CIF RENEWABLE ENERGY INTEGRATION PROGRAM

Investment pathways consistent with a 2°C warming scenario will require increasing the flexibility of energy systems to enable the smooth integration of higher shares of intermittent renewable energy generation into power systems.

To this end, CIF's Integration of Renewable energy into Power system program will deploy scaled concessional resources to demonstrate the scaled deployment of flexibility solutions into developing countries' power grids.

THE SHIFT TO ZERO CARBON FUELS

To meet the climate goals, the global energy sector needs to shift from fossil-based to zero-carbon by the second half of this century. At its heart is the need to reduce energy-related CO2 emissions to limit climate change. Coal-fired power generation accounted for 30 percent of global energy-related CO2 emissions in 2018, continuing to be the single largest emitter and the single largest contributor to the growth in emissions observed in 2018. Coal is also the single largest source of global temperature increase.

To shift from fossil-based to zero-carbon the share of renewables in the power mix needs to rise from one-quarter of the total generation in 2018 to two-thirds in 2040 and to over two-thirds by 2050.[1] Most power systems, however, are not yet designed to deal with the variability and uncertainty of renewable energy generation at scale. Several flexibility sources[2] need to be harnessed in all sectors and planned ahead of time to shift cost-effectively from a fossil fuel-based energy system toward one dominated by renewable energy.

The integration of variable renewable energy into the grid poses certain unique challenges and is emerging as a key barrier to the scaling up of renewable energy. Solar, wind and other forms of renewable energy produce variable electricity that most power grids are not designed to accommodate. Key characteristics of renewable energy generation include the following:

- Output variability, leading to increased reserves/ramping requirements, or curtailment of RE;
- Location dependence, requiring upgrades to distribution/transmission power transfer capabilities to accommodate RE;
- Changes to voltage, frequency, reactive power and/or fault current performance, leading to the grid operating close to or outside established operating parameters;
- A general increase in price volatility, for countries with spot markets, otherwise lower marginal costs resulting in impacts on the revenue stream of existing generation assets.

The impact of, and challenges associated with variable renewable energy generation depend mainly on the level of deployment, the context and size of the power system,17 including the geographic dispersion of related renewable power generating facilities and the technology used by many of the generators, market design, regulation and supply/demand fundamentals. Such challenges can increase over time along with the increase in variable renewable energy generation.

A power system must be able to cope with the variability that solar and wind energy introduce at different time scales (from the very short to the long term) to avoid curtailment of power from these variable renewable energy sources and reliably supply all customer energy demand.18 In the absence of such capability, the energy transition risks proceeding on a suboptimal path, with power systems reliant on fossil backup. In many developing countries, highly polluting diesel generators and heavy fuel oil are being used as sources of flexibility.

1 IEA (2018), Global Energy & CO2 Status Report 2018; NCE (2018), Unlocking the Inclusive Growth Story of the 21st Century – Accelerating Climate Action in Urgent Times.

2 Flexibility refer to technical and operational aspects. Technical flexibility sources refer to a set of supply-side, demand-side and grid related measures including energy storage, demand-side management programs and transmission networks-related interventions. Operational flexibility refers to how the assets in the power system are operated. Beyond the constraints associated to each technology's capabilities, it is dependent on the regulatory and market environment that surrounds the physical system and drives system operations. (Source IRENA (2018), Power System Flexibility for the Energy Transition).

THE PROGRAM

CIF's Renewable Energy Integration program aims to increase the flexibility of energy systems to enable the smooth integration of higher shares of intermittent renewable energy generation into developing and emerging countries' energy mix. To this end, it would use scaled concessional finance to accelerate the deployment of an integrated mix of supply/demand side flexibility measures — enabling technologies, enabling infrastructure, market design and system operations improvement and electrification and demand management. Concessional resources will be critical in tackling the system-wide technical, operational, regulatory and financial barriers hindering public and private investments in flexibility measures (see Figure 1).

Experience in countries with growing shares of renewable energy generation show that unless these barriers are tackled, they can inhibit and discourage investment into renewable energy generation at the speed needed to achieve international climate change goals.

