Asia-Pacific Tech Monitor

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Innovative Technologies for Air Pollution Control

ESCAP
APCTT
Asian and Pacific Centre for Transfer of Technology

*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.

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CONTENTS

Foreword

Air pollution is acknowledged globally as a significant threat to environmental health. The population of Asia is exposed to some of the highest concentrations of PM2.5 in the world. Recent data suggests that more than 7 million premature deaths are attributed to air pollution globally, with two-thirds occurring in the Asia-Pacific region. Beyond health ramifications, air pollution also presents a significant environmental and developmental challenge.

In this edition of the Asia-Pacific Tech Monitor, a range of technologies is scanned, offering unique pathways toward enhanced air quality and pollution control. Presented in this issue are details of technologies related to air pollution sensors, vehicle emission, and particulate matter monitoring. Technologies for addressing crop residue burning in South Asia, including biofuel conversion methods like briquettes, pellets, bio-compressed natural gas, and biodiesel, are also covered. Moreover, the crucial role of cross-sectoral collaboration in combating air pollution is emphasized, highlighting existing policies and collaboration avenues in countries including China, the Republic of Korea, and Japan.

By sharing information about these technologies, we hope to stimulate a collaborative effort amongst stakeholders toward a cleaner and more sustainable future for the Asia-Pacific region. This edition aims to support the transformative potential of innovation to address the challenges of air pollution.

Dr. Preeti Soni
Head
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Transfer of Technology

INTERNATIONAL

Summary of Climate Action at COP 28

Under the leadership of the COP 28 Presidency and the multilateral process of the United Nations Framework Convention on Climate Change (UNFCCC), considerable progress has been observed under the Global Climate Action Agenda. Some of the key developments were:

- To accelerate the energy transition, the COP 28 Presidency took a leading role in launching the **Global Renewables and Energy Efficiency Pledge**. With the endorsement of 130 national governments (as of December 11, 2023 including the European Union (EU)), the Pledge stipulates that signatories commit to work together to triple the world's installed renewable energy generation capacity to at least 11,000 GW by 2030 and to collectively double the global average annual rate of energy efficiency improvements from around two percent to over four percent every year until 2030.
- The Presidency also led the **Global Cooling Pledge** for COP 28, which includes 66 national government signatories committed to working together with the aim of reducing cooling-related emissions, relative to 2022 levels, by at least 68 percent globally, across all sectors, by 2050.
- The **Powering Past Coal Alliance** of new national and subnational governments is working to advance the transition from unabated coal power generation to clean energy. Coinciding with this progress, France, together with other countries and organizations, launched the Coal Transition Accelerator, which aims to share expertise, design new policies through best practices and lessons learned, and unlock new sources of public and private financing to facilitate just transitions from coal to clean energy.
- A **Declaration to Triple Nuclear Energy,** with a goal of tripling nuclear energy capacity globally by 2050 and inviting shareholders of international financial institutions to encourage the inclusion of nuclear energy in energy lending policies, was endorsed by 22 national governments.
- The **Utilities for Zero Alliance** has 31 partners, including 25 global utilities and power companies, united for a joint commitment to advance electrification, renewables-ready grids, and clean energy deployment.
- The Joint Declaration and Task Force on Credit Enhancement of Sustainability-Linked Sovereign Financing for Nature and Climate: The Declaration, and its subsequent establishment of a Task Force, aims to respond to the needs of developing countries, multilateral development banks, and international financial institutions.
- The launch of **the Nature Solutions Hub for Asia and the Pacific** by the Asia Development Bank to proactively scale up the flow of public and private finance into conserving nature and biodiversity loss in Asia and the Pacific.
- The **COP 28 UAE Declaration on Climate and Health,** which commits to the advancement of climate-resilient development, the strengthening of health systems, and the building of resilient and thriving communities for the benefit of present and future generations. A total of 141 national governments joined the initiative.
- In this regard, the COP 28 Presidency also launched the UAE **Declaration on Sustainable Agriculture, Resilient Food Systems, and Climate Action**. The 153 national government (including the EU) signatories have committed to several actions, including scaling up adaptation and resilience to reduce the vulnerability of all farmers, fisherfolk, and other food producers, mitigating the impacts of climate change, and promoting food security and nutrition.

This is not an exclusive or complete list of outcomes of the global climate action agenda. The accountable implementation of these myriad actions involves a collaboration between multiple actors across the global climate action agenda. This could significantly contribute towards achieving climate action targets in this decisive decade.

https://unfccc.int

First Global Stocktake on Climate Action

The Conference of the Parties under the United Nations Framework Convention on Climate Change (UNFCCC), serving as the meeting of the Parties to the Paris Agreement, shared the first global stocktake of climate action; some of the highlights of the stocktake are:

There is recognition that limiting global warming to 1.5 °C with limited or no overshoot requires deep, rapid, and sustained reductions in global greenhouse gas emissions of 43 percent by 2030 and 60 percent by 2035, relative to the 2019 level, and reaching net zero carbon dioxide emissions by 2050.

All Parties are called to contribute to the following global efforts in a nationally determined manner, taking into account the Paris Agreement and their national circumstances, pathways, and approaches:

a) Tripling renewable energy capacity globally and doubling the global average;

b) Annual rate of energy efficiency improvements by 2030;

c) Accelerating efforts towards the phase-down of unabated coal power;

d) Accelerating efforts towards net zero emission energy systems and utilizing zero- and low-carbon fuels well before or by around mid-century globally;

e) Transitioning away from fossil fuels in energy systems in a just, orderly, and equitable manner, accelerating action in this critical decade so as to achieve net zero by 2050 as advocated by science;

f) Accelerating zero- and low-emission technologies, including, interalia, renewables, nuclear, abatement, and removal technologies such as carbon capture and utilization and storage, particularly in hard-to-abate sectors and low-carbon hydrogen production;

g) Accelerating and substantially reducing non-carbon-dioxide emissions globally, methane emissions in particular, by 2030;

h) Accelerating the reduction of emissions from road transport on a range of pathways through the development of infrastructure and rapid deployment of zero and low-emission vehicles;

i) Phasing out inefficient fossil fuel subsidies that do not address energy poverty or just transitions as soon as possible;

There is an urge for Parties and Non-Party stakeholders to foster ambition and enhance adaptation action and support for:

a) Significantly reducing climate-induced water scarcity and enhancing climate resilience to water-related hazards for climate-resilient water supply, climate-resilient sanitation, and access to safe and affordable potable water for all.

b) Attaining climate-resilient food and agricultural production, supply and distribution of food, as well as increasing sustainable and regenerative production and equitable access to adequate food and nutrition for all.

c) Attaining resilience against climate change-related health impacts, promoting climate-resilient health services, and significantly reducing climate-related morbidity and mortality, particularly in the most vulnerable communities.

d) Reducing climate impacts on ecosystems and biodiversity and accelerating the use of ecosystem-based adaptation and nature-based solutions, including through their management, enhancement, restoration, and conservation and the protection of terrestrial, inland water, mountain, marine, and coastal ecosystems.

e) Increasing the resilience of infrastructure and human settlements to climate change impacts to ensure basic and continuous essential services for all and minimize climate-related impacts on infrastructure and human settlements.

f) Substantially reducing the adverse effects of climate change on poverty eradication and livelihoods, in particular by promoting the use of adaptive social protection measures for all;

g) Protecting cultural heritage from the impacts of climate-related risks bydeveloping adaptive strategies for preserving cultural practices and heritage sites and designing climate-resilient infrastructure guided by traditional knowledge, the knowledge of indigenous people, and local knowledge systems.

It is highlighted that there is currently an estimated requirement of USD 5.8–5.9 trillion for the pre-2030 period. The adaptation finance needs of developing countries are estimated at USD 215–387 billion annually up until 2030, and about USD 4.3 trillion per year needs to be invested in clean energy up until 2030, increasing thereafter to USD 5 trillion per year up until 2050, and to reach net zero emissions by 2050;

A decision was also taken to strengthen support for the implementation of technology priorities identified by developing countries and to address the challenges identified in the first periodic assessment of the Technology Mechanism.

https://unfcc.int

Cooling Pledge

The UN Environment Programme (UNEP) estimates that more than 1 billion people - the vast majority living in Africa and Asia- are at high risk from extreme heat due to a lack of cooling access. Moreover, nearly one-third of the world's population is exposed to deadly heat waves more than 20 days a year.

The cooling brings relief to people and is also essential for several other critical areas and services, such as global food security and vaccine delivery through refrigeration.

But at the same time, conventional cooling, such as air conditioning, is a major driver of climate change, responsible for over seven percent of global greenhouse gas emissions. If not managed properly, energy needs for space cooling will triple by 2050, together with associated emissions.

Therefore, the more we try to keep cool, the more we heat the planet. If current growth trends continue, cooling equipment represents 20 percent of total electricity consumption today and is expected to more than double by 2050.

Today's cooling systems, such as air-conditioners (ACs) and refrigerators, consume a massive amount of energy and often use refrigerants that warm the planet. The latest UNEP report shows that taking measures to reduce the power consumption of cooling equipment can lead to a reduction of at least 60 percent of predicted sectoral emissions by 2050.

The report was released in support of the Global Cooling Pledge, a joint initiative between the United Arab Emirates as host of COP28 and the UNEP-led Cool Coalition.

It outlines actions to take for passive cooling strategies, such as insulation, natural shading, ventilation, and reflective surfaces, higher energy efficiency standards, and a rapid phase-down of climate-warming hydrofluorocarbon (HFC) refrigerants.

Following the report's recommendations can reduce the projected 2050 emissions from business-as-usual cooling by around 3.8 billion tons of CO2 equivalent.

Allow an additional 3.5 billion people to benefit from refrigerators, air conditioners, or passive cooling by 2050: Reduce

electricity bills for end users by US$1 trillion in 2050 and by US$17 trillion cumulatively between 2022 – 2050; reduce peak power requirements between 1.5 and 2 terawatts (TW), which is almost double the EU's total generation capacity today; and a void power generation investments to the order of $4 to $5 trillion.

https://news.un.org/en/story/2023/12/1144382

https://coolcoalition.org/global-cooling-pledge/

UAE Climate and Health Declaration

The COP28 Presidency, in partnership with the World Health Organization and UAE Ministry of Health and Prevention, unveiled the COP28 UAE Declaration on Climate and Health to place health at the heart of climate action and accelerate the development of climate-resilient, sustainable, and equitable health systems.

A set of new finance commitments on climate and health were announced to back up these political commitments, including the provision of USD 300 million by the Global Fund to prepare health systems, USD 100 million by the Rockefeller Foundation to scale up climate and health solutions, and an announcement by the UK Government of pledging up to GBP 54 million.

Endorsed by 123 countries, the Declaration marks the world's first in governments acknowledging the growing health impacts of climate change on communities and countries. It also acknowledges the large benefits of stronger climate action for people's health, which can be conferred by reducing air pollution and lowering healthcare costs.

The announcement comes as annual deaths from polluted air hit almost 9 million, heat-related illnesses and deaths are on the rise, and 189 million people are exposed to extreme weather-related events each year.

Signed by 123 countries, the Declaration is announced one day ahead of the first-ever Health Day at a COP and marks the world's first acknowledgement of the need for governments to protect communities and prepare healthcare systems to cope with climate-related health impacts, such as extreme heat, air pollution, and infectious diseases.

The Declaration was developed with the support of a number of " country champions," including Brazil, Malawi, the UK, the US, the Netherlands, Kenya, Fiji, India, Egypt, Sierra Leone, and Germany. This joint action comes as annual deaths from polluted air hit almost 9 million, and 189 million people are exposed to extreme weather-related events each year.

The Declaration covers a range of action areas at the nexus of climate and health, including building more climate-resilient health systems, strengthening cross-sectoral collaboration to reduce emissions, maximizing the health benefits of climate action, and increasing finance for climate and health solutions. Signatories have also committed to incorporating health targets in their national climate plans and improving international collaboration to address the health risks of climate change, including at future COPs. It is also recognized that finance will be a significant driver of the Declaration's success.

Endorsed by over 40 financing partners and civil society organizations, the COP28 Guiding Principles for Financing Climate and Health Solutions signal the growing collaboration across funders and the momentum to support climate and health solutions in a sustainable manner.

It also welcomed the finance announcements made by a wide range of stakeholders, including governments, development banks, multilateral institutions, philanthropies, and NGOs, to expand their investments in climate and health solutions. Collectively, these partners have committed to dedicate USD 1 billion to address the growing needs of the climate health crisis.

The COP28 Presidency recognizes that reducing the health impacts of climate change will require action across society, including rapid and large-scale action to decarbonize energy systems to reduce emissions by at least 43% over the next seven years.

To this end, the announcement of the Declaration at the World Climate Action Summit on December 2nd was just one of a number of announcements from the COP28 Presidency that recognized the need to reduce the health impacts of climate change beyond the health sector; it included new initiatives to drive rapid decarbonization to reduce emissions by at least 43% over the next seven years to keep 1.5C within reach.

December 3rd, COP28's Health Day, will see the first-ever climate and health Ministerial at a COP. Ministers of Health and senior health delegations from over 100 countries are expected to attend. The COP28 Presidency will also gather climate and global health financiers, development banks, countries, philanthropies, and the private sector to respond to the country priorities and needs raised at COP28 and scale up finance interventions to protect and promote human health.

https://www.cop28.com

Advanced Negotiations on Global Plastic Treaty

The third session of the Intergovernmental Negotiating Committee to develop an international legally binding instrument on plastic pollution, including the marine environment (INC-3), concluded in Nairobi, Kenya, with the agreement on a starting point for negotiations at the fourth session (INC-4).

More than 1,900 delegates participated in INC-3, representing 161 Members, including the European Union and over 318 observer organizations – UN entities, intergovernmental organizations, and non-governmental organizations. The third session follows INC-1 in Punta del Este, Uruguay, in November 2022 and INC-2 in Paris, France, in May/June 2023.

Over the course of INC-3, Members discussed the Chair's Zero Draft, went through a compilation of text to include all the views of the Members, prepared a

validated, co-facilitator-merged text, and found a way forward on issues not discussed yet.

The negotiations lasted ten days and were a significant step forward toward the achievement of our objective to develop an international legally binding instrument to end plastic pollution. But more work needs to be done.

INC Members also agreed on the dates of both INC-4, to take place in Ottawa, Canada, in April 2024, and INC-5, which is scheduled for November/December 2024 in the Republic of Korea.

https://www.unep.org

CHINA

China reshuffles its Research and Development

At the 20th National Congress of the Communist Party of China held in March 2023, China decided to overhaul its technology governance system completely. The Ministry of Science and Technology lost its central position, replaced by the newly formed Central Science and Technology Commission. The Ministry of Science and Technology was relegated to the Commission's daily office.

The Ministry of Science and Technology's responsibility to promote the application of advanced technology was allocated to various other ministries, including the Ministry of Industry and Information Technology, the National Health Commission, the Ministry of Ecology and Environment, and the Ministry of Agriculture.

It is worth emphasizing that while the Ministry of Science and Technology's functions have been reduced during the reforms, the Ministry has been marginalized within the government. As the standing operator of China's Central Science and Technology Commission, the Ministry's capacity to shape the national scientific system has likely been strengthened, as it is tasked with guiding other ministries and organizations.

China believes that it is still underperforming in fundamental research and disruptive innovation — or at least not as well as its output of papers would suggest. More importantly, the Chinese central government is concerned that its control over the country's overall technological development has not been as effective as expected. China's reform agenda in March explicitly called for the strengthening of the Communist Party of China Central Committee's centralized and unified leadership in the field of science and technology.

The newly formed Central Science and Technology Commission ranks higher than all government ministries. It has the highest decision-making power over China's science and technology priorities and strategies. The Ministry of Science and Technology has been reorganized into an implementation office with narrower responsibilities. The reform clearly signaled the leadership's aim to tighten its grip on China's innovation agenda and accelerate progress in strategic technologies.

The new role of the Ministry of Science and Technology, according to the reform plan, reflects China's conflicting views on technological development. On the one hand, China's leaders recognize the importance of market forces for technological innovation. The restructured Ministry of Science and Technology is tasked with promoting technology transfer and commercialization. However, compared to before, the Ministry has significantly less powerto allocate resources directly and will instead focus on developing fair and reasonable allocation rules.

The Ministry of Science and Technology is also tasked with promoting international scientific cooperation. On the other hand, China has a stronger desire to harness science and technology for national strategic priorities. The Ministry remains responsible for advancing China's New Nationwide System for science and technology. Chinese leaders frequently cite the examples of "two bombs and one satellite" — missiles, nuclear weapons, and satellites — as successes of China's militarized science and technology system in the 1960s and 1970s. They believe that this model can also help China to overcome current US restrictions on high-tech products.

Though there are still many uncertainties in the ongoing reform, China clearly has the ambition to construct an optimal science and technology system. China believes that science, knowledge, and information are crucial to prevailing in great power competition.

Consistent with this view, China's reform plan in March elevated the China National Intellectual Property Administration in the government hierarchy and established a new National Data Office. These bodies will play an increasingly significant role in China's national development and security strategy.

https://www.eastasiaforum.org

Regulatory Technology for Financial Institutes

Last year, banks and other global financial institutions published more than 61,000 regulatory alerts concerning new trade policies and rules or 234 updates on business regulations per workday. Complying with new regulations has been a laborious process.

However, adopting technology in regulations compliance — which is also known as regulatory technology (regtech) — as part of efforts to facilitate business and fight financial fraud has emerged as a game changer worldwide.

The Hong Kong Special Administrative Region, as an international financial technology center, has made significant strides in embracing regtech, particularly in the financial sector.

According to the Hong Kong Monetary Authority (HKMA), the city's de facto central bank, more than 80 percent of banks surveyed have adopted regtech as a standard procedure. It is expected that, by 2025, regtech's adoption rate will have reached 89 percent, and it will be one of the top three most commonly used tools in financial technology.

The HKMA developed a two-year roadmap in 2020 to promote the adoption of

regtech in the local banking sector. As part of the roadmap, it has launched a "regtech knowledge hub" to encourage greater sharing of regtech adoption experience and expertise within the city's regtech ecosystem.

In addition, various initiatives have been launched to promote regtech's adoption, including the "global regtech challenge," "regtech adoption practice guide" series, a "regtech skills framework," and a "regtech use case video" series.

Benefits for end-users

Regtech is not limited to government compliance requirements aimed at anti-money laundering. Its application, in fact, is closely intertwined with people's daily lives. "Know Your Customer" is also a mandatory responsibility for banks. When a new customer opens an account with a bank, a background check is required to ensure the client's legitimacy. The process has to be repeated when the same client opens an account with another lender, which makes for unnecessary effort. Banks and other financial institutions need to spend a significant amount of time and effort to comply with these regulations, and this raises transaction costs.

Detecting fraudulent transactions in real time is another formidable task. Transaction abnormalities characterized by mismatched transaction patterns and profiles of the transacting parties need to be swiftly identified. The sheer volume of transactions and the myriad suspicious patterns have made manual monitoring unfeasible. Regtech can be precise in identifying potentially fraudulent transactions and reducing false alarms that may inconvenience clients.

Since Hong Kong's new licensing regime for virtual asset service providers came into force in June, there has been a greater focus on regulatory compliance requirements, including anti-money laundering and on-chain transaction monitoring. Consequently, technological products tailored to meet these demands are gradually entering the market.

Hong Kong has emerged as a pioneer in developing a regulatory framework for new financial technology solutions, such as blockchain, Web3, and virtual assets. The new products are technology-based. So, regulations also need to be revised to become relevant.

In view of the sharp increase in financial crime globally, especially digital fraud, there is an increasing concern about the potential harm to victims and consumer confidence in new digital financial services, as well as its wider possible impact on the banking system's integrity and stability.

The authority says it will continue to promote the adoption of technology, data, and network analytics to boost the innovative capability of banks in combating fraud and financial crime. It will promote adopting a consistent and coordinated approach to real-time fraud monitoring by all retail banks before the end of September.

The HKMA will also expand its pilot bank-to-bank information-sharing platform and the financial intelligence evaluation-sharing tool, which was rolled out in June, covering more retail banks and personal accounts.

The HKMA hosted the fourth Anti-Money Laundering Regtech Lab (AMLab) in June, bringing together retail banks, technology companies, and industry experts to innovate and develop a sector-wide approach to real-time fraud monitoring. The AMLab series covered solutions, including experiments with network diagrams, for identifying suspected money mules and learning how to integrate alternative data into more traditional data sets for analysis.

With enhanced information-sharing and data analytics, lenders have so far identified more than 21,000 previously unknown accounts, according to the HKMA. As a result, the number of intelligence-led suspicious transaction reports climbed by 319 percent last year, compared with 2021, leading to an increase of 113 percent in criminal proceeds restrained or confiscated.

https://chinadaily.com

Industry-Academia Alliance launches 10 Programs

An eco-environment industry-academia alliance under the China Association for Science and Technology has unveiled the top 10 programs that represent the scientific and technological progress China made last year in the environmental protection sector.

One of them, for instance, is a research program on technologies and management systems for the conservation and remediation of the Yangtze River, Asia's longest watercourse.

For Yangtze conservation, the Ministry of Ecology and Environment launched the National Joint Research Center for Yangtze River Conservation in 2018. Then, over 5,000 researchers from 269 research institutions across the country were dispatched to 58 cities along the trunk of the Yangtze for joint research.

Since it was implemented, the joint research has not only identified the causes of the outstanding water environmental problems in the Yangtze basin but also managed to introduce a series of solutions, which have been applied in 58 cities, and supported continuous water quality improvement in the river.

Another selected program is about noise pollution management, which the alliance stressed as being closely related to people's daily lives.

A team mainly supported by members of the China National Environmental Monitoring Center has established an institutional system for noise pollution control, it said. The system can offer technical support for the enactment of a legal system, standard system, and policy measures for noise pollution governance.

The other 10 programs include the control of heavy metal pollution in soil, nitrogen and phosphorus management in lakes, remote sensing for atmospheric aerosol detection, and synergizing air pollutants and greenhouse gas emissions in the steel sector.

https://www.chinadaily.com

REPUBLIC OF KOREA

Sustainable Aviation Fuel Program

South Korea's largest airline, Korean Air, has launched a new sustainable program to encourage its air cargo customers to pay more towards the purchase of sustainable aviation fuel (SAF).

The Korean Air Cargo SAF program will allow customers and forwarders to make a customized contribution to "reduce their carbon footprint," which will then be used by the airline to buy additional SAF and communicate with customers about their carbon emissions reduction.

According to Korean Air, the program continues its action at the "forefront" of paving the foundation for SAF use in Korea, including its role in the government's eco-friendly biofuel activation alliance since October.

