



Energy Systems

DECARBONIZING ENERGY SYSTEMS FOR NET ZERO

CTCN works with developing countries to accelerate, develop and transfer technologies for low carbon, climate resilient development.

Why energy systems matter

Energy systems are the largest source of CO₂ emissions globally and achieving net zero will require a paradigm shift in energy production, conversion and use. But these systems are complex, entailing both physical infrastructure and equipment (supply), and societal elements (demand). Also, they are linked across all economic sectors, and are controlled by laws, regulations, exemptions and subsidies.

Therefore, any ongoing technology innovation must develop and integrate rapidly, and create

transformation through system-wide transitions across entire value chains.

This is where The Climate Technology Centre and Network (CTCN), the implementation arm of the UN Framework Convention on Climate Change Technology Mechanism, can add its expertise. Recognizing the complexity and urgency of energy system transformation, CTCN offers support to developing countries to build resilient and clean energy as a core priority of its 2023–2027 Programme of Work.¹

CTCN case studies, pilot projects, RD&D, and concept notes can be leveraged/are pivotal to attract investments and funds. CTCN collaborates with The Green Climate Fund, The Global Environmental Facility, The Adaptation Fund Climate Innovation Accelerator, and several regional and national development banks, supporting systems transformation in over 30 countries.

CTCN responds to the energy systems innovation needs of developing countries

Since 2014, CTCN has been working with governments through their National Designated Entities (NDEs)² and over 800 Network members, providing a range of technical assistance, capacity-building and knowledge-sharing, such as:

Energy efficiency

- ▶ Supporting countries in developing energy efficiency and conservation regulations and planning. For example, an institutional framework for the energy efficiency act and regulations targeting energy intensive sectors, such as household and industries (Nigeria).
- ▶ Supporting the development of energy efficiency standards for domestic appliances and industrial processes and equipment (Botswana).
- ▶ Incentivizing energy-efficient solutions and creating a favourable ecosystem for solutions to thrive, such as the development of green building guidelines and standards (Ghana).

Renewable energy

- ▶ Developing grid codes and policies for renewable energy and grid integration, such as formulating a national electricity grid code and the definition of a net metering policy (Timor-Leste).
- ▶ Creating enabling environments to accelerate renewable energy uptake through policies and capacity building. For example, a pre-feasibility study of the use of photovoltaic systems on the roofs of public buildings, with a connection to the network, and the definition of a net metering policy (The Comoros).
- ▶ Providing solutions to lower existing barriers to deploying renewables and preventing technology lock-ins, such as the feasibility study of a combined heat and power supply using green hydrogen (Thailand).

In parallel, technical assistance and interventions work to strengthen national systems of innovation³ (NSI) and digitalization⁴ as proven technology enablers.

Pakistan develops an energy auditor workforce



Prior to 2017, Pakistan had no professional certification system for energy auditors. With the passage of the National Energy Efficiency and Conservation Act in 2016, **CTCN and the Energy and Resources Institute developed a national certification scheme for energy auditors and managers**, including rules and regulations required for making the certification



scheme effective, together with training programmes and guidebooks. The National Energy Conservation Centre is responsible for audits and is supported to conduct certification examinations and select qualified energy auditors for the textile, cement, conventional power plant and pulp and paper sectors.

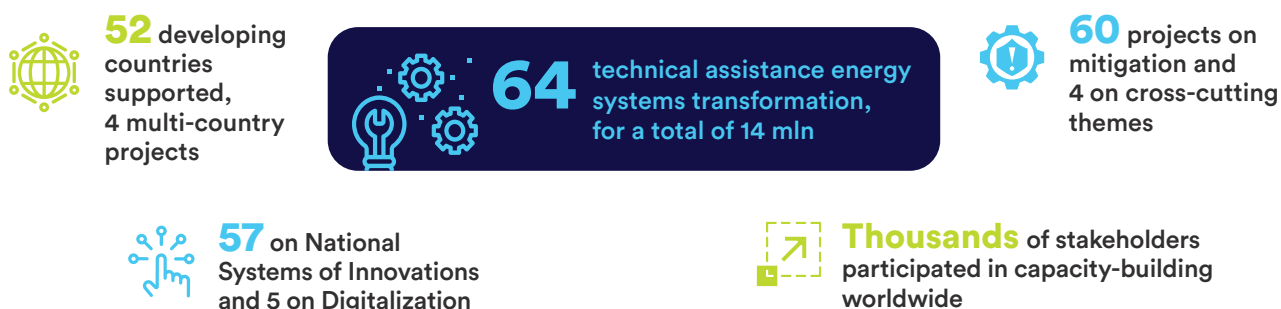
The energy certification scheme in Pakistan has to potential to:

- ▶ **Reduce 42,000 tonnes** of CO₂ emissions per annum
- ▶ Defer the need to install extra electricity generation capacity
- ▶ Offer a potential **20–25 per cent of energy saving in the industrial sector**.
- ▶ Promote green job growth via the certification programme and generate a pool of energy auditors/managers

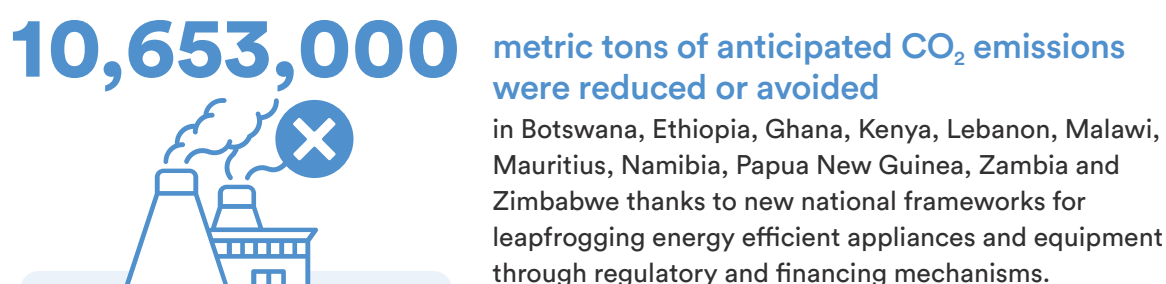
“CTCN support in the design and implementation of climate technology solutions has created a virtuous circle; it helped Pakistan decarbonize energy systems and at the same time created a wealth of other economic opportunities from green jobs growth to new markets creation.”

Dr Saima Shafique, NDE, Ministry of Climate Change, Pakistan

How CTCN is enabling transformative solutions



Led by a demand-driven process working with NDEs, CTCN also supports national decision-making, sectoral technology roadmaps, market assessments and feasibility studies to create an enabling environment for climate technology development and transfer.



Selected examples of CTCN energy system technical assistance

Examples of CTCN technical assistance	Countries	Impacts
Development and implementation of energy efficiency and conservation regulations through certification courses for energy managers and energy auditors	Bangladesh, Nigeria, Pakistan	National policies addressing climate change mitigation officially proposed, adopted, or implemented
Direct use applications and technologies in low to medium-temperature geothermal systems	Djibouti, Ethiopia, Kenya, Rwanda, Tanzania, Uganda, Uruguay	National roadmap proposed, adopted, or implemented
Development of an energy efficiency master plan	Tonga	National roadmap adopted
Capacity development for the deployment of demand response to mitigate against carbon emissions and electricity supply shortages	South Africa	Increased national and local implementation capacities
Accreditation for a laboratory for energy efficient testing and quality control	Algeria, Jordan	Standards and regulations supported by the assistance
Formulating a national electricity grid code and the definition of a net metering policy	Bahamas, Cambodia, Comoros, Seychelles, Timor-Leste	Standards and regulations supported by the assistance
Industrial energy efficiency in large industries and SMEs	Chile, Congo, Kenya, Paraguay, South Africa, Thailand, Viet Nam, Zimbabwe	Industrial energy efficiency standards and process optimization developed, and efficient technologies identified
Development of a national power-to-gas master plan	Lao PDR	National roadmaps and policy measures developed.

