for SDG7 include accessibility of 99% households to electricity; reduction to 30%—from nearly 75% now—the households who resort to firewood for cooking; limiting the use of LPG to less than 40% of the households. The share of industry in total output remains at just 15% and this sector employs less than 7% of the labor force. The target for 2030 is to increase the share of industry to 25% to promote labor intensive activities and raise employment in manufacturing to 13% of total employment.

Success of W2E project with PPP approach

The PPP model for promotion of large biogas plants in Nepal has been envisioned to mitigate any economic and financial risks to the project, as the stake of the private sector is very high. The detailed scrutiny of the project proposals including the preparation and approval of the business and revenue plan ensures that the economic and financial risks are well mitigated during the project inception phase. The financial performance of the project has been tested under different scenarios for the deeper understanding of the project and to obtain information for informed decision-making. The project's financial performance has been observed in two different scenarios, viz. Base Case Scenario and Pessimistic Scenario. In the base case scenario, the economic viability of the project has been calculated under the current envisioned scenario, which was measured in terms of parameters like Internal Rate of Return (IRR), Payback Period, and Debt-Service Coverage Ratio (DSCR). In case of the pessimistic scenario, the biogas production and corresponding CNG production was assumed to be decreased by 10% and the economic viability of the project was considered.

The SREP W2E project with PPP model has envisioned to produce 29.2 million cubic meters of biogas per annum, which is equivalent to 973,000 LPG cylinders. Assuming that a household will have 5 people, each bottle of LPG replaced shall directly impact 5 people in the households. Hence, 4.8 million people shall feel the direct impact of the project per annum. Similarly, the project targets to produce 5 GWh of electrical energy. The current per capita electricity consumption being 196 kWh/annum (October 2020 index), this shall impact approx. 25,000 people. In addition, the project targets to produce 10,000 tons of the organic fertilizer. Therefore, the World Bank supported SREP W2E can be considered as the first of its own kind of project with PPP approach, which is being successfully implemented and contributing to the environmental and socio-economic benefit of the country.

Conclusion

To conclude, PPP model in Nepal is being promoted in hydropower sector since the 1990s and it has been adopted for SREP Biogas project with an innovative financial mix. The interest shown by the private sector to invest in Biogas project and the enthusiasm expressed by municipalities to participate demonstrate the success of this approach. This project supports to ensure efficient energy supply and proper waste

management in the Nepalese communities. A successful demonstration of the Waste Extended Biogas project in Nepal, have laid foundation to develop market for W2E projects in other potential areas, which would enable to manage organic wastes sustainably thereby contributing to reduce imported fossil fuel and fertilizers.

References

- ✓ Chaurey, A., Krithika, P.R., Palit, D., Rakesh, S. and Sovacool, B.K. 2012. New partnerships and business models for facilitating energy access. *Energy policy*, 47:48–55.
- ✓ Evangelisti, S., Lettieri, P., Borello, D. and Clift, R. 2014. Life cycle assessment of energy from waste via anaerobic digestion: a UK case study. *Waste management*, 34:226–237.
- ✓ Government of Nepal, 2019. Public Private Partnership and Investment Act, 2019.
- ✓ Ismail, S. 2013. Critical success factors of public private partnership (PPP) implementation in Malaysia. *Asia-Pacific Journal of Business Administration*.
- ✓ Malinauskaitė, J., Jouhara, H., Czajczyńska, D., Stanchev, P., Katsou, E., Rostkowski, P., Thorne, R.J., Colon, J., Ponsá, S., Al-Mansour, F. and Anguilano, L. 2017. Municipal solid waste management and waste-to-energy in the context of a circular economy and energy recycling in Europe. *Energy*, 141:2013–2044.
- ✓ Patinvo, R.J. and Taherzadeh, M.J. 2019. Challenges of biogas implementation in developing countries. *Current Opinion in Environmental Science & Health*, 12:30–37.
- ✓ Peimani, H. 2018. *Financial barriers to development of renewable and green energy projects in Asia* (No. 862). ADBI Working Paper Series.
- ✓ Sodari, K.B. and Nakarmi, A.M. 2018. Electricity Generation Potential of Municipal Solid Waste of Nepal and GHG Mitigations. *Journal of the Institute of Engineering*, 14:151–161.
- ✓ Sovacool, B.K. 2013. Expanding renewable energy access with pro-poor public private partnerships in the developing world. *Energy Strategy Reviews*, 1:181–192.
- ✓ Tomić, T. and Schneider, D.R. 2018. The role of energy from waste in circular economy and closing the loop concept—Energy analysis approach. *Renewable and Sustainable Energy Reviews*, 98:268–287.
- ✓ Ullah, A. 2015. Public private partnership in hydro-power development of India: prospects and challenges. *Journal of Business Management & Social Sciences Research (JBM&SSR)*, 4. ■

Asia and the Pacific Renewable Energy Status Report

Published by the Asian Development Bank (ADB), this report provides a comprehensive overview of renewable energy developments in Asia and the Pacific. It covers 18 countries in the region considered fundamental to the clean energy transition.

Covering five subregions in Asia and the Pacific, the report presents the current status of renewable energy by examining the policy landscape, investment flows, and how renewables are increasing energy access. The report was produced by REN21 in collaboration with the Asian Development Bank and the United Nations Economic and Social Commission for Asia and the Pacific.

For more information, access:

<https://www.adb.org/sites/default/files/publication/611911/asia-pacific-renewable-energy-status.pdf>

Tech Events

2021

**Mar 15–18
Singapore**

8th Annual Biologics Manufacturing Asia 2021

Contact: Kashmiira Nayar
Marketing Manager
Tel: +65 3109 0122
E-mail: kashmiira.nayar@imapac.com
https://www.imapac.com/en/business_conferences/biologics-manufacturing-asia/

**Mar 24–25
Singapore**

IoT Asia

Contact: SingEx Exhibitions Pte Ltd
11 Tampines Concourse #01-01,
Singapore 528729
Tel: +65 6403 2100
E-mail: sales.iotasia@singex.com
<https://www.internetofthingsasia.com/>

**Mar 27–29
Singapore**

2021 2nd Asia Conference on Renewable Energy and Environmental Engineering (AREEE 2021)

Contact: Nancy Liu
Conference Secretary
Tel: +86-28-86512185
E-mail: areee@iacsitp.com
<http://www.areee.org/>

**Apr 5–7
Abu Dhabi,
UAE**

World Future Energy Summit

Contact:
Abu Dhabi National Centre, UAE
Tel: +971 2 4917615
E-mail: info@worldfutureenergysummit.com
<https://www.worldfutureenergysummit.com/>

**Apr 20–21
Singapore**

3rd annual Cleantech Forum Asia

Contact: Secretariat
E-mail: forums@cleantech.com
<https://www.cleantech.com/event/cleantech-forum-asia/>

