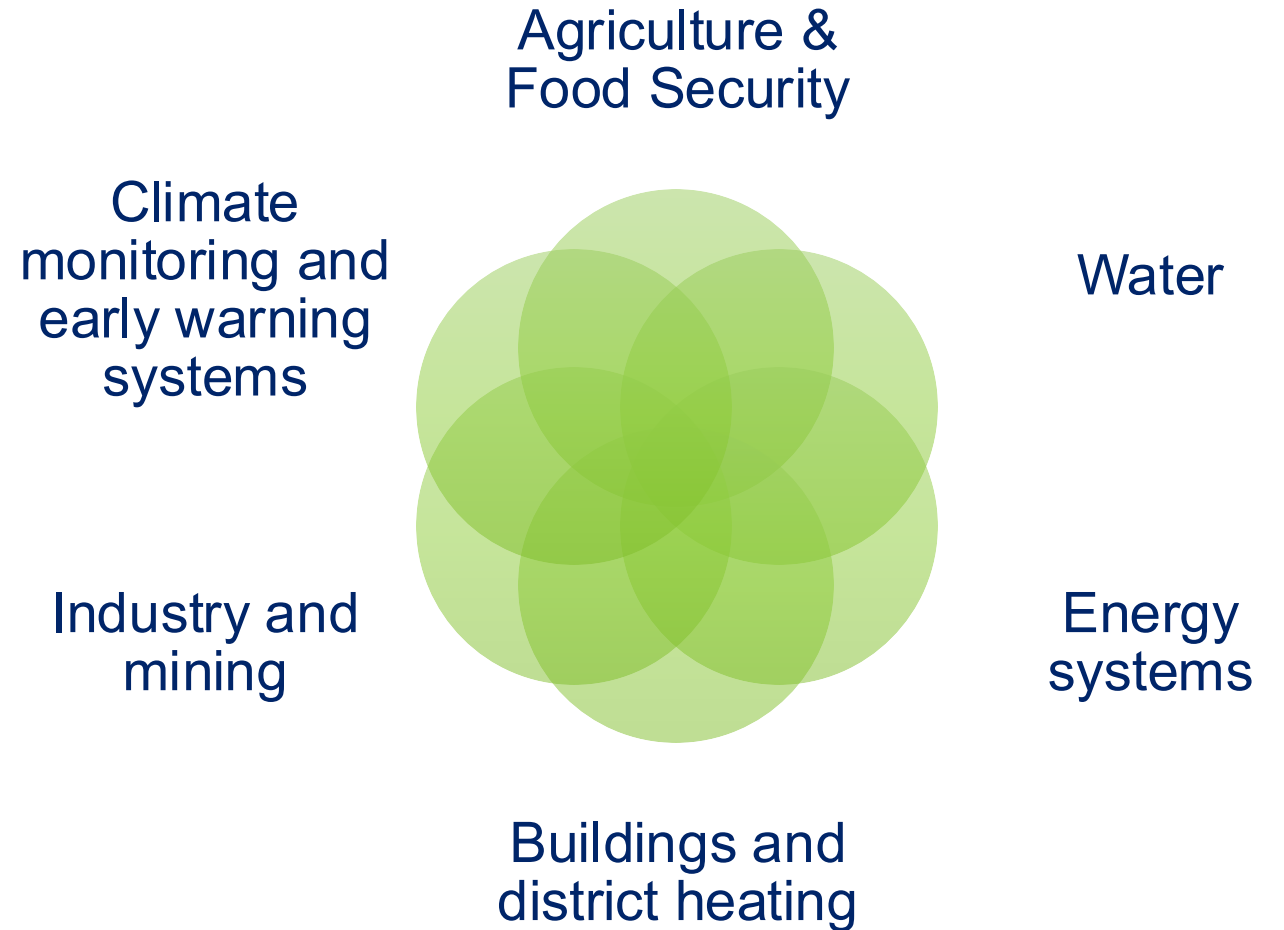
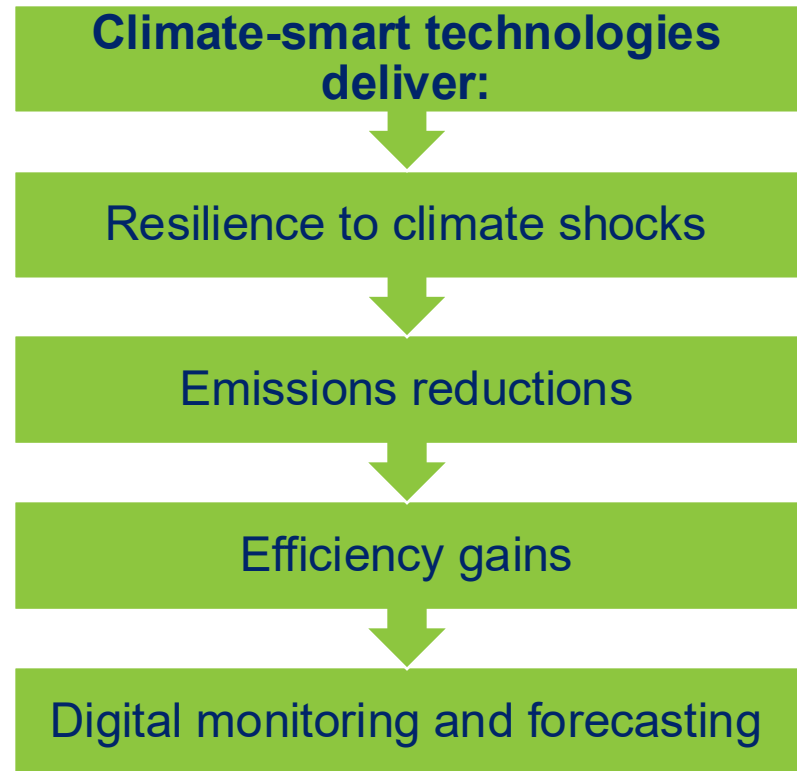