SAF has become one of the aviation industry's main focuses in the fight to create more sustainable practices for a historically high-polluting industry, with the International Air Transport Association (IATA) saying that it expects the fuel to account for 65% of the carbon reductions needed to reach net zero by 2050.

The push towards biofuel has seen significant investment from companies such as Google and Shell, International Airlines Group, Microsoft, and Virgin Atlantic, which is expected to run the first transatlantic SAF flight in November.

https://www.airport-technology.com/news/korean-air-saf-program-cargo-customers/

Nature-Based Solutions

In March 2023, during the UN Water Conference in New York, the International Union for the Conservation of Nature (IUCN) signed a Memorandum of Understanding (MoU) with the Ministry of Environment, Republic of Korea (MoE) and the Korea Water Resources Corporation (K-Water).

IUCN and Korea have strengthened cooperation to support Nature-based Solutions for water management in the Mekong region.

The MoU establishes a framework for cooperation on resolving water issues in Asia-Pacific, with a focus on the implementation of Nature-based Solutions (NbS) in the Lower Mekong Region. The agreement supports the goals of each of the partners' plans, including the Republic of Korea's Indo-Pacific Strategy, IUCN's Nature 2030 Program, and K-Water's Korea-Mekong Water Management Collaboration Research Center (KMCRC).

Moreover, the agreement formalizes the partnership between the three institutions and builds on previous collaborative work. The Republic of Korea has been an IUCN State Member since 2006, a Framework Partner to IUCN, and has recently hosted the IUCN Leader's Forum in Jeju in October 2022.

The cooperation would conduct planning and research for a trilateral cooperation project that will commence this year and expand it to a green-grey infrastructure project for the Mekong region as part of MoE's official development assistance program.

The role of water was emphasized for societies and economies. It is important to manage water and its ecosystems so that they can deliver benefits to society and the environment. Nature-based Solutions support the achievement of these results. NbS will provide an optimal solution to support the conservation of ecosystems and biodiversity of Mekong countries while effectively addressing water issues in the region.

The MoU will help the three signatories achieve their common goal of promoting effective water resources management in the region by fostering exchanges between the public and private sectors and pooling technical resources and experts to increase effectiveness.

https://www.iucn.org

PAKISTAN

AI-Based Horticulture in Pakistan

Agriculture is an indispensable component of economic growth, food security, job creation, and poverty reduction in developing countries like Pakistan. It accounts for almost a quarter of Pakistan's GDP and employs over one-third of its population.

A member institution of the United Nations Academic Impact (UNAI) in Pakistan, the Iqra University, has helped the South Asian country with an impending food crisis predicted within two years.

The team of Dr. Mansoor Ebrahim, Dr. Kamran Raza, and Dr. Hasan Adil at the university's Faculty of Engineering, Sciences, and Technology has developed Smart Farming, an innovative urban farming solution of its own.

The project's primary goal is to create a test bed based on the hydroponics technique that integrates the so-called Internet of Things (IoT) and systems with artificial intelligence (AI) to create an effective, controlled, and autonomous environment for plant growth.

Smart Farming is the adoption of Web 5.0 technologies in agriculture, with hydroponics being a notable example. This process involves cultivating plants without soil in nutrient-rich water. Despite the various projects underway around the globe, there is yet to be a comprehensive solution providing all related elements in one package.

This project strives to provide an innovative solution to various agricultural problems in Pakistan, combining both physical and digital technologies for maximum sustainability and adaptability.

In addition to designing a completely monitored hydroponic farming system, the team has also incorporated an IoT interface in order to measure Total dissolved solids (TDS), PH, humidity levels, and temperature and perform automated operations to ensure optimal crop health. The sensors are employed to ensure a steady state for plants. Data collected from the IoT sensors is then processed and analyzed by an AI-based system trained on both images of plant stages as well as live pictures of crop yield provided by drone cameras set to collect information at regular intervals.

The overall system can be managed and reset conveniently using a user-friendly, mobile-based application. Its pioneering framework promotes a number of advantages, such as superlative water savings of nearly 90 percent, a 25 percent reduction in fertilizers, and low area utilization, leading to substantial cost savings on transportation and carbon emissions.

As a result, Smart Farming has been praised at the national level and awarded funding by the Higher Education Commission of Pakistan.

With many vegetables successfully grown and initial targets achieved, favorable results in the first phase are already visible. They have been able to perfect the nutrient solution that has yielded excellent outcomes. This remarkable crop output clearly illustrates that Smart Farming is a promising and environmentally friendly method of cultivation. Moreover, its automated system reduces labor efforts, cost, and area needed for cultivation, thereby making it suitable for urban settings.

Perfecting the algorithm still requires vast amounts of data sets to be fed into the system, training it, and enabling it to make accurate decisions and craft flawless communication for its eventual purpose—automating the agricultural process altogether. Until that is achieved, this project will need to continue being a collaborative effort between machines and people.

The initiative has tremendous potential for replication on a large scale, which could both sustain and strengthen the current labor market of the farming world.

Until now, production has been interfered with due to numerous socio-economic issues, such as depletion of farmland, climate variation, migration from rural areas to cities, and, most significantly, water scarcity and salinization. Irrigation also plays an indispensable role since farming relies on it greatly.

Nearly 90 percent of water usage is for irrigation. Also, Pakistan loses a vast majority of its supply due to inadequate management. In order to combat the demand, farmers turn to low-grade groundwater that results in the salination of valuable land.

https://indepathnews.net

PHILIPPINES

Draft Natural Gas Rules

Natural gas-fired power plants could be a quick starting reserve that could complement the variability of renewable energy technologies, such as solar and wind. It is seen as a suitable transition fuel by which the private sector investments in this technology will be facilitated to enable the viability of large renewable energy capacity additions and ensure the reliability and security of the power system.

The Department of Energy (DOE) has come out with a draft circular prescribing the policy framework for the development of natural gas power generation facilities in the Luzon grid in support of the energy transition.

With the cost of imported liquefied natural gas (LNG) slightly higher than the indigenous Malampaya, the DOE said the draft policy supports a gas aggregation scheme that would allow Luzon distribution utilities to benefit from a relatively lower price of blended imported LNG and natural gas from Malampaya.

The agency has come out with a draft circular prescribing the policy framework for the development of natural gas power generation facilities in the Luzon grid in support of the energy transition.

The agency has said that flexible power plants, such as the availability of natural gas-fueled power facilities, are crucial in attaining the country's energy security goals and renewable energy targets. It said transitioning to clean energy would require a transition fuel capable of providing baseload generation that would fill in the gap when existing coal-fired power plants start to retire.

According to the agency, getting a minimum percentage of power supply from natural gas would give the distribution utilities an advantage of taking a competitive price without going through a competitive selection process.

LNG is considered by the government an important source for fuel diversification, capable of increasing the diversity and security of the country's energy needs. It is seen as providing the country with fuel and technology that allows flexibility in supporting the various grid demands, from baseload to reliable mid-merit to peaking power supply. Though it is understood that LNG is transitory and not an end in itself, the ultimate trajectory is to transition LNG plants to non-fossil-based fuels once the latter are mature.

https://ieefa.org

PH, S Korea sign an agreement for air quality monitoring through space

The Korean government, through the Korea International Cooperation Agency (KOICA) and the Philippine Space Agency (PhilSA), signed a partnership agreement to strengthen national capacity to monitor the condition of air quality and improve air quality plans and policies in the Philippines on August 2, 2023.

The Pan-Asia Partnership for Geospatial Air Pollution Information and the Pandora Asia Network (PAPGAPI-PAN) project is a technology transfer, data-sharing, and capacity-building initiative on air pollution, using data from the Geostationary Environment Monitoring Spectrometer (GEMS) aboard Korea's GEO-KOMPSAT-2B satellite and complemented by the ground-based remote sensing instruments called Pandora. Launched by the Republic of Korea in February 2020, GEMS is the world's first geostationary satellite sensor for air quality monitoring. This technology enables hourly monitoring of air pollution levels in almost twenty (20) countries in Asia, including the Philippines.

The project will give PhilSA the capability to combine satellite and ground measurements for a comprehensive overview of air quality in the Philippines. The Pandora instruments, expected to be installed and operated in the country within the year, will be a part of the Pandonia Global Network (PGN), which collects Pandora data around the world and provides real-time standardized, calibrated, and verified air

quality data. It is expected that this will fill information gaps to help build more evidence-based policymaking to address air quality issues in the country. KOICA and PhilSA will jointly provide technical and operational support to implement the project in the identified sites.

Selected Pandora sites in the country include Puerto Princesa in Palawan and Manila Observatory in Quezon City, Metro Manila. These sites were identified based on existing infrastructure, logistics, and scientific merit. In particular, the proposed Pandora sites are selected to cover different concentrations of air pollutants (such as nitrogen dioxide and particulate matter) across the country based on historical records both from ground and satellite observations. Meteorological parameters such as rainfall and cloud cover are also considered in the selection process. Other candidate sites for potential additional Pandora instruments include Ilocos Norte and Cebu City.

The ground vertical column measurement of air pollutants from Pandora will be used in conjunction with the GEMS observation for comprehensive and improved monitoring of air quality across the country and the Asia-Pacific region. With its hyperspectral sensor and geostationary orbit, GEMS will provide measurements of different air pollutants such as nitrogen dioxide, sulfur dioxide, ozone, formaldehyde, and particulate matter at an hourly rate during the daytime.

With the 12.6 million ($230,000) partnership aiming to monitor the condition of the Philippines' air quality using data from the GEMS and Pandora instruments, this will further enhance national capacity as well as fill in the data gap in the country for better understanding of air pollution and air quality monitoring.

The project is a collaboration among various agencies, including KOICA, PhilSA, the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), Korea National Institute of Environmental Research (NIER), and Korea Environment Corporation (KECO).

It is expected to contribute to further enhancing the strong and dynamic relationship between the Philippines and Korea through the sharing of satellite air quality data, best practices of GEMS data application and technology, joint research, and successful project implementation.

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htpps://www.manilatimes.net

KYRGYZSTAN

SCO Council Meeting in Bishkek: Outcomes and Implications

Dr S Jaishankar, India's peripatetic Minister of External Affairs, visited Bishkek, the capital of Kyrgyzstan, from October 25 to 26. He was there to represent India at the 22nd meeting of the Shanghai Cooperation Organization (SCO) Council of Heads of Government (CHG), held under the Chairmanship of Kyrgyzstan. The visit received only limited attention in India. It is difficult to believe that the 23rd SCO Summit was hosted by New Delhi in virtual format just over three months back amid heightened media attention and some controversy. But so much has happened since then, including the G20 New Delhi Summit and the outbreak of the Israel-Hamas war.

SCO is undoubtedly on the radar of India's strategic community as a key multilateral grouping. This is a nine-member club of two major Asian states (China and India), one Eurasian state (Russia), the four 'stan' nations (Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan) as well as Pakistan and Iran. Established in 1996 as the Shanghai Five, it became SCO, with the inclusion of Uzbekistan in 2001. Later, it began to expand with the entry of India and Pakistan, and subsequently Iran. Belarus will be its 10th member. SCO has two observers (Mongolia and Afghanistan) and 14 dialogue partners, many of whom would like to become its members. A grouping committed to greater security and political and economic cooperation, it has secured slow progress because of its internal contradictions and persisting tensions.

The importance of SCO may be gauged by the fact that it represents 42% of the world population and about one-third of the global Gross Domestic Product (GDP). It grapples with its anti-Western impulses to carve out its role as a non-Western organization. It also copes with the ever-present competition between China and Russia in a region where the latter was once the dominant partner. SCO also struggles to cope with the adversarial relations between India and Pakistan and the strained ties between China and India. The return to power of the Taliban in Afghanistan threw up its challenges for the SCO.

India's one-year-long presidency of the SCO summit ran quite well from September 2022. But the government's sudden decision to host the 23rd meeting of SCO's Council of Heads of State, the highest body, in a virtual format (on 4 July) rather than with the physical presence of the leaders caused surprise and disappointment. New Delhi, of course, had compelling reasons to do so, with no confirmation forthcoming about the participation of Russia's President Vladimir Putin and China's President Xi Jinping. Besides, it probably had little interest in welcoming the Prime Minister of Pakistan after the controversy created by Foreign Minister Bilawal Bhutto Zardari at the SCO foreign ministers meeting in Goa in May on the issues of cross-border terrorism and Jammu and Kashmir. SCO's doublespeak on terrorism has been a matter of concern in India.

India at Bishkek

Although the Council of Heads of Government (CHG), the second highest organ, is

composed of prime ministers/premiers/vice presidents, two nations, i.e., India and Pakistan, were represented by their foreign ministers. External Affairs Minister Jaishankar highlighted four key points in his address at the conference.

First, he suggested that SCO should focus on promoting the region's stability and prosperity by adhering to international law, respecting the sovereignty and territorial integrity of the member-states, and encouraging economic cooperation among them. This was a pointed message to China and Pakistan and veiled criticism of the way the Belt and Road Initiative (BRI) has evolved during the past decade.

Second, the minister stressed India's deep civilizational and cultural ties through history with the region's people. "These historical relationships should now create a template for greater economic cooperation," he added. Third, he reiterated that high priority should be accorded to expanding connectivity between India and the region, especially given the centrality of Central Asian states. He spoke of the International North-South Transport Corridor (INSTC), along with the recently launched vision of the India-Middle East-Europe Economic Corridor (IMEC), as potential "prosperity enablers."

Finally, he recalled how, with much interest and careful preparations, the Indian presidency of the SCO had focused attention on five new verticals of cooperation: Startups and Innovation, Traditional Medicine, Science and Technology, Youth Empowerment, and Shared Buddhist Heritage.

Bishkek Outcomes

A total of 14 documents were approved by the CHG meeting at Bishkek, which shouldered an array of administrative, budgetary, and financial responsibilities of the grouping. The documents signed were related to diverse matters, such as regulations on the salary of staff of the permanent SCO bodies and organizational charts of the Secretariat and the Regional Anti-Terrorist Structure (RATS) of the SCO.

To appreciate where the SCO stands today on the larger issues of political and economic cooperation, a brief look at the 11-page joint communiqué issued on 26 October should be helpful. This document places on record the high praise of the member-states for India's leadership of the SCO in 2022–23 and advocates "active, practical implementation of the decisions by the summit held in July 2023."

It projects the SCO as "an influential and responsible participant" in the system of today's international relations, which is committed to "strict compliance with the generally recognized principles of international law as enshrined in the UN Charter." It favors efforts to upgrade and overhaul the global economic governance framework as well as an equitable multilateral trade system.

The joint communiqué also refers to "deep and large changes" taking place in the world that indicate the emergence of "a more just and multipolar world order" as well as the escalation of multi-dimensional challenges "aggravated by geopolitical tensions and conflicts." The participating delegates agreed on the need to expand cooperation in diverse fields such as politics and security, trade, economics, finance and investment, and cultural and humanitarian ties.

The governments encouraged business leaders to deepen their mutual contacts in specific areas like investment, digital transformation, and the creation of a regional startup ecosystem. These match fully with India's priorities.

However, on China's BRI, India's isolation in the SCO continued as the other seven countries once again "reaffirmed support" for it, noting the ongoing work to implement the project jointly. In particular, they supported the efforts to align the development of the Eurasian Economic Union (EEU) and BRI.

The Council meeting reviewed the earlier meetings of the ministers for energy, finance, railways, health and transport, etc., and guided the follow-up actions. The issues of climate change, the development of mountain regions, and glacier conservation drew special attention.

Conclusion

Despite its limited achievements, SCO continues to be a consequential grouping for India due to strategic, economic, and cultural factors. The nation's engagement with its future deliberations and work will no doubt be ensured in an appropriate manner. Media and think tanks can perhaps help by closely following all relevant developments as they impact India's national interest.

This matter will now assume greater significance as the Chairmanship of the SCO Council of Heads of Government is transferred to Pakistan, which will run from 2023 to 24. This development could pose a special challenge for India's diplomacy next year. South Block will need to keep a sharp eye on the Pakistan-China axis while doing its best to strengthen the SCO, especially India's relations with the four Central Asian states.

https://www.wionews.com

INDIA

National Circular Economy Roadmap

India released a document, the "National Circular Economy Roadmap for Reduction of Plastic Waste in India," a collaborative exercise between leading research institutions from India and Australia.

The document aims to foster research and industry partnerships between the two countries and co-develop a roadmap for India's transition to a circular economy in the Plastics sector.

India and Australia are active participants in the negotiations for the formulation of a Global Plastics Treaty to be finalized next year. Both countries aim to leverage their respective strengths in waste management, recycling policies, and environmental initiatives to foster a circular economy that prioritizes resource efficiency and environmental protection.

The present research commenced in July 2020 as part of the India-Australia Comprehensive Strategic Partnership announced by the Indian and Australian Prime Ministers in June 2020. India's Council of Scientific & Industrial Research (CSIR) is developing various technologies for reducing India's Carbon footprint and recycling.

Dr. Jitendra Singh, the Union Minister of State (Independent Charge) Science & Technology, MoS PMO, Personnel, Public Grievances, Pensions, Space and Atomic Energy, said that the Government has earned a total revenue of Rs.11,000 crore just by disposing of electronic scrap in the last three years. "Swachhata campaign, inspired by PM Modi, has generated awareness about 'waste to wealth' concept. There is now also better mass understanding about the application of innovation and technology for Recycling and Reuse of Waste materials for productive means," he said.

Some other initiatives launched at the event were the Recycling on Wheels bus, which can generate Waste to Wealth at different spots due to its mobility, a Repurposed Used Cooking Oil (RUCO) van that collects used cooking oil and converts it into biofuel by Dehradun-based Indian Institute of Petroleum (CSIR-IIP), a revolutionary Steel slag road technology which facilitates the large-scale utilization of waste steel slag of steel plants in road construction, pioneered by CSIR- Central Road Research Institute (CRRI), New Delhi.

India remains committed to addressing the plastic waste challenges and its consequences on human health and ecological impact. Reducing plastic waste in India will help drive the transformation of the plastic waste economy into a circular economy. The introduction of the Plastic Waste Management Rules in 2016 for India has led to a raft of measures directed at municipal, industry, residential, and commercial actors.

https://pib.gov.in

National Framework for Energy Storage Systems

The Union Minister for Power and New & Renewable Energy has informed that the Government has issued a National Framework for Promoting Energy Storage Systems in August 2023 for the development and deployment of Energy Storage Systems to facilitate energy transition in the country.

As per the updated Nationally Determined Contributions (NDCs) submitted to the United Nations Framework Convention for Climate Change (UNFCCC), India has committed to achieve 50 percent of cumulative installed electric power capacity from non-fossil fuel-based energy resources by 2030. As of October 31, 2023, a total of 186.46 GW (43.8%) of non-fossil fuel-based capacity has been installed in the country out of an overall installed electricity capacity of 425.5 GW.

India's energy mix is set to undergo a transition from fossil fuel sources to non-fossil fuel-based sources dominated by Renewable Energy (RE) in the future. However, solar and wind energy are not available around the clock. To facilitate the transition from fossil fuel-based sources to RE sources, it is crucial to make RE dispatchable and available around the clock. Energy Storage Systems (ESS) play a key role in achieving this objective by storing energy generated from RE sources when the sun is not shining or the wind is not blowing. They also help address RE variability, enhance grid stability, facilitate energy/peak shifting, provide ancillary support services, and foster greater integration of RE. The National Framework for promoting Energy Storage Systems will encourage and create an ecosystem for the development of Energy Storage based on requirements and financial feasibility to guarantee affordable, clean, reliable, and environmentally sustainable power for everyone.

https://pib.gov.in

Digital Public Infrastructure for Climate Finance

India is at the forefront of a groundbreaking initiative poised to merge the forces of technology and ecology. The government, in collaboration with Niti Aayog, is developing a Digital Public Infrastructure (DPI) for climate finance. This endeavor is more than an advancement in environmental strategy; it is a blueprint for sustainable growth, signaling India's role as a pioneer in the global narrative of digital-led environmental sustainability.

The DPI addresses a persistent challenge: the misdirection of climate finance due to information asymmetry. By building and deploying DPI, which facilitates data exchange, the government can receive data from members of the community who are most affected by climate change, as well as climatic and weather data from various agencies. This framework aims to ensure that funds are allocated effectively, prioritizing the needs of regions and communities most vulnerable to the effects of a changing climate and facilitating direct aid in the wake of disasters. In the aftermath of climate-induced disasters, the DPI is envisioned to play a critical role in providing immediate financial relief to those affected. DPIs that enable direct digital payments can assist those persons affected by extreme weather events and who may not have ready access to banks and other physical infrastructure.

Niti Aayog's strategic involvement Niti Aayog is not merely a facilitator but a strategic collaborator in this initiative. Their role extends to policy integration and active stakeholder engagement. This involves a series of workshops and discussions aiming to calibrate India's policies toward a sustainable and low-carbon future. Immediate and future horizons. The DPI is more than an infrastructural project; it's a vision for India's future. In the near term, it is expected to prioritize funding for projects that reduce carbon emissions, like promoting electric vehicles and

developing green hydrogen. Looking further ahead, the DPI aspires to provide the government with actionable climate and weather data, supporting India's ambitious goal to achieve net-zero emissions by 2070, in line with its commitments under the Paris Agreement.

India's DPI for climate initiatives represents a fusion of digital innovation with environmental responsibility. It is a blueprint for a sustainable future, one that promises a more resilient infrastructure capable of withstanding and responding to the climate challenges ahead. This initiative by India, in collaboration with Niti Aayog, is a testament to the country's commitment to leading the way in climate-smart governance and sustainable development.

https://energy.economictimes.indiatimes.com/news/renewable/india-developing-digital-public-infrastructure-for-climate-finance-a-historic-clean-growth-initiative/105083581

https://www.business-standard.com

Centre to Monitor and Enhance Air Quality

The Indian Institute of Kanpur (IIT-K) has established a Centre of Excellence (CoE) named ATMAN (Advanced Technologies for Monitoring Air-quality Indicators). The CoE will focus on building indigenous low-cost sensor manufacturing and Artificial Intelligence/Machine Learning (AI/ML) capabilities to enhance air quality across urban and rural areas.

The CoE ATMAN aligns with the vision of the principal scientific advisor of India, aiming to translate sustainable technologies and business models into practical products and services accessible globally.

IIT Kanpur has taken significant strides in the battle against air pollution. Through ATMAN, IIT-Kanpur is dedicated to the meticulous evaluation of health risks associated with air pollutants, as well as a comprehensive review of air quality standards. Several projects are currently underway at the ATMAN. The Ambient Air Quality Monitoring of Rural Areas using Indigenous Technology (AMRIT) is a flagship project that will deploy a dense Sensor Ambient Air Quality Monitor (SAAQM) network with 1,400 nodes across rural areas in the states of Bihar and Uttar Pradesh.