**Apr 22–23
New Delhi,
India**

Plastic Recycling Conference Asia 2.0

Contact: Secretariat
Tel: +91 - 9009 844 333, +91 - 9009 2443 33
E-mail: Info@Plasticrecyclingconference.Com
<https://www.plasticrecyclingconference.com/>

**May 12–14
Bangkok,
Thailand**

Renewable Energy Asia

Contact: Ms. Jittraporn Kulwanich
Tel: +66 2036 0500 ext. 244 & 235
Fax: +66 2036 0588
E-mail: jittraporn.k@informa.com;
asew-th@informa.com
<https://www.asew-expo.com/2021/>

**May 24–25
Dubai,
UAE**

International Conference on Artificial Intelligence & Robotics

Contact: Meetings International
28 Maxwell Road,
#03-05 Red Dot Traffic
Singapore (069120)
E-mail: contact@meetingsint.com
<https://www.meetingsint.com/conferences/artificialintelligence>

**May 22–24
Hong Kong,
China**

2021 3rd Asia IoT Technologies Conference (AIOTT 2021)

Contact: Ms. Penny Gan
Tel: 86-13290000003
E-mail: aiott_conf@yeah.net
<http://www.aiott.net/>

**Jun 14–18
Queensland,
Australia**

6th International EcoSummit Congress: EcoSummit 2021

Contact: Secretariat
E-mail: content-ECOS2020@elsevier.com
<http://www.ecosummitcongress.com/>

**Jun 21–23
Singapore**

Asia Climate Forum

Contact: Tony Stephenson, Event Director
Tel: +44 (0) 1423 524545
E-mail: tony@mediageneration.co.uk
<https://www.asiaclimateforum.com/>

**Jun 30–July 2
Bangkok,
Thailand**

Future Energy Asia 2021

Contact: Secretariat
E-mail: info@futureenergyasia.com
<https://www.futureenergyasia.com/>

**July 20–22
Dalian,
China**

2021 Asia-Pacific Conference on Robotics, Automation and Communication Engineering (RACE 2021)

Contact: Ms. Hailey R. Wu
Tel: +852-30697093
E-mail: race@hksra.org
<http://www.aprace.org/>

**Sept 3–5
Gandhinagar,
India**

Agri Asia 2021 - 10th International Exhibition and Conference on Agriculture Technologies

Contact: RADEECAL COMMUNICATIONS
402, 4th Floor, "Optionz" Complex,
Opp. IDFC BANK,
Between Girish Coldrink and Xaviers Corner,
Off C.G. Road, Navrangpura,
Ahmedabad- 380009, Gujarat, India.
Tel: +91-079-26401101/02/03
E-mail: agriasia@agriasia.in
<https://www.agriasia.in/>

**Aug 26–28
Sapporo,
Japan**

2021 4th International Conference on Bioenergy and Clean Energy (ICBCE 2021)

Contact: Ms. Hedy Zhao
HKCBEEES Senior Editor
Tel: +852-3500-0137
E-mail: icbce@cbces.net
<http://www.icbce.org/>

**Oct 12–14
Tashkent,
Uzbekistan**

3rd Central Asian International Exhibition and Business-Forum «Green technologies, environmental protection and recycling – GET Central Asia 2021

Contact: CCA
Mustakillik Avenue, 59A 2nd floor
Tashkent, Uzbekistan
Tel: +998 71 237 15 54
Fax: +998 71 237 15 54
E-mail: getca@cca.uz
<https://getca.uz/en/>

Tech Ventures & Opportunities

Business Coach

Start-up Venture Creation 33

- Startup Development in the Philippines
- Bookkeeping: Anticipate your accounting cycle

Technology transfer 35

- Registration of licensing agreement
- Voluntary licensing of patents in the Philippines

Venture Financing 39

- Select venture funding support for startups in India
- Managing the finance of your business

Managing Innovation 41

- Innovation by MSMEs in the Philippines: Select provisions of The Philippine Innovation Act
- Inclusive and grassroots innovations in Malaysia

Green Productivity 43

- Green Technology Financing Scheme of Malaysia
- Promoting cleaner production in Sri Lanka

Tech Opportunities

Technology Offers 45

- Cleaner chromium tanning
- Room-temperature biodiesel production
- Nano gold-loaded carbon bullets as gene carriers
- Plant biomass-based metal sorption column
- Tea catechins as anti-aging compounds
- Sensor for detecting nitrogen dioxide gas
- Zero-head hydro turbine
- Virgin coconut oil
- Chitin and chitosan

Startup Development in the Philippines

Department of Trade and Industry, Philippines

<http://innovate.dti.gov.ph/>

The Startup ecosystem in the Philippines is young, vibrant, and full of potential. Startups introduce innovative products and create new business models that address changing societal and market needs. As such, it is important for the government to support the development of the startup ecosystem to foster an innovative and entrepreneurial culture in the country. DTI, DOST, and DICT, together with other government agencies are working together in order to further develop the Philippine Startup Ecosystem through the implementation of the Innovative Startup Act.

The recently enacted Innovative Startup Act provides benefits, incentives, and other forms of support to the startup ecosystem including the provision of startup visas, expedited processes, establishment of the Startup Venture Fund, Grants-In-Aid, the crafting of the Startup Ecosystem Development Program, and the establishment of Startup Eco-zones among others.

The nurturing of Startup Ecosystems are at the forefront of the government's initiatives in forging partnerships, bridging gaps, and enabling stakeholders to ensure a competitive, innovative, and inclusive Philippines.

SMART (Strategic MSMLE & Startup) Link

SMART Link aims to match leading-edge innovative startups in the Philippines with commercial products to traditional enterprises (MSMLEs) through conducting business-to-business matching sessions or Smart Link Sessions. The objective of this program is to facilitate partnerships and collaborations between startups and traditional enterprises to (i) provide startups an opportunity to access different markets across different industries thereby increasing revenue streams, (ii) expose traditional enterprises to startups and engage in innovative activities (e.g., through acquisition of digital solutions), and (iii) drive digitalization in traditional enterprises to increase firm productivity, competitiveness, and business resiliency.

Startup Acceleration and Incubation by DTI (startupAID)

The startupAID program aims to assist innovative startups in their product launch, commercialization, and scaling up. It helps accelerate the growth of viable technological startups by undergoing a specialized training program co-developed with partnered startup enablers.

DTI partners with local and international startup enablers to provide a specialized incubation/acceleration program designed to enable tech startups pursue business development, fundraising, and other strategic opportunities. Program participants will be exposed to the enabler's extensive network of corporate, technology, and investment partners as well as mentors and advisors.

