The Climate Technology Centre and Network (CTCN) is the operational arm of the UNFCCC Technology Mechanism, hosted by the UNEP. Since 2013, the CTCN has been promoting the accelerated transfer of environmentally sound technologies for low-carbon and climate-resilient development at the request of developing countries. CTCN delivers technology solutions, capacity building, and advice on policy, legal, and regulatory frameworks tailored to the needs of individual countries by harnessing the expertise of a global network of technology companies and institutions.

More information on CTCN's work in global can be found at: www.ctc-n.org

The National Institute of Green Technology (NIGT), a policy research institute affiliated with Korea's Ministry of Science and ICT, serves as a key facilitator in researching climate change and responding to the climate crisis through its work to develop national green technology policies, establish international cooperation strategies for innovation in global green technologies, and build infrastructure for technology information and talent cultivation.

More information on NIGT's work can be found at: www.nigt.re.kr

Integrating AI into Climate Action:

Enhancing Climate Technology Capacity in Asia-Pacific Countries

CONTENTS

FOREWORD

At COP 28, Parties requested the Technology Executive Committee (TEC) and the Climate Technology Centre and Network (CTCN) to enhance awareness on artificial intelligence (AI) and its potential to support countries to accelerate climate action. In response, TEC and CTCN are implementing the #AI4ClimateAction Initiative providing a space for policy discussions, awareness raising, capacity building and exchange of knowledge and experience on developing and deploying climate solutions powered by AI.

In this context, this year, the CTCN delivered a series of region-tailored capacity-building events for the UNFCCC Technology Mechanism's National Designated Entities (NDEs) on the use of AI to support and enhance adaptation and mitigation measures in countries. And as a complement to these in-person training events, I am pleased to introduce this compilation of curated national projects implemented in developing and developed countries from Asia and the Pacific region, enhancing climate technology capacity through digitalization.

Compiled by the CTCN, in partnership with the National Institute of Green Technology (NIGT), this brief intends to capture the pioneering efforts the countries have taken to apply emerging AI technology for climate action. Initially starting with a series of cases from the Asia-Pacific region, this knowledge piece will be updated to provide case studies from other regions of the world. The next version will include case studies from Latin America and the Caribbean.

We hope this will inspire countries to apply digital solutions and AI technologies to achieve the goals set out in their Nationally Determined Contributions (NDCs) under the Paris Agreement.

Jonathan Duwyn
Director OIC, CTCN

FOREWORD

As we have heard, our planet is no longer merely warming but boiling. This stark reality demands that we move beyond justification and take decisive action to halt climate change. While climate change is not a challenge that can be solved by individual nations acting alone, requiring a unified global response, reducing carbon dioxide emissions remains a daunting challenge for countries lacking in technology and financial resources.

It is in this critical context that we present our brief, 'Integrating AI into Climate Technology Capacity in Asia-Pacific Countries.' NIGT is pleased to once again collaborate with CTCN on this joint publication as a leading network member of the CTCN. This timely study serves as a testament to the potential of science and technology, particularly artificial intelligence, to lead the charge in the fight against climate change.

This brief explores how AI can revolutionize our approach to climate mitigation and adaptation, from optimizing energy grids to predicting extreme weather events. By showcasing successful case studies, including South Korea's TOPIS system, which optimizes traffic flow to reduce emissions, and identifying existing AI practices, this brief provides a guide for countries seeking to leverage AI for climate action. The insights presented here demonstrate how AI can play a transformative role in bridging the technology gap between nations.

We firmly believe that science and technology are the most effective tools for combating climate change. It is our hope that the insights in this brief will inspire and empower nations to integrate AI into their climate strategies.

Sanghyup Lee
President, National Institute of Green Technology

ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
AI4ClimateAction	Artificial Intelligence for Climate Action Initiative
AIMS	Australian Institute of Marine Science
AMAP	Artificial intelligence-based Mangrove Adaptive mapping tools in Pacific Island regions
AMI	Advanced Metering Infrastructure
BP	British Petroleum
COP	Conference of the Parties
CO_2	Carbon Dioxide
CTCN	Climate Technology Centre and Network
FAO	Food and Agriculture Organization
GIS	Geographic Information Systems
HVAC	Heating, Ventilation, and Air Conditioning
ICZM	Integrated Coastal Zone Management
IoT	Internet of Things
ITS	Intelligent Transport Systems
LDCs	Least Developed Countries
MRV	Monitoring, Reporting, and Verification

NDCs	Nationally Determined Contributions
NDEs	National Designated Entities
NSW	New South Wales
PIR	Passive Infrared
PoW	Programme of Work
PUB	Public Utilities Board
SIDS	Small Island Developing States
SuM4All	Sustainable Mobility for All
TA	Technical Assistance
TEC	Technology Executive Committee
TOPIS	Transport Operation and Information Service
UNEP	United Nations Environment Programme

INTRODUCTION

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1. INTRODUCTION

Background: Global Initiative - #AI4ClimateAction

The #AI4ClimateAction Initiative, a joint effort by the Technology Executive Committee (TEC) and the Climate Technology Centre and Network (CTCN), was officially launched during a side event at the 2023 Bonn Climate Conference and is currently exploring the potential of artificial intelligence (AI) to accelerate climate action. Recognizing AI as a powerful tool, the initiative focuses on developing and scaling up transformative solutions for both climate change mitigation (reducing emissions) and adaptation (adjusting to climate impacts).

The initiative serves as a multifaceted platform, with a particular emphasis on the Least Developed Countries (LDCs) and Small Island Developing States (SIDS). It fosters policy dialogue among policymakers and stakeholders, including national focal points and NDEs, to shape effective AI-driven climate strategies. Additionally, the initiative facilitates knowledge exchange, sharing insights, best practices, and lessons learned on the development and deployment of AI-powered climate solutions.

A key focus of the initiative is capacity building, empowering developing countries with the knowledge and skills needed to harness emerging digital technologies, including AI, and to create locally-led solutions. Furthermore, it aims to develop regional networks of organizations that support the use of AI for climate action.

This collaborative approach, combining the TEC's policy expertise with the CTCN's implementation capabilities, aims to ensure that AI is effectively harnessed to address the specific climate challenges faced by vulnerable nations.

Objectives

This brief has several important objectives. First, it aims to analyze how developing countries, particularly in the Asia-Pacific region, are integrating AI into their national climate action strategies. This analysis will provide valuable insights into current trends and challenges in AI adoption for climate action.

Secondly, the brief seeks to showcase successful case studies where AI has been applied to enhance climate technology capacity. These real-world examples will illustrate the practical applications and benefits of AI in addressing climate change.

Lastly, the brief aims to identify existing AI practices in Asia-Pacific regions and lessons learned that can guide other nations in leveraging AI for climate action. By distilling these insights, the brief will provide a framework for countries looking to incorporate AI into their climate strategies.

Through these objectives, the brief aims to contribute significantly to the understanding and implementation of AI-driven climate solutions, particularly in the Asia-Pacific region, while also offering insights that may be valuable to other developing nations facing similar challenges.

Two Key Enablers and Five System Transformation Areas

The CTCN Programme of Work (PoW) 2023-2027 is a strategic framework that leverages two key enablers – national systems of innovation and digitalization – to drive transformative change across five interconnected system transformation areas: the water-energy-food nexus, buildings and infrastructure, sustainable mobility, energy systems, and business and industry. These areas represent the core sectors where CTCN aims to focus its efforts for maximum impact in addressing climate change. This structure allows CTCN to maintain its demand-driven nature while adopting a more programmatic approach to enhance transformational impact and scale across its core areas.