This initiative is the first of its kind to monitor air quality comprehensively in these regions, where data has been limited to cities and towns. The CoE team will be working with the State Pollution Control Board of Bihar and the Department of Environment, Forests & Climate Change, Uttar Pradesh, on AMRIT to enhance air quality action in these states.

The Dynamic Hyper-local Source Apportionment (DHSA) is a cost-effective approach to source apportionment that is currently being pioneered in Lucknow and Kanpur in Uttar Pradesh. The data from DHSA will enable city authorities to make informed decisions in air quality action planning.

The CoE is at the forefront of indigenous air quality sensor fabrication, combining it with artificial intelligence and machine learning models to ensure precise and reliable results.

It is reported that Bihar took the initiative to collaborate with IIT-Kanpur toward the installation of sensor-based air quality monitors in all its 534 administrative blocks. The measured air quality data will help formulate an action plan for safeguarding the rural population in the state.

https://timesofindia.com

India Carbon Market

The government plans to develop the Indian Carbon Market (ICM), where a national framework will be established to decarbonize the Indian economy by pricing the greenhouse gas (GHG) emissions through trading the carbon credit certificates. The Bureau of Energy Efficiency, Ministry of Power, along with the Ministry of Environment, Forest & Climate Change, is developing the Carbon Credit Trading Scheme for this purpose.

As India currently has an energy savings-based market mechanism, the new Carbon Credit Trading Scheme will enhance the energy transition efforts by increasing its scope to cover the potential energy sectors in India. For these sectors, GHG emissions intensity benchmarks and targets will be developed, which will be aligned with India's emissions trajectory as per climate goals. The trading of carbon credits will take place based on the performance against these sectoral trajectories. Further, it is envisaged that a voluntary mechanism will be developed concurrently to encourage GHG reduction from non-obligated sectors.

The ICM will develop methodologies for the estimation of carbon emissions reductions and removals from various registered projects and stipulate the required validation, registration, verification, and issuance processes to operationalize the scheme. A comprehensive institutional governance structure will be set up with specific roles of each party involved in the execution of ICM. Capacity building of all entities will be undertaken to improve upskilling in the subject matter.

https://pib.gov.in

THAILAND

Draft Clean Air Act

The Ministry of Natural Resource and Environment (MNRE) will press for a draft Clean Air Act for cabinet consideration to prevent air pollution from spinning out of control. The bill has been put up for public opinion on the Ministry's website until Nov 13. The bill will then be passed to the cabinet secretariat office to gather opinions from state agencies.

The bill focuses on measures to prevent pollution as well as cutting back on government red tape in executing actions to combat pollution. Once enacted, the law will remove hindrances to tackling the causes of smoke from forest fires -- a long-standing trans-border issue -- and allow for an integration of efforts by all sides via the Public-Private-People Partnership approach in easing air pollution.

With the creation of the Pollution Mitigation [CAPM], reports of PM2.5 pollution will be delivered at 8.30 am daily on its Facebook page. The center also will sound the alarm in cases when the level of PM2.5 exceeds the safe threshold. A

national committee on wildfire, smog, and haze pollution prevention would also be set up. The committee will look into the national management of wildfires in agricultural areas and transborder air pollution issues and work with neighboring countries to end pollution affecting the region. Next year, MNRE will establish operation centers in 17 northern provinces, to be chaired by the provincial governors who will execute national agendas at the provincial level.

https://www.bangkokpost.com

New Environment Legislations

In recent years, environmental issues have been increasingly prioritized, leading to positive results in the development of national policies in Thailand. Many draft environmental legislations, which were previously stalled, are now regaining momentum as key enablers to drive Thailand towards a more sustainable future.

Some key environmental bills that have been made available to the public so far include a draft amendment to the Enhancement and Conservation of National Environment Quality Act, B.E. 2535 (1992) (NEQA) (Draft New NEQA), Draft Sustainable Packaging Management Act (Draft Packaging Act), Draft Waste Electrical and Electronic Equipment Management Act (Draft WEEE Act).

Additionally, with the development of these bills, a study is underway to introduce a new draft law, namely the Draft Act on Sustainable Waste Management and Promotion of Circular Economy (Draft CE Act). The Draft CE Act is intended to be the main governing law for the management and utilization of all types of waste, maximizing them as resources in a sustainable way and facilitating the transition to a circular economy with more responsible consumption. The Draft CE Act is expected to involve various governmental agencies, academic institutes, and the private sector in the drafting process.

The Draft New NEQA

The NEQA is a primary environmental legislation designed to take precedence over other laws regarding environmental issues. The provisions in the NEQA can be deemed as an umbrella framework law. It sets out an administrative framework and basis regarding various environmental issues and provides a basis for claims of environmental damage caused by pollutants. The NEQA sets out quality standard levels for water, air, noise levels, and soil, with benchmarks for desirable environmental conditions.

The Draft New NEQA, which was already approved in principle by the Cabinet and recently was deliberated upon by the Council of State, contains noteworthy points as outlined below:

Major environmental principles – Major environmental principles, including the prevention principle, precautionary principle, and polluter pays principle, are taken into consideration.

Extended applicability – To include continental shelf and high seas.

Revised pollution control mechanism – The Minister of Natural Resources and Environment, under the advisory of the Pollution Control Committee, is empowered to determine and issue "pollution control standards at source" and criteria to categorize "pollution generating sources" with specific requirements, including preparation of directory on pollution emission and movement and public disclosure of the directory.

Pollution control standards as licensing conditions – Once the pollution control standards at source are issued, the standards will be deemed as conditions of issuance and renewal of relevant licenses under the applicable laws. Violation of the standards may be subject to suspension, revocation, or rejection of the renewal of the licenses.

Environmental collateral requirement – The Draft New NEQA includes a new requirement on placing collateral for damages on certain types of businesses or projects (to be determined by the Minister of Natural Resources and Environment) that use harmful substances or have a nature that may significantly pollute or affect the natural environment, national environmental quality, human lives, public health or well-being.

Extended and more clarified civil liability – The criteria for calculating compensation are clearer, where damages will be calculated by considering the total affected area, other environmental effects, and the remedial period. Any person – not only the government – who helps contain a source of damage or limits the spread of pollution will also be entitled to compensation. The courts have the discretion to impose punitive damages of up to four times the actual damages. They may order a polluter to place a security for any possible future damages that it is unable to determine at the time of the judgment or order. The owner or possessor of the pollution-generating sources will also be liable to the injured for the consequences of the actions of its employee or any third person who acts for its benefit.

It should also be noted that the existing concepts under the current NEQA, such as the environmental fund and the requirements in connection with the EIA (environment impact assessment) and EHIA (environmental and health impact assessment), will be inherited in the Draft New NEQA.

The Parliament will further consider the Draft New NEQA. If enacted, the existing NEQA will be repealed and replaced by this new piece of legislation with an expectation of more effective pollution prevention and rectification of damages against the environment.

https://www.globalcompliancenews.com

Revised Air Quality Standards

Thailand has decided to implement a new PM2.5 standard level, reduced from 50 microns (microgram/cubic meter) to 37.5 microns, and a new air quality index (AQI) standard, reduced from 91 to 75.1, from June 1st, to bring them in line with the World Health Organization's standards.

Under the new standard, the AQI will be divided into five levels, each colo r-coded.

- The AQI 0-25 (Blue) level means that the air quality is very good and suitable for all outdoor and tourism activities.

- The AQI 26-50 (Green) level means air quality is good enough for people to undertake general activities as normal.
- The AQI 51-100 (Yellow) level means moderate air quality, in which healthy people can perform outdoor activities as normal. Those who have to take special care of their health, however, should reduce outdoor activity if they develop a cough or experience breathing difficulties.
- The AQI 101-200 (Orange) level means that air quality is starting to affect people in general. With a cough, breathing difficulties, or eye irritation, people should reduce outdoor activity or wear face masks, and anyone experiencing chest pain, headache, fatigue, nausea, or irregular heartbeat should see a doctor.
- An AQI of more than 200 (Red) means that air quality has become so bad that people should avoid outdoor activities, wear face masks, and see a doctor if they feel ill.

The Ministry has asked all state agencies to be prepared to address the PM2.5 problem in line with the new standard, while the Department of Pollution Control and the Thai Health Promotion Foundation should inform and educate the general public about the changes.

https://www.thaipbsworld.com

Cutting-Edge Air Purification Tower

Thailand's Electricity Generating Authority (EGAT) recently unveiled the prototype of an air purification tower designed to tackle the issue of PM2.5 air pollution. This initiative is a result of collaboration between EGAT researchers and inventors who intend to implement this technology in communities across the country.

The innovative tower stands six meters high and weighs six tons, employing plasma generation techniques to generate an electric charge capable of capturing PM2.5. PM2.5 refers to particulate matter less than 2.5 micrometers in diameter, which can cause severe health issues if inhaled over a long period. This tower can capture more than 80% of PM2.5 and purify up to 30,000 cubic meters of air per hour, effectively covering an area within 250 meters.

The air purification towers were initially installed in EGAT areas to improve efficiency before expanding to other parts of the country. Northern Thailand is a region of concern where these machines are expected to be deployed in the future. Furthermore, the knowledge gained from this research can be applied to enhance the efficiency of dust filters in other protective devices, such as facemasks and home air purifiers.

The air purification tower prototype is a step towards addressing the significant environmental and health challenges posed by PM2.5 pollution in Thailand. Long-term exposure to PM2.5 can cause damage to respiratory systems and blood vessels and, in some cases, even be fatal.

The Thai and Chinese initiatives demonstrate innovative approaches to tackling air pollution by implementing large-scale air purification systems. These structures can potentially save tens of thousands of lives each year by reducing air pollution levels in metropolitan areas. However, some experts argue that it is essential to consider the energy costs involved in building and operating these towers, as well as the effectiveness of the filtration systems. Ultimately, solving outdoor air pollution issues will require reducing emissions from major sources such as heavy industry, coal-burning power plants, motor vehicles, and residential cooking and heating.

https://www.envirotech-online.com

TURKEY

Green Initiatives

Türkiye is one of the countries most affected by the adverse consequences of climate change. As efforts to curb emissions have topped the global agenda, Ankara's vision for a green transformation of the country was discussed by President Recep Tayyip Erdoğan.

Türkiye intends to increase the proportion of renewable energy to 69% by 2053 and achieve the net zero emissions target by the same year. Türkiye has committed to meeting the net zero emissions target by 2053; the country has since engaged in several steps to address the issue. It renamed its relevant ministry "Ministry of Environment, Urbanization and Climate Change" as a sign to show the emphasis on climate. Türkiye also signed an agreement with the World Bank, France, Germany, the U.N., the International Finance Corporation (IFC), and the European Bank for Reconstruction and Development (EBRD) to support Ankara's climate policies.

Türkiye has started to take action on a multilateral scale. A climate law is expected to be approved by the Parliament in the upcoming period; a National Strategy Document will be prepared by 2024 for the gradual reduction of hydrofluorocarbon emissions; work is ongoing for an Emissions Trading System, and decarbonization road maps for the vital steel, aluminum, cement and fertilizer industries have been finalized.

The "zero waste" program launched in 2017 has resulted in a 35% waste recycling rate and generated an income of TL 96 billion. Today, it has become a global Turkish brand, with the U.N. declaring March 30 as International Day of Zero Waste. The rate of recycling is expected to reach 60% in 2035.

Türkiye's recently introduced electric car as part of the country's green transformation endeavors. In terms of sustainable transportation, the country aims to reduce the share of road freight transportation from 72% to 57% while increasing the share of railway freight transportation from 5% to 22% by 2053. Sustainable and smart transportation, green navigation and ports, and developing railway freight while decreasing emissions are points of focus. Türkiye's first national electric train began operating this year. A project for carbon-free airports has also been launched and will be implemented in more airports. Within the scope of the Airports Council International's (ACI) Airport Carbon Accreditation

(ACA) program, 50 Turkish airports have received certificates, considering 557 airports in 90 countries are involved.

The Energy Ministry has also set its goals to reduce emissions by 100 million tons within the scope of the Second Energy Efficiency Action Plan, covering the years 2024-2030. The share of renewable energy reached 55%, ranking Türkiye fifth in Europe and 12th in the world in terms of sustainable energy solutions.

According to a report of the Istanbul Policy Center of Sabancı University, it is predicted that Türkiye will be able to provide 91% of its electricity production from renewable sources in 2050, and the share of electric vehicles in the passenger vehicle market may increase to 66% with the acceleration of clean energy transformation in the transportation sector. The report also calculated that Türkiye can decommission all its lignite coal power plants by 2035 and all its coal power plants, including imported coal power plants, before 2040.

Türkiye has already begun discussions with the World Bank, which has committed to support the scale-up plan with financial and technical assistance, partnering with the ministry and key private sector actors. Ankara has to position and brand itself as a destination for green investment. Investors have to be attracted through incentives, clear regulations, and policies. Considering Türkiye has a huge potential in this regard, investors' risks are highly likely to pay off.

https://www.dailysabah.com

UZBEKISTAN

Cutting Subsidies to Support Transition

During the 2023 World Bank Group and International Monetary Fund Annual Meetings in Marrakech, Morocco, the government of Uzbekistan and the World Bank signed an agreement to allocate $46.25 million for financing the Innovative Carbon Resource Application for Energy Transition Project (iCRAFT).

These funds will help implement a project supporting the country's clean energy transition, energy efficiency, and energy subsidy reforms, the World Bank indicated in a press release.

The iCRAFT Project, funded by the World Bank's Transformative Carbon Asset Facility (TCAF), is the Bank's first global initiative to support policy reforms through payments for emission reductions. It expands the focus of carbon finance operations to fundamental reform measures that will help Uzbekistan achieve its international climate commitments and improve the efficient use of energy resources. Thus, the project will serve as a model for similar future operations across the globe.

Uzbekistan is one of the most energy and emissions-intensive countries in the world. High subsidies keep electricity and natural gas prices low, resulting in low revenue generation that is insufficient for recovering its costs of production and delivery. Low prices discourage households and businesses from pursuing energy efficiency and conservation efforts, and they limit the capacity of the sector to improve service delivery. To change the situation in the sector, the government has launched energy subsidy reforms, which gradually adjust tariffs to bring prices in line with costs.

The government has committed to using a portion of the project funds to protect vulnerable households from energy tariff adjustments. The project funds will also further finance the national green transition agenda and broader energy sector reform initiatives.

The new project is a critical first step in the gradual elimination of energy subsidies, which encourage waste and divert government resources from other priorities, such as health, education, and social protection. Effective policy reforms in the energy sector would strengthen Uzbekistan's economy while substantially reducing greenhouse gas emissions.

The iCRAFT Project is the first climate and carbon finance transaction in Central Asia under the Paris Agreement, an international treaty that aims to limit global temperature increases by lowering global greenhouse gas emissions. It will purchase – annually until 2027 – emission reductions achieved through efficient use of energy resources and incentivized by energy subsidy reforms.

The project will also help Uzbekistan access international carbon markets through the pilot international carbon trade transaction, providing further incentives for the country to pursue its green transition.

The government of Uzbekistan is proud to implement this innovative project. The project-supported activities are expected to reduce emissions of around 60 million metric tons of CO2 over the project's lifetime. Under the project, approximately 2-2.5 million tons of CO2 will be purchased, and the country will be able to sell the remaining emissions reductions on international carbon markets using the systems, infrastructure, and processes established and tested through this project.

The World Bank and the TCAF assist developing countries in meeting their international commitments to reduce emissions and adapt to the effects of climate change. The project implemented in Uzbekistan will potentially serve as proof of concept for other member countries of the World Bank in the future.

https://kun.uz

USA

Plant-based Disinfectant

The Clorox Company (NYSE: CLX) was named a winner of the Environmental Protection Agency's (EPA) 2023 Green Chemistry Awards for its efforts to design products that reduce the generation and use of hazardous substances. The company was distinctly recognized in the "Designing Greener Chemicals" category for its development and launch of Clorox EcoClean™ Disinfecting Cleaner, which is made with a plant-based active ingredient that kills 99.9% of illness-causing germs in two minutes or less when used as directed.

The Clorox Company (NYSE: CLX) champions people to be well and thrive every single day. Headquartered in Oakland, California, since 1913, Clorox was one of the first U.S. companies to integrate ESG into its business reporting.

Ingredient advocacy is a critical element of Clorox's environmental, social, and governance goals, which are embedded in the company's corporate IGNITE strategy. The Clorox EcoClean™ product line, sold via the Clorox Professional business unit, includes All-Purpose Cleaner and Glass Cleaner in addition to Disinfecting Cleaner. Clorox EcoClean™ helps the company deliver on its promise to enhance the sustainability of its products via the use of plant-based ingredient alternatives and to reduce virgin plastic in its supply chain by using a minimum of 25% post-recycled plastic in packaging.

This recognition builds upon Clorox's longstanding product stewardship efforts, which include becoming the first major consumer packaged goods company to voluntarily disclose ingredients in U.S. retail and professional cleaning, disinfecting, and laundry products over a decade ago. Clorox was also recently named an EPA 2023 Safer Choice Partner of the Year for its outstanding achievement in the manufacturing of products with ingredients that are safer for families, pets, workplaces, communities, and the environment.

EPA's Green Chemistry Challenge Awards: Since the inception of the awards more than a quarter century ago, EPA and the American Chemical Society, which co-sponsor the awards, have received more than 1,800 nominations and presented awards to 133 technologies that decrease hazardous chemicals and resources, reduce costs, protect public health, and spur economic growth. Winning technologies are responsible for reducing the use or generation of hundreds of millions of pounds of hazardous chemicals, saving billions of gallons of water, and eliminating billions of pounds of carbon dioxide equivalents annually.

https://www.prnewswire.com

Aclima: Hyperlocal Air Pollution Monitoring

Fine particles enter the air from a wide range of sources, such as energy production, industry, transport, agriculture, waste, forest fires, and households, causing air pollution. These particles linger in the air for long periods and can be transported long distances. Particles that measure less than 2.5 µm in diameter are particularly concerning for public and environmental health. Greenhouse gas pollutants also significantly contribute to air pollution. There is a vast body of research that connects exposure to air pollution (both short-term and long-term) with adverse health outcomes.

It is well-known that exposure to air pollution increases the risk of many diseases, including respiratory illnesses, cardiovascular illnesses, neurovascular diseases, and cancer (including lung cancer).

It is also recognized that air pollution can exacerbate the symptoms of those who are already ill. It is estimated that around one-third of deaths caused by stroke, heart disease, and lung cancer are due to air pollution exposure. In Europe, air pollution is the single largest environmental health risk and one of the greatest causes of premature death and disease.

Increasing evidence reveals the link between air pollution and health outcomes for babies. Studies have shown that exposure to high levels of air pollution may reduce lung function development. Research has discovered that air pollution particles are present in babies' lungs as early as the first trimester. Air pollution has also been linked to an increased risk of preterm birth and low birth weight.

Air pollution has also been linked to an increased risk of mental illness. There is growing evidence to support the link between exposure to air pollution and mental health problems such as depression and anxiety. Research has also exposed a link between air pollution and psychiatric disorders such as schizophrenia.

Unfortunately, almost every inhabitant (99% of the global population) is exposed to air that contains pollutants that exceed what is deemed safe by the WHO. Therefore, it is essential to monitor air pollution to help fight it. Monitoring levels of air pollution is vital to understanding its role in influencing human health. It also highlights regions that are most intensely plagued by dangerous air pollutants. Furthermore, it can give insight into how initiatives to reduce air pollution are working, which is important for guiding future initiatives and maximizing their efficacy.

Aclima, a US-based technology company that seeks to protect public health, reduce emissions, and deliver clean air, has established the world's most advanced air measurement and analysis platform to monitor air pollution. Its technology, which leverages hyperlocal data, is an important tool for fighting against air pollution.

Aclima has developed air pollution monitoring technology that maps and analyzes air pollution and greenhouse gases unprecedentedly. Aclima's solution is based on a complex network of sensors, both stationary and roving, that collects fine-grain information on the nature of air pollution in different neighborhoods. The technology gathers pollutant measurements with block-by-block resolution, helping

to highlight air pollution disparities and identify areas most in need of intervention.

Specialized sensors are employed to collect measurements each second from the global mapping fleet, either from stationary locations or on the move. Routing software ensures that data collected from these sensors is scientifically robust. Community members are hired into full-time paid positions to run and maintain the network so that this fine-grain data can be collected around the clock.

As a result, Aclima's solution allows us to understand air pollution at the human scale. Its innovative network of sensors provides as much as 100,000x greater resolution information collected by traditional air pollution monitoring platforms. The solution is also able to track multiple pollutants simultaneously using chemical fingerprinting. This technology makes it the only platform to measure and analyze air pollution, greenhouse gases, and toxins at the same time.

Aclima's sensor technology allows air pollution information to be gathered from urban, suburban, and rural landscapes, offering a solution that works for all geographic types. With the widespread adoption of the platform, entire cities/states/regions and even countries could pool together their information to understand air pollution at an unprecedented level.

Notably, the platform developed by Aclima answers essential questions about air pollution at the neighborhood block level. In doing so, it gives decision-makers critical insights as to where and when air pollution is most dangerous. It also highlights who is at maximum risk. This information may reveal that air pollution is particularly high when people are commuting to work. If there are congested roads along schools, this could mean that young children are being exposed to dangerous levels of air pollution on their walk to school. Having real data to expose these dangers is important to influence decision-makers to make critical changes, such as pedestrianization, that could improve the health outcomes of those at risk. For example, Aclima has already been used to expose air disparities in the Bay Area, which may lead to a positive change and reduce air pollution in key areas.

The technology offered by Aclima collects hyperlocal data, which can play an important role in tackling air pollution on a large scale. Policymakers need to see real data on air pollution to make changes. Sensor technology can expose areas at the block level that are particularly at risk of air pollution and even reveal the times of day when air pollution is at its worst. This enables experts to understand the factors that contribute to air pollution, such as rush hour traffic, and protect the most vulnerable, such as young children whose schools are close to congested areas.

A wider adoption of sensor technology so that air pollution can be better monitored would allow for well-designed interventions. Other global experts in sensor technology are likely to improve on the currently available technology so that it is even more fine-grained and actionable. Overall, sensor technology will play a key role in emissions reduction.

https://www.azocleantech.com

Sensor-Equipped Google Street View Cars Prove Adept at Sniffing Out "Hyperlocal" Pollution Sources

Researchers from the Universities of Utah and California at Riverside have experimented with tracking down "hyperlocal" sources of airborne pollution by equipping Google Street View cars with sensors.

With mobile vehicles, you can send them anywhere they can drive to map out pollution, including sources that are off the road.

The core concept behind the project is simple: fixed-position monitoring systems can provide an overview of air quality, but only across a relatively wide area. By equipping vehicles with the same technology, it is possible to gather data over a much wider area and model the results to find the sources of pollution, even when they occur off-road.