Turning Climate Risk into Opportunity: Technology Solutions for CAREC

High-Impact Sectors for Technology Deployment



Climate-Resilient Agriculture Technologies

Climate-Resilient Agriculture Technologies

Precision Irrigation



Drip irrigation systems



Solar irrigation pumps

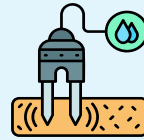


Variable-rate irrigation & Low-pressure sprinkler systems



Subsurface irrigation

Water Monitoring Technologies



Soil moisture sensors



Satellite monitoring



Canal flow sensors



Digital & SCADA irrigation control

Climate-Resilient Crop Technologies



Drought-tolerant, heat-resistant, salt-tolerant crop varieties and seeds.



Locust swarm early-warning systems using satellite monitoring and digital pest reporting



Precision agriculture drones



Satellite crop monitoring



Precision Irrigation

India's *Per Drop More Crop (PMKSY)* program has deployed drip irrigation across 13+ million hectares, including large-scale use in Maharashtra's sugarcane belt (e.g., Jain Irrigation projects in Jalgaon)



Solar Irrigation Pumps

India's *PM-KUSUM Scheme (Component B)* has installed over 3 million standalone solar pumps across states like Rajasthan and Haryana



Agricultural Drones

DJI's *Agricultural Drone Program (Agras series)* has deployed over 200,000 drones across China (e.g., Heilongjiang rice farms) for precision spraying and monitoring.