The five system transformation areas are not isolated sectors but interconnected systems crucial for achieving global climate goals.

Water-Energy-Food Nexus : This area is critical due to the complex relationships between water, energy, and food systems, especially considering the projected global population growth. Climate change is exacerbating water scarcity and energy and food insecurity, disproportionately affecting vulnerable communities. The Water-Energy-Food nexus approach integrates hydrological, biological, social, and technological aspects to address these interconnected challenges. It aims to enhance efficiency and efficacy through technology and innovation, considering policy impacts and other factors on these vital resources (CTCN, 2023; FAO, n.d.).

Buildings and Infrastructure : This sector is a significant contributor to global energy consumption and CO_2 emissions. With building and construction accounting for nearly one-third of total final energy consumption and up to 15% of direct CO_2 emissions (CTCN, 2023), there's an urgent need for transformation. The challenge lies in balancing increasing energy needs in developing countries with improved energy efficiency and emission reductions. Climate technology and innovation play a key role in new construction, retrofitting, and redesigning existing infrastructure. Smart solutions can enhance both energy efficiency and resilience to climate change impact (UNEP, 2022; Shoaib et al., n.d.).

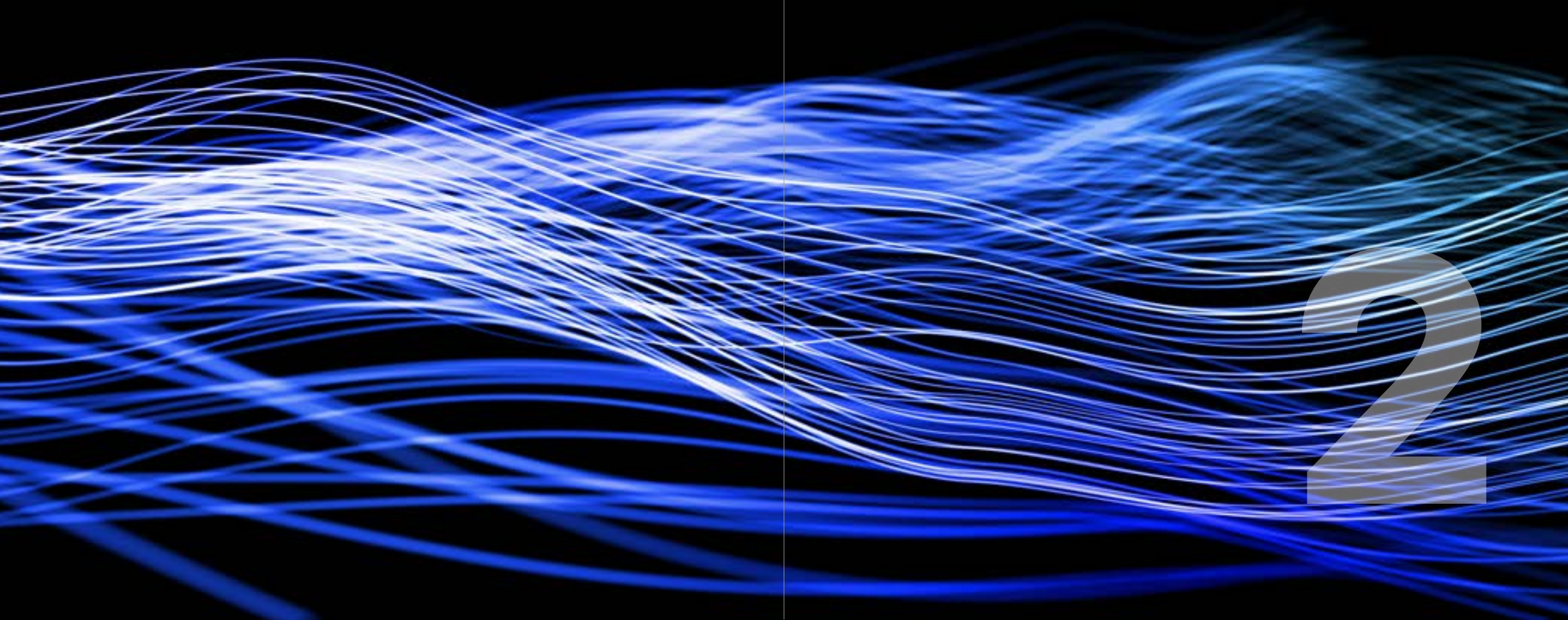
Sustainable Mobility : The transport sector's substantial contribution to CO_2 emissions (36% in 2021) makes this area crucial for climate change mitigation (CTCN, 2023). The transformation of this sector presents both challenges and opportunities for innovation-driven change throughout the entire value chain. Supporting sustainable mobility involves various strategies, including developing mobility regulations, deploying low-emission vehicles, improving fuel economy, and utilizing digital technologies for intelligent urban transport systems. This transition also opens up new markets for electric vehicles, renewable fuels, and smart mobility services (SuM4All, 2022).

Energy Systems : As the largest source of global CO_2 emissions, energy systems require a paradigm shift in production, conversion, and use to achieve net-zero emission goals. Their complexity, involving both physical infrastructure and societal elements, necessitates rapid development and integration of innovative technologies. International collaboration and support are crucial in assisting developing countries to build resilient and clean energy systems, recognizing the urgency and complexity of this transformation (CTCN, 2023; Do, 2024).

Business and Industry : This sector accounted for 24% of global GHG emissions in 2019 (IPCC, 2022), with energy-intensive processes in industries like cement and steel. Climate change also threatens businesses and industries through extreme weather events. A transformation in this area aims to reduce the carbon footprint while increasing climate resilience. With an increasing portfolio of low-carbon and cost-competitive technologies, there is a strong business case for climate action. This transformation can stimulate economic growth, enhance natural capital, boost technological change, and increase productivity and efficiency across various scales of businesses (CTCN, 2023; NSW Government, n.d.).

By focusing on these five interconnected systems, the CTCN aims to catalyze transformative change at a systemic level, fostering a holistic approach to climate action that addresses multiple dimensions of the climate crisis simultaneously. AI, as a cross-cutting technology, has the potential to accelerate progress in each of these areas, making it a critical tool to achieve a sustainable and climate-resilient future.

AI TECHNOLOGIES IN FIVE SYSTEM TRANSFORMATION AREAS



2. AI TECHNOLOGIES IN FIVE SYSTEM TRANSFORMATION AREAS

The examples across five key areas demonstrate the transformative potential of AI in addressing climate change and promoting sustainability. As these technologies continue to evolve and be adopted more widely, they promise to play an increasingly crucial role in our transition to a more sustainable future.

Water-Food-Energy Nexus

AI is transforming agriculture by addressing food security challenges while optimizing water and energy use. Sensor deployment in fields powered by AI bolsters crop

resilience by providing real-time data on soil conditions, plant health, and potential climate threats. Advanced technologies like drones and satellites further enable precision farming, allowing for targeted irrigation and precise input application, ultimately leading to improved water management, accounting, and productivity. AI systems can predict crop yields, identify threats early, and minimize loss through timely interventions (Hung and Siddiqi, 2024).