The team launched trials in 2019, partnering with Google to add air quality sensors to a pair of Street View cars – vehicles that were always on the road and visited large areas, taking images for the company's mapping service. The data thus gathered showed expected spikes in pollutant levels along highways. At the same time, a new atmospheric modeling method proposed by Lin confirmed pollution from two known sources as well as a previously unknown source in an industrial area near Salt Lake City airport.

The learning is that there is a lot of spatial variability of air pollution from one end of a block to another. There can be a big difference in what people are breathing, and this scale is not captured by the typical regulatory monitors and the policy that the US EPA uses to control air pollution.

There is a need to understand what average air pollution looks like in different communities and then understand the causes of its variability and hotspots to determine what we can do about it. The team's work has been published in the journal Atmospheric Environment under open-access terms.

https://www.hackster.io

SWITZERLAND

Air Capture Tech to Offset Carbon Emissions

Solving the climate crisis would require a level of global cooperation that has never been achievable in human history. Climeworks is a company providing a unique solution to a complex issue and one of many technological solutions being explored across the world. This Swiss company was set up by two mechanical engineers in 2009. Dr. Christoph Gebald and Dr. Jan Wurzbacher pooled their knowledge and created the world's first industry-scalable direct air capture facility based in Iceland. Partnering with Carbfix, Orca essentially sucks carbon dioxide right out of the air and stores it in underground deposits where it cannot contribute to global warming and the chaotic climate fluctuations that come

with it. The technology is called direct air capture and storage (DAC+S).

Climeworks' efforts are not intended to replace global reductions in emissions but focus on removing historical emissions already present in the atmosphere. Orca's direct air capture and storage (DAC+S) can run 24/7, largely autonomously, save for a small crew with maintenance considerations. The Orca plant was designed as something of a "proof of concept" and is the basis for a vast expansion.

The Orca plant is impressive to behold. The footprint of the plant is less than half an acre, making it a thousand times more effective than tree planting, which is often touted as an alternative to reducing emissions. The Orca plant can absorb 4,000 tons of carbon dioxide from the atmosphere every year. If replaced with trees, the same land area would only absorb around 4.7 tons of carbon dioxide per year. Trees also release much of the carbon they store when they die.

Iceland has a unique and dramatic landscape. Iceland, a relatively young island, millions of years old rather than hundreds of millions, has huge plains of volcanic stone that are quite remarkably bereft of trees. For a fraction of the space, Climeworks' systems use gigantic fans with a modular, stackable design to absorb air, linked up to a filter that collects carbon dioxide. Once full, the system heats up to boiling point and combines the particles with water, pushing the mixture into the earth's crust. There, the carbon remains trapped and mineralized for anywhere up to 10,000 years. It is a particularly exciting solution that, even in its infancy, has the potential to become incredibly scalable.

Sitting between tectonic plates, Iceland offers unique geography and abundance of space, coupled with the presence of geothermal energy, making DAC+S plants a lucrative investment area for the region.

Companies like Microsoft are seeking to account for decades of carbon emissions. Some companies are less concerned than others, but Microsoft seems to be putting its money where its mouth is despite being criticized for its more recent boost in water and energy usage for AI push.

For Climeworks and similar companies, the business model revolves around selling carbon credits, occasionally called carbon offsets. Climeworks charges roughly 1000 euros per ton of carbon stored by its system, and Microsoft is one of its customers. A third party verifies Climeworks' operations to ensure the validity of those credits, and Microsoft and other companies can purchase those carbon dioxide tons in advance, before the system scales up. And scaling up is exactly what is next for Climeworks.

Orca serves as the blueprint for Mammoth, Climeworks' next major DAC+S facility, built a few hundred meters away from the original Orca site. Mammoth will remove up to 36,000 tons of carbon dioxide from the atmosphere once fully operational in the coming years.

https://www.windowscentral.com

FRANCE

Aeroleaf to power homes

A new technology can help the European Union (EU) achieve carbon neutrality. Aeroleaf, a French company created by New World Wind, has developed micro wind turbines designed to resemble trees.

The technology, named WindTrees, comprises metallic structures designed to mimic trees, equipped with branches and adorned with small wind turbines that resemble leaves.

The WindTrees technology has been installed globally, including in Europe, the US, South Korea, and specific locations like Birmingham (UK), Vermont (USA), and Switzerland.

Furthermore, the color of the trunk and leaves is customizable. There are additional features, including trees ranging from 5 to 33 feet (10 meters) in height. They facilitate straightforward installation, even in urban settings, without the need for extensive engineering efforts.

Once a turbine is positioned, completing the construction requires just a single bracket and three bolts. Additionally, their smaller size mitigates certain challenges encountered by larger turbines, such as bird collisions; they also operate silently.

Such features offer several advantages, including a biomorphic appearance that blends with surroundings, ease of installation (requiring only a single bracket and three bolts), and compact size.

The technology allows small-scale wind turbines to supply energy directly to the existing electrical system of a building, adhering to a self-consumption model. These turbines are capable of producing energy continuously, 24/7, and any surplus energy can be stored in batteries with a capacity of 60Ah.

The company plans to unveil a new design, which aims to triple the power output of the Aeroleaf, by January 2024.

Each leaf will have the capacity to generate up to 1,000 kilowatt-hours (kWh) per year. Consequently, the 36-leaf WindTree is projected to achieve a maximum annual output of 36,000 kWh when exposed to a wind speed of 39 feet (12 meters) per second (m/s). However, since the wind is unlikely to stay high at all times, even under typical conditions of 26 feet (eight meters) per second (m/s), a single WindTree can generate nearly 18,000 kWh annually.

This amount of energy is sufficient to power a household with four residents and has the potential to decrease the home's yearly CO2 emissions by more than 12 tons. If excessive energy was generated beyond consumption needs, whether during the day or night, it could be stored in the battery with a capacity of 60Ah, equivalent to approximately 45 minutes to one hour under normal conditions. Each tree is equipped with four batteries. The company has deployed 130 units worldwide, spanning regions from Europe and the United States to South Korea.

https://interestingengineering.com/

INDIA

Chakr innovation for mitigating vehicular Air Pollution

Chakr Innovation is a registered company that develops innovations to reduce emissions that contribute to air pollution. As an engineering student at IIT-Delhi, Kushagra Srivastava, with the help of his faculty members, got exposure to various expert committees and panels working with the government to tackle the air pollution issue. He spent the next 2.5 years in research and development; in 2019, the product was ready for commercialization. Chakr, developed by Srivastava, is the world's first retro fit emission control device (RECD) for diesel generators. The Chakr Sheild, a patented technology, reportedly captures over 70 percent of particulate matter emissions from the exhaust of diesel generators.

The technology has been deployed at over 1,000 locations, and the company has more than 150 customers. These include Reliance Industries, the Tata group, ITC, Amazon, and the Coca-Cola Company, among others. So far, over 40,000 metric tons of carbon dioxide have been prevented from going out into the air by deploying this emission control technology at various locations.

The retrofit emission control device has received approval from the Central Pollution Control Board (CPCB). Anyone else entering the sector will have to incur a significant amount of capital expenditure and conduct hours of testing on the devices with the accredited government labs to get these approvals. Chakr started with one product at the time of their investment and wanted to become a multi-product company.

The startup has raised about $22 million (close to Rs162 crore) in funding and has developed other technologies that have been commercialized, while two others are in the research and development (R&D) stage.

Their diesel fuel kit enables a diesel engine to run on a mix of gas and diesel. It uses 70 percent gas and 30 percent diesel, which reduces emissions. Another innovation that has been in the works for the past three years is an indigenous energy storage technology that may reduce India's dependence on lithium-ion, which is currently the default energy storage solution. As of now, India relies heavily on China and Hong Kong for its lithium requirements.

Chakr's aluminum-based indigenous energy storage technology has an initial capex that is 40 percent less than that of lithium-ion, and the operational expense is 30 percent less than that of an internal combustion engine. This energy storage technology is recyclable, unlike lithium-ion batteries, which need to be disposed of. In electric vehicles, this indigenous storage tech will be non-flammable (unlike lithium-ion), have three times the range, and generate zero waste.

The cleantech startup is also developing a software platform for connecting decentralized sources of energy, which is in the R&D stage. Srivastava claims that Chakr is a profitable company, with average revenues of over Rs10 crore a month. As an investor, Panth expects the company to perform strongly and feels that there are strong commercialization prospects for the solutions that are currently in development.

https://www.forbesindia.com

Data Science, IoT-based Method for Mobile Pollution Monitoring

Researchers at the Indian Institute of Technology Madras (IIT Madras) have recently developed a low-cost mobile air pollution monitoring framework in which pollution sensors mounted on public vehicles can dynamically monitor the air quality of an extended area at high spatial and temporal resolution. Traditionally, ambient air quality is measured in monitoring stations and reported by the 'Air Quality Index' (AQI). Since these stations are at fixed locations, they only measure the air quality of a small geographic area.

Air pollution, however, is dynamic, with locations just a few hundred meters away from each other exhibiting different levels of pollution. Levels can also vary at different times of the day. However, setting up more stations is not practical because of the high costs.

To tackle this issue, IIT Madras researchers have developed a new IoT-based mobile air pollution monitoring technology wherein low-cost air quality sensors are mounted on vehicles to gather spatiotemporal air quality data. For the cost of a single reference monitoring station, it would be possible to map an entire city at high resolution using these low-cost mobile monitoring devices.

Led by professor Raghunathan Rengaswamy, Dean (Global Engagement) and Faculty, Department of Chemical Engineering, IIT Madras, Project Kaatru (air in Tamil) leverages IoT, big data, and data science to achieve the following goals:

In an interesting observation, one specific location showed a significant spike in PM2.5 pollution between 2 am and 3 am. This was associated with trucks carrying milk from a major milk distribution hub in this location at that time. PM2.5 spikes were also found in school neighborhoods during the start and end of school hours and in commercial zones during peak hours.

Mobile air quality sensors will find extensive use in both personal and public health initiatives. Personal monitoring devices can help people know the extent of pollution in their neighborhood so that they can take protective measures. Traffic can be rerouted if local pollution levels are known. Government policy changes and smart city planning would benefit enormously from the use of mobile air quality trackers.

Our affordable IoT-based mobile monitoring network, coupled with data science principles, offers an unprecedented advantage in gathering hyperlocal insights into air quality. It is the only viable option at present, capable of offering high spatio-temporal awareness that could allow for informed mitigation and policy decisions.

The devices can measure multiple parameters, ranging from PM1, PM2.5, and PM10, and gases such as NOx and SOx.

In addition to pollutants, the devices can assess road roughness, potholes, and UV index, among others. The device's modular design allows for sensors to be replaced on demand.

https://www.indiatoday.in

Air Quality Monitoring for Steel Industries

Oizom, an Air Quality Monitoring company from Ahmedabad, is providing an innovative solution for air quality monitoring in the steel industry. The steel industry generates large amounts of air pollution, including harmful gases like sulfur dioxide and nitrogen oxide, through the traditional blast furnace process. The solution is designed to help the steel industry comply with environmental regulations as well as minimize the impact of their operations on the environment and local communities.

Oizom smart air quality monitors are built with robust sensors, data analytics, and cloud-based software to provide real-time information on air quality. These monitors provide companies with accurate insights to take precautionary actions and stay within environmental regulatory limits.

The auto alert feature enables the maintenance crew to take immediate action when pollution threshold limits are breached. The relay-based systems also enable the automation of mitigation systems like scrubbers and purifiers. With Oizom's EHS air monitoring, steel companies can ensure that their employees are safe from any health hazards caused by dust.

The steel industry is among the top 17 industries responsible for massive emissions of pollutants in the environment. Thus, it is crucial to find a way by which steel companies can monitor air pollution and take preventive steps. The multiparameter air quality monitors provide real-time data and accurate insights, allowing companies to make informed decisions to minimize their negative impact and improve their sustainability.

Oizom's solution has been adopted by some of the leading steel companies in India and across the globe.

The calibrated and robust air quality monitors help mitigate the causes of excess dust, saving steel plant owners from significant penalties for exceeding the limits of air pollution. Thus, by providing real-time data and insights even in extreme climatic conditions, Oizom is enabling companies to stay compliant and demonstrate their commitment to reducing air pollution and taking care of their employees.

Oizom offers cutting-edge air quality monitoring devices with accurate data analytics to provide real-time data, smart alerts and notifications and support informed decision-making in various industries. The company's solutions have been adopted by leading organizations, helping companies prevent excessive air pollution and improve their overall sustainability. Oizom's mission is to help companies take proactive steps towards a cleaner and greener future.

https://www.prnewswire.com

Pulsed Wifi Technology for Air Pollution Control in Heavy Industries

Devic Earth provides plug-and-play air pollution control equipment for heavy industries, factories, businesses, and outdoor spaces. Devic Earth's flagship product, Pure Skies, works on Pulsed WiFi technology and covers large areas — both indoors and outdoors — with cost-effectiveness. Rapid pulses originate from the device in the Wi-Fi frequency band, creating a temporary charge on microscopic pollutant particles (PM2.5 and PM10) present in the air. Due to the increased charge, the natural process of agglomeration and settling of pollutant particles (known as dry deposition) is accelerated. The air quality index typically improves by 50-90 percent outdoors. Pure Skies is backed by 13 years of research and development (R&D) and is third-party-certified for efficacy and safety.

The motto is to offer a technological intervention that would be safe and effective and cover large areas at a low cost.

Customer feedback at Devic Earth ranges from healthier employees who apply for fewer sick leaves to happier customers. All of these account for cost-saving measures on the company's part, depending on the company's size.

The important feature of Devic Earth's product is that it is able to cover large areas. The team learned that they needed to take technology to the people who are worst affected, so they focused on the heavy industries – steel, cement, mines, and power plants. Owing to the increased emphasis on the United Nations (UN) Sustainable Development Goals (SDGs), every company is more willing to prove its eco-friendly credentials in operations and practices. The company is also focusing on business-to-government (B2G), having already engineered a number of efficient pilot projects in collaboration with government outfits, while others are currently under commercial discussions.

https://yourstory.com

SERBIA

Liquid Tree

Liquid Trees is a new creation that could potentially replace the traditional trees in urban areas. The concept involves a tank filled with water and microalgae that can absorb carbon dioxide and release oxygen into the atmosphere. The microalgae also absorb pollutants, making the air cleaner and fresher.

The idea for this innovation has come from Serbian scientists. Dr Ivan Spasojevic, a Biophysical Science Ph.D. and one of the authors of the project at the University of Belgrade, has developed an amazing new tool to combat greenhouse gas emissions and improve air quality: the liquid tree, or LIQUID 3 for short.

According to World Bio Markets Insights, this revolutionary urban photo-bioreactor, the first of its kind in Serbia, utilizes

microalgae to bind carbon dioxide and produce oxygen through photosynthesis. It is a fantastic replacement for trees or lawns, as it is 10 to 50 times more efficient at reducing carbon emissions. The goal of LIQUID 3 is to be of use in urban areas where planting trees is not feasible. In polluted areas such as Belgrade, trees often cannot survive, but algae can thrive.

The reactions to Liquid Trees have been mixed. Most people believe that trees provide more to an urban area than just being a "living thing" and offer benefits such as shade, decoration, traffic calming, and supporting biodiversity. Others are completely thrilled and have expressed their excitement about this new development.

https://www.news18.com

GERMANY

Air Quality Monitoring System Harnessing AI Technology

DEUS Pollutrack is an IoT solution platform for monitoring air pollution and emissions. They are proud to operate Europe's largest connected environmental data platform, utilizing over 4000 mobile sensors to measure air quality for over 45 million citizens in 30 major European cities.

DEUS Pollutrack has engineered a breakthrough IoT system to effectively monitor air pollution factors and greenhouse gases (GHGs) such as CH4, CO2, particulate matter (PM 1, PM2.5, PM10), VOCs, and NOx. Their customers benefit from the unique modular and customizable sensor monitoring systems that can effortlessly be deployed and expanded with additional sensors. The installation process is designed to be user-friendly and requires no technical knowledge, optimizing both time and cost for DEUS's customers.

The new EU methane regulation requires the oil, gas, and coal sectors to measure, report, and verify methane emissions to the highest standards. Operators must measure and report methane emissions continuously in ambient air and surface areas, which are then verified by independent accredited auditors. For this application, the DEUS Pollutrack system offers unsurpassed precision (from 0.1ppm) with a lifetime of 7 years per sensor. This provides the industry with a truly powerful tool for continuously monitoring methane emissions.

DEUS Pollutrack leverages laser-based techniques to identify leaks, enabling fast and efficient repairs. This proactive approach significantly reduces emissions, minimizes wasted resources, and improves operational efficiency. Advanced sensors, data analytics, and artificial intelligence can significantly improve the accuracy and efficiency of leak detection systems. The data collected in real time is invaluable to the industry in creating comprehensive sustainability reports. Moreover, DEUS Pollutrac's seamless continuous monitoring enables oil and gas operators to achieve Level 5 of the OGMP 2.0 Gold Standard.

DEUS Pollutrack leverages AI to provide a scalable and customizable innovative dashboard tailored to meeting their customers' specific needs and enhancing user-friendliness. Their comprehensive support includes installation planning, data analysis, evaluation, and expert consulting. DEUS provides actionable emission mitigation strategies and ensures its customers receive extensive support and guidance to create seamless, data-driven sustainability reports. This will revolutionize emissions monitoring and greatly assist the industry in achieving its sustainability responsibilities.

https://www.envirotech-online.com

UNITED KINGDOM

Breathe London: technology supported grassroots Clean Air Movement

London has battled poor air quality for centuries, with records of deadly air pollution events dating back to the 13th century. Major smogs in the 1940s and 1950s led to the implementation of the UK's Clean Air Act in 1956. But while air quality improved dramatically, London still exceeds World Health Organization limits for key pollutants like nitrogen dioxide (NO2) and fine particulate matter (PM2.5).

Recent research indicates that in 2019 alone, air pollution contributed to the equivalent of more than 4,000 early deaths in London. The health impacts of pollution exposure are wide-ranging, including increased risk of respiratory disease, cardiovascular disease, adverse birth outcomes, and neurological disorders. Children, the elderly, economically disadvantaged groups, and those with existing health conditions are among the most vulnerable.

To combat air pollution, London has implemented one of the world's first Ultra Low Emission Zones (Ulez). Effective in 2019, the Ulez creates a central London area where vehicles must meet strict emissions standards or face daily charges. Early data indicates Ulez has reduced NO2 and PM2.5 within the zone.

Traditionally, ambient air quality monitoring has been conducted by local authorities using expensive reference-grade instruments housed in large roadside cabinets. While critical for regulatory reporting and research, these networks provide limited spatial coverage and little opportunity for community involvement.

With a vision to supplement London's reference monitoring and empower citizens, the Greater London Authority (GLA) partnered with Imperial College London's Environmental Research Group (ERG) to fund the Breathe London network of low-cost sensors in 2021. Leveraging the Clarity Node-S sensors, Breathe London provides Londoners with hyperlocal air pollution data while promoting education, civic engagement, and policy decision-making.

A key enabler of the Breathe London network is the Clarity Node-S. The Node-S measures NO2 and PM2.5, two priority pollutants for health. Its compact size and solar panel enable installation virtually

anywhere to provide hyperlocal air quality data.

Clarity's sensing-as-a-service model has been invaluable in supporting the large-scale Breathe London network. Clarity hosts a cloud-based data platform to ingest, process, and visualize measurements. Users can access air quality data through a dashboard and API. The dashboard also provides tools to manage devices and configure alerts crucial for managing a network of this scale. If any nodes are damaged or need to be replaced, Clarity swiftly ships free replacement devices to minimize data gaps. ERG has developed proprietary algorithms that correct raw sensor measurements based on data from London's network of reference monitors.

This unique "transfer of value" from the reference network enables Breathe London to provide enhanced data quality and reliability compared to sensor networks in other cities. Today, all Breathe London Node-S devices are collocated with London air reference monitors before calibration is applied and the devices are deployed.

Interfacing with London's existing air quality reference network, Breathe London data is robust enough for research applications and remains accessible to the public. The network has informed analyses of pollution exposure inequalities as well as spatial variability of pollution from traffic, airports, industry, and wood burning. Outcomes help target interventions, including expansion of low-emission zones, deployment of green infrastructure, limiting wood burning, and more.

Unlike many community air quality monitoring initiatives that take a top-down approach, Breathe London is intentional in enabling community-led projects. The team distributes Node-S devices through innovative community programs funded by Bloomberg Philanthropies, through which local groups are encouraged to share their concerns and objectives and apply for a Node-S device. Working together, Breathe London and communities can determine optimal locations to install Clarity Node-S sensors, which measure PM2.5 and NO2 and run on solar power. Local groups manage the devices day-to-day while Breathe London provides training, data quality assurance, technical support, and a platform to share results.

This grassroots approach ensures each Node-S device is sited based on community priorities. Clarity devices have been installed everywhere, from schools, hospitals, and parks to busy roads, market stalls, and bus stops. As of 2023, the network has grown to over 400 Nodes across all 33 London boroughs.

For many groups, joining Breathe London is their first foray into air quality monitoring. The ability to easily obtain local pollution data is often a catalyst for community organizing and civic participation. Take the case of Clean Air 4 Schools, a group of parents at William Patten Primary School in the London borough of Hackney. After learning the school playground exceeded NO2 limits, the group installed a Breathe London Node-S in 2021. Access to real-time monitoring data enabled compelling outreach campaigns, driving concrete policy changes by Hackney Council, which improved the air quality at William Patten and the surrounding schools.

In addition to community empowerment, Breathe London is generating data to inform urban planning decisions and policies for cleaner air.

With over 400 sensors and counting, Breathe London has become a globally recognized model for community air quality monitoring. Breathe London also provides a model for the Breathe Cities Network, an initiative by the C40 Cities and the mayor of London, Sadiq Khan, to expand community air quality monitoring globally. By combining reference monitoring with affordable, easy-to-use sensors, Breathe London has engaged everyday citizens in improving their local air quality. The initiative provides a model for urban communities worldwide to take air monitoring into their own hands, empowering impact from the ground up.

https://www.smartcitiesworld.net

Pigment-Producing Microbes for Dyeing Textiles

A new way to dye fabrics, yarns, and other materials could make the textile industry more sustainable and chemical-free. Fabric dyeing consumes 1.3 trillion gallons of water every year globally, which is the equivalent of two million Olympic-sized swimming pools. Synthetic dyes make up most of the pigments that color garments sold for mass fashion retail, amounting to billions of articles of clothing per year. In addition to using up water resources, these dyes also contain harmful chemicals.