International and Local Exposure Assistance Program (ILEAP for Startups)

As one of the lead host agencies of the Innovative Startup Act, the DTI is mandated to support the growth of local startups and the development of the country's startup ecosystem as a whole. By doing so, more entrepreneurial opportunities are facilitated and more job-generating businesses are established. Among the benefits and incentives that host agencies can provide to qualified startups is support to their participation in local or international startup events or competitions.

Global Acceleration Program

The Global Acceleration Program (GAP) aims to assist startups survive its early stages, scale up, and globalize. It seeks to help accelerate the growth of viable technological startups with priority given to startups that address the challenges brought about by the covid-19 pandemic. Startups will be immersed in the global ecosystem to enable them to pursue global business development, fund-raising, and other strategic opportunities. The program will help startups get across the tail-end of the "Valley of Death" and further increase their market reach and valuation by expanding into regional and global markets.

World Intellectual Property Indicators Report 2020

This authoritative report analyzes IP activity around the globe. Drawing on 2019 filing, registration and renewals statistics from national and regional IP offices and WIPO, it covers patents, utility models, trademarks, industrial designs, microorganisms, plant variety protection and geographical indications. The report also draws on survey data and industry sources to give a picture of activity in the publishing industry.

The report collects and analyzes IP data from some 150 national and regional offices to inform policy makers, business leaders, investors, academics and others seeking macro trends in innovation and creativity.

For more information, access:

https://www.wipo.int/edocs/pubdocs/en/wipo_pub_941_2020.pdf

Bookkeeping: Anticipate your accounting cycle

SME Corporation Malaysia, Malaysia

<https://smeinfo.com.my/>

The main objective of starting a business is definitely to reap a profit. Many startups failed within 3 years of establishment due to poor financial management and no proper bookkeeping.

It is important for entrepreneurs to have a proper recording of business transactions; income and expenses to determine whether your business is operating at a profit or at a loss. Knowledge of basic bookkeeping will ensure the consistency of your business financial reporting.

Cashbook

The basic accounting system would be keeping a cashbook record. It is important to keep all your record of expenses and original documents such as bills, invoices, receipt, payment, and sales voucher as a proof of the statement of your entry in your cashbook. From this cashbook, later on, you will transfer all the data to your business account for the monthly statement. For small business entrepreneurs normally they just use a cashbook to manage their daily transaction.

This Toolkit will teach you how to prepare and maintain a simple cashbook recording. The cashbook will help to analyze your income and as well as determine your tax and GST returns. A good cashbook can be in a manual or electronic format, but must be easy to use and does not take up too much of your time to understand. The manual cashbook example explained here serves as a guide, shows a few entries, but understanding its operation will give you a basic understanding of a computerized cashbook.

Cash flow from operating activities

The cash flow includes activities from generating principal revenue such as a purchase of goods and services and sales. It can be computed using two methods which are Direct and Indirect Method.

Direct method

The direct method is to record all operating activities that involve various types of cash receipts and payments such as cash paid to suppliers, cash receipts from customers, salaries etc. and then putting it together into the operating section of a cash flow statement.

Indirect Method

In the indirect method, the amount of net cash flow from operating activities is calculated by using the net income figure from the income statement. It uses net income as a starting point makes

adjustments for all transactions for non-cash items, then adjust for all cash-based.

Statement of cash flow forecast

A statement of cash flows forecast shows the estimation of money flow in and out of a business. This includes all projected income and expenses over a period of time. Statement of cash flows forecasting is a very important and useful tool for an entrepreneur. It will help entrepreneurs in budgeting and plan their expenses commitment and payment to relevant parties.

We have already projected the amount of money that is needed to start a business, i.e., the "outflow" for ABC Enterprise. We also have to project how much money will come in through business activities, i.e., sales or additional cash injected. Amounts forecasted from sales should be shown with the accurate expected period under "inflow."

In statement of cash flows forecast, only cash sales and cash expenses are taken into account.

Determine your own fund capacity

Estimate the loan disbursement timing

Business might apply for a loan and the process might take some time. The timing of the cash inflows from the loan will greatly affect your cash flow forecast.

Sales estimation

A sales estimation is a plan of how much you expect to sell in the future, normally broken down by month. For a startup business, you'll need to estimate your forecasts based on information from customer surveys, market research, suppliers, industry experts, the performance of similar businesses, and the capacity of your business operation. For a mature business, sales estimation can be based on the sales history or trends.

Payment timing

It's important to understand that the timing of cash inflow and cash outflow comes down to the operating cycle of your business. This involves the timing of buying and selling, sales collection time, credit payment terms, and specific time payment commitment.

Cost estimation

Cost estimation is a forecast of all expenses that a business may incur. It can be estimated daily, monthly, or annually.

Registration of licensing agreement

Department of Intellectual Property, Thailand

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

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;
 - (i) 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
 - (ii) 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
 - (i) The law stipulates that the fee must be refunded, or
 - (ii) 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

Digital Economy Report 2019

The rapid spread of digital technologies is transforming many economic and social activities. While creating many new opportunities, widening digital divides threaten to leave developing countries, and especially least developed countries, further behind. A smart embrace of new technologies, enhanced partnerships and greater intellectual leadership are needed to redefine digital development strategies and the future contours of globalization.

This first edition of the *Digital Economy Report* – previously known as the *Information Economy Report* – examines the scope for value creation and capture in the digital economy by developing countries. It gives special attention to opportunities for these countries to take advantage of the data-driven economy as producers and innovators – but also to the constraints they face – notably with regard to digital data and digital platforms.

Digital advances have already led to the creation of enormous wealth in record time, but this is highly concentrated in a small number of countries, companies and individuals. Meanwhile, digitalization has also given rise to fundamental challenges for policymakers in countries at all levels of development. The Report presents recent trends and discusses key policies for value creation and capture in the digital economy, notably with regards to entrepreneurship, data, trade, competition, taxation, intellectual property and employment.

The Report provides valuable insights and analyses to support policymakers at the national and international levels to ensure that no one is left behind by the fast-evolving digital economy.