Energy Systems Technologies

Energy Systems Technologies

NextGen Solar

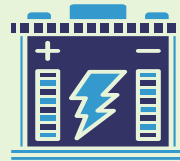


Floating solar on hydro dams



Agrivoltaics Solar

Energy Storage



Battery energy storage systems (BESS)

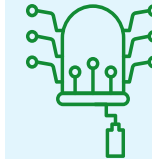


Hydrogen energy storage

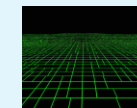
Smart Grid



Advanced metering infrastructure (AMI)



AI demand forecasting



Digital Twin monitoring systems

NextGen Solar Case Studies



EGAT Thailand is developing 2,725 MW hydro-floating solar hybrid project across its major dams by 2037.



50 kW agrivoltaic project in Gulestan, Uzbekistan. The system uses transparent bifacial solar panels that provide approximately 70% shading,

Energy Systems Case Studies



Battery Energy Storage (BESS)

Sungrow and China Energy Engineering Corporation (CEEC) commissioned the *Lochin 150 MW / 300 MWh Battery Energy Storage Project* in Andijan, Uzbekistan, the largest energy storage project in Central Asia, using Sungrow's PowerTitan 2.0 system to provide grid stability, frequency regulation, and support integration of renewables as Uzbekistan targets 40% clean energy by 2030.



Hydrogen Energy Storage

YPP Corporation (Korea) and Kazakh Invest are developing integrating up to 2 GW of wind and solar with electrolysis and ammonia synthesis to produce ~75,000 t/year of green hydrogen (~310,000 t ammonia), supported by storage, water, and logistics infrastructure, with output primarily for export and partial use in CHP decarbonization in Almaty

Regulatory Sandbox

A regulatory sandbox in could offer a low-risk, high-impact way to trial innovations like energy sharing, mobile storage, and virtual power plants, helping to overcome core structural challenges in generation, grid management, and energy access.

Accelerated tech adoption: Faster rollout of decentralized renewables and storage.

Reduced import dependence: By localizing generation and managing demand peaks.

Attract investment: Private sector more likely to participate under flexible, risk-managed frameworks.

Improved resilience: Especially in winter and rural/remote areas.

Successful Asian Sandboxes



Jeju Island’s Smart Grid Test-Bed (launched 2009) demonstrated smart grid technologies at scale under real conditions, covering 186 km² and ~15,000 residents. With regulatory flexibility, it validated integrated systems across power, transport, renewables, and services. The program cut approval times (22→8 months), mobilized 160+ firms, attracted major investment, and delivered new technologies, business models, and jobs.



Singapore’s EMA sandbox (2017) enables controlled, time-bound trials (1–2 years) with safeguards and oversight in the live energy market. It has accelerated distributed energy and grid flexibility, scaling virtual power plants and demand response, expanding capacity, lowering price volatility, and generating cost savings, while informing permanent regulatory updates.



Thailand’s ERC sandbox (since 2019) supports energy transition through phased, tightly managed pilot projects. It has tested innovations like peer-to-peer trading, microgrids, storage, and virtual PPAs, approving dozens of projects and launching a one-year virtual PPA pilot in 2025 to enable corporate renewable investment without physical delivery.