Over the past decade, the UK-based company Colorifix has developed DNA sequencing to derive microorganisms that produce pigments through a fermentation process similar to making beer. The company was a finalist for this year's Earthshot Prize awards that recognize technology innovation. The process involves less water and no chemicals, making for minimal environmental impact. Unlike other sustainable dyes or dyes derived from nature, the Colorifix technology uses the biological process to produce, deposit, and fix pigments to textiles. While natural dyes can be produced without chemicals, the dyes have to be bound to the fabric, which is a process involving chemicals. Colorifix pigments solve both problems–producing pigments and binding them without chemicals.

Instead of the pigment, the message contained within the DNA of a living organism is extracted. This extract is the message [DNA sequence] that specifically relates to how the living organism encodes color.

The customer base of Colorifix is higher up in the fashion chain and consists of manufacturers who produce the raw materials for fashion houses and brands. The distribution model is decentralized, where Colorifix sends vials of the microbes and trains the manufacturers in growing the colors directly on-site. The fermentation hardware is a modular system that can

be scaled up according to the size of the manufacturing facility.

Colorifix currently works with manufacturers in Portugal and Italy but will be expanding to India, Brazil, and other parts of the world in the coming year.

https://qz.com

Road suction technology

Roadvent, developed by UK firm Pollution Solution, actively captures vehicle exhaust emissions and ultra-fine particles originating from tires and brake pad wear. Suction technology installed on roads offers a novel solution to the problem of urban air pollution.

Roadvent is discreetly installed into roads to capture, filter, and release clean air on the roadside directly below traffic. This has been independently and scientifically verified to reduce human exposure to road-based air pollution by 91 percent.

A new study led by Swansea University's Professor Paul Lewis appeared to rank Roadvent technology as preferable to several other approaches when it comes to reducing nitrogen dioxide (NO2) concentrations to below UK regulatory standards.

Roadvent significantly lowers NO2 concentrations and minimizes the long-term economic burden on healthcare systems without implementing big changes for the public.

https://envirotechmagazine.com

Monitoring Indoor Air Quality

Indoor Air Quality (IAQ) is a global concern for health, well-being, and productivity, as people spend 90% of their time indoors. At times, IAQ can be worse than outdoor air quality. Poor air quality in indoor spaces can lead to pathogen transmission, high CO2 levels that worsen cognitive function, and respiratory issues.

The Building Research Establishment (BRE) recently released a report finding that 2.4 million UK homes are hazardous to health. Employees are demanding more transparency when it comes to IAQ and are aware of the impact of air quality on their health. According to the Healthy Building Survey 2022 by Honeywell, 62% of global workers would consider leaving their jobs if their employers do not prioritize a healthier indoor environment.

Butterfly is an innovative and patented IAQ monitoring system, including a suite of beautifully designed hardware with integrated software, that has been developed at Imperial College London over the past four years to address this issue responsibly.

Butterfly has received patent status, and it has been meticulously designed, rigorously tested, and backed by scientific research from Imperial College London.

The Butterfly system offers dual functionality: monitoring and management. Particulate Matter (PM) is one of the biggest areas of focus for the next generation of building management. The Butterfly can control the way a building "breathes," offering both Indoor and Outdoor Air Quality measurement on a location-specific basis to provide 20/20 vision – an industry first – with sensors measuring different levels of PM, including PM1, PM2.5, and PM10. Butterfly can, therefore, help reduce PM for current occupants, plus minimize energy consumption with impactful benefits on sustainability, thus contributing to lower emissions and a fully circular outcome. The system has already been deployed at Imperial College, covering a range of modern and historic buildings and showcasing its adaptability across diverse property portfolios. It not only keeps a vigilant eye on air quality but also optimizes building operations, potentially saving up to 40% of energy consumption.

The Butterfly IAQ monitoring system leverages cutting-edge technology to provide highly accurate and user-friendly data, explains the group. A unique sensing chamber, LaminAIR flow, is said to provide accurate measurements by controlling the sample airflow while its intuitive gloWING Interface changes colo r to reflect air quality, making it easily accessible for users.

Butterfly offers a flexible suite of products to meet international standards for various building types, from battery-powered Sapho and Antenna to cable-powered Morpho. The system hub, Chrysalis, connects all monitors and exports data to the Butterfly portal via multiple secure channels.

Butterfly seamlessly integrates with Building Management Systems (BMS) to optimize IAQ and minimize energy use, offering a substantial return on investment through enhanced well-being and sustainability.

Butterfly's secure platform continuously ingests data from all devices, empowering clients to monitor and manage their indoor spaces effectively, while the Butterfly App provides mobile connectivity across all devices, offering efficient and user-friendly data access.

https://envirotechmagazine.com

CHINA

Reusable Batteries

Green, Renewable, Sustainable Technology (GRST), an eco-friendly lithium-battery technology start-up based in Hong Kong, has been named one of five winners of this year's Earthshot Prize.

The inventor of a water-based battery manufacturing and recycling technology will receive a £1 million (US$1.2 million) cash prize to help scale up its operations to bring positive impact to the planet's climate, environment, and people. It was among the 15 finalists nominated in September.

GRST is the first company from Hong Kong or mainland China to win the prestigious award.

"With the development of a new way to build and recycle vital lithium-ion batteries, GRST's solution offers a pathway to make the electric cars of the future even cleaner," said an Earthshot Prize statement issued during the awards ceremony held in Singapore late on Tuesday. GRST was the winner in the "Clean Our Air" category.

Britain's Prince William launched the Earthshot Prize in 2020 to search for and scale up the most innovative solutions to the world's greatest environmental challenges by 2030.

"The last year has been one of great changes and even greater challenge," Prince William said in the statement. "A year in which the effects of the climate crisis have become too visible to be ignored," he continued.

The five winners were selected by Prince William and the Earthshot Prize Council, chaired by Christiana Figueres, architect of the Paris Agreement signed by over 190 nations that have made commitments to decarbonize their economies and fight climate change.

The other winners include the South American forest protection community-based initiative Accion Andina, ocean conservation group WildAid Marine Program, India-based solar-powered crop-drying equipment developer S4S Technologies, and land restoration carbon-credit marketplace operator Boomitra.

GRST, founded in 2015 and based in the Hong Kong Science and Technology Park, said that its technology can cut emissions of greenhouse gases by up to 40 percent during the production of lithium-ion batteries and by up to 80 percent during recycling.

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The world will need many batteries to achieve net zero [emission] by 2050, but a revolution is needed to make these batteries cleaner and more recyclable. Today, our water-based technology is driving this transformation to provide consumers with a sustainable energy future.

The start-up aims to raise US$50 million over the next two years to fund joint ventures in Europe and North America as it vies to grab a slice of the fast-growing sustainable batteries market. This includes raising about US$25 million through its series B fundraising round in the next few months to add some strategic collaborators to its shareholder base.

The entire lithium-ion battery supply chain, from mining to battery recycling, can grow by over 30 percent annually between last year and 2030. By that time, it can potentially reach a scale of 4.7 trillion kilowatt-hours valued at over US$400 billion, according to the forecast by the business consultancy McKinsey.

Conventional batteries are energy-intensive because they need to be produced at high temperatures and low humidity and require binding chemicals made from fossil fuels. GRST's technology removes such requirements. Recycling of conventional batteries is also highly energy-intensive and results in the emission of toxic fumes.

https://www.scmp.com

Rocket with Remote Sensing Satellites Launched

China launched a Long March 6A carrier rocket on Sunday to send a remote-sensing satellite into orbit. The rocket blasted off at 12:30 pm from the Taiyuan Satellite Launch Center in Shanxi province and successfully placed the Yaogan 40 satellite into its intended orbit.

Remote-sensing satellites are used to observe, survey, and measure objects on land or at sea, as well as monitor weather. The Yaogan family is the largest fleet of remote-sensing spacecraft in China, and governments, public service sectors, and businesses have widely used their data.

The Yaogan 40 satellite is designed to obtain data on the electromagnetic environment and conduct related technological tests.

The medium-lift rocket is a product of the Shanghai Academy of Spaceflight Technology and consists of a 50-meter liquid-propelled core booster and four solid-fuel side boosters. It has a liftoff weight of 530 metric tons and is mainly tasked with transporting satellites to multiple types of orbits, including sun-synchronous, low-Earth, and intermediate circular.

The mission was China's 42nd rocket launch this year and the 487th flight of the Long March rocket family, the nation's main launch vehicle fleet.

https://www.chinadaily.com

ISRAEL

Air Conditioning Through Humidity in Air

Israeli startup ThermoTerra is developing a renewable energy system that harvests energy from fluctuations in humidity.

Water vapor in the air absorbed by a material transfers a significant amount of energy. Evaporation of water causes a cooling effect. Think about the human body – when we are hot, we produce sweat that, when it evaporates, keeps us from overheating.

When water vapor is absorbed or condenses on a material, the opposite occurs: it generates heat.

On a hot day, ThermoTerra's technology brings ambient warm and dry air into the home or office. It is stored inside the insulation of the building's walls — hempcrete, silica gel, or wood wool insulation can absorb humidity especially well. When the air evaporates subsequently, it absorbs energy and cools the building.

When temperatures are cooler, cold and humid air is brought in; as this air is absorbed, it warms the air, heating the home or office.

The ThermoTerra system is controlled by sensors embedded in the walls. Smart algorithms monitor when to bring in hot or cold air and when to release it. The algorithms learn owner preferences and automatically adjust the temperature accordingly. They can also tap into external weather forecasts.

If it is very hot now but the system knows that in a week it will be cold, it can store water in advance. The need for new technologies like ThermoTerra is indisputable: Some 40 percent of the energy usage in buildings around the world is spent on heating and cooling, and buildings represent 30% of the world's energy usage.

ThermoTerra's system is composed of three main components:

To work its magic, ThermoTerra requires integrating a structure of ducts and conduits into a new wall. In existing buildings, a new façade with built-in insulation and ducts can be added to the walls. This may take up a few inches, but the environmental impact and financial savings are significant, claims the company.

This is a system of fans, ducts, and dampers. A smart fan is inserted into the wall, controlled by algorithms, and moves the hot or cold air around as required. This is the only part of the system that requires electricity.

ActiveMemBrain consists of IoT smart sensors, the controller, algorithms, and cloud computing. Storage reservoir contains a special absorption material packed inside a wall with air channels designed for maximum air flow.

Using special materials that can absorb a large amount of water, combined with the company's patent-pending control system, ThermoTerra uses humidity variations to charge the insulation material – making it drier in winter or damper in summer – and then force the air through the material to release hot or cold air as necessary.

By constantly passing such ambient air through its system, ThermoTerra smooths out the peaks and troughs so that both temperature and humidity cycles are shallower, resulting in a more comfortable environment.

Traditional mud and clay buildings are very good at keeping the cold out and the heat in using humidity. By tapping into the natural fluctuations in humidity, one could increase the temperature from 12 degrees Celsius (53.6 Fahrenheit) to 26 degrees Celsius (78.8 Fahrenheit).

Zchori founded ThermoTerra in 2015 with patent attorney Jeremy Rutman and data analysis expert Yonatan Nathan. The company employs five people. The Israeli Ministry of Energy, the Israel Innovation Authority, and the founders have provided the funding. The company is currently applying for an EU research grant.

The company is seeking such collaboration now as it is in the product development phase, conducting experiments in different parts of Israel.

Going forward, ThermoTerra may be used to cool cars. When a car is sitting in the sun, it gets hot. We can cool it using evaporative water harvested overnight.

https://www.israel21c.org

REPUBLIC OF KOREA

Organic–Inorganic Hybrid Gas Sensors

The world has become increasingly industrialized over the past few centuries, bringing technology and convenience to the masses. However, workers in industrial environments are often at risk of exposure to many dangerous gases, such as nitrogen dioxide (NO2). Inhaling this gas can lead to serious respiratory diseases, like asthma and bronchitis, and severely compromise the health of industrial workers. Constant monitoring of NO2 levels is thus needed to ensure a safe workplace.

To help with this, many types of selective gas sensors have been developed using different organic and inorganic materials. Some of them, such as gas chromatography sensors or electrochemical gas sensors, are highly sophisticated yet expensive and bulky. On the other hand, resistive and capacitive sensors based on semiconductors seem to be a promising alternative, with organic semiconductor (OSC) gas sensors representing a low-cost and flexible option. Nonetheless, these gas sensors still face some performance issues, including low sensitivity and poor stability for sensor applications.

Against this backdrop, a team of researchers from Korea, led by Professor Yeong Don Park from the Department of Energy and Chemical Engineering at Incheon National University, set out to find innovative strategies to take Organic Semiconductor (OSC) NO2 sensor technology to the next level. Their study was made available online on August 15, 2023, and published in Volume 473 of the Chemical Engineering Journal on October 1, 2023. It was carried out in collaboration with researchers from Jeonbuk National University, including Professor Min Kim.

To this end, the team proposed a hybrid organic–inorganic gas sensor design based on the combination of a conductive organic polymer and perovskite nanocrystals. They incorporated a CsPbBr3 perovskite into a conductive polymer matrix to enhance its gas sensing performance while maintaining sensing speed. They further modified the surface of the perovskite nanocrystals with zwitterionic polymer ligands. Once hydrated, these ligands greatly improved the affinity of the sensor for NO2 gas molecules, thus resulting in improved absorption.

Further experiments revealed that the proposed design outperformed conventional sensors in terms of chemical sensitivity to NO2. Moreover, their system was highly resistant to oxidation, thanks to the protective action of the perovskite nanocrystals. Thus, it could withstand storage in ambient conditions for several weeks, showcasing impressive durability and higher potential for long-term installation.

Given that OSCs can be designed to be flexible, lightweight, and relatively inexpensive when mass-produced, they could pave the way to the widespread adoption of gas sensors in various contexts. Beyond specific settings like industrial sites, OSC gas sensors could enable individuals to readily access information about air pollution levels through commonplace devices like smartwatches. Moreover, these sensors have the potential to advance diagnostic technology by facilitating the early detection of medical conditions. Therefore, it has potential not only for industrial safety but also in the realms of food safety, chemical substance monitoring, and medical diagnosis.

https://www.eurekaalert.org

All-in-One Air Purifier-Sterilizer

The Korean Federation of Mechanical Engineering Societies named the "discharge technology/air sterilizing purifier for removing bacteria and viruses floating in the air," jointly developed by Kumoh Industry with the Korea Institute of Industrial Technology, one of the "Top 10 Mechanical Technologies of the Year 2020."

The KIAS All-in-One is an innovative premium air sterilizer that combines clean technology with sterilization technology. This hybrid air purifier, which combines air sterilization and air purification functions at the same time, is capable of comprehensive and effective indoor air quality management. Furthermore, it is equipped with DBD plasma, which uses innovative patented sterilization technology. Plasma removes fine dust, bacteria, and viruses smaller than 0.3 µm and generates hydroxy radicals, a powerful sterilizing and disinfecting substance, while eliminating 99.9% of airborne bacteria, such as super bacteria and E. coli.

Among the air purifier products available in the global market, there are only two complex air sterilizing purifiers that remove bacteria and viruses, including Kumoh Industry's KIAS. Despite being a latecomer to the market, Kumoh Industry has a "comparative advantage" over other complex air sterilizing purifiers in terms of price, power consumption efficiency, and maintenance.

Kumoh Industry's KIAS generates plasma at low voltage to capture bacteria, viruses, and volatile organic compounds (VOC). KIAS' technology, based on the creation of "dielectric barrier discharge plasma," was developed after two years of research conducted jointly by Kumoh Industry and the Korea Institute of Industrial Technology.

KIAS' plasma generation technology can operate at low voltage (60 W/h, maximum), making it competitive with other products that employ high-voltage plasma generation technology. It is also more affordable at about a third of the price of its competitors.

https://www.businesswire.com

Gas Sensor Technology Proposed for Industrial, Medical Settings

Researchers at South Korea's Incheon National University and Jeonbuk National University are proposing an innovative approach for creating organic-inorganic hybrid gas sensors, which have shown to be durable, selective, and highly sensitive.

In a paper published in the Chemical Engineering Journal, the scientists point out that harmful gases, such as nitrogen dioxide, are commonplace in industrial settings.

NO2 inhalation can lead to serious respiratory diseases like asthma and bronchitis and severely compromise the health of industrial workers. Constant monitoring is thus needed to ensure a safe workplace.

To help with this, many types of selective gas sensors have been developed using different organic and inorganic materials. Some of them, such as gas chromatography sensors or electrochemical gas sensors, are highly sophisticated yet expensive and bulky. On the other hand, resistive and capacitive sensors based on semiconductors seem to be a promising alternative, with organic semiconductor (OSC) gas sensors representing a low-cost and flexible option. Nonetheless, these gas sensors still face some performance issues, including low sensitivity and poor stability for sensor applications.

Against this backdrop, the Incheon team led by Yeong Don Park set out to find innovative strategies to take OSC NO2 sensor technology to the next level. To this end, the team proposed a hybrid organic-inorganic gas sensor design based on the combination of a conductive organic polymer and perovskite nanocrystals. They incorporated a CsPbBr3 perovskite into a conductive polymer matrix to enhance its gas sensing performance while maintaining sensing speed. They further modified the surface of the perovskite nanocrystals with zwitterionic polymer ligands. Once hydrated, these ligands greatly improved the affinity of the sensor for NO2 gas molecules, thus resulting in improved absorption.

Further experiments revealed that the proposed design outperformed conventional sensors in terms of chemical

sensitivity to NO2. Moreover, their system was highly resistant to oxidation, thanks to the protective action of the perovskite nanocrystals. Thus, it could withstand storage in ambient conditions for several weeks, showcasing impressive durability and higher potential for long-term installation.

The new approach for the development and design of gas sensors is based on various material composites to achieve both superior sensitivity and selectivity. Given that OSCs can be designed to be flexible, lightweight, and relatively inexpensive when mass-produced, they can pave the way for the widespread adoption of gas sensors in various contexts.

Beyond specific settings like industrial sites, OSC gas sensors can enable individuals to readily access information about air pollution levels through commonplace devices like smartwatches. These sensors have the potential to advance diagnostic technology by facilitating early detection of medical conditions. Therefore, it has potential not only for industrial safety but also in the realms of food safety, chemical substance monitoring, and medical diagnosis.

https://www.mining.com

Light-Activated concrete to scrub Air Pollution out of traffic tunnels

Traffic is among the biggest sources of air pollution, but what if the roads themselves can help clear the air? Engineers in Korea have now demonstrated that photocatalytic concrete can help reduce pollution in tunnels.

While we need to transition to greener vehicles as soon as possible, it is still going to take a few decades. In the meantime, finding other ways to mitigate air pollution is important. So, why not turn to the most common building material in the world to help? In recent years, scientists have developed concrete that can convert some of the pollutants in the surrounding air into harmless products.

These air-purifying concrete systems rely on a coating of titanium dioxide, which reacts with sunlight to produce molecules called reactive oxygen species (ROS). These have strong oxidizing power, which breaks down air pollutants like volatile organic compounds (VOCs), nitrogen oxides, sulfur oxides, and ammonia to prevent the formation of fine particulate matter.

In the new study, researchers at the Korea Institute of Civil Engineering and Building Technology (KICT) developed this kind of photocatalytic concrete and tested it in a traffic tunnel, where pollution is often higher due to poor air circulation. Artificial lights were installed along the walls to fuel the light-activated reactions in the concrete.

The team found that the levels of nitrogen oxides dropped by about 18% over 24 hours, and the end products of the reactions were salts formed in part from the calcium in the concrete. These salts were quickly washed away by rain. Better yet, the team says this process should allow the photocatalytic concrete to function indefinitely without needing any extra maintenance beyond that of regular concrete.

The team plans to continue researching the technology to help get it commercialized and improve its effectiveness. Other examples have managed to reduce nitrogen oxide levels by 45%, or even an astonishing 70%, when paired with graphene.

Construction technology using photocatalysts can have an immediate effect on reducing fine particulate matter in the nation's living environment. There are plans to build a system of cooperation with local governments and public corporations to expand trial demonstrations to other sites and achieve commercialization and distribution with practical effects.

An earlier paper describing the photocatalytic concrete was published in the KSCE Journal of Civil and Environmental Engineering Research.

https://newatlas.com

Customized Air Purification of Toxic Gases

There are Volatile organic compounds (VOCs) in daily products such as paints, adhesives, furniture, cosmetics, and deodorants. Constant exposure to these can cause serious health problems such as respiratory illness, headaches, dermatitis, and cancer. Natural ventilation is the most effective way to reduce VOCs in indoor air. However, recently, air purifiers have become a common method to maintain indoor air quality due to the frequently extreme outdoor conditions (e.g., high concentrations of fine dust, heat waves, and extreme cold). Generally, air purifiers remove VOCs by adsorption using activated carbon, which has a non-polar carbon surface and a large specific surface area. This activated carbon can effectively remove non-polar substances such as toluene and benzene but cannot remove polar substances such as ketones and aldehydes.

The Korea Institute of Science and Technology (KIST) announced that Dr. Jiwon Lee and Dr. Youngtak from the Center for Sustainable Environment Research have developed a new adsorbent technology that can efficiently adsorb amphiphilic VOCs, which have both hydrophilic and hydrophobic properties and are difficult to remove with existing activated carbon technology.

The KIST research team synthesized a graphene-iron oxide heterostructure by precisely controlling the surface oxidation of graphite and iron, resulting in a high adsorption capacity for amphiphilic VOCs due to the increase of oxygen functional groups and iron oxide on the surface. This unique adsorbent showed up to 15 times better adsorption efficiency for amphiphilic VOCs than conventional activated carbon adsorbents do.

They also found that precise control of oxygen functional groups and iron oxides in the adsorbent can offer flexible surface optimization freedom for the desirable nature of the pollutant.

By testing four different ketones that are difficult to control with activated carbon adsorbents, the researchers found the correlation between the length of carbon chains and the adsorption efficiency; by optimizing the content of oxygen functional groups and iron oxides in the adsorbent, they were able to bring the maximum removal efficiency for the ketones. The researchers also analyzed the sub-nanometer electron transfer phenomenon between the adsorbent and VOC molecules; they found a link between the geometric shape of the pollutant and its adsorption trend for the first time. This is expected to enable the development of customized detection and control technologies for various air pollutants in our environment.

Unlike previous studies that focused on mere improvement of the adsorption performance and regeneration efficiency of adsorbents, this study helped the team succeed in developing a breakthrough material that exceeds the limits of existing adsorbents using accessible materials such as graphite and iron, which have high commercialization potential.

KIST was established in 1966 as the first government-funded research institute in Korea. KIST now strives to solve national and social challenges and secure growth engines through leading and innovative research.