These innovations extend beyond the field, revolutionizing the entire food supply chain. AI-powered platforms and tools are fostering collaboration and learning across the agri-food sector, accelerating technology development and transfer. AI optimizes food storage, transportation, and distribution, reducing waste and maintaining product freshness. The integration of these technologies is paving the way for a more efficient and resilient agricultural system that not only balances the complex interplay of water, energy, and food production but also recognizes the vital importance of ecosystem conservation and restoration to ensure food security in the face of a changing climate (FAO, 2022; Ikram et el., 2024).

Examples

- The **PATS-X,** being tested in the Netherlands and Belgium, is an autonomous drone that uses AI and a computer vision system to detect and eliminate harmful pests in crops with high precision. This innovative approach aims to dramatically reduce pesticide use, promoting more sustainable agriculture. If successful, PATS-X has the potential to reduce the carbon footprint of agricultural chemical production and application, potentially leading to more environmentally friendly farming practices (PATS, 2024).

- The **CropX,** an AI-powered agricultural management platform that helps farmers boost crop yields and reduce resource waste through real-time field monitoring and smart recommendations, is utilized in more than 70 countries. The system integrates data “from soil to sky,” enabling farmers to optimize irrigation timing, prevent crop diseases, and manage nutrition more efficiently while reducing water and fertilizer usage through its user-friendly interface that doesn't require extensive expertise (CropX, 2024).

Building and Infrastructure

AI is transforming building and infrastructure development, driving the creation of sustainable and resilient urban environments while optimizing energy consumption and operational efficiency. AI-powered design tools are revolutionizing how buildings are conceived and constructed, enabling the integration of energy-efficient features from the earliest planning stages. Building automation systems powered by AI intelligently control heating, cooling, and lighting systems, while predictive maintenance capabilities anticipate equipment failures, minimizing downtime and reducing operational costs. AI-powered early warning systems enhance infrastructure resilience by predicting and mitigating potential disruptions (Himeur et al., 2022).

Through optimized energy management and urban planning, AI is enabling the development of smarter and more adaptable infrastructure across different economic contexts. AI technologies support the design of buildings and infrastructure that integrate nature-based solutions and ecosystem-based approaches, such as Google's Tree Canopy Lab detecting urban tree coverage and IBM's carbon sequestration measurement systems in cities, providing cost-effective ways to address climate change and urbanization challenges (Ghisleni, 2024). These innovations are particularly valuable in rapidly developing urban areas, where AI-enabled solutions can help create more sustainable, efficient, and resilient built environments while reducing overall environmental impact.

Examples

- The **PEAK Platform** is an AI-powered building analytics software that has been operationalized in various commercial buildings in Australia, UK, and Ireland. It optimizes plant and equipment performance by identifying energy-draining faults, influencing procurement choices, and continuously monitoring for opportunities. By integrating existing building data and providing real-time insights, PEAK reduces energy consumption and lowers carbon emissions (CIM, 2024a, 2024b).

- **BrainBox AI** is an innovative AI-powered building management system that changes energy consumption in large commercial buildings by optimizing HVAC energy use through data analysis from equipment performance, utility patterns, and weather conditions. It has been successfully implemented in various climates and building types worldwide, including Australian shopping malls, Canadian office buildings, and Loyola University in the United States (BrainBox AI, 2024).

Sustainable Mobility

AI is driving a transformation in transportation, leading to systems that are more efficient, safer, and environmentally friendly. To reduce the transportation sector's carbon footprint, AI is optimizing traffic flow in real-time, minimizing congestion and emissions. AI is also revolutionizing vehicle operation and maintenance, paving the way for a future where transportation is not only greener but also more reliable and cost-effective. AI-powered data analysis and digital technologies are being leveraged to enhance urban transport systems, facilitating the development of informed public and shared mobility regulations (Hever, 2023).

Advances in autonomous driving technology are pushing the boundaries of what is possible in transportation. For electric vehicles, AI is optimizing routes and charging stops, maximizing their range and efficiency. AI is also instrumental in promoting the deployment of low-emission vehicles through intelligent urban planning and infrastructure development. AI-powered solutions are also enhancing the efficiency and sustainability of existing transportation infrastructure, ensuring its longevity and reducing its environmental impact (Conde & Twinn, 2019). Through these applications, AI is paving the way for a future of sustainable mobility.

Examples

- The United States' **Waymo Driver** is an AI-driven system for autonomous vehicles that aims to make transportation safer and more efficient. By optimizing routes and driving patterns, Waymo Driver can reduce fuel consumption and emissions from transportation, showcasing AI's potential to create more sustainable mobility solutions (Waymo, 2024).

- **Railigent X** is an AI-powered predictive maintenance suite applied in the Rhein-Ruhr-Express (Germany) project, enhancing rail system efficiency and sustainability by predicting problems, reducing downtime, and extending component lifetime. This efficiency leads to reduced material use, decreased resource and energy consumption, and lower emissions, thereby advancing sustainable transportation and increasing rail system capacity (Siemens Mobility, 2024).

Energy System

The energy sector is being revolutionized by AI technologies, leading to more efficient and sustainable power systems. In grid management, AI-powered smart grids are optimizing energy distribution, predicting demand, and seamlessly integrating renewable energy sources. AI is also proving invaluable in maximizing the efficiency and output of renewable energy generation. Energy forecasting, driven by AI, is predicting energy generation and consumption patterns to improve grid management and minimize waste. AI is also playing a crucial role in decarbonization initiatives, investigating technology options, energy flows, and life-cycle emissions to guide policy development (Argonne National Laboratory, 2024).

AI not only enables the intelligent management and optimization of diverse energy assets, including renewables like solar and wind power but also facilitates demand response management. This AI-driven approach dynamically adjusts energy consumption in response to real-time grid conditions, balancing supply and demand (Shim, 2024). Furthermore, AI is helping to understand the dynamic energy landscape by investigating emerging technologies and trends, including platforms for peer-to-peer renewable energy trading (Schabram & Veillard, 2021). Through these AI applications, the energy sector is undergoing a significant transformation towards a more sustainable future.

Examples

- Omega Energia (Brazil) improves the efficiency and reliability of clean energy production by utilizing IBM's AI-driven **Renewable Forecasting Platform**. The enhanced accuracy of wind and solar farm operations optimizes renewable energy generation and promotes sustainable energy solutions (IBM Corporation, 2021).

- BP (UK) deploys the **Open Energi** AI platform to optimize energy assets like battery storage, hydrogen electrolyzers, and solar farms. The platform connects to power markets, enabling flexible management during low renewable generation and price peaks. This boosts the efficiency and profitability of BP's renewable energy assets and allows for more flexible energy supply and demand management (BP, 2024).

Business and Industry

AI is catalyzing a transformation in the business landscape, driving greater efficiency and environmental sustainability across various operations. In supply chain management, AI is streamlining logistics and reducing transportation costs while minimizing environmental impact. In manufacturing, AI optimizes production processes, reduces material waste, and improves energy efficiency. AI-powered tools, such as natural language processing algorithms, enable companies to accurately estimate and track their carbon footprints, facilitating informed decision-making towards sustainability goals. AI is also enabling decarbonization initiatives for carbon-intensive industries, including optimization of energy consumption in data centers and other energy-intensive operations (Mehta, 2024).

AI contributes to fostering active partnerships between the scientific community, the private sector, and the government to develop and implement new technologies and business models for sustainability. These collaborations are facilitated through regional fora and matchmaking services, supporting early-stage innovation (Sharma, 2024).

Furthermore, AI contributes to sustainable product development by aiding in material selection and conducting life-cycle assessments, resulting in products with a lower environmental footprint (Wasserman, 2023). Through these diverse applications, AI is playing a critical role in mitigating the environmental impact of industrial activities and fostering a more sustainable future for businesses.