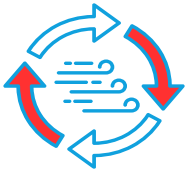


**Buildings
and Heating**

Energy-Efficient Building Technologies



High-performance insulation



Heat recovery ventilation



Triple-glazed windows

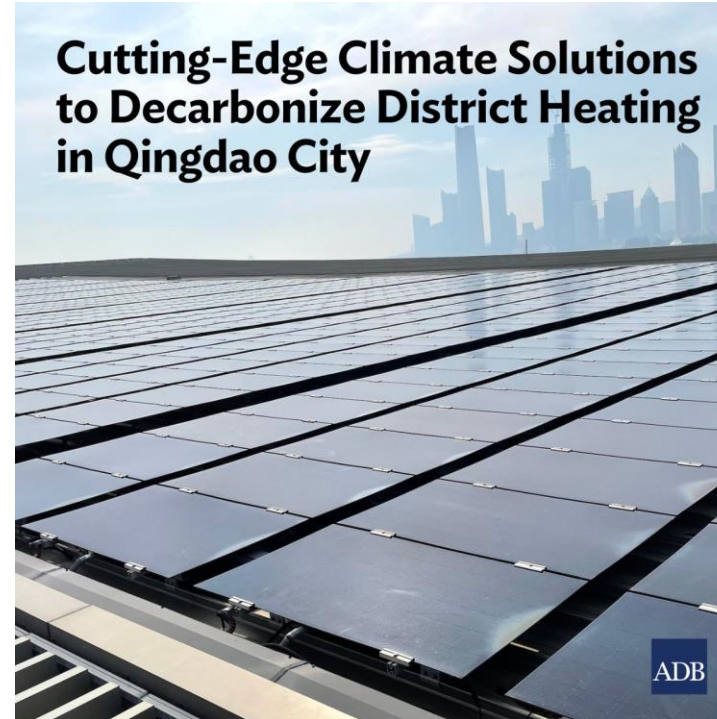
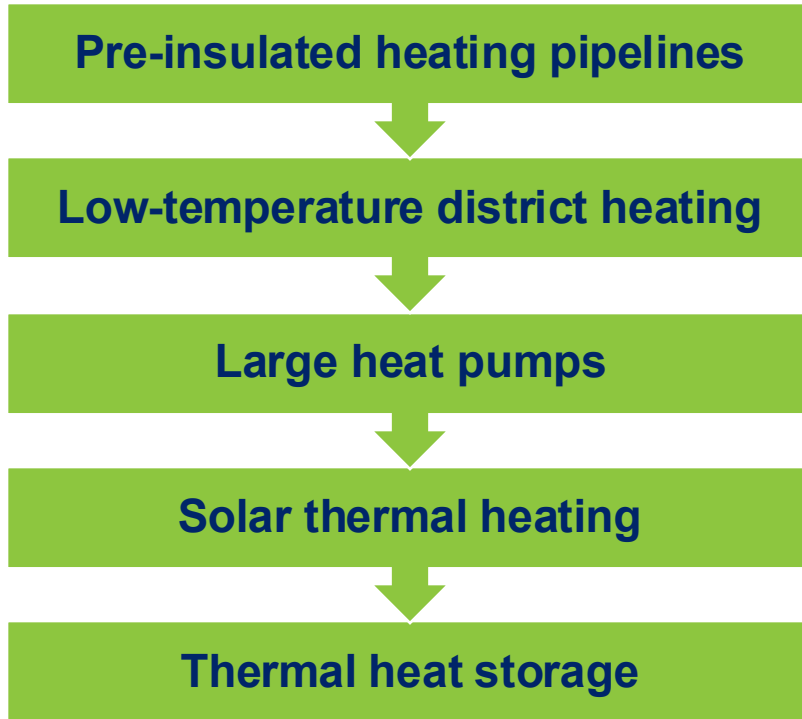


Passive building design



Smart thermostats

District Heating Technologies



- Integrated heating and cooling platform
- Reduced standalone AC/Heating demand
- Reduced indirect electricity emissions

Qingdao Smart Low-Carbon District Energy Project (China)

Energy-Efficient Building Case Studies



Heat Recovery Ventilation (HRV)

Korea's *Zero Energy Building Initiative* mandates HRV systems in new public and residential buildings which reduces heating and cooling losses by 20–30%



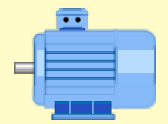
Passive Building Design

Mongolia's *Ulaanbaatar Green Affordable Housing Project* (ADB) incorporates passive design to reduce coal-based heating demand

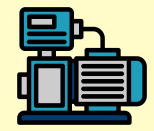
Industry and Mining

Industry and Mining Technologies

Industrial Efficiency



High-efficiency electric motors



Industrial heat pumps



Waste heat recovery systems

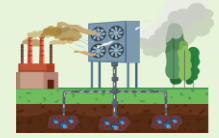
Carbon Reduction



Electric arc furnaces for steel



Low-carbon cement



Carbon capture

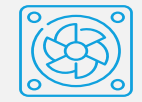


Green hydrogen

Mining Decarbonization Technologies



Electric mining trucks



Ventilation-on-demand systems



Renewable microgrids for mines



Autonomous mining equipment

Industry and Mining Case Studies



Electric Arc Furnace Steel

China Baowu Steel operates large-scale electric arc furnace facilities as part of China's transition toward scrap-based steel production.