The research, which was conducted as a major project of KIST (Air Environment Research Program) with support from the Ministry of Science and ICT (Minister Jong-ho Lee), was published in the Chemical Engineering Journal.

https://www.newswise.com

Air Pollution: Technologies for Solving Crop Residue Burning in South Asia[1]

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Deputy Head, United Nations Economic and Social Commission for Asia and the Pacific, South and South West Asia Office. Gabriel Aufils, Intern, assited in creation of maps in this paper.

Abstract

With the development of modern technologies and an increase in agricultural products, crop straw yield has also been growing in South Asia. Furthermore, inadequate access to suitable technologies and machinery to sustainably utilize the straw or promote its recycled usage has led to its burning, causing air pollution, including through transboundary sources. Currently, crop residue burning is one of the primary sources of severe air pollution in many parts of this subregion. Aside from health issues for people and climate change impacts from the emission of greenhouse gases, there are adverse impacts on agricultural production and food security due to deteriorating soil health. While it is essential to adopt suitable technologies for efficient and effective crop residue management, it is crucial to remember that in order to create a sustainable solution, strategies addressing the residue burning should also focus on interventions that generate real economic and commercial value for crop residues so that their burning results in an economic loss to the farmers. Thus, this article, after a brief review of the connection between air pollution and crop residue burning, provides information on some of the available crop residue management technologies and the incentives behind using them.

JEL Codes(s): O13, Q16, Q53, Q55

Keywords: air pollution, crop residue management, straw burning, agriculture technology and machinery

Introduction

Air pollution is a major environmental issue that affects countries worldwide, and South Asia is no exception. Many countries in this subregion, such as Bangladesh, India, Nepal, Pakistan, and Sri Lanka, face significant air pollution challenges due to various factors. Rapid industrialization has led to an increase in emissions from industries such as power plants, refineries, cement factories, and steel mills. Increasing transport vehicles on roads contributes significantly to air pollution, especially in cities. Old and poorly maintained vehicles, coupled with traffic congestion, result in high levels of exhaust emissions containing harmful pollutants. The high rate of urbanization and construction activities in South Asia has caused the release of dust particles into the air, and inadequate waste management systems have resulted in the open burning of waste, releasing toxic fumes into the atmosphere. At the same time, in rural areas of South Asia, biomass burning for cooking and heating purposes is prevalent. Agricultural practices such as seasonal stubble burning after harvest are another contributing factor to air pollution. Burning crop residues releases large amounts of smoke and pollutants into the air.

Air pollution has severe health impacts. The high levels of PM2.5 (particulate matter with a diameter of less than 2.5 micrometers) can penetrate deep into the lungs, causing respiratory problems, cardiovascular diseases, and even premature death. Some studies find connections between air pollution and an increase in infertility rates for both men and women. (Kumar&Singh (2022), Conforti et al. (2018)). Children, the elderly, and individuals with pre-existing health conditions are particularly vulnerable. Air pollution contributes to environmental degradation by damaging vegetation, reducing agricultural productivity, and harming ecosystems. Some air pollutants, such as black carbon or soot, contribute to climate change by absorbing sunlight and warming the atmosphere. Air pollution imposes significant economic costs on South Asian countries. The damage to crops and ecosystems affects agricultural output and livelihoods.

Addressing air pollution requires a multifaceted approach involving government

[1] Disclaimer: The views expressed in this Development paper are those of the author(s) and should not necessarily be considered as reflecting the views or carrying the endorsement of the United Nations. This publication has been issued without formal editing. The innovative technologies cited in this paper are based on ESCAP Development paper series.

*The designations employed and the presentation of material on the maps and figures 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 its authorities, or concerning the delimitation of its frontiers or boundaries.

policies, technological advancements, public awareness campaigns, and international cooperation. In border areas of Bangladesh, India, Nepal, and Pakistan, straw burning is widespread, leading to severe air pollution across borders, as they are beyond national boundaries. Every year, cities like Dhaka, Delhi, and Lahore reel under severe PM2.5 impact, which causes health hazards as well as a lack of visibility for driving vehicles, landing planes, and train arrivals.

This paper discusses one of the important causes of air pollution, biomass or crop residue burning, and how innovative and localized technologies can be effective in the comprehensive management of this problem. This paper is based on a series of recent studies by ESCAP on straw management in Bangladesh, India, Nepal, and Pakistan and a subregional overview of this topic.

Various existing literature has examined how crop residue burning has a direct link with air pollution as it leads to atmospheric emissions of various pollutants such as Particulate matter (PM10, PM2.5), Carbon monoxide (CO), Carbon dioxide (CO2), Sulphur dioxide (SO2), Oxides of nitrogen (NOx), Ammonia (NH3), Methane (CH4), Elemental Carbon (EC), Organic Carbon (OC), Volatile Organic Compounds (VOCs), Polycyclic Aromatic Hydrocarbons (PAHs). (Awasthi et al. (2011), Jain et al.(2014) and Oanh et al. (2018)). Many studies find crop burning to be a strong contributor to South and South-West Asia's seasonal air pollution. (Ghosh et al. (2019), Kübra et al. (2023) Abdurrahman et al. (2022)).

Crop Residue Burning in South Asia

Agriculture is central to South Asian economies, lives, and livelihoods. For example, in Bangladesh, agriculture contributes nearly 13.02 % of Bangladesh's Gross Domestic Product (GDP) and employs 40.6 % of the country's workers. (BBS (2019), BBS (2020)). In India, it accounted for 16.6% of GDP in 2022[4] and 44 % of the employment (World Bank data, (2021, 2022)); in Pakistan, in recent years, it contributed to more than 19.2 % of Pakistan's aggregate GDP and employed 38.5 % of the labor force, and in Nepal, it accounts for 15.44 % of GDP (2019-20) covering 60.4 % of the employment in the country. (ESCAP.e (2023)). Air pollution caused by straw burning can also pose a transboundary issue, as smog may be easily picked up by the wind and carried over extended distances across countries and regions. (ESCAP(2020)).

Due to the development of modern technologies, the agricultural production rate has increased; however, this has caused a corresponding increase in crop residue yield as a by-product. These residues contain a considerable nutrient value. About 25 % of nitrogen (N) and phosphorus (P), 50 % of Sulphur (S), and 75 % of potassium (K) uptake by cereal crops are retained in crop residues. (ESCAP.e (2023)). However, optimizing the crop residue is a challenging task. With emerging outmigration patterns in the rural areas causing a shortage in agricultural labor and adding to the rise in the total amount of crop residue, short time spans between harvest and farming periods, and the high cost of available technologies and machinery, a sustainable crop residue management might not be manageable (or even economically reasonable) for farmers. In their study in Pakistan, Ahmed et al. (2013) estimated that the cost of collecting straw from the field was approximately US$140 per hectare, which is far more expensive than field burning. In addition, these straws might not be usable as a by-product for traditional use or with the available technologies. Despite the legal bans in place and as a result of these issues, many countries, especially in South Asia, have seen

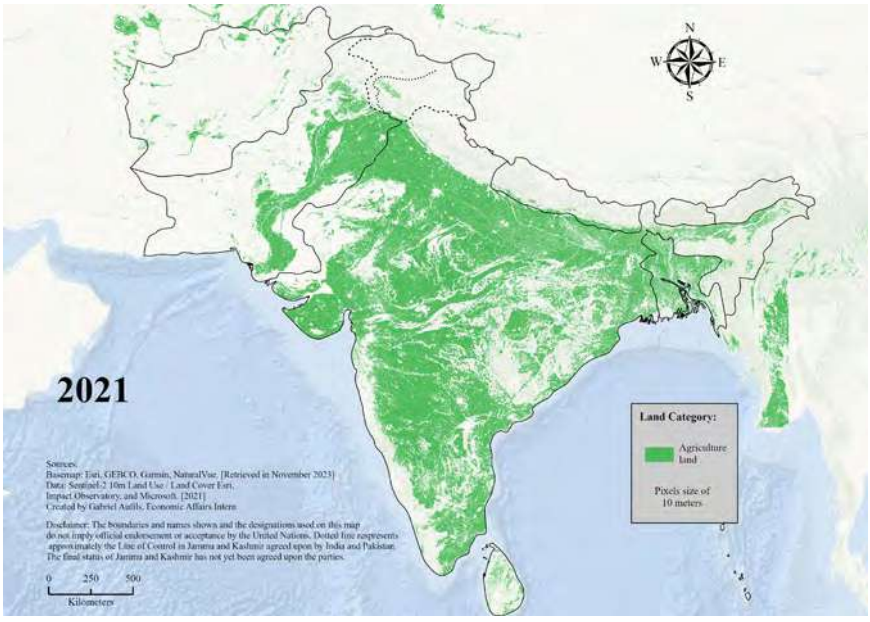

Figure 1. Map of Agricultural Area in South Asia
Source: ESCAP SSWA

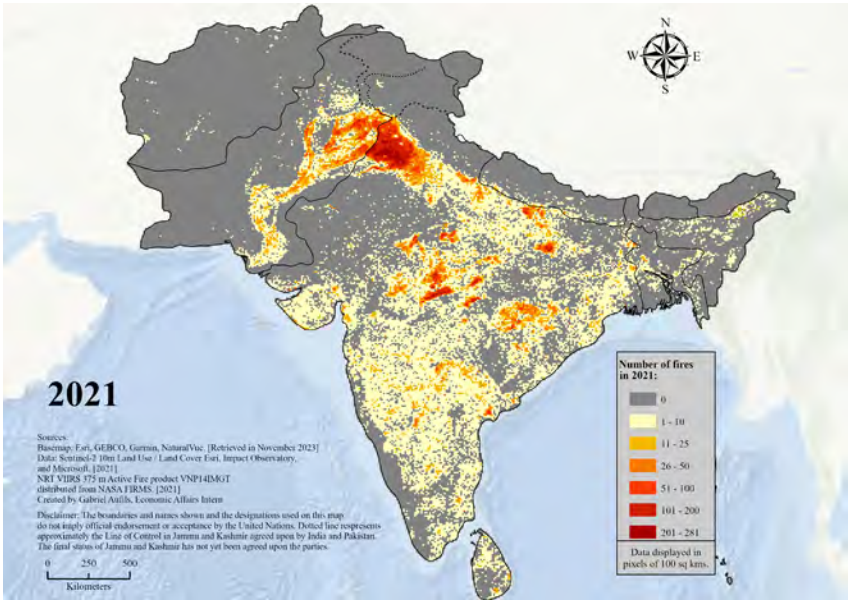

Figure 2. Pattern of Crop Fires in South Asia in 2021

Source: ESCAP SSWA

Note: This map shows the estimated number and concentration of fires in crop areas in South Asia over 2021. Identifying the crop and the calculations of fire in agricultural areas were based on the methodologies used by Kumar et al. (2019) and Kauchal & Leena (2022).

an increase in the burning of crop residue. Figure 1 presents the distribution of agricultural lands in South Asia, while Figure 2 shows the location and density of fire practice on agricultural lands in South Asia over one year in 2021.

The share of crop residue type differs by country based on their main agricultural products. For instance, in India, among the different crop residues, rice (43 %), wheat (21 %), and sugarcane (19 %) have had major contributions; however, residue burning is highly variable and dependent on usage patterns in each state. (ESCAP.e (2023)). For instance, residues subjected to burning could range from 8% to 80 % for rice crops across the states. (Jain et al. (2014)). Table 1, from ESCAP.e (2023),

Table 1. Biomass Burned and Emission Data for Major Crops in India

Crop	Year	Production* (Mt)	Straw production (Mt)	Biomass burned (dry matter) (Mt)	N_2O emission (kt)	CH_4 emission (kt)
Wheat	2016	92.29	161.51	12.17	0.85	32.85
	2017	98.51	172.39	12.31	0.86	33.24
	2018	99.87	174.77	11.86	0.83	32.02
	2019	103.6	181.30	11.72	0.82	31.66
Rice	2016	104.41	156.62	24.07	1.66	64.13
	2017	109.7	164.55	24.07	1.68	65.00
	2018	112.7	169.05	24.28	1.7	65.57
	2019	116.48	174.72	24.07	1.68	65.01
Maize	2016	22.57	33.86	9.9	0.693	26.73
	2017	25.9	38.85	9.63	0.67	26.00
	2018	28.75	43.13	9.38	0.66	25.32
	2019	27.72	41.58	9.02	0.63	24.37
Sugarcane	2016	348.44	139.38	3.22	0.22	8.68
	2017	306.07	122.42	2.88	0.20	7.78
	2018	379.90	151.96	3.07	0.21	8.31
	2019	405.11	162.04	3.289	0.23	8.88

*Source: *Ministry of Agriculture and Farmers Welfare (2021-22)*

shows a sample of crop residues burned in India and the corresponding N2O and CH4 emissions produced between 2016 and 2019. At the same time, in recent years, Punjab (the state in Pakistan) has seen the burning of around 72% of rice straws due to difficult management techniques, limited resources of the farming community, and a short interval for seeding (ESCAP.d (2023)). Even though straw burning is not common across all South Asian countries, it is essential to pay attention to the projections and the potential rise in their occurrence due to the continuing structural changes.

Depending on the seasonal pattern of crop residue burning, the weather, and the temperature of the region, the resulting level of air pollution can vary. For example, seasonal crop residue burning (CRB) in the North-West (NW) agricultural states of Punjab and Haryana is a major source of PM2.5 air pollution in north India. (Kaskaoutis et al. (2014), Lohan et al. (2018)). Sembhi et al. (2020) found that during the 2016 air quality crisis, the NW Indian CRB timing shifts made a small contribution to worsening air quality (3% over Delhi) during the post-monsoon season.

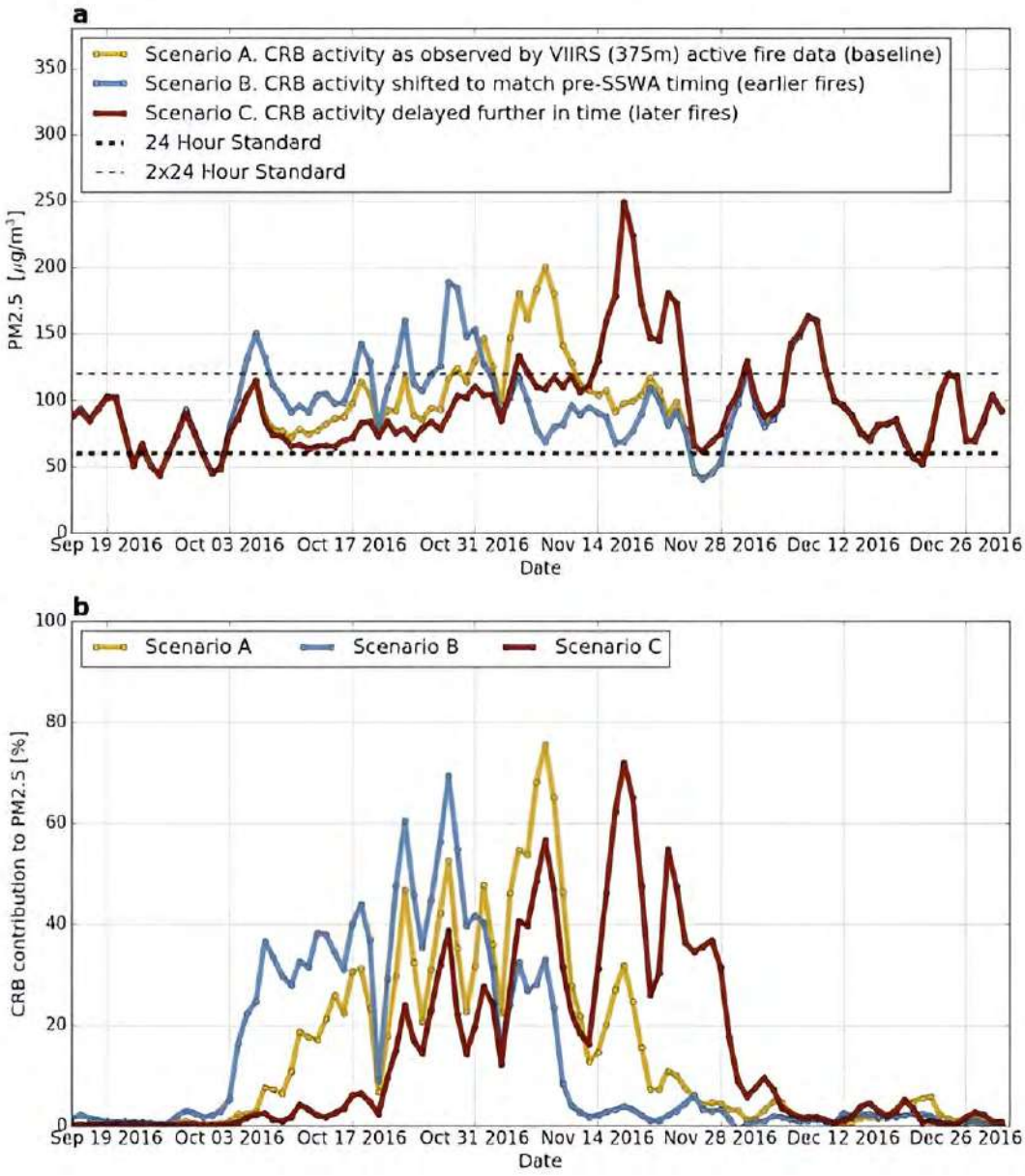

Figure 3. Time Series of Post-Monsoon CRB Smoke Emissions Impacts over Delhi under Different CRB Timing Scenarios for 2016

Source: Sembhi et al. (2020)

Note: (a) shows the absolute daily mean ambient PM2.5 concentration, and figure 3(b) shows the CRB contribution (in %). Simulated. PM2.5 data from the baseline Scenario A (mustard line), along with that of Scenario B (earlier fires than currently experienced, blue line) and C (later fires than currently experienced, maroon line), are shown.

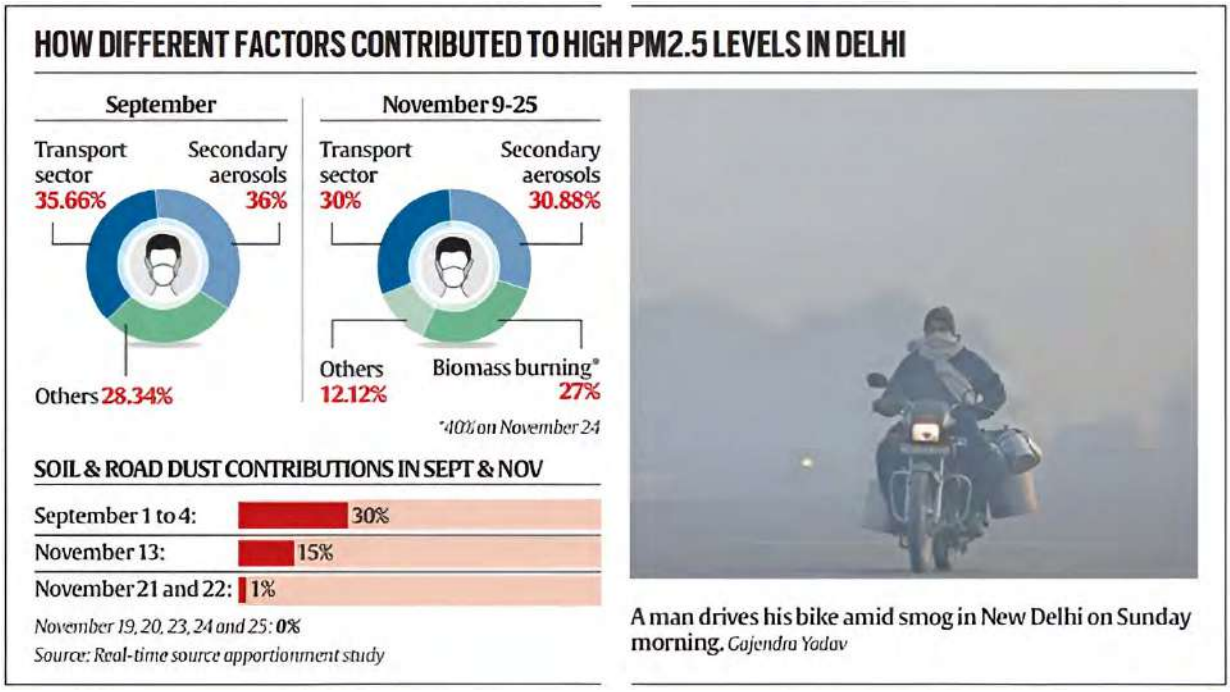

Figure 4. Airpollution Contributors in Delhi

Source:https://indianexpress.com/article/cities/delhi/real-time-source-apportionment-study-delhi-air-quality-transport-sector-delhi-vehicles-9043660

However, their estimations predicted that further delayed CRB would cause a much more severe situation in the source region (i.e., Ludhiana) and for Delhi by deteriorating the air quality by 30% and 4.4%, respectively. Figure 1 presents the pattern of the PM2.5 level in 2016 and the estimated contribution of crop residue burning during the same period.

A recent report on Delhi in November 2023 indicated that vehicles and secondary aerosols are the largest contributors to Delhi's PM2.5 level during September, which is pre-harvest, as shown in Figure 4. The average percentage contribution from vehicles was around 35.66% in September, while the contribution of secondary aerosols was 36%. Biomass burning emerged as an addition to these sources in November 2023 and is now one of the top three, with a contribution of around 27% to the overall causes.

Technological Solutions for Crop Residue Management

Innovative and localized technologies can help manage the in-situ and ex-situ crop residue. Retaining or mulching and incorporating the crop residues in the field and decomposing them using a consortium of microbes are methods of in-situ crop residue management, which can be easily managed with local technologies. Baling and transporting straw outside the field for alternative uses is known as the ex-situ management method. Various methods, technologies, and machinery are used in crop residue management for both methods.

Technologies for In-Situ Management

Farmers usually do not prefer in-situ incorporation because the stubble takes a long time to break down into the soil (particularly paddy crops). However, the in-situ incorporation of straw has benefits for soil properties. Ploughing back or surface retention of farm waste yields many benefits to soil's physical, chemical, and biological properties. (ESCAP.e (2023)). Selecting the appropriate type of technology depends on many factors, such as the type and size of land, crop, and temperature. In addition, the direct and indirect cost of using these types of machinery is a significant factor for the farmers. Some of the examples of in-situ machinery, as well as some challenges in using them, are presented in Table 2. Overall, the machinery cost seems to be a major issue that can especially affect small farmers. Localizing the available machinery is also needed based on the land, soil, and crop type.

In-situ and Mechanization Solutions

On-farm use of crop residues is the easiest way to prevent burning, as it requires minimum effort, and the cost incurred is also low in comparison to any other ex-situ management techniques. With the following three core interlinked principles, conservation agriculture is a viable option for sustainable agriculture and an effective solution to check land degradation. (Friedrich et al. (2009)). First, it is important to minimize mechanical disturbance in the soil and seed directly into untilled soil to improve its organic matter content and health. The next step is enhancing the organic matter cover on the soil using cover crops and/or crop residues. This protects the soil surface, conserves water

and nutrients, promotes biological activity, and contributes to integrated pest management. Finally, it is important to diversify crops in associations, sequences, and rotations to enhance system resilience.