For more information, access:

https://unctad.org/en/PublicationsLibrary/der2019_en.pdf

Voluntary licensing of patents in the Philippines

The Intellectual Property Office, Philippines

<http://ipophil.gov.ph>

REPUBLIC ACT NO. 8293

SECTION 85. Voluntary License Contract — To encourage the transfer and dissemination of technology, prevent or control practices and conditions that may in particular cases constitute an abuse of intellectual property rights having an adverse effect on competition and trade, all technology transfer arrangements shall comply with the provisions of this Chapter. (n)

SECTION 86. Jurisdiction to Settle Disputes on Royalties — The Director of the Documentation, Information and Technology Transfer Bureau shall exercise quasi-judicial jurisdiction in the settlement of disputes between parties to a technology transfer arrangement arising from technology transfer payments, including the fixing of appropriate amount or rate of royalty. (n)

SECTION 87. Prohibited Clauses — Except in cases under Section 91, the following provisions shall be deemed prima facie to have an adverse effect on competition and trade:

- 87.1. Those which impose upon the licensee the obligation to acquire from a specific source capital goods, intermediate products, raw materials, and other technologies, or of permanently employing personnel indicated by the licensor;
- 87.2. Those pursuant to which the licensor reserves the right to fix the sale or resale prices of the products manufactured on the basis of the license;
- 87.3. Those that contain restrictions regarding the volume and structure of production;
- 87.4. Those that prohibit the use of competitive technologies in a nonexclusive technology transfer agreement;
- 87.5. Those that establish a full or partial purchase option in favor of the licensor;
- 87.6. Those that obligate the licensee to transfer for free to the licensor the inventions or improvements that may be obtained through the use of the licensed technology;
- 87.7. Those that require payment of royalties to the owners of patents for patents which are not used;
- 87.8. Those that prohibit the licensee to export the licensed product unless justified for the protection of the legitimate interest of the licensor such as exports to countries where exclusive licenses to manufacture and/or distribute the licensed product(s) have already been granted;
- 87.9. Those which restrict the use of the technology supplied after the expiration of the technology transfer

arrangement, except in cases of early termination of the technology transfer arrangement due to reason(s) attributable to the licensee;

- 87.10. Those which require payments for patents and other industrial property rights after their expiration, termination arrangement;
- 87.11. Those which require that the technology recipient shall not contest the validity of any of the patents of the technology supplier;
- 87.12. Those which restrict the research and development activities of the licensee designed to absorb and adapt the transferred technology to local conditions or to initiate research and development programs in connection with new products, processes or equipment;
- 87.13. Those which prevent the licensee from adapting the imported technology to local conditions, or introducing innovation to it, as long as it does not impair the quality standards prescribed by the licensor;
- 87.14. Those which exempt the licensor for liability for non-fulfillment of his responsibilities under the technology transfer arrangement and/or liability arising from third party suits brought about by the use of the licensed product or the licensed technology; and
- 87.15. Other clauses with equivalent effects. (Sec. 33-C (2), RA 165a)

SECTION 88. Mandatory Provisions — The following provisions shall be included in voluntary license contracts:

- 88.1. That the laws of the Philippines shall govern the interpretation of the same and in the event of litigation, the venue shall be the proper court in the place where the licensee has its principal office;
- 88.2. Continued access to improvements in techniques and processes related to the technology shall be made available during the period of the technology transfer arrangement;
- 88.3. In the event the technology transfer arrangement shall provide for arbitration, the Procedure of Arbitration of the Arbitration Law of the Philippines or the Arbitration Rules of the United Nations Commission on International Trade Law (UNCITRAL) or the Rules of Conciliation and Arbitration of the International Chamber of Commerce (ICC) shall apply and the venue of arbitration shall be the Philippines or any neutral country; and

88.4. The Philippine taxes on all payments relating to the technology transfer arrangement shall be borne by the licensor.
(n) cdt

SECTION 89. Rights of Licensor — In the absence of any provision to the contrary in the technology transfer arrangement, the grant of a license shall not prevent the licensor from granting further licenses to third person nor from exploiting the subject matter of the technology transfer arrangement himself. (Sec. 33-B, R.A. 165a)

SECTION 90. Rights of Licensee — The licensee shall be entitled to exploit the subject matter of the technology transfer arrangement during the whole term of the technology transfer arrangement. (Sec. 33-C (1), R.A. 165a)

SECTION 91. Exceptional Cases — In exceptional or meritorious cases where substantial benefits will accrue to the economy, such as high technology content, increase in foreign exchange

earnings, employment generation, regional dispersal of industries and/or substitution with or use of local raw materials, or in the case of Board of Investments, registered companies with pioneer status, exemption from any of the above requirements may be allowed by the Documentation, Information and Technology Transfer Bureau after evaluation thereof on a case by case basis. (n)

SECTION 92. Non-Registration with the Documentation, Information and Technology Transfer Bureau — Technology transfer arrangements that conform with the provisions of Sections 86 and 87 need not be registered with the Documentation, Information and Technology Transfer Bureau. Nonconformance with any of the provisions of Sections 87 and 88, however, shall automatically render the technology transfer arrangement unenforceable, unless said technology transfer arrangement is approved and registered with the Documentation, Information and Technology Transfer Bureau under the provisions of Section 91 on exceptional cases.

Selected Green Technology Funds

Adaptation Fund (AF)

<https://www.adaptation-fund.org>

The Adaptation Fund (AF) was created under the United Nations Framework Convention on Climate Change. The fund is designed to finance climate change adaptation projects and programs based on the priorities of eligible developing countries.

Climate Investment Funds

<https://www.climateinvestmentfunds.org>

The \$8 billion Climate Investment Funds (CIF) accelerates climate action by empowering transformations in clean technology, energy access, climate resilience, and sustainable forests in developing and middle-income countries. The CIF's large-scale, low-cost, long-term financing lowers the risk and cost of climate financing.

Global Environment Facility Trust Fund

<http://www.thegef.org>

The Global Environment Facility (GEF or the Facility) was established in the International Bank for Reconstruction and Development (IBRD or World Bank) as a pilot program in order to assist in the protection of the global environment and promote thereby environmentally sound and sustainable economic development.

Least Developed Countries Fund (LDCF)

<https://www.thegef.org/topics/least-developed-countries-fund-lDCF>

The LDCF was established in November 2001 under the United Nations Framework Convention on Climate Change to address the needs of least developed countries whose economic and geophysical characteristics make them especially vulnerable to the impact of global warming and climate change.

Special Climate Change Fund (SCCF)

<https://www.thegef.org/topics/special-climate-change-fund-sccf>

The Special Climate Change Fund was established in November 2001 under the United Nations Framework Convention on Climate Change to finance activities, programs and measures relating to climate change that are complementary to those funded by the resources allocated to the climate change focal area of the Global Environment Facility Trust Fund.

Select venture funding support for startups in India

Startup India, Government of India

<https://www.startupindia.gov.in/>

Gujarat Venture Finance Limited (GVFL) supported by the State Government is one of the oldest venture funds in the country. Founded in 1990 at the initiative of Government of Gujarat and World Bank, GVFL has supported ventures working on cutting edge technology as well as encouraged entrepreneurs with innovative ideas. State Government has contributed INR 75 crore to the overall fund corpus of INR 250 crore. The investment from the fund is in the range of INR 2 crore to INR 20 crore in single or multiple rounds as per Startup business needs.

Looking at the current scenario in the Startup ecosystem and leveraging on decades of full investment lifecycle experience in startup investing, GVFL has launched "GVFL Startup Fund." The fund focuses on highly scalable, innovative business models, across, sectors, which use technology as an enabler or differentiator and are backed by credible teams.