Carbon Capture (CCUS)

China's *Shengli Oilfield CCUS Project* (Sinopec) captures over 1 million tonnes of CO₂ annually from the Qilu petrochemical plant and transports it ~100 km for enhanced oil recovery and permanent storage in the Shengli oilfield



Electric Mining Trucks

Caterpillar Electric Trucks are being trailed BHP's Jimblebar iron ore mine in Western Australia. These trials aim to test the performance, battery technology, charging infrastructure, and power management of the vehicles under real-world mining conditions.

Digital & AI Platforms



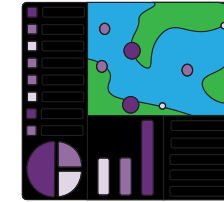
Climate Modelling

- AI & Satellite climate observation & monitoring
- Geospatial climate risk maps



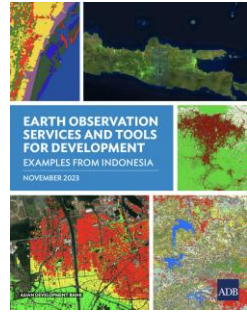
Early Warning Technologies

- Flood forecasting systems
- Drought prediction models
- Heatwave early warning systems
- Multi-hazard early warning platforms
- AI climate risk forecasting



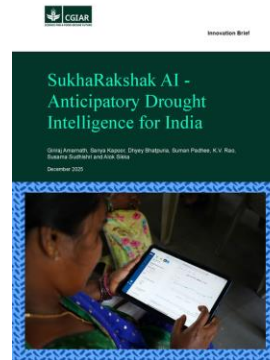
Digital Platforms

- Digital twins for infrastructure
- Smart city management platforms
- Climate-resilient infrastructure design tools
- Water management



Geo-Digital Twin

ADB and ESA are developing the *Geo-Digital Sumatra Platform* in Indonesia, integrating satellite Earth Observation data (e.g., land use, peatland emissions) with geospatial analytics and modeling tools to create a real-time digital twin of Sumatra, enabling scenario analysis for deforestation, flooding, and infrastructure planning.



AI Drought Advisory

Microsoft Research India and ICRISAT developed *SukhaRakshak AI*, which combines satellite data, weather forecasts, and soil moisture indicators to generate district-level drought predictions and deliver crop advisories via SMS and voice to smallholder farmers across multiple Indian states.



Glacier Monitoring

Pakistan's *Upper Indus Basin Monitoring System* integrates glacier observations, automatic weather stations, and river flow gauges across the Hindu Kush–Karakoram region to track snowmelt and water availability, supporting irrigation planning and flood forecasting in a basin that supplies ~90% of the country's water.

1. Scale proven technologies

- Focus on precision agriculture, BESS, smart grids, and digital climate platforms
- Deploy pilot-to-scale pathways using proven case studies from Asia

2. Enable Innovation through Policy & Regulation

- Establish regulatory sandboxes to test new business models
- Streamline approval processes and reduce time-to-market for climate technologies

3. Mobilise Private Sector Investment

- De-risk investments through public-private partnerships
- Use concessional finance to crowd in private capital

4. Strengthen Regional Collaboration

- Share data, platforms, and lessons across CAREC countries
- Promote cross-border energy systems and digital infrastructure

5. Invest in Digital & Data Systems

- Scale AI, satellite monitoring, and early warning systems
- Build national and regional climate data platforms