The program's investment strategy envisages the deployment of most of the concessional resources in support of key flexibility technologies and services. Key measures proposed for financing are listed in Table 1. These will be complemented by targeted technical assistance to support pipeline and project preparation, structuring and engage in policy dialogues.

FIGURE 1. MAIN BARRIERS TO INVESTMENTS IN RENEWABLE ENERGY INTEGRATION

INSTITUTIONAL, REGULATORY AND POLICY BARRIERS

- Institutional inertia, weak capacity & siloed supply-driven perspective
- Weak policy and regulatory frameworks
- Lack of/inadequate pricing of negative externalities

FINANCIAL AND ECONOMICAL BARRIERS

- High upfront costs & transaction costs
- Inadequate-risk adjusted returns
- inadequate access to finance
- Market distortions

TECHNICAL AND INFORMATION BARRIERS

- Lack of track-record
- Inadequate conversion & connection infrastructure
- Transition shortages (e.g. lack of charging infrastructure) & innovation gaps
- Inadequate knowledge & skills

SOCIO-CULTURAL BARRIERS

- Inadequate awareness & risk perception
- Behavioral or lifestile issue
- Public opposition
- Poor social inclusion in the energy value chain

TABLE 1. POSSIBLE ACTIVITIES TO BE SUPPORTED UNDER THE PROGRAM

Scaling up renewable energy enabling technologies	• Energy storage technologies, such as batteries, pumped hydro, and green hydrogen, which can back up the variability of renewables and provide various services • New technologies for real-time grid management that enhance electricity system flexibility and facilitate distributed generation, such as advanced metering systems, wireless network control, and demand side management, including outreach to women and men users • Technologies that enable electrification of other sectors, such as electric vehicle charging infrastructure, to open doors to new markets for renewable generation and new ways to store the generation surplus • Green fuels/e-fuels in sectors like transportation or heating
Enhancing infrastructure to be renewable energy -ready	• Grid interconnection to integrate regional markets and increase their flexibility • New and smart grids, both large and small scale, that complement each other and enable new ways to manage variable renewable energy generation. • Changes in the operation of existing hydropower plants to accommodate more penetration of VRE.
Supporting renewable energy innovation	• Business models that empower consumers, turning them into active participants in demand-side management • Innovative schemes that enable renewable energy supply, in both off-grid and connected areas
Enhancing system and market design and operation	• New regulations in the wholesale markets that encourage flexibility from market participants, better signal firming power supply's value, and properly remunerate their grid support services • Design and regulatory change in the retail market that stimulate flexibility on the consumer/prosumer side, including on pricing structures • New operation procedures that improve predictability of renewable energy such as advanced weather forecast procedures.

Photo: Jitendra Parihar/ Thomson Reuters Foundation

WHY CIF?