Examples

- Amazon's AI-powered **Flamingo** algorithm uses natural language processing to estimate carbon footprints by matching text descriptions for Environmental Impact Factors (EIF). It has significantly reduced calculation time, helping Amazon assess the environmental impact of items sold by Amazon Private Brands and Amazon Fresh. Flamingo is also available for other companies, aiding their sustainability goals (Amazon News. 2024).

- Google's **DeepMind** AI optimizes cooling in data centers, significantly reducing energy consumption in these energy-intensive facilities. By decreasing cooling energy use by 40%, this system directly cuts emissions from data center operations, showcasing AI's potential to improve energy efficiency in the technology sector (Evan & Gao, 2016; Google DeepMind, 2023).

CASE STUDIES IN ASIA

3

3. CASE STUDIES IN ASIA

National AI Strategies for Climate Action in Asia: An Overview

Many Asian countries have recognized AI's potential to accelerate climate action and are developing national AI strategies that align with their climate goals specified in nationally determined contributions (NDCs). These strategies typically focus on using AI in areas such as agriculture, disaster risk reduction and management, emissions monitoring and reporting, energy management, transport, water management, etc. This overview highlights the key strategies and initiatives being undertaken by Asian nations to leverage AI and digital technologies in their climate action plans.[1]

Agriculture

Armenia

Promoting digital agriculture and technological innovation for sustainable intensification of animal breeding and improved efficiency.

[1] This section's information draws from individual country Nationally Determined Contributions (NDCs). Individual citations are omitted for brevity.

Cambodia

Utilizing AI to enhance animal breeding techniques for climate resilience and to establish a National Water Resource Management Information Centre.

Thailand

Implementing precision farming, low-methane rice production, and digitalization throughout the agricultural production chain.

UAE

Modernizing traditional farms with AI-powered operating models for optimized production and water conservation.

Disaster Risk Reduction and Management

China

Developing platforms like the "city brain" in Lishui to digitally transform disaster prevention, relief, and emergency management.

Pakistan

Leveraging space technologies and digital innovation to enhance community resilience to climate shocks.

UAE

Utilizing space-based technologies and AI for rapid flood damage assessment and comprehensive flood monitoring.

Emission Monitoring and Reporting

Cambodia

Deploying digital systems for monitoring, reporting, and verifying greenhouse gas emissions from the transport sector.

China

Creating platforms like the Low-Carbon City Construction Management Cloud Platform in Zhenjiang to visualize urban greenhouse gas emissions.

Energy Management

UAE

Implementing Advanced Metering Infrastructure (AMI) and smart meters for real-time monitoring and management of energy consumption.

Transport

Cambodia

Identifying digital systems as crucial for emissions monitoring in the transport sector and exploring spatial planning tools for network management.

Jordan

Implementing Intelligent Transport Systems (ITS) to enhance efficiency and reduce emissions.

Sri Lanka

Exploring intelligent transport management systems to improve traffic flow and reduce emissions.

Water Management :

Cambodia

Establishing a National Water Resource Management Information Centre with digital technologies for data storage, analysis, and dissemination.

Pakistan

Leveraging space technologies and digital innovation for improved water resource management.

Sri Lanka

Implementing real-time water quality and water level monitoring systems.

Additional Strategies:

Bangladesh

Incorporating AI and digitalization into the Accelerated Digital Revolution under the Mujib Climate Prosperity Plan.

Lebanon

Planning to use innovative digitalization of climate action for a more efficient and sustainable green transition.

UAE

Launching the Jahiz initiative to upskill government employees in AI, data analytics, and net zero concepts.

Vietnam

Employing AI, big data, IoT, blockchain, and cloud computing to estimate climate change impacts, support stakeholders, and turn challenges into opportunities.

The integration of AI and digital technologies into national climate action plans in Asia holds immense potential for accelerating progress towards climate goals. By harnessing the power of data-driven insights, predictive analytics, and automation, these countries can enhance the efficiency and effectiveness of their climate mitigation and adaptation efforts.

While AI integration plans might not be explicitly detailed in their NDCs, several Asian countries are already demonstrating proactive leadership in harnessing AI for climate action. The Oxford Insights AI Readiness Index, which evaluates governments' preparedness for AI implementation in public services, highlights Singapore and South Korea as frontrunners in East Asia, while India leads in South and Central Asia (Oxford Insights, 2023). The next section delves into specific case studies from these three countries, showcasing their innovative AI applications for climate change mitigation and adaptation. These real-world examples aim to provide practical insights and lessons learned, offering valuable guidance to other countries seeking to leverage AI's potential in their climate action strategies.

Case 1
India

Optimizing Household Energy Consumption : India's Tata Power EZ Home

Tata Power leverages AI to enhance household energy efficiency and support India's clean energy goals

Electricity distributors face the complex challenge of balancing supply and demand across millions of households, each with unique consumption patterns. As India integrates more renewable energy sources into its grid, this balancing act becomes even more intricate. The variability of solar and wind power generation, combined with the diverse and often unpredictable nature of household energy consumption, creates a significant challenge for energy management.

This challenge is further complicated by the fact that household energy consumption is largely driven by individual behaviors and routines. Factors such as weather conditions, work schedules, holidays, and even major events can significantly influence electricity usage. Traditional methods of forecasting and managing household energy consumption often fail to capture these nuances, leading to inefficiencies and potential grid instability.

Recognizing these challenges, Tata Power, one of India's largest integrated power companies, has developed the EZ Home platform. This AI-powered solution leverages machine learning and Internet of Things (IoT) technologies to optimize household energy consumption, control appliances, and enhance overall energy efficiency. By integrating smart home automation features, EZ Home aims to provide a seamless and energy-efficient living experience (Tata Power, 2024).

The EZ Home system incorporates several key technologies (Tata Power, 2024).

- **IoT-enabled Smart Devices** : EZ Home uses IoT technology to allow users to operate, schedule, and monitor household appliances, including lighting, fans, air conditioners, and more, via smartphone applications or voice commands.
- **AI-Powered Motion Sensors** : The system includes AI-powered Passive Infrared (PIR) Motion Sensors that can control attached appliances based on human presence.
- **Energy Management Analytics** : EZ Home provides end-users with data on their actual and predicted consumption at various levels (product, room, and home), helping them manage their energy use more effectively.
- **Seamless Integration** : The EZ Home devices are designed for easy installation and offer backward compatibility, allowing for integration into existing home setups without extensive rewiring.

The EZ Home system is expected to offer significant benefits in energy management and sustainability.

- **Reduced Energy Waste** : By optimizing energy consumption and distribution, EZ Home reduces the need for overproduction and minimizes energy loss during transmission and distribution.
- **Enhanced Energy Efficiency**: The platform promotes energy-saving practices and technologies, contributing to overall energy efficiency at the household level.

- **Lowered Carbon Footprint** : By reducing energy waste and promoting efficient energy use, EZ Home directly contributes to lowering greenhouse gas emissions at the household level.
- **Consumer Empowerment** : By providing detailed consumption data and insights, EZ Home empowers consumers to make informed decisions about their energy use, potentially leading to behavioral changes that further reduce energy consumption.

The EZ Home platform represents a significant step towards creating a more responsive and efficient energy ecosystem at the household level. By leveraging AI to enhance smart home automation and optimize energy consumption, Tata Power's EZ Home is playing a crucial role in supporting India's clean energy transition and climate goals.