In order to provide sustained support to the Startups, Government of Karnataka has operationalized fund of funds for investing in venture funds that invest in Startups in various sectors. Following Venture capital funds have been launched in the State with key focus on selected sectors:

- Karnataka Semiconductor Venture Capital Fund (KARSEMVEN Fund) with INR 100 crore
- KITVEN 3 (Bio-tech) with INR 50 crore
- KITVEN 4 (Animation Visual Effects Gaming and Comics) with INR 20 crore and
- KITVEN 2

The funds have been established to assist Startups in the field of semiconductor, bio-tech and allies sectors and animation, video, gaming, and comics. To guide the above process, an investment committee with Officers from the Government, industry, and academic experts with sector-specific domain knowledge, financial and legal background etc. with no conflict of interest has been constituted.

KITVEN funds have also release guidelines for entrepreneurs applying to these funds for their funding needs. Companies seeking Venture Capital assistance may please forward their Executive Summary (not exceeding 4–5 pages) online keeping in mind investment criteria, objective, and the area of operation of the respective fund under management

Bhamashah Techno Fund of INR 500 crore for Startups has been introduced to give an open sky to the potential Startups of the state. The fund is used for Startups of the State for their growth and all-round development and to levitate the Startup commu-

nity of Rajasthan. The Fund was announced in February, 2018 to ensure the robust growth in the investment infrastructure or substructure and encouraging the Startup ecosystem. Out of the said fund, INR 100 crore is earmarked for Women Startups and INR 50 crore for Green Startups.

Another venture funding mechanism has been established in the form of Rajasthan Venture Capital Fund (RVCF) which is managed by Rajasthan Asset Management Company Pvt. Ltd. The fund invests in Early and growth stage companies with equity exposures ranging from INR 1 crore to INR 10 crore. As of June 2018, 36 Startups have been provided venture funding through abovementioned venture funds.

Government of Uttar Pradesh has established a UP Startup Fund with a corpus size of INR 1,000 crore. The Fund shall be in the form of fund of funds. In this model, the Fund will not be invested directly into startups; rather, it shall participate in SEBI approved investors.

Alternatively, the Fund shall not be invested directly into startups; rather, it shall make investment in "Daughter Funds," which would invest in startups promoting innovative ideas across all sectors in Uttar Pradesh.

The Government of Uttar Pradesh would take minority participation in the Daughter Fund, by being a limited partner of up to 25%. The fund would be professionally managed and a Fund Manager shall be nominated/appointed to manage the UP Startup Fund. A formal Memorandum of Understanding (MoU) would be signed with the Small Industries Development Bank of India (SIDBI) to manage the fund operations.

IT & Electronics Department, Government of Uttar Pradesh has also signed MoUs with two Venture Funds, Venture Catalysts and Orios Venture Advisors for investing in UP-based Startups.

Government of Bihar has created Bihar Startup Fund Trust with a corpus of INR 500 crore for funding Startups. The fund will operate as a "Fund of Funds" and will nurture Startups supported by Government of Bihar to grow organically and scale to create the intended impact in the society. The fund shall enable creation of an ecosystem for providing risk capital to young enterprises to undertake research and development in high priority technology areas. As of September 2018, Bihar Government was in discussion with SIDBI for their role as fund manager.

Kerala Startup Mission (KSUM), the nodal agency for Startup initiative in Kerala is partnering with SEBI accredited Venture Capital Funds for the creation of corpus fund for supporting the emerging startups in the State.

Managing the finance of your business

SME Corporation Malaysia, Malaysia

<https://smeinfo.com.my/>

Potential sources of fund

With the derived total amount of business investment cost, entrepreneurs now have to try to find the best way to fund the cost. Here are some potential sources of fund to consider for your startup.

Funding a business using own savings is good because you do not have to deal with other parties in starting your business. However, you probably will not have sufficient amount to sustain the business after a certain period of time; hence, other options should be considered.

Normally loan is involved when the business needs a large startup cost. Entrepreneurs have to prepare a payback plan in time if borrowing money from external investors. There is a high chance also that owner has to give up some control (ownership) of the business to the investors.

What is gross profit margin?

Gross Profit Margin is the difference between revenue and cost of products sold (include raw material, packaging, and production costs) or Gross Profit divided by Revenue and expressed as a percentage. The purpose of margin is to determine the value of incremental sales, to guide pricing and promotion decision.

What is break even for revenue?

Breakeven is the point at which a business covers its costs. It refers to the number of product units must be sold or sales

amount a business required to cover all costs. It is the point at which total cost and total revenue are equal to neither profit nor loss.

The purpose of break-even analysis is to determine the minimum output that must be exceeded for a business to make a profit.

Statement of financial position (balance sheet)

A statement of financial position (balance sheet) is a financial statement that shows what the business is worth for a specific period of time. It shows the total assets that a company owns and any amounts that it owes to lenders or bank which is called liabilities, as well as the amount of owner's equity or capital.

The statement of financial position (balance sheet) has two sides that must be equal or balance each other out (Total Net Assets = Total Net Equity).

Account aging

An account receivable aging is a report that lists your unpaid customer invoices that are overdue for payment and normally used as a primary tool by collections personnel.

The account payable aging report determining payable invoices which are overdue to your suppliers.

New Patent Information Tool

The World Intellectual Property Organization (WIPO) has expanded its suite of online services with an online platform providing free access to comprehensive, unbiased, and structured reports on many patent databases. WIPO INSPIRE (Index of Specialized Patent Information Reports) will help a range of stakeholders in searching the myriad of patent databases around the world.

WIPO INSPIRE offers a range of powerful but easy-to-use functionalities for both novice and expert patent information users in mind. They include:

- a comparison of features for up to four patent databases,
- an interactive world database coverage map, allowing users to determine, at a glance, which patent databases offer coverage of a specific jurisdiction.

WIPO INSPIRE is integrated with WIPO's Patent Register Portal and eTISC, providing a seamless environment for users to get information about patent databases and patent registers and an opportunity to interact with patent information experts and discuss these tools.

For more information, access:

<https://inspire.wipo.int/>

Innovation by MSMEs in the Philippines: Select provisions of The Philippine Innovation Act

National Economic and Development Authority, Philippines

<https://www.neda.gov.ph/>

Republic Act (RA) No. 11293 otherwise known as the “Philippine Innovation Act” was signed by President Rodrigo R. Duterte on April 17, 2019. The law mandates the creation of the National Innovation Council (NIC) that will steer the whole-of-government coordination and collaboration and to remove the fragmentation in the country’s innovation governance.