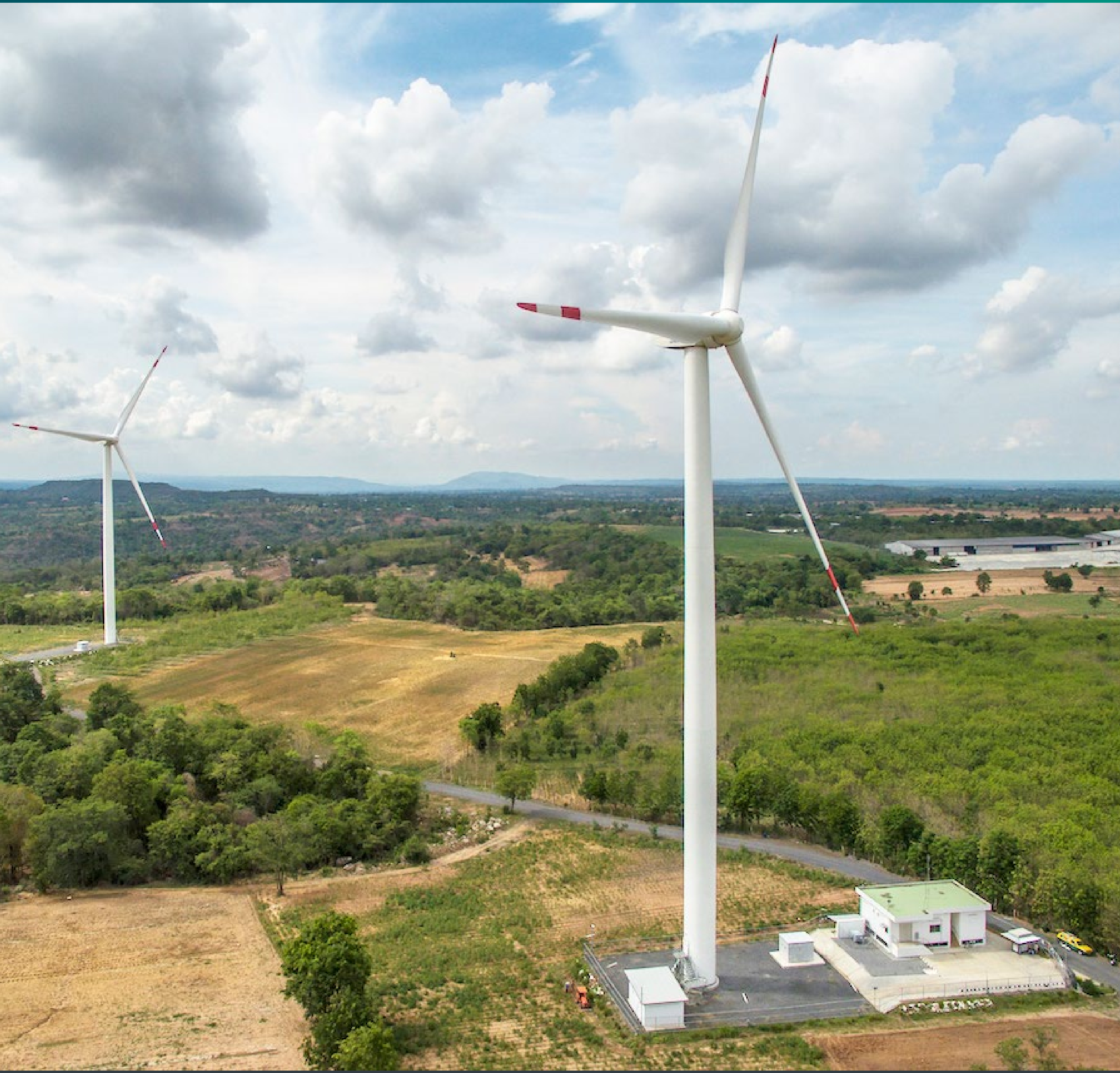
CIF Renewable Energy Integration Program is unique in its targeted strategic focus and approach, and harnesses CIF's well-tested business model. Other initiatives are not explicitly considering integration of renewable energy as a core programming focus and priority.

EXPECTED OUTCOMES

The main expected outcomes of the program include: (i) improved policies, plans and institutional capabilities of governments to plan, execute and sustainably manage flexible energy systems; (ii) mobilized public and private capital into flexibility-related investments that will help secure the safety, reliability, and security of clean energy supply; (iii) reduced total system cost and (iv) fostered innovation.

FIGURE 2. THE CIF'S BUSINESS MODEL IS WELL-SUITED TO DELIVER THE PROGRAM'S OBJECTIVES

COUNTRY-LED PROGRAMMATIC PARTICIPATORY APPROACH	To enable cross-government levels and cross-ministerial coordination in planning and policy-making
MULTI-MDBS COORDINATION & ACTION	To encourage sustained investments in multiple energy infrastructure areas
RISK-APPROPRIATE FINANCING TOOLS AT SCALE	Help initiate investments that go beyond the grid's business-as-usual needs
SCALED-UP, PREDICTABLE, AND FLEXIBLE CONCESSIONAL RESOURCES	To meet investment-specific needs, mobilize private capital at scale and enable innovation



THE CLIMATE INVESTMENT FUNDS

c/o The World Bank Group
1818 H Street NW, Washington, D.C. 20433 USA

Telephone: +1 (202) 458-1801
Internet: www.climateinvestmentfunds.org

@CIF_action
CIFaction
CIFaction
CIFaction
CIFaction
@CIF_action