An impact assessment of in-situ residue management machinery was conducted by the Ministry of Agriculture and Farmers Welfare, Government of India. (MAFW (2019)). The committee recommended that the best and the most environmentally sustainable use of paddy straw is its incorporation into the soil. However, a series of challenges in using crop residue management machinery to sow seeds and apply fertilizer and pesticides need to be considered; some of them are shared in Table 2. Some of the limiting factors in the adoption of crop residue management (CRM) machinery for farmers include additional management skill requirements, apprehension of lower crop yields and/or economic returns, negative attitudes or perceptions, and institutional constraints. These need to be addressed through large-scale demonstrations and training. It is essential to support on-farm adaptation of CRM machinery in both large and scattered small fields and develop focused institutional and policy support, including appropriate incentives for its widespread dissemination and adoption. (ESCAP.e(2023)).

Technologies for Ex-Situ Management

Various existing and emerging technologies such as pyrolysis (biochar), biomethanation (biogas), and conversion

Table 2. Machinery for In-situ Management of Crop Residue

Happy Seeder

Punjab Agricultural University (PAU), Ludhiana, India, has developed a Happy Seeder for sowing wheat directly into the combined harvested paddy fields without any other operation. Happy Seeder cuts straw in front of furrow openers and throws it over the sown crop in a single operation, which simultaneously acts as a mulch while drilling the seed and fertilizer. This mulch helps conserve soil moisture, prevent erosion, and suppress weed growth. Mulch helps to reduce irrigation requirements by about 15-20 % and weed emergence by about 50 %. Happy seeders cannot be used on unlevelled fields. However, in suitable locations, sowing with the help of Happy Seeders reduces labor requirements by 80 %, saves up to 10 % of fertilizers, and increases yield by up to 5 %. It also prevents the machine from choking under a heavy straw load. It can cover about 2.4 - 3.2 ha in one day. Happy Seeders are commercially available in 10, 11, and 13-row models. (Manes *et al*., (2017)). In Pakistan, the Rocket Seeder (eight-row), suitable for removing loose straws without cutting stubbles in front of each tine, was modified and named the Pak Seeder. This ten-row machine can undertake direct seeding of wheat into heavy rice residue and can be used immediately after combined harvesting on the same day. The results indicated that the average yield in heavy rice residue increased up to 600 kg/ha. Around 40 Happy Seeders are being used in the far-west, mid-west, and central parts of Nepal by commercial farmers and in research stations. Happy Seeders are not commonly used among marginal farmers as the capital investment required is high, and they need technical support.

Super Straw Management System (SMS)

The combine harvester throws straw residues from straw walkers in the center of the harvested area. The width of straw walkers is usually one-third the width of the combined cutter bar. This forms heaps of loose residues (as wide as the straw walker width) in lines, hindering Happy Seeders' operation. PAU developed a super straw management system as an attachment for the self-propelled combine harvester. Super SMS chops and uniformly spreads loose straw coming out of straw walkers of the harvester. It facilitates the working of Happy Seeders and increases its capacity. However, sometimes there is additional fuel consumption.

In Pakistan, efforts were made to integrate a fine straw mechanism with combined harvesters, but this mechanism has not gained popularity among farmers. It was due to a decrease in operational capacity from 10 to 4 hectares per day and a high cost of operation.

It is vital to spread loose straw uniformly before seeding to ensure a better yield utilizing the Pak Seeder/Happy Seeder. A simple, low-cost straw-spreading kit was developed in Pakistan to fix onto a combine. Owners/rental companies remove the chopping and spreading mechanism since it requires more power. Farmers who do not want to pay the additional cost of spreading straw also do not see any benefit in spreading out the straw in the field.

Mulcher

The Mulcher, with a vertical axis of rotation, is a rotation mower. Rotary mulchers cut standing stubble and leftover straw into small pieces and lay them over the field's surface. Small pieces of straw are then pressed by a roller attached to the rear side, creating a mulch layer over the topsoil. A Happy Seeder or reversible MB plow can then be used to sow wheat or invert straw into the soil, respectively. (Chaudhary et al. (2019)). To use this machine effectively, the straw needs to be dry.

Source: ESCAP.a(2023), ESCAP.b (2023), ESCAP.c (2023), ESCAP.d (2023), ESCAP.e (2023).
Pictures are Courtesy of ICAR/PAU

to biofuels (such as briquettes, pellets, bio-compressed natural gas [CNG], and bio-diesel) have been recommended for ex-situ use of paddy crop residue. (CII and NITI Aayog, (2018)). These newer options have been added to other existing practices, such as using straws for animal feed, mushroom cultivation, paper production, building materials, and handicrafts. (ESCAP.e (2023)).

The supply chain of crop residue and using it as fodder for animals, for electricity generation, or other ex-situ options requires various on-farm and off-farm operations, including collection, packing, handling, transportation, storage, and pre-feed processing. Any types of gaps and challenges within this process can interrupt the economic use of the residues. For example, a reliable supply of biomass to the end user requires a dense network of collection centers and supply chain management (SCM) facilities. However, the high cost of collection and transportation of residues from the field to the end-user has proven to be the prime impediment for scaling up ex-situ management practices. (Singh et al. (2010)). Therefore, entrepreneurs in the supply chain find the economics of handling crop residue unattractive. A sample of the supply chain of ex-situ management of crop residues has been presented in Figure 5.

Other Factors for Crop Residue Management

Concrete action plans and short- and long-term strategies built on collaboration among all the relevant stakeholders need to be developed to provide a sustainable solution. Some of the main guiding factors to achieve this goal are as follows:

Data Support

Significant amounts of crop residues are generated from agricultural crop production. The amount of extra residues depends on in-situ use to maintain soil fertility and the residue's competitive use for agricultural or industrial purposes. The use of agricultural crop residues for ex-situ purposes, such as bioenergy production (as straw or stover – stalks, ears, leaves, or cobs), requires accurate data on the availability of the crop residue by type as well as their local and annual variability. Estimating the residues available for bio-energy production provides information on the best locations for a bio-energy plant and plant size.

Therefore, the first and foremost action required is collecting accurate data about different residue production and use stages. For example, assessing the available amount of crop for ex-situ use and properly estimating the amount of potential biomass that can be generated from different crops is important. The availability of data is essential for the formation of an action plan for effective crop residue management. Using modern technologies such as Artificial intelligence (AI) can assist in data preparation, collection, and management; however, this needs to be explored further.

Increasing the direct value of the crops, Biomass Products, and Energy Generation

Ex-situ management can be a viable solution for using crop residues in a circular economy in an economically acceptable or attractive way for the farmer. To do so, good supply chain management is needed. This can include a strong network of biomass depots, providing a minimum support price for crop residue and its products, and creating accessible markets for the residues as well as their products.

Conducting Research and Development to identify more ways of using crop residue is also essential. Some of the new technologies that use crop residue as input include Gasification and Biofuel Production. Gasification is a process that converts biomass (wood, agriculture residues, briquettes, etc.) or fossil fuel-based carbonaceous materials into gases. India is one of the few countries in the world with an active research and demonstration program on small-scale biomass gasification

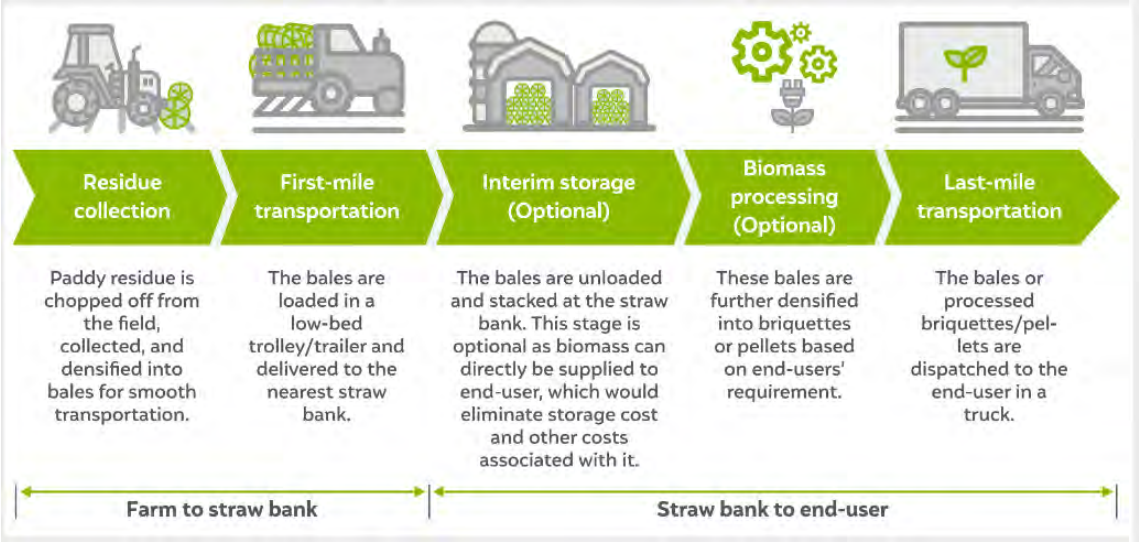

Figure 5. Supply chain of crop residue for ex-situ management
Source: Kurinji&Sankalp (2021).

technologies. About 1.2-1.4 kg of biomass is required to produce 1 kWh of electricity (using a 100 % producer gas engine). Crop residues can be utilized as fuel for running a biomass gasifier for multiple applications, including electricity, agro-processing, and running decentralized cold storage at the village level. This can also provide farmers with an alternate option to shift to horticulture crops for which farmers currently are reluctant, owing to limited cold storage capacity at the local level. A 250-kW capacity biomass gasifier plant can utilize about 2,000 tons of paddy straw annually and support a 50-tonnage refrigeration (TR) cold storage facility besides producing electricity. (Datta et al. (2020)).

There is a huge potential to offset fossil fuels by generating ethanol from bulk crop residues with efficient commercial technologies. Potentially, 250–350 l of ethanol can be produced from each metric ton of dry crop residues. Considering that only 20 % of the world's rice straw is used for this purpose, this would lead to an annual ethanol production of 40 billion liters, which would be able to replace about 25 billion liters of fossil fuel-based gasoline (Bhattacharyya and Barman, (2018)). For instance, in India, the potential of annual bio-ethanol production from surplus crop residue (178 Mt) has been estimated at 51.12 billion liters (Bl) out of the total annual bio-ethanol potential, ranging between 13.08 Bl and 38.04 Bl, depending on the season. Sugarcane biomass has the maximum bio-ethanol potential, followed by rice, cotton, and wheat crops.

Conclusion

This paper discussed the relationship between air pollution and crop residue burning, the leading causes of crop residue burning, and existing technologies for in-situ and ex-situ management methods. The alarming level of contribution from crop residue burning to air pollution in the northern areas of India and other countries in the subregion, observed in recent years, suggests that addressing this issue is an urgent task.

To overcome crop residue burning, an inexpensive and labor-efficient way of removing unwanted crop residues, technological solutions need to be explored, localized, and promoted by the government and the private sector.

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Energy Sector and Trilateral Cooperation between the Republic of Korea, China, and Japan for Addressing Both Air Pollution and Climate Change

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Abstract

Ambient air pollution and climate change are key environmental issues for the Asia region, with the death toll from these problems projected to rise in the future. There are significant synergies between policies to address both challenges. This article outlines the current state of air pollution impacts and policy responses in the Republic of Korea, China, and Japan, the co-benefits of phasing out fossil fuel use, and the potential of decarbonizing the electricity generation sectors in the three countries as an efficient means of achieving dual gains. The article focuses on the importance of regional cooperation as both air pollution and climate change are challenges that no single country can solve alone. To effectively address these issues, a shared policy response is required. The article also discusses the importance of trilateral leadership to foster momentum for achieving mutual health and climate benefits and for realizing the 2030 sustainable development goals.

Introduction

Ambient air pollution exposure is the largest environmental risk factor for premature death worldwide (UNEP, 2023b). Air pollution causes over 6.5 million deaths annually, with 70% of deaths occurring in the Asia-Pacific region (UNEP, 2023c). Reducing the level of air pollutant emissions would vastly enhance health outcomes in Asia (Conibear et al., 2022)"ISSN":"1748 9326","abstract":"Air pollution exposure is a leading public health problem in China. Despite recent air quality improvements, fine particulate matter (PM2.5. Given that air pollution is a cross-boundary problem, cooperation is vital to address it. Climate change is also a serious environmental problem that will inflict massive amounts of damage in Asia if it continues unmitigated. The effects of climate change are increasing in Asia, causing losses to human life and economic development (WMO, 2023). Similar to air pollution, climate change is a problem that no single country can overcome alone and would require international cooperation to be addressed effectively. The primary cause of both air pollution and climate change is the combustion of fossil fuels; therefore, there are significant synergies between efforts to mitigate both environmental issues. The decarbonizing of our energy systems would yield significant health co-benefits (Ouyang et al., 2022).

The energy sectors in the Republic of Korea, China, and Japan combust the largest volume of fossil fuels and, therefore, are the most significant sources of air pollution. This article focuses on how changes in the energy sectors of the Republic of Korea, China, and Japan can achieve the double dividend of addressing air pollution and climate change and also the vital role of regional and international cooperation in achieving these double benefits. The study begins by presenting an overview of the impacts of ambient air pollution in the Republic of Korea, China, and Japan and proceeds to discuss promising emission reduction technologies and policies within the three countries. It also discusses how cooperation in terms of collaborative research between the countries and combined leadership in capacity building in the wider Asia region can address both air pollution and climate change, resulting in mutually beneficial outcomes.

Air pollution in the Republic of Korea, China, and Japan

The leading pollutants in the Asia region are particulate matter (PM10 and PM2.5), sulfur dioxide, nitrogen oxides, volatile organic compounds (such as hydrofluorocarbons), and short-lived climate pollutants (such as carbon, methane, and tropospheric ozone). The World Health Organization (WHO) issues guidelines on air quality levels and recommendations on exposure limits to various pollutants based on the most updated available findings on the pollutants' impact. For example, the current WHO guidelines state that annual average concentrations of PM2.5 exposure should not exceed 5µg/m (WHO, 2021), updated from the previous recommended limit of 10µg/m (WHO, 2005). As can be seen in Figure 1, the average ambient air pollution exposure levels in the Republic of Korea, China, and Japan exceed WHO guidelines.

Emission sources discharge multiple types of air pollutants that have a variety of characteristics and effects. Therefore, building our understanding of multi-air pollution risk processes is important (Sakti et al., 2023).

PM2.5 is especially harmful to human health as it can be breathed most deeply into the lungs, and exposure to PM2.5 increases the risk of lung cancer, chronic

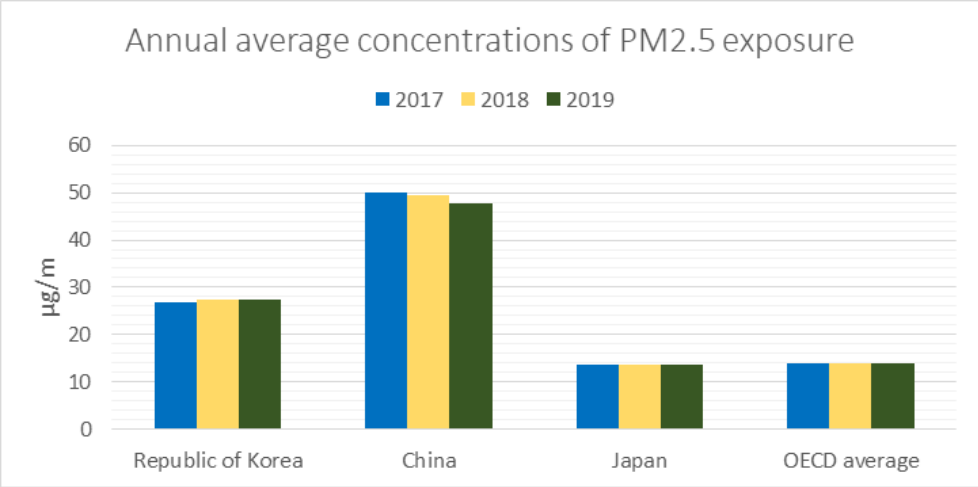

Figure 1. Annual average concentrations of PM2.5 for the Republic of Korea, China, Japan, and the OECD average

obstructive pulmonary disease (COPD), acute respiratory infections, ischemic heart disease, and strokes (EPA, 2023). PM2.5 greatly increases mortality and morbidity from these diseases and other PM2.5-related illnesses in these countries. Table 1 shows deaths due to PM2.5 exposure in 2019 in the Republic of Korea, China, and Japan. The majority of deaths occur in China, with PM2.5-related deaths nearing 1.5 million in 2019. Accounting for China's far larger population using the standardized unit of deaths per 100,000, China still has over twice the number of deaths due to PM2.5 exposure than the Republic of Korea and Japan. Therefore, the country can achieve the greatest rate of mortality reduction if radical action is taken to reduce PM2.5 emissions in the region.

The Republic of Korea, Japan, and the Eastern half of China, where over 90% of its population reside, are located within a 2000km radius. Therefore, the countries share the same airmass and are majorly affected by air pollutants emitted by each other. The adverse impact of ambient air pollution in the Republic of Korea, China, and Japan will increase over time as the three countries face changing demographic structures with a greater proportion of older citizens. By the year 2050, the population aged 50+ is projected to be 61%, 52%, and 56% for the Republic of Korea, China, and Japan respectively (UN, 2022). Older individuals are more vulnerable to air pollution-related diseases; thus, the death toll from poor [air] quality will rise sharply (Conibear et al., 2022). Air pollution exposure may even alter the genetic aging pathway, further increasing the air pollutant disease burden (Kuntic et al., 2023). Radical action to reduce air pollution would entail massive health and overall quality of life benefits for citizens in the region.

The governments of the Republic of Korea, China, and Japan have implemented various policies to reduce ambient air pollution. The governments of all three countries have introduced various policies to improve air quality, such as clean production incentives, vehicle emissions standards, fuel sulfur content regulations, and strengthened target air quality standards. The Republic of Korea began the phasing out of old diesel vehicles, with them being replaced by electric or LPG vehicles, launched various public awareness campaigns, and limited the operation of high air pollutant sources during extremely low air quality.

China's Air Pollution Prevention and Control Action Plan, launched in 2013, has helped reduce the trend in all pollutants except for tropospheric ozone (Dilawar et al., 2023). In 2022, to reduce the number of days of extreme air pollution, PM2.5 levels in Northeast China were targeted for the first time (Cheng et al., 2023). Air pollution pilot studies in cities have demonstrated a decrease in air pollutant levels compared to those in the cities not included in the pilot studies (Niu et al., 2023). Clean air policies have brought about substantial health benefits, generating major savings in air-pollution-related healthcare spending, which has helped alleviate

Table 1. PM2.5 air pollutant impacts in 2019 in the Republic of Korea, China, and Japan.

Sector	Total deaths due to PM2.5 exposure	Deaths per 100,000 people due to PM2.5 exposure	Percentage of ischemic heart disease deaths attributable to PM2.5
Republic of Korea	21,837	41	15%
China	1,423,633	100	20%
Japan	39,692	31	7%

Source: UNEP. (2023b)

health expenditure inequality (Weng et al., 2023). Technological advancement in modeling based on openly available data from China's Environmental Protection Agency has greatly improved their forecasting capacity (Dai et al., 2022). Despite the progress made over the past decade to achieve their own updated PM2.5 emission target, the Chinese government will need further action (Li et al., 2023).

In Japan, the "Comprehensive Policy Efforts on PM2.5 commenced in 2013, and this resulted in various positive progress outcomes, like a reduced number of extreme PM2.5 level alert incidents from 37 in 2013 to just 2 in 2017 (TPDAP, 2019). Vehicle emission controls in Japan strengthened over time, with the latest measure introduced in June 2018, which included reducing motorbikes and gasoline direct injection (GDI) PM2.5 emissions and enacting further controls for fuel gas evaporation during parking. Further electrification of the residential building and transportation sectors, increasing use of electric vehicles, and electrified heating and cooking systems can reduce PM2.5 and combat ozone depletion. These are estimated to have large positive human health and economic impacts (Long et al., 2023). End-of-pipe measures such as the phasing out of small-scale polluting factories and outdated industrial boilers, as well as strengthening vehicle emission standards, would also have similar beneficial effects.

Co-benefits of air pollution and climate change mitigation

The principal source of both air pollutants and climate change-inducing greenhouse gas (GHG) emissions is the burning of fossil fuels. Therefore, moving away from fossil fuels to low-carbon sources of energy such as renewables and nuclear power has dual benefits in terms of both of these environmental issues. These additional benefits of climate change mitigation policy are generally termed co-benefits. Recognition and understanding of interrelations and synergies between these issues are vital for building policy momentum. Holistic approaches to climate change and human health impacts require an integrated approach (Zhang et al., 2022).

There is a significant potential to decrease air pollution through decarbonization of the countries' energy mixes. Rapid decarbonization of the electricity generating sector would yield substantial air quality improvement co-benefits in near-term improvements of health outcomes (Jiang, 2023). Electricity generation in the Republic of Korea, China, and Japan is still fossil-fuel intensive. As shown in Figure 1, the energy mixes of the three countries still rely heavily on fossil fuel energy sources, primarily coal and natural gas. The green transition of the electricity generating sector would reduce the volume of air pollutant emissions while simultaneously helping to mitigate climate change by reducing GHG emissions.