The system demonstrates how advanced technologies can empower individuals to manage their energy use more effectively, contributing to broader national and global sustainability objectives. As countries worldwide strive to reduce their carbon footprint and build a more resilient future, solutions like EZ Home showcase the transformative potential of AI in creating a more sustainable and energy-efficient world.

Case 2
Singapore

Optimizing Water Management : Singapore's Smart Water Technology

Singapore's PUB leverages AI to enhance water resource management and conservation

As a small island nation with limited natural resources, Singapore faces unique challenges in managing its water supply. With increasing urbanization, population growth, and the impacts of climate change, the need for efficient water management has never been more critical. The Public Utilities Board (PUB), Singapore's national water agency, has embraced artificial intelligence, automation, data analytics, and machine learning to address these challenges and ensure a sustainable water future for the city-state (PUB, 2019).

Managing water resources effectively requires a delicate balance of supply and demand, much like electricity grids. However, water management presents its own set of complexities, including the need to detect leaks, predict demand patterns, and optimize treatment processes. Forecasting water demand is particularly challenging due to the multitude of factors influencing consumption patterns, such as weather patterns, population dynamics, economic activities, and even major events that alter daily routines. Accurately predicting and managing water demand requires advanced analytics capable of processing and learning from vast amounts of data – a task well-suited for artificial intelligence.

PUB has developed and invested in Smart Water Technology, which utilizes an AI-powered approach incorporating machine learning to analyze data from sensors throughout the water supply network. This system is capable of detecting leaks, predicting water demand, and optimizing water usage.

The Smart Water Technology incorporates several key technologies (Brears, 2024; PUB, 2023; Biswas, 2021).

- **Smart Water Meters** : These advanced meters provide accurate, real-time data on water consumption, enabling both PUB and consumers to monitor usage, detect water leaks almost immediately, and identify abnormal usage patterns.

- **Real-Time Monitoring and Control Systems** : These systems, coupled with data from smart meters and other sensors, allow PUB to gain valuable insights into water usage patterns and make informed decisions about water management.

- **Data Analytics** : By collecting and analyzing data from various sources, including water meters, weather stations, and other sensors, PUB can identify trends, predict demand, and optimize water distribution for maximum efficiency and sustainability.

The Smart Water Technology is expected to offer significant benefits in water management and sustainability.

- **Water Conservation** : By detecting leaks early and optimizing water distribution, the system helps conserve resources and reduce the energy footprint of water treatment.

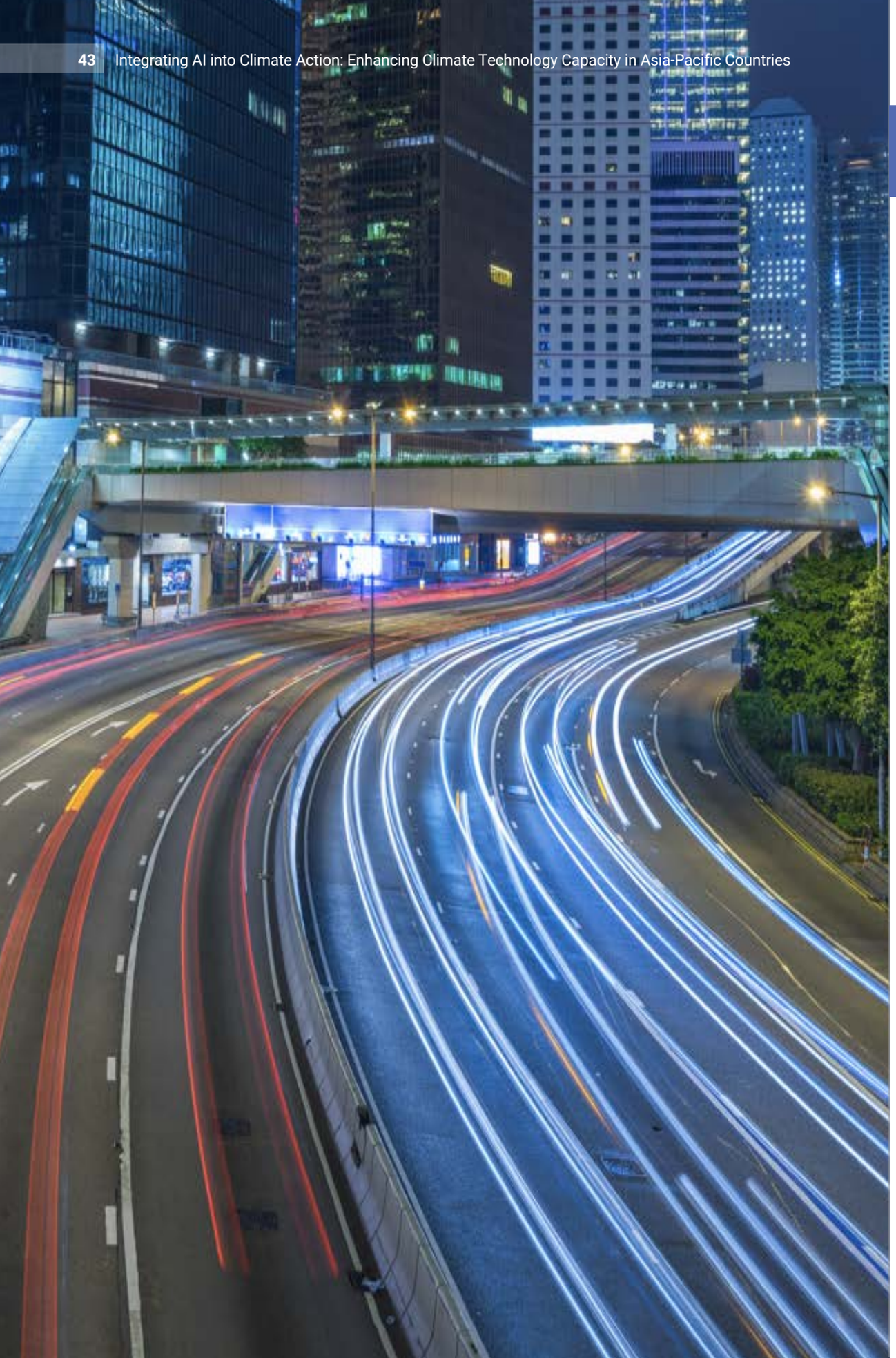
- **Energy Efficiency** : Optimizing water treatment operations reduces energy consumption, thereby lowering greenhouse gas emissions associated with energy production. This contributes to a more sustainable and environmentally friendly water management system.

- **Consumer Empowerment** : Smart meters provide real-time feedback on water consumption, enabling consumers to make informed decisions and adopt water-saving behaviors. This promotes greater awareness and proactive management of water use at the household level.

- **Predictive Maintenance** : The system can predict potential issues in the water network, allowing for proactive maintenance and reducing the risk of major disruptions. This helps maintain a reliable and efficient water supply system

Every drop of water comes at a cost, requiring energy, chemicals, labor, and resources to produce. With a growing population and economy, coupled with the looming threat of climate change, the need for efficient water management is paramount. The Smart Water Technology, with its AI-powered capabilities, is a testament to Singapore's proactive approach to addressing these challenges. By enabling real-time monitors, leak detection, and demand forecasting, this system is not only ensuring a reliable water supply for the present but also building a resilient water future for generations to come.

Singapore's embrace of AI in water management exemplifies how technology can revolutionize resource conservation and contribute to broader sustainability goals. As the world grapples with the increasing pressures on water resources, Singapore's Smart Water Technology serves as an inspiring model for other nations seeking to leverage innovation for a water-secure future.