Rule 10: Consideration in Setting Priority for Innovations. In identifying the priority areas for innovation, the NIC shall, in consultation with the sectors concerned, consider the issues, challenges, and potentials in the following areas:

- (a) Food security and sustainable agriculture and natural resources;
- (b) The blue economy;
- (c) Education and the academe including STEM Education and high-grade, technology-focused, upskilling and re-skilling vocational training (i.e., advanced, intermediate, and entry-level digital skills);
- (d) Health;
- (e) Secure, clean, renewable and reliable energy;
- (f) Climate change and disaster resilience;
- (g) Resource efficiencies;
- (h) National and community-based comparative advantages in the context of global value chains;
- (i) Comparative strengths and advantages of sectors and communities;
- (j) Traditional knowledge, traditional cultural expressions, and genetic resources;
- (k) Infrastructure;
- (l) Governance;
- (m) Development of human capital;
- (n) Digital economy;
- (o) Transportation services; and
- (p) Others as maybe deemed relevant by the NIC.

Rule 12. Micro, Small and Medium Enterprise (MSME) Innovation. The NIC shall develop strategies towards promoting MSME internationalization, digitalization, and participation in the local and global value chains. A comprehensive support program, from incorporation to internationalization, including industry firm-level collaborations, shall be developed by the NIC and implemented by the agencies concerned. These programs shall include coaching and mentoring in the areas of:

- (a) design;
- (b) technology extension services;

- (c) standard business practices in contracting, accounting, and project management;
- (d) quality control;
- (e) standard-setting;
- (f) business services such as commercialization market needs assessment, marketing and promotion and management;
- (g) patents, and other forms of intellectual property rights; and others.

The Department of Trade and Industry (DTI) shall look for high productivity innovative businesses to help them identify and exploit opportunities in overseas markets. The NIC shall develop metrics for the purposes of assessing the progress of work in these areas.

The NIC shall assign areas of responsibility to implementing agencies according to their mandate to avoid duplication of assistance provided.

For purposes of implementing Section 12 of the Act, these Rules further define the Startup MSME Innovation Development Program.

The MSME Innovation Development Program shall mobilize government agencies to work hand in hand with private organizations and academic institutions to provide technical and/or financial support programs for the development training of entrepreneurs. The Program shall also include the search for high productivity innovative businesses that could help in identifying and exploiting opportunities in overseas markets and provide for appropriate incentives, intellectual property registration, among others, under the Investment Priorities Plan (IPP).

The innovation development program for startups shall be done through the Philippine Startup Development Program as provided under Republic Act No. 11337 or the Innovative Startup Act of the Philippines. The DTI shall lead the development of this comprehensive support program for MSME innovation in coordination with relevant members of the NIC.

The Programs shall also provide for capacity-building for the public sector particularly, those who shall be expected to provide training to startups and MSMEs in order to ensure that the training shall be suitable, updated, and valuable. Other existing initiatives must be considered in the design of financial support programs.

Inclusive and grassroots innovations in Malaysia

Malaysian Foundation for Innovation, Malaysia

<https://www.yim.my/programmes/>

By trailblazing an innovation and science-driven path for grassroots-centric innovations, Yayasan Inovasi Malaysia (YIM), or the Malaysian Foundation for Innovation, has played an integral role in leading Malaysia's towards enhanced growth, competitiveness, and prosperity.

Our supportive awareness, development, and financing environments help innovations come to life with both economic potential and social impact to grassroots communities. From ground events to grants to commercialisation and market diffusion programmes, YIM's programmes have generated continuous and sustainable impact nationwide.

High Impact Project 6 – Inclusive Innovation

Specifically designed to empower the bottom 40% of the income group to leverage on innovations to promote the transformation of communities including microenterprises in the rural areas through handholding and technical and management support, the High Impact Project 6 – Inclusive Innovation (HIP6) programme is part of the SME Masterplan 2012–2020 organised by SME Corp and managed by YIM as appointed Lead Agency.

HIP6 promotes public–private partnership to share responsibility and accountability in creating drivers of change that can empower the bottom 40% of the income pyramid to leverage on innovations created for the benefit and well-being of the communities.

Since the programme was inceptioned, almost 23,000 people have participated in the HIP6 Inclusive Innovation Challenges which is organised to identify deserving innovations for support and funding.

Mainstreaming grassroots innovations

YIM's Mainstreaming Grassroots Innovation (MaGRIs) programme is a project that focuses on upscaling and accelerating the development and diffusion of potential grassroots innovations in Malaysia via collaboration with various parties from government, industry, grassroots community, and youth.

The MaGRIs programme provides an environment to develop grassroots innovators (GRIR) with potential innovations and groom them to become community role models. New methods to stimulate grassroots commercial activities into mainstream commercial activities are often uncovered while GRIR leverage through opportunities to mainstream their innovations into mainstream commercial activities. Often, academic and industry collaborators are roped in to support the MaGRIs programme activities.

From innovation development to commercialisation with market diffusion to inclusive communities, the programme even has its own

MaGRIs Ambassador originating from the same communities, sharing community success stories, and creating engagement with this targeted community. Since MaGRIs was inceptioned in 2016, more than 13,000 people have engaged with the programme.

MOSTI Social Innovation Fund

The MOSTI Social Innovation (MSI) project was launched with the objective of improving the well-being of the society through the implementation of project, services, capacity and skill building or innovation output using the existing technology that can be implemented sustainably.

As a start, the implementation of MSI involves outreach programmes to the grassroots level and scaling up innovative ideas from the outreach programme with the objective of "humanising innovation."

Innovators can submit their project ideas to MESTECC for the MSI grant. MESTECC functions as a one-stop centre for innovators to submit their innovations with proof-of-concept. The innovation projects will be matched with its agencies and collaborators to facilitate and monitor the projects.

Lifelong Learning Initiative

GRIR have benefited the community by innovating products and services that are useful and of values to their community. However, their contributions are often neglected, not brought to proper authorities for their development and advancement. GRIR are national assets contributing to social and economic growth. GRIR need proper recognition, capacity building initiative to motivate, sustain them to innovate better solutions, provide leaderships at grassroots level.

This project was funded by The Boeing Company under Boeing Global Corporate Citizenship (BGCC). In the first sequel, the project has successfully accredited 20 GRIR in 2016 and with the BGCC support again an additional 20 GRIR are selected for APE in the second sequel, 2017.

Through Lifelong Learning Initiative – Accreditation of Prior Experience (APE) platform, an individual's expertise, skills, and experiences officially recognised based on National Occupational Skills Standards (NOSS) into Malaysian Skills Certificate qualifications: Certificate of Competency, MSC levels 1 to 3, Diploma Malaysian Skills or Advanced Diploma Malaysian Skills; awarded by the Government.

The programme will be implemented throughout Malaysia, segmented into six zones which are North, South, Central, East Coast, Sabah, and Sarawak.

Green Technology Financing Scheme of Malaysia

Malaysian Green Technology and Climate Change Centre, Malaysia

<https://www.mgtc.gov.my/>

As part of the effort to ensure continuous supports toward Green Technology projects, the Ministry of Finance has agreed to the recommendation proposed by Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC), with several enhancement and improvement to the scheme and known as GTFS 2.0.