Inclusive and just energy system transition

The transition to clean and resilient energy systems is a shared responsibility between developed and developing countries, including the private sector and governments protecting vulnerable groups as well as those whose livelihoods rely on fossil fuel-based sectors. Working with various constituencies under the UNFCCC, including youth, women and indigenous communities, CTCN is closing the technology gap, and ensuring developing countries have access to and reap the benefits of reliable,

affordable, and sustainable energy. These include, for example, support in the Gender Just Climate Solutions Awards and the Youth Climate Innovation Labs.

Investing in the clean energy transition generates an array of socioeconomic benefits in the longer term, including economic growth, job creation, improved livelihoods, support for entrepreneurs, and improvements to gender equality.

Next-generation net-zero energy systems

CTCN is exploring emerging technologies and solutions to continue to support countries in developing decarbonization pathways (long-term emissions reduction plans), including:

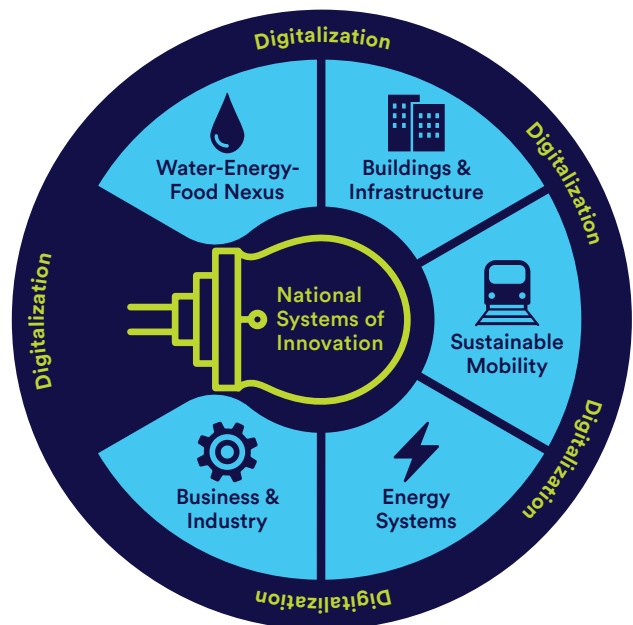
- ▶ Use of digitalization and AI for energy system management
- ▶ Demand-side management and demand response, and energy storage applications
- ▶ Grid optimization and smart grid operation including decentralized power systems (IPPs)

- ▶ Decarbonizing or greening the grid and hard-to-abate sectors
- ▶ Strengthening National Systems of Innovation to create market mechanisms for energy supply
- ▶ Use of non-conventional renewable energy systems, such as ocean thermal energy, offshore wind, geothermal energy, energy islands, etc.
- ▶ Fuel substitution through alternative energy carriers, such as green hydrogen, bioenergy and ammonia as substitutes

About CTCN

The Climate Technology Centre and Network (the implementation arm of UNFCCC's Climate Change Technology Mechanism, mandated under the Paris Agreement) provides accelerated development and transfer of environmentally sound technologies for low carbon and climate resilient development at the request of developing countries.

CTCN provides a portfolio of 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. CTCN is hosted by the UN Environment Programme and is headquartered in Copenhagen, Denmark.



¹ UNEP CTCN (2022), Changing the Systems That Change the Climate <https://pow.ctc-n.org/>

² NDEs are technology representatives selected by each country's government representing 164 parties to the UNFCCC <https://www.ctc-n.org/about-ctcn/national-designated-entities/national-designated-entities-by-country>



³ National Systems of Innovation (NSI): IPCC defines NSI as: "the set of institutions to create, store and transfer the knowledge, skills and artifacts which define technological opportunities" (Metcalfe, 1995). National systems of innovation reflect a complex mixture of institutions (e.g., financial; legal; scientific and technological; educational), public policies (regarding, e.g., taxation; export/import promotion; science, technology, and innovation), and business and social relationships.

⁴ Digitalization: Digital technologies impact positively and negatively on GHG emissions through: their carbon footprint; technology application for mitigation; and induced social change. Whether digital tech will be an enabler or a barrier for decarbonisation depends on governance of both digital decarbonisation pathways and digitalization in general. CTCN takes the approach that positive impacts of digitalization are realized for emission reductions and resilience.

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