Case 3
Korea

Optimizing Urban Mobility : South Korea's TOPIS

South Korea’s TOPIS uses AI to revolutionize traffic management and reduce emissions

Urban transportation managers face the daunting task of managing complex traffic flows in real-time, balancing the needs of various modes of transport while minimizing congestion and emissions. As cities grow and vehicle numbers increase, this challenge becomes increasingly complex. The integration of public transportation, private vehicles, and emerging mobility solutions adds further layers of intricacy to urban traffic management.

Forecasting traffic patterns is particularly challenging due to the multitude of factors influencing urban mobility, such as daily commute patterns, weather conditions, economic activities, public events, and even unexpected incidents. Accurately predicting and managing traffic in real-time demands advanced analytics capable of processing and learning from vast amounts of data—a task for which AI is ideally suited.

The Seoul Metropolitan Government has developed the Transport Operation and Information Service (TOPIS), an AI-powered traffic management system that uses data to predict traffic patterns and adjust traffic light timing in real-time to reduce congestion (Seoul Transport Operation & Information Service, n.d.a).

The TOPIS system incorporates several key technologies (Seoul Transport Operation & Information Service, n.d.b).

- **Real-time Data Collection** : Utilizes a network of sensors, cameras, and GPS devices to gather comprehensive traffic data across the city.
- **AI-powered Predictive Analytics** : Employs machine learning algorithms to analyze historical and real-time data, predicting traffic patterns and potential congestion points.
- **Adaptive Traffic Signal Control** : Automatically adjusts traffic light timings based on current and predicted traffic conditions to optimize flow.
- **Public Transportation Prioritization** : Gives priority to buses and other public transit vehicles to encourage their use and improve efficiency.

The TOPIS system is expected to offer significant benefits in urban traffic management and sustainability.

- **Reduced Traffic Congestion** : TOPIS optimizes traffic flow to reduce idling and unnecessary acceleration/deceleration, leading to lower fuel consumption and emissions from vehicles.
- **Improved Air Quality** : Reduced congestion contributes to improved air quality, benefiting public health and reducing the impact of air pollution on the climate.
- **Efficient Public Transportation** : The system prioritizes public transportation, encouraging its use and further reducing emissions.
- **Enhanced Emergency Response** : TOPIS enables faster response times for emergency vehicles by dynamically adjusting traffic signals.

The TOPIS system has evolved into TOPIS 3.0, a smart metropolitan city management hub that integrates transportation, disaster management, and security-related events. This advanced system not only allows for prompt decisions and responses in times of emergency, and predicts and prevents transportation problems before they occur through big data analysis.

By leveraging AI to optimize traffic flow and reduce congestion, South Korea's TOPIS significantly decreases emissions from the transportation sector. Moreover, its ability to detect and restrict high-emission vehicles within designated zones further strengthens its direct contribution to mitigating climate change and promoting cleaner air within the city.

TOPIS serves as a powerful example of how AI-driven solutions can empower cities to tackle multiple challenges simultaneously, promoting both efficiency and environmental sustainability. As cities worldwide grapple with the dual challenges of urbanization and climate change, such AI-driven solutions will become increasingly vital in creating more sustainable and efficient urban environments.

CASE STUDIES IN THE PACIFIC

4

4. CASE STUDIES IN PACIFIC

National AI Strategies for Climate Action in the Pacific: An Overview

Pacific Island countries are acutely vulnerable to the impacts of climate change, facing rising sea levels, extreme weather events, and threats to their ecosystems and livelihoods. While many of these nations may not have fully developed national AI strategies, they are increasingly recognizing the potential of AI to enhance climate resilience and adaptation efforts.[2]

[2] This section's information draws from individual country Nationally Determined Contributions (NDCs). Individual citations are omitted for brevity.

Papua New Guinea

Papua New Guinea is leading the way in utilizing AI and the IoT in its climate action plans. The country plans to :

- **Mitigate the Impact of Flooding** : Utilize AI and IoT technologies for improved flood prediction models and real-time monitoring of water levels and infrastructure.
- **Enhance the Timber Legality System** : Implement a "Near-Real-time Deforestation and Degradation Alerts Monitoring System" potentially incorporating AI for data analysis to identify illegal logging.
- **Understand Landslide Risks** : Employ AI to analyze data from Geographic Information Systems (GIS) and Remote Sensing Tools to better predict and understand landslide risks.

Other SIDS

While not as explicitly detailed as Papua New Guinea, other SIDS are also exploring the potential of AI and digital technologies for climate action.

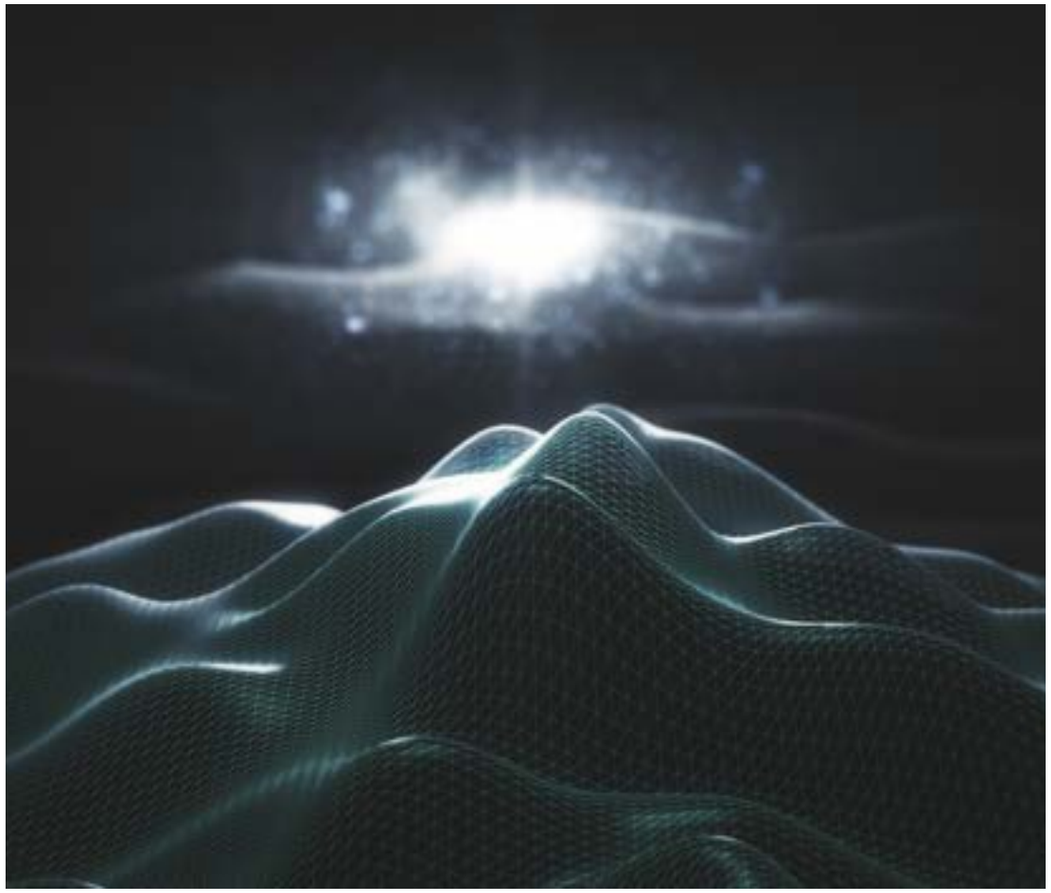
- **Fiji** : Focuses on utilizing digital technologies for early warning systems, climate modeling, and data analysis to improve climate resilience and adaptation planning.