GTFS 2.0 also offer a financial support (subject to only to the green technology/component cost finance by Participating Financial Institutions (PFIs)) for Producer, User and also offer a financial support to a new category, which is for Energy Services Companies (ESCOs) also offer a rebate of 2% on interest/profit, is to accelerate the expansion of green investments by providing easier access to funding via financing from PFIs with a total funding earmarked up to RM 2.0 billion. The new category is to support ESCOs to finance investment or assets related to energy efficient project and/or energy performance contracting.

All applications of the Scheme are channeled to Malaysian Green Technology Corporation (GreenTech Malaysia) on which conducts the initial screening and certification prior to applying financing from financial institutions. The Scheme is made available until 31 December 2020 or upon reaching a total financing/funding approval amount of RM 2.0 billion whichever is earlier or any subsequent extension on the availability date expected to facilitate

the growth of local green businesses and generates new markets and job creation.

Malaysian Green Technology Corporation (GreenTech Malaysia), Credit Guarantee Corporation Malaysia Berhad (CGC) are the agencies tasked with administering the Scheme. GreenTech Malaysia is responsible for the promotion, assessment, certification, and monitoring to Producers, Users & ESCOs under the Scheme, while CGC is responsible to manage, administer, and monitor the scheme which includes the verification and process of guarantee applications, subsidy reimbursements, claim payments, and reports to the Government.

In April 2018, the MOF had approved an extension of the GTFS known as GTFS 2.0 with a financing amount earmarked up to RM 5.0 billion. The Scheme was later launched on 3rd May 2018 in Kudat, Sabah. However, after the 14th General Election in May 2018, the new Government administration had decided to discontinue the Scheme. Later, on 6th March 2019, MOF had approved to reinstate GTFS 2.0 with the allocation of RM 2.0 billion for the period of January 2019 until the end of 2020. The Scheme which will last for 2 years will be offering a 2% p.a. interest/profit rate subsidy for the first 7 years with 60% government guarantee on the financing.

ASEAN Renewable Energy Integration Analysis

In support of the development of the ASEAN Power Grid (APG), the International Energy Agency (IEA) has undertaken a quantitative assessment of the impact of regional power system integration in ASEAN to accommodate the growing share of variable renewable energy (VRE), which consists of solar and wind generation.

The analysis explores the impact of multilateral power trading (MPT) and expanded cross-border interconnectors as well as the value of flexibility resources for the APG from economic, operational, environmental and policy-related perspectives. Cross-border interconnectors with MPT in ASEAN can promote effective asset utilisation and resource sharing that benefits regions. This will enhance the flexibility of the ASEAN power sector to accommodate an increasing share of renewables, particularly solar and wind, in a cost-effective, reliable, and environmentally sustainable manner.

For more information, contact:

International Energy Agency

9 rue de la Fédération

75739 Paris Cedex 15

France

Tel: +33 (0)1 40 57 65 00; Fax: +33 (0)1 40 57 65 09

E-mail: info@iea.org

Web: <https://www.iea.org>

Promoting cleaner production in Sri Lanka

National Cleaner Production Centre, Sri Lanka

<http://www.ncpcsrilanka.org>

Resource Efficient and Cleaner Production (RECP) assessments

A cleaner production audit is often the first step towards managing, controlling and improving the environmental performance of a company. If a company was not previously concerned about the environmental impacts of its production, an audit is the best way to establish the actual status and determine the best approach to reducing waste, wastewater, and emissions. It analyses and quantifies input, output, and waste generation at each step of a production process. As a proactive environmental measure CP helps companies to comply with rules and regulations. There are three types of audits focuses on improving resource efficiency.

GHG assertion

NCPC has the expertise and capacity to measure and report your organization carbon footprint. Our services are ranging from organization level to product level in line with GHG Protocol, ISO 14064-1 & -2, ISO 14067, and PAS 2050 carbon foot printing standard. Our in-house expertise in cleaner production and energy will help to propose comprehensive GHG mitigation opportunities to the company.

Quantification of GHG emissions of your business activities or product will help you to:

- Understand the impact that your product/business has on the climate at each stage of its life cycle.
- Identify the most effective way of reducing emissions, whether it is in your own operations, with your suppliers, or in how your customers use and dispose of your product.
- Reduce costs through greater energy efficiency and waste reduction.
- Respond to customer demand – and enhance your brand reputation (credible, confident, and positive external messaging).
- Develop successful, long-term, and economically competitive relationships with suppliers.
- Minimize risk by ensuring compliance with the carbon legislation

Product Carbon Footprint

The Product Carbon Footprint (PCF) sums up the total greenhouse gas emissions generated by a product over the different stages of its life cycle. Different types of PCFs exist.

- “Cradle to Gate” - From raw material extraction to point of distribution

- “Cradle to Grave” - From raw material extraction to point of consumption & disposal

- “Cradle to Cradle” - From raw material extraction to point of reuse

There are three main PCF standards that are or will be applied worldwide:

- PAS 2050
- GHG Protocol
- ISO 14067

Environment management

Centre conducts water and energy audits and facilitates the clients' relevant information on enhancing their water and energy performances. NCPC has been registered as an ESCO (Energy Service Company) with the Sustainable Energy Authority (SEA) since 2009. NCPC has acquired modern energy measuring equipment to carry out electrical and thermal energy measurements.

Energy management

The concern on energy consumption and energy cost has been increasing across all energy-intensive industry sectors not only because of its immediate impact on production costs, but also because of environmental impacts. Cost of energy in any organization can potentially bring significantly down to improve business benefits, through proper energy services. NCPC, Sri Lanka is a member of “RECPnet” global network, leading the global Cleaner Production agenda, with a network of over 70 such Centres around the globe. As such, there is no organization better equipped to deliver a robust solution that best suits your energy efficiency needs.

Chemical management

This component is carried out according to Responsible Production which is a unique initiative that drives continuous improvement in health, safety, and environmental performance.

Water auditing and water footprint

Water is an indispensable but scarce resource today, hence demonstration of the corporate commitment to protect the fresh water resources through conducting water audits & implementing the recommendations, quantifying the water footprint (ISO 14046) inevitably boost the corporate image of a company. Using water efficiently support in savings of energy and raw materials as well as to cut down waste water treatment costs. Every business is a little different, but a water audit is an easy way to start.