As can be seen in Figure 2, over the past twenty years, all three countries have increased their renewable energy capacity, particularly solar PV, yet their energy mixes are still dominated by the fossil fuels of coal and natural gas. Achieving carbon neutrality over the next few decades would be impossible without the rapid growth of low-carbon electricity generation infrastructure. The governments of three countries should push for more rapid expansion of their low air pollutant and GHG-emitting energy capacity through support to solar PV, wind, hydro, and nuclear energy. Decarbonization of the electricity sector is relatively less complicated than other sectors, such as the

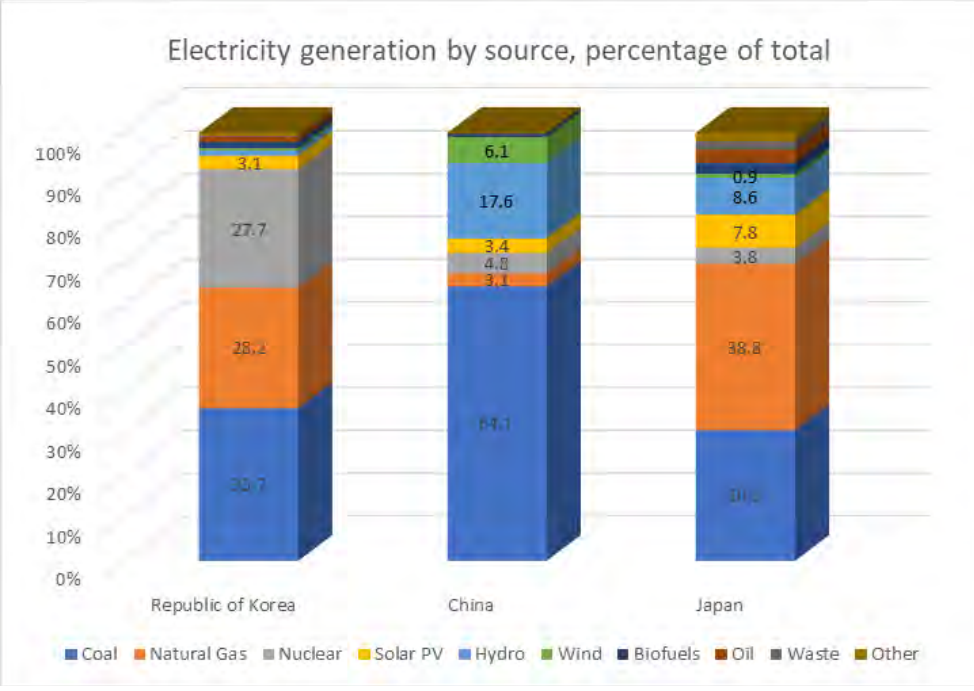

Figure 2. Electricity generation by source, percentage of total electricity generated, 2020. Source: (IEA, 2023)

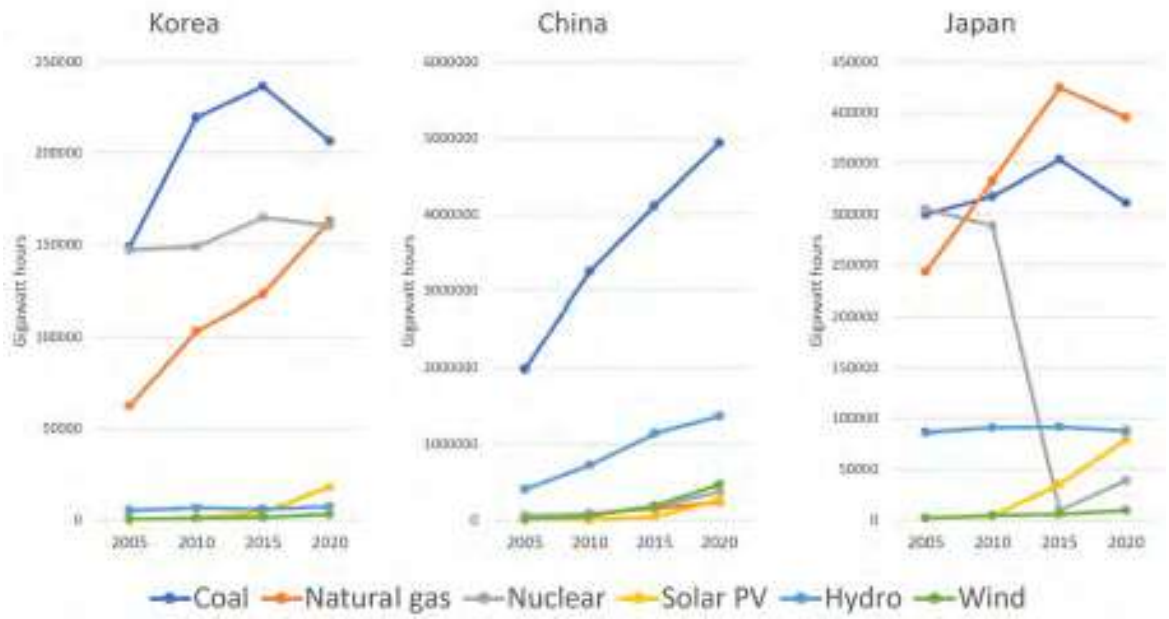

Figure 3. Electricity generated by sources of Korea, China, and Japan, 2005-2020. Source: (IEA, 2023).

transport and industry sectors, due to the government's power to set out and implement policies and construct the required green electricity generation infrastructure.

Trilateral cooperation and leadership

International cooperation is very important to reduce air pollution as air pollutants travel across national borders. As the largest economies and emitters of both air pollutants and GHGs, the Republic of Korea, China, and Japan should take an active role in accelerating regional cooperation on air pollution and climate change. The three countries can play a leading role in disseminating knowledge regarding air pollution control technology and effective policy responses due to their experience in these matters. For example, the Republic of Korea has experience in development collaborations between local government and experts from state research institutes to provide practical, context-specific advice for enterprises on how to reduce their air pollutant emissions. A key strength of this customized approach is enterprise leaders engaging with the process, as the steps were pragmatic and based on realistic constraints. In China, although a similar process still needs to be made, the government has vast experience implementing and overseeing long-term environmental action plans and creating successful subsidy programs for end-of-pipe pollution control for coal power plants and heavy industry (Liu et al., 2023). China has applied various technologies to reduce air pollutants in its coal and steel industries, such as hydrogen-rich fuel injection and semi-coke sintering technologies, flux and carbon-containing pellet technologies, and flue gas desulfurization technologies (Yu et al., 2023). Japan has a similarly vast experience with air pollution control policies and measures, with its Air Pollution Control Act of 1968 being regularly updated to incorporate the changing nature of the local emission profile. Numerous platforms for dialogue and cooperation on air pollution have already been established. Regional committees play an important role in communicating and reconciling interests, discovering mutually beneficial areas of cooperation, and facilitating coordination in the region. Current cooperation and policy measures include air pollution monitoring and data sharing. The Asia-Pacific Clean Air Partnership, established in 2015, allows policymakers and stakeholders to engage in knowledge sharing and the diffusion of effective tools and solutions for reducing air pollution (UNEP, 2023a). Its additional aims are to act as a mechanism for improved collaboration of clean air programs in Asia, serve as a platform to create and share knowledge on air pollution initiatives, and strengthen the institutional capacity of countries in the region. The Tripartite Policy Dialogue on Air Pollution (TPDAP) was established to enable the Republic of Korea, China, and Japan to exchange information on air quality management policies and discuss potential future initiatives. The 10th TPDAP, held on September 20, 2023, was hosted by Japan's Ministry of Environment and focused on the topic of the latest research on synergistic control technologies for PM2.5 and tropospheric ozone (TPDAP, 2023). Examples of new technologies include the improved air emission filters in coal power plants and the use of triboelectric nanogenerators in air dust removal systems (Zheng et al., 2022). Still, widespread adaption remains a challenge due to cost feasibility at a large scale. Other future initiatives outline the dialogue for increased utilization of satellite data for air quality monitoring and incorporation of the Acid Deposition Monitoring Network in East Asia (EANET) and other international frameworks.

Despite these initiatives, more action in terms of regional cooperation can be taken. Republic of Korea, China, and Japan can take further action to aid capacity building and share best practices on how to reduce air pollutant emissions with other countries in Asia. Further cooperation in terms of collaborative research between the countries and combined leadership in capacity building in the wider Asia region can address both air pollution and climate change, resulting in mutually beneficial outcomes.

Subsidies and other support for renewable energy development should be primarily focused on replacing fossil fuel energy sources rather than just providing government funding for domestic industries or constructing other trade barriers. For example, in the case of solar PV, there have been various WTO trade disputes regarding subsidies and domestic content requirements involving the three countries in complainant and respondent roles (Hajdukiewicz & Pera, 2020). Additionally, the promotion and sharing of technologies for improving efficiency in fossil fuel electricity generation, such as the installation of flue gas desulphurization and other emission control technologies, would help emerging economies improve national and regional air quality.

Future policy initiatives could include the sharing of air pollutant filtering technologies and chemical analytic methods with less developed countries in Asia and discussion on grid interconnection for efficiency gains, as China, in particular, has a huge renewable energy generation potential that could be utilized for national and regional gain. The creation of knowledge management hubs would help other countries in the region develop their capacity to address air pollution. Further installation of remote monitoring equipment in countries would help authorities prepare for periods of high levels of air pollution. The governments of the three countries should also lead and accelerate increased cooperation among government departments, universities, research institutes, and private sector actors in the Asia region.

Sustainable Development Goal (SDG)17 recognizes cross-country collaborations and coordinated policies are crucial for achieving the other SDGs. Figure 3 visualizes the crucial role cooperation and partnerships can play in achieving health, climate action, inequality reduction, and increased innovation outcomes in the Asia region. Through regional cooperation, the green transition of the energy sector, industrial sector, and other emission-intensive sectors can be enhanced. This will lead to positive impacts in terms of both SGD3 (Good Health and Well-being) and SDG13 (Climate Action), as the volume of high air pollutants and GHG emissions from fossil fuel combustion would be greatly diminished. Partnerships through regional agreements and research collaborations would also foster innovation for the development of technologies to address both air pollution and climate change, thus helping to advance SDG 9 (Industry, Innovation and Infrastructure). Regional inequality would also be addressed as wealthier and more powerful countries in Asia could provide expertise, capacity building, and other kinds of support to the less developed countries in the region.

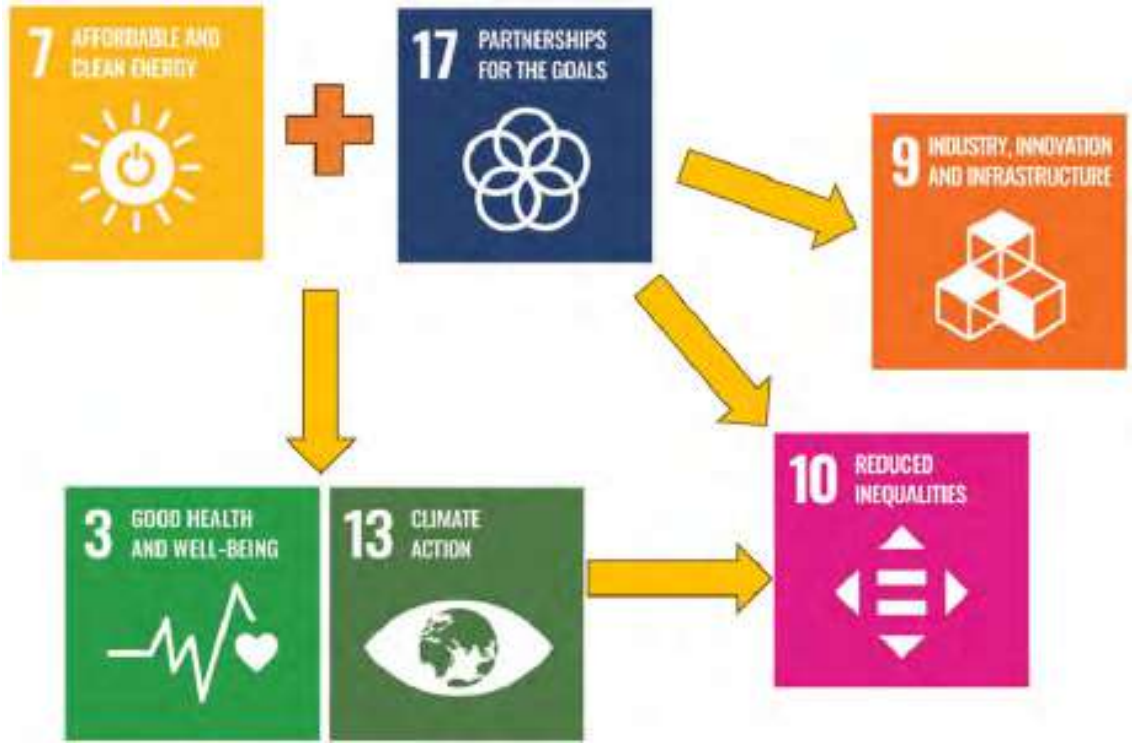

Figure 4. The vital role of partnerships in achieving the SDGs

Conclusion

Despite advancements in addressing air pollution over the past twenty years in the Republic of Korea, China, and Japan, significant progress still needs to be made. The stated air quality targets and carbon neutrality goals of the three countries will also be extremely difficult to achieve without a swift change in policy trajectory. The rapid phasing out of fossil fuel electricity generation offers the most efficient, near-term solution for addressing both issues. Regional cooperation is vital to improve air quality in Asia effectively. Enhancing cooperation and partnerships can help achieve the goal of addressing air pollution and mitigating climate change. Recognition of shared interest can lead to constructive and fruitful dialogue toward mutually beneficial outcomes. Regional cooperation plays a vital role in lowering air pollution levels and spreading awareness about successful policy options and technological solutions. The Republic of Korea, China, and Japan should play an active leadership role in promoting regional collaboration and capacity building.

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Tech Events

2024

15–16 Jan, Bangkok, Thailand
International Conference on Air Quality and Emission Management
Website: https://waset.org/air-quality-and-emission-management-conference-in-january-2024-in-bangkok

08–09 Feb, Colombo, Sri Lanka
The 8th International Conference on Climate Change 2024
Theme: Effective and Innovative Solutions for Achieving Net Zero
Organizer: The International Institute of Knowledge Management
Website: https://climatechangeconferences.com/
Phone: +94 117 992 022
Fax: +94 112 835 571
Email: isanka.gamage@tiikmedu.com

16–17 Feb, Greater Noida, India
ACREX India 2024
Place: India Expo Centre & Mart
Website: https://www.acrex.in/
Phone: +911141635655

21–23 Feb, Nairobi, Kenya
Climate and Clean Air Conference 2024
Website: https://www.ccacoalition.org/events/climate-and-clean-air-conference-2024

20–23 Feb, Bangkok, Thailand
Asia Pacific Forum on Sustainable Development 2024
Place: United Nations Convention Centre,
Organizer: Economic and Social Commission for Asia and the Pacific
Contact: escap-apfsd@un.org
Website: https://www.unescap.org/events/apfsd11

25–27 Feb, Nha Trang, Vietnam
10th International Conference on Environment and Renewable Energy
Website: http://www.icere.org/
Contact: Conference Secretary- Ms. Alice Lin
Tel: +86-18117801445
Email: icere@ieet.ac.cn

27–29 Feb, London, UK
International Energy Week
Place: Intercontinental London Lane
Organizer: Energy Institute
Website: https://www.ieweek.co.uk/
Email: ieweek@energyinst.org

Feb 27–Mar 01, Moscow, Russia
Climate World 2024
Place: Expocentre Moscow, Russian Federation
Organizer: Euro Expo
Website: https://www.climate-expo.com/
Phone: +43 1 230 85 35
Fax: +43 1 230 85 35 - 50
Email: office@euroexpo-vienna.com

15–17 March, Matsue City, Japan
14th International Conference on Future Environment and Energy (ICFEE 2024)
Contact number: +86-18117805914
E-mail: icfee@academic.net
Website: http://www.icfee.org/

02–05 April, Gold Coast, Australia
Second Asia Pacific Conference on Sustainable Development of Energy, Water and Environment Systems
Email: sdewes.ap@sdewes.org
Website: https://www.goldcoast2024.sdewes.org/

14–16 April, London, UK
International Conference on Environmental Pollution, Treatment, and Protection
Place: Imperial College
Phone: +1-613-834-9999
Email: info[@]iceptp.com
Website:https://icepp.org/

26–28 April, Madrid, Spain
4th World Conference on Climate Change and Global Warming
Organizer: Universidad Complutense de Madrid Facultad de Bellas Artes
Website: https://www.ccgconf.org/registration/

13–17 May, Helsinki, Finland
14th International Conference on Air Quality
Website: https://www.helsinki.fi/en/conferences/air-quality-2024

15–17 May, Bangkok, Thailand
Future Energy Asia: Exhibition and Summit
Place: Queen Sirikit National Convention Center
Email: info@futureenergyasia.com
Website: https://www.futureenergyasia.com/conference/call-for-papers/

28–30 May, Colorado, USA
2024 Air Forum
Place: Denver
Email: forum@airweb.org
Fax: 8503855180
Website: https://www.airweb.org/forum/2024/home\

10–12 June, Sarawak
Asia Pacific Hydrogen Summit
Place: Borneo Convention Centre Kuching
Website: https://hydrogenapac.com/
Contact: +608-2555189

28–30 June, Frankfurt, Germany
International Conference on Environment and Industrial Innovation (ICEII 2024)
Email: iceii@ieet.ac.cn.
Website: http://www.iceii.org/

07–11 July, Hawaii, Honolulu
Indoor Air 2024
Theme: Sustaining the Indoor Air Revolution: Raise Your Impact
Organiser: International Society of Indoor Air Quality and Climate
Website: https://indoorair2024.org/

15–16 July, Melbourne, Australia
Indoor Air Quality Conference
Organizer: Australian Institute of Refrigeration Air Conditioning and Heating (AIRAH)
Website: https://www.airah.org.au/iaq/2024/
Phone: 03 8623 3000

03–04 July, Bangkok, Thailand
Asean Sustainable Energy Week
Phone: +66 2036 0500
Fax: +66 2036 0588, +66 2036 0599
Email: asew-th@informa.com
Website: https://www.asew-expo.com/2023/en/about_show.asp

25–27 August, Barcelona, Spain
14th International Conference on Environmental Pollution and Remediation (ICEPR 2024)
Email: info[@]icepr.org
Phone: +1-613-834-9999
Website: https://icepr.org/

Oct 28–Nov 01, Accra, Ghana
Second Global Conference on Air Pollution and Health
Organizer: World Health Organization
Website: https://www.who.int/news-room/events/detail/2024/10/28/default-calendar/second-global-conference-on-air-pollution-and-health

09–10 Oct, Birmingham, UK
AQE 2024
Phone: +44 (0) 1727 858840
Email: info@ilmexhibitions.com
Website: https://www.ilmexhibitions.com/aqeshow/about-aqe/

03–07 Nov, Sarawak, Malaysia
13th Asian Aerosol Conference 2024
Organizer: Clean Air Forum Society of Malaysia (MyCAS) with the collaboration of the Asian Aerosol Research Assembly (AARA)
Website: https://www.asianaerosol2024.com/

Jan-Mar 2022

Technology transfer for sustainable development in the Asia-Pacific

Jan-Mar 2023

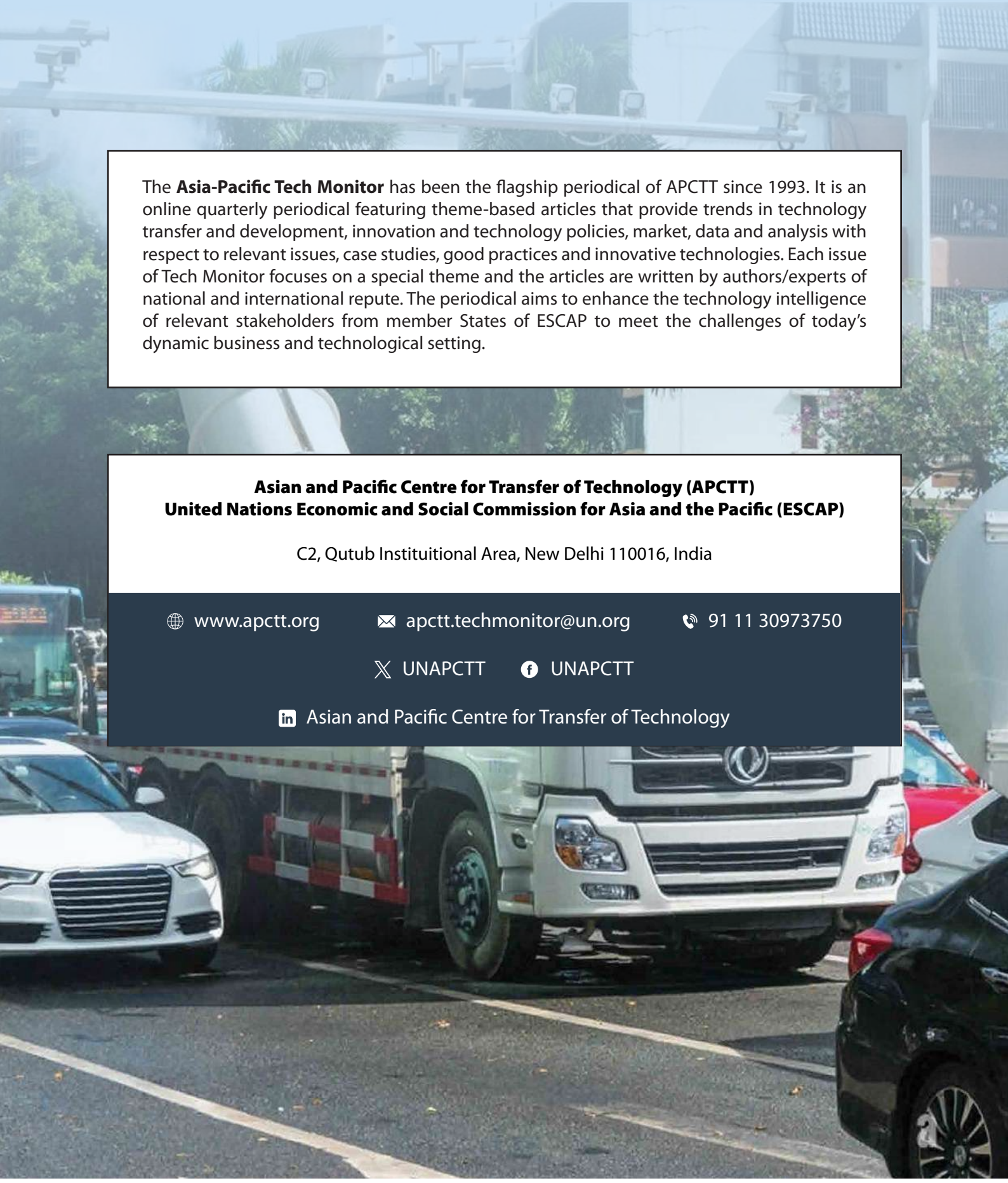
Technologies for decarbonizing transport systems

Apr-Jun 2023

Innovative technologies for disaster risk reduction

Jul-Sep 2023

Partnerships and regional collaborations: Integrating climate finance with the technology mechanism for climate change



The **Asia-Pacific Tech Monitor** has been the flagship periodical of APCTT since 1993. It is an online quarterly periodical featuring theme-based articles that provide trends in technology transfer and development, innovation and technology policies, market, data and analysis with respect to relevant issues, case studies, good practices and innovative technologies. Each issue of Tech Monitor focuses on a special theme and the articles are written by authors/experts of national and international repute. The periodical aims to enhance the technology intelligence of relevant stakeholders from member States of ESCAP to meet the challenges of today's dynamic business and technological setting.

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United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)

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