- **Samoa** : Explores the use of digital tools, potentially including AI, for data collection and analysis to monitor climate change impacts and the effectiveness of adaptation measures.

- **Tonga** : Emphasizes the importance of digital infrastructure for early warning systems and disaster risk reduction, with potential applications of AI in climate modeling and data analysis.

Pacific Island countries are demonstrating a growing commitment to harnessing the power of AI and digital technologies to address the urgent challenges posed by climate change. While the specific plans and strategies vary across countries, the overarching goal remains the same: to build a more climate-resilient and sustainable future for their communities and ecosystems. The continued development and deployment of AI-powered solutions in the Pacific region hold the promise of transformative change in the fight against climate change.

While the Asia-Pacific region showcases a range of AI readiness and implementation levels, the Pacific Island nations, though often overlooked, are also making significant strides in leveraging AI for climate action. Despite in light of their unique



vulnerabilities and resource constraints, these SIDS recognize the potential of AI to enhance their climate resilience and adaptation efforts. This section will explore two specific case studies from these island nations, showcasing their innovative approaches to leveraging AI for climate mitigation and adaptation. These real-world examples aim to provide practical insights and lessons learned, potentially offering a framework for other countries facing similar challenges.

Case 1

Fiji, the Maldives, Palau, Solomon Islands, and Vanuatu

Optimizing Marine Ecosystem: Pacific Islands' ReefCloud

Five Pacific nations leverage AI for real-time coral reef monitoring and conservation

Coral reef managers face the daunting task of monitoring and protecting complex marine ecosystems in real time, balancing the needs of various species while minimizing degradation and climate impacts. As ocean temperatures rise and human pressures increase, this challenge becomes increasingly complex. The integration of diverse coral species, marine life, and emerging conservation solutions adds further layers of intricacy to coral reef management.

Managing coral reefs effectively requires a delicate balance of factors, including assessing reef health, optimizing conservation efforts, and prioritizing the protection of vulnerable areas. Challenges such as climate change, ocean acidification, and evolving marine ecosystems further complicate these efforts. Accurately monitoring and managing coral reefs in the face of these dynamic conditions necessitates advanced analytics capable of processing and learning from vast amounts of visual and environmental data in real time—a complex task that AI is uniquely equipped to handle.

ReefCloud has been developed as an AI-powered coral reef management system that uses data from images of coral reefs to rapidly assess and share information about reef health and composition worldwide.

The ReefCloud system incorporates several key technologies.

- **Machine Learning** : ReefCloud's AI utilizes advanced algorithms trained on the Australian Institute of Marine Science (AIMS)'s Long-Term Monitoring Program data to identify and classify coral reefs from images automatically. This allows for rapid and accurate assessment of reef health, standardizing collected data with 80-90 percent accuracy and analyzing coral reef composition at a speed 700 times faster than traditional manual methods (AIMS, 2024).

- **Cloud Computing** : ReefCloud employs a cloud-based platform that enables users to upload, access, and share data from anywhere in the world. This facilitates collaboration among researchers and managers and supports the processing of large image datasets (Chanthadavong, 2024)

- **Big Data Analytics** : ReefCloud Analytics processes millions of quality-controlled point annotations to identify trends and patterns in coral reef health data. This informs conservation and management decisions by providing detailed insights into reef composition and condition over time (Williams et al., 2019).

- **3D Visualization** : ReefCloud incorporates high-tech computer programs to visualize reefs in 3D, offering a more comprehensive understanding of reef structures and health (AIMS, 2024).

ReefCloud is expected to offer significant benefits in coral reef protection and climate change mitigation.

- **Improved Monitoring** : ReefCloud provides a rapid and accurate way to assess coral reef health, helping to track changes over time and identify areas that need protection.

- **Enhanced Management** : The system provides managers with the information needed to make informed decisions about conservation and restoration efforts.

- **Increased Collaboration** : ReefCloud facilitates collaboration between researchers and managers by offering a platform for sharing data and information, leading to more effective coral reef conservation efforts.

- **Resource Optimization** : By analyzing coral reef composition with 80-90 percent accuracy and 700 times faster than traditional manual assessment, ReefCloud saves weeks to months of labor, freeing up precious reef management resources.

ReefCloud has evolved into a user-friendly platform that is positioned to transform coral reef monitoring and management by allowing the world's coral reef monitoring community to work together in real time. This advanced system allows for standardized data collection and rapid analysis, enabling prompt decisions and responses in times of environmental stress.

By leveraging AI to optimize coral reef management, ReefCloud is not only playing a crucial role in protecting marine ecosystems but also actively contributing to the mitigation of climate change impacts on coral reefs. The system demonstrates how advanced technologies can empower conservationists to more effectively manage complex marine systems while contributing to broader national and global sustainability objectives. As coastal communities worldwide face the increasing threats of ocean warming and ecosystem degradation, AI-driven solutions like ReefCloud will become increasingly vital in creating more resilient and healthy coral reef environments.

Case 2
Solomon Island

Safeguarding Coastal Ecosystems: Solomon Islands' ICZM with AMAP[3]

Solomon Islands leverages AI to enhance mangrove conservation and climate change adaptation

The Solomon Islands, like many Pacific Island nations, faces a complex set of resource and environmental challenges. The degradation of coastal ecosystems, such as mangroves, poses a significant threat to the country's biodiversity, food security, and resilience to climate change. The unsustainable harvesting of coastal fishery resources, pollution, and the impacts of climate variability further exacerbate these challenges. The Solomon Islands' economy, heavily reliant on agriculture, forestry, and fisheries, is particularly vulnerable to the degradation of these vital ecosystems.

Mangroves play a crucial role in coastal protection, providing a natural barrier against storms and erosion. They also serve as important habitats for a variety of marine life and contribute to the overall health and productivity of coastal fisheries. The loss of mangroves not only jeopardizes the livelihoods of coastal communities but also undermines the country's efforts to adapt to climate change.

The government of the Solomon Islands recognizes the urgency of addressing these challenges, so the protection of mangroves through ecosystem-based adaptation

[3] The CTCN's TA project supported the implementation of Integrated Coastal Zone Management (ICZM) in the Solomon Islands. The key technological insights presented are based on expertise provided by Professor Chul-Hee Lim of Kookmin University, South Korea.

solutions has been developed by the CTCN's technical assistance (TA) project. The development of Artificial intelligence-based Mangrove Adaptive mapping tools in Pacific Island regions (AMAP), the output of the CTCN TA, represents a significant step in this direction.

AMAP is an AI-powered system that utilizes satellite imagery and advanced analytics to monitor and assess the health of mangrove forests in the Solomon Islands (CTCN, 2022).

The AMAP system incorporates several key technologies.

- **Satellite Data Processing** : AMAP processes satellite images, filtering out those with excessive cloud cover and removing clouds from the remaining images. It then calculates a mangrove-specific index to facilitate mangrove detection.

- **Deep Learning** : The U-Net deep learning algorithm is employed to classify mangroves based on the mangrove-specific index. This enables the generation of detailed maps illustrating mangrove distribution, aiding in conservation, restoration, and management efforts.