CHINA

Cleaner chromium tanning

A Chinese firm is offering technology of cleaner chromium tanning method, closed pickle tan loop system. The technology involves continuous recycling of spent liquors from a suitably standardized less-chrome, high-exhaustion chrome tanning in pickling such that there is no discharge of exhaust liquors containing chrome tanning processes, preventing pollution due to these substances on the one hand and avoiding material loss on the other. Compared to conventional chrome tanning process, this new pickle-tan closed loop system ensures near-zero discharge of potential pollutants such as chrome and neutral salts viz. sodium chloride and sodium sulphate. Since sulphate-bearing streams viz. pickling and chrome tanning spent liquors are continuously recycled and not being allowed to mix with other sectional waste liquors, the anaerobic treatment of end of pipe treatment is improved. Sludge produced would be almost free chrome and hence, disposal becomes easier.

Area of Application

Chemical industry, Tanning industry, Leather industry

Advantages

- Cleaner production: near-zero discharge of chrome and neutral salts in pickle and chrome tanning processes thus preventing pollution due to these substances
- Avoids material loss
- Water consumption in pickle-tan stage is considerably minimized

Technical Specifications

- Cleaner chromium tanning method
- Closed pickle tan loop system

Contact

Polytex Chemical Engg Co.
No. 317 Wenhuidong Rd, Yangzhou city, Jiangsu, China
Yangzhou, China
Zip/Pin Code: 225009

HUNGARY

Room-temperature biodiesel production

Our partner, a Hungarian Institute has developed a novel continuous process for the room-temperature production of biodiesel. The main advantage of this technology is the avoidance of soap formation which so far causes many problems during biodiesel production (emulsion formation, washing problems, slow phase splitting, etc.). They are interested in a license agreement or selling of production equipment.

Area of Application

Biofuel production plants, fuel mixing firms

Advantages

- Room temperature process, energy saving
- Avoidance of soap formation, thus many other problems do not occur
- Continuous production technology in a simple apparatus (tube reactor)

- Cheap catalyst removing (KHSO_4 or H_2SO_4) by recyclization of catalyst-removing KHSO_4 (acid) with regenerable ion exchangers
- The byproducts (K_2SO_4 , glycerol, or methanol) can be used as rapeseed production fertilizer or starting material for biogas production
- No water in glycerol phase
- Low methanol and potassium content in the raw ester phase

Environmental Aspects

- Cleaner production
- Energy efficiency

Development Status

Pilot plant

Legal Protection

Patent

Technical Specifications

Vegetable oil methyl esters are generally produced at 60°C in the presence of 1% KOH/NaOMe catalyst with stirring for 15–60 min.

Transfer Terms

- Technical services
- Technology licensing
- Equipment supply

Target Countries

Worldwide

Contact

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

Nano gold-loaded carbon bullets as gene carriers

National Chemical Laboratory (NCL) 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* are 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

INDIA

TECHNOLOGY OFFERS

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

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

Plant biomass-based metal sorption column

The invention provides a process for developing a plant biomass-based biosorption column for the removal of metal ions. The biomaterial comprising of leaves of *Jatropha* is immobilized on a modified silica gel. The silica gel is modified with cationic polymers for improving the binding of the biomaterial, porosity of the column and to maintain uniform flow rate. The biosorption column may have possible application in the removal of specific ions from contaminated sites or wastewater. The prepared biosorbent column is very cheap, recyclable, and can be used for selective sorption of Cr(VI) and Cu(II) ions from synthetic multi-elemental water samples.

Area of Application

The biosorbent can be used for purification of water in terms of heavy metals.

Advantages

The prepared biosorbent column is very cheap, recyclable, and can be used for selective sorption of Cr(VI) and Cu(II) ions from synthetic multi-elemental water samples.

Environmental Aspects

Environment friendly

Development Status

Laboratory model

Legal Protection

Patent

Transfer Terms

- Consultancy
- Technical services
- Technology licensing

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.

Area of Application

Application includes anti-aging agents

Environmental Aspects

Environment friendly

Development Status

Laboratory model

Legal Protection

Patent

Transfer Terms

- Consultancy
- Technical services
- Technology licensing

Sensor for detecting nitrogen dioxide gas

A novel nitrogen dioxide gas detecting film has been developed. The detecting film is based on light-emitting conjugated polymer poly[2-methoxy-5-(3,7'-dimethyloctyloxy)-1,4-phenylenevinylene (MDMO-PPV). It has been demonstrated for the first time that a thin film of MDMO-PPV deposited on glass substrate or filter paper can be used to sense NO₂ gas by just change in color at room temperature. It has been observed that the bright orange fluorescence of MDMO-PPV is quenched to yellow in color in the presence of NO₂ gas above 150 ppm level in few seconds. The quenching time is proportional to the concentration of the NO₂ gas. The quenching of the fluorescence of the detecting film after exposure to NO₂ is also studied by absorption and emission spectroscopy.

Area of Application

The technology is useful for monitoring nitrogen dioxide in:

- Factories
- Environmental monitoring
- Medical applications

Advantages

- Easy detection procedure in the form of color code in few minutes above 150 ppm.
- A sensor based on conjugate polymer on various substrates such as glass, plastic, or paper.

TECHNOLOGY OFFERS

- No change in color of the sensor is observed on exposure to any other gases and chemical vapors like LPG, ammonia gas, hydrogen peroxide, and alcohols.
- Process is very cheap and hence can be used as disposable strips.

Development Status

Laboratory model

Legal Protection

Patent

Technical Specifications

A conjugate polymer poly[2-methoxy-5-(3',7'-dimethyloctyloxy)-1,4-phenylenevinylene (MDMO-PPV)-based NO₂ gas sensor film.

Transfer Terms

- Consultancy
- Technical services
- Technology licensing
- Research partnerships

Target Countries

Worldwide

For the above three offers, Contact

Amity University
Sector-125, Noida
Distt Gautam Buddha Nagar 201303
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.

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

Virgin coconut oil

Virgin coconut oil (VCO) is the oil obtained from fresh, mature endosperm (kernel-meat) of the coconut by mechanical or natural means, with or without use of heat, no chemical refining, bleaching, or deodorizing and maintains the natural aroma and nutrients.

Area of Application

Many potential applications in food, health, and cosmetics sectors.

Development Status

Pilot plant

Commercial prototype

Transfer Terms

- Consultancy
- Technology licensing

Chitin and chitosan

Chitin and chitosan are important byproducts from the shell of shellfishes. Chitin is the most important organic constituent of the exoskeletal material of invertebrates and the important economical source of this material is the shrimp processing industry.

Area of Application

Various industrial applications like biotechnology, food processing, pharmacy, and medicine.

Environmental Aspects

Waste utilization

Development Status

- Pilot plant
- Fully commercialized

Transfer Terms

- Consultancy
- Technology licensing

For the above two offers, Contact

Central Institute of Fisheries Technology
CIFT Junction, Matsyapuri, Willingdon Island
Cochin - 682029
India

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/>

Techmonitor.net

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

Website managed by

Value Added Technology Information Service
Asian and Pacific Centre for Transfer of Technology
New Delhi, India