- **Machine Learning** : AMAP leverages historical climate data and climate change scenarios to develop models using various machine learning algorithms. These models are then combined through an ensemble approach to predict changes in vegetation species, including mangroves. This process helps identify more reliable projections for future habitat distributions, informing adaptation strategies.

- **Patial Visualization** : AMAP integrates with Google Earth imagery to visualize and overlay analyzed results, providing a visual assessment of mangrove distribution and changes over time.

AMAP is expected to offer significant benefits in mangrove conservation and climate change adaptation.

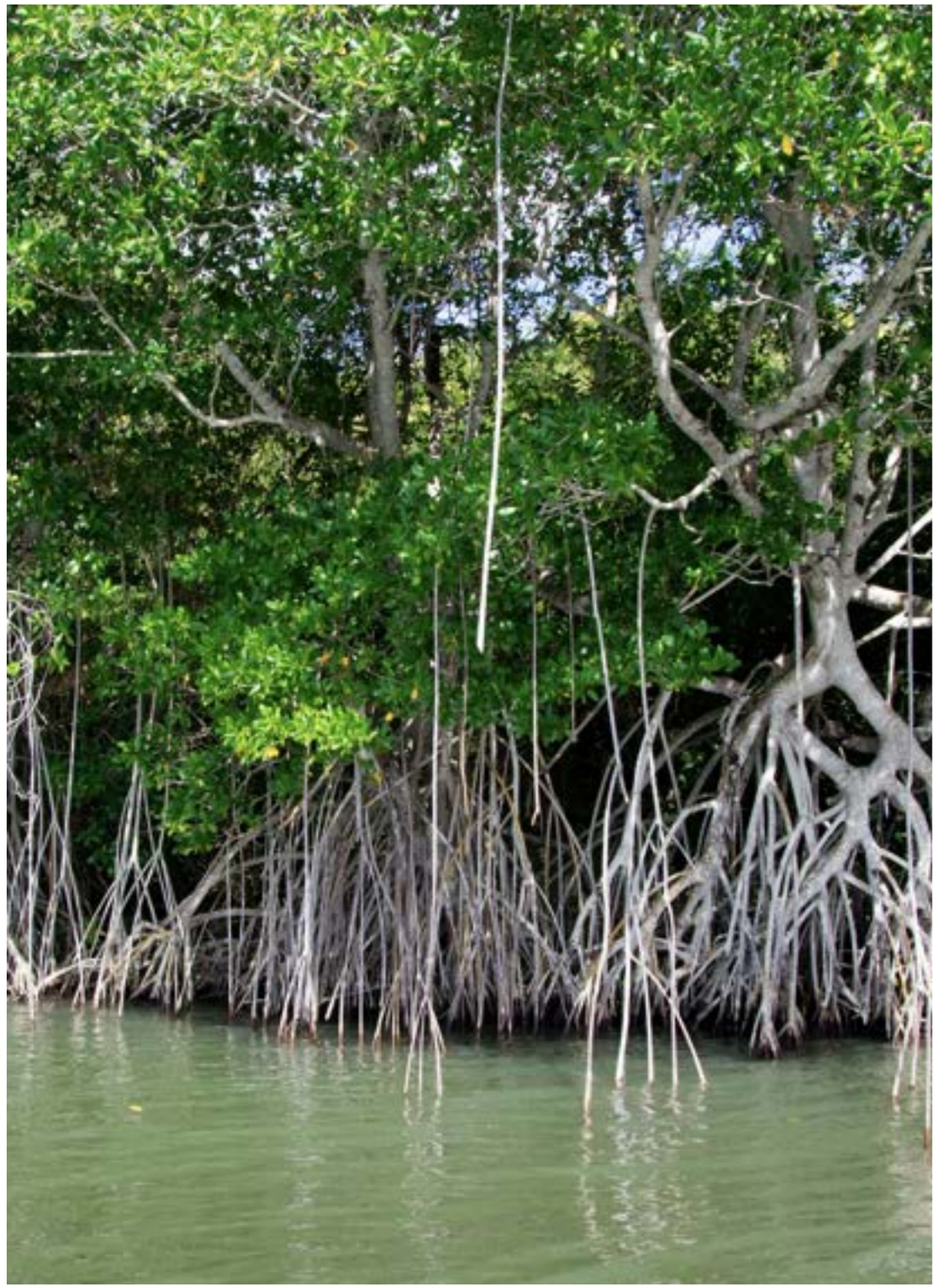
- **Improved Monitoring** : By providing a rapid and accurate way to assess mangrove health and distribution, AMAP tracks change over time and identifies areas requiring protection or restoration.

- **Enhanced Management** : The system equips managers with the information needed to make informed decisions about conservation and adaptation strategies, ensuring the sustainable management of mangrove ecosystems.

- **Climate Change Adaptation** : AMAP's ability to predict future habitat distributions under different climate change scenarios supports the development of proactive adaptation measures to protect mangroves and the communities that depend on them.

- **Resource Optimization** : By automating the analysis of satellite imagery and providing detailed mangrove maps, AMAP saves valuable time and resources, allowing for more efficient and effective conservation efforts.

The ICZM with AMAP represents a powerful tool in the Solomon Islands' efforts to protect its vital mangrove ecosystems and adapt to the challenges of climate change. By harnessing the power of AI and satellite imagery, the system empowers decision-makers and conservationists with the information and insights needed to safeguard these critical habitats for future generations. As the impacts of climate change continue to unfold, such innovative solutions will play an increasingly important role in building resilience and ensuring the sustainability of coastal communities in the Pacific and beyond.



CONCLUSION

5

5. Conclusion

This brief explores AI's transformative potential in addressing climate change, particularly within the Asia-Pacific region. The findings underscore the significant strides these nations are making in integrating AI into their climate action strategies, showcasing a diverse range of applications across key sectors such as energy, water management, urban mobility, agriculture, and marine conservation.

The case studies highlight AI's profound impact on climate action in the region. AI-driven solutions are proving invaluable in enabling enhanced monitoring and management of critical systems, optimizing resource use, curbing greenhouse gas emissions, and bolstering climate change adaptation strategies. AI's role in infrastructure management ensures greater resilience while empowering consumers with data-driven insights and fostering cross-border collaboration, further amplifying its positive influence. The scalability and adaptability of these solutions offer a beacon of hope, demonstrating that the lessons learned and technologies developed and utilized in the Asia-Pacific can be applied globally to tackle similar climate challenges.

While AI's potential in climate action is immense, its successful implementation faces several hurdles. Substantial investments are required in infrastructure, data collection systems, and algorithm development. The availability and quality of data, particularly in resource-constrained environments, can pose a significant challenge. Ensuring equitable access to AI technologies and building local capacity is critical, especially in developing nations. Additionally, the ethical dimensions of AI including data privacy and algorithmic bias, must be carefully considered. Finally, adaptive policy and regulatory frameworks are necessary to keep pace with the rapid

The integration of AI into climate action strategies represents a significant step forward in addressing the complex challenge posed by climate change. To fully harness AI's potential, continued collaboration between technology providers, policymakers, and local communities is essential. Investments in capacity building, data infrastructure, and research and development will be crucial to overcome the identified challenges and ensure equitable and effective deployment of AI solutions.

As we move forward, the insights gained from these pioneering efforts in the Asia-Pacific region can serve as valuable guides for other nations seeking to leverage AI in their climate strategies. By addressing the challenges and building on the successes highlighted in this brief, we can work towards a future where AI plays a significant role in creating more sustainable, resilient, and climate-smart communities worldwide.

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