OFFICIAL USE ONLY
GEF/R2019-0002/3

April 30, 2019

Closing Date: Friday, May 3, 2019 at 6:00 p.m.

FROM: Vice President and Corporate Secretary

China - Distributed Renewable Energy Scale-Up Project

Project Appraisal Document

Corrigendum

1. Attached is the revised Project Appraisal Document regarding a proposed grant from the Global Environment Facility (GEF) to China for a Distributed Renewable Energy Scale-Up Project (GEF/R2019-0002/1), which is being processed on an absence-of-objection basis.

2. This corrigendum is issued to reflect the changes:

- Paragraph 12 on page 14 has been revised to read:

  "By strengthening policies to scale-up clean energy, the project aligns with higher-level objectives to meet the challenges of pollution and climate change under the World Bank Group (WBG) partnership with China. This focus area is identified as a priority in the WBG Country Partnership Strategy (Report 67566-CN), discussed by the Board in November 2012; and it was reaffirmed in the Performance and Learning Review (Report 95709-CN), discussed by the Board in January 2016. In addition, making fuller use of market mechanisms to promote green growth is one of the five priorities identified in the 2018 China Strategic Country Diagnostic (Report 113092-CN).

3. The fully revised document has been published on BOS.

Distribution:
Executive Directors and Alternates
President
Bank Group Senior Management
Vice Presidents, Bank, IFC and MIGA
Directors and Department Heads, Bank, IFC, and MIGA

THE WORLD BANK
IBRD • IDA | WORLD BANK GROUP

FOR OFFICIAL USE ONLY

Report No: PAD3084

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

PROJECT APPRAISAL DOCUMENT
ON A
PROPOSED GRANT FROM THE GLOBAL ENVIRONMENT FACILITY TRUST FUND

IN THE AMOUNT OF US$7,278,600

TO

THE PEOPLE'S REPUBLIC OF CHINA

FOR A

DISTRIBUTED RENEWABLE ENERGY SCALE-UP PROJECT

April 26, 2019

Energy & Extractives Global Practice
East Asia And Pacific Region

CURRENCY EQUIVALENTS
Exchange Rate Effective April 1, 2019

US$1.00 = ¥ 6.712

FISCAL YEAR
January 1 - December 31

Regional Vice President:	Victoria Kwakwa
Country Director:	Martin Raiser
Senior Global Practice Director:	Riccardo Puliti
Practice Manager:	Jie Tang
Task Team Leader(s):	Yanqin Song, Alan David Lee

ABBREVIATIONS AND ACRONYMS

CGF	Competitive Subgrant Facility
CNAO	China National Audit Office
CNREC	China National Renewable Energy Center
CPF	Country Partnership Framework
CRESP	China Renewable Energy Scale-Up Program
CSF	Cost-sharing Subgrant Facility
CSG	China Southern Grid
DA	Designated Account
DRE	Distributed Renewable Energy
EMF	Environmental Management Framework
ERI	Energy Research Institute
FiT	Feed-in Tariff (price for distributed generation supplied to the grid)
FYP	Five-Year Plan
GEF	Global Environment Facility
GHG	Greenhouse Gas
GRS	Grievance Redress Service
GW	Gigawatt
ICT	Information and Communication Technologies
IO	Intermediate Outcome
IRR	Internal Rate of Return
kWh	Kilowatt-hour
M&E	Monitoring and Evaluation
MoF	Ministry of Finance
mtce	million tons of coal equivalent (29.39 gigajoules)
NDRC	National Development and Reform Commission
NDC	Nationally-Determined Contribution (to climate action under the Paris Agreement)
NEA	National Energy Agency
PDO	Project Development Objective
PMO	Project Management Office
PPSD	Project Procurement Strategy for Development
PRC	People's Republic of China
PV	(Solar) Photovoltaic
RE	Renewable Energy
R&B Project	China Renewable Energy and Battery Storage Promotion Project
REDF	Renewable Energy Development Fund
REDP	Renewable Energy Development Project
RP	Resettlement Plan
RPF	Resettlement Policy Framework
SEPAP	Solar Energy for Poverty Alleviation Program
SGCC	State Grid Corporation of China
SME	Small and Medium Enterprises
T&D	Transmission and Distribution
TA	Technical Assistance
VAT	Value-added Tax
WBG	World Bank Group

TABLE OF CONTENTS

DATASHEET

BASIC INFORMATION

Country(ies)	Project Name	
China	China Distributed Renewable Energy Scale-Up Project	
Project ID	**Financing Instrument**	**Environmental Assessment Category**
P162299	Investment Project Financing	B-Partial Assessment

GEF Focal Area

Climate change

Financing & Implementation Modalities

[ ] Multiphase Programmatic Approach (MPA)	[ ] Contingent Emergency Response Component (CERC)
[ ] Series of Projects (SOP)	[ ] Fragile State(s)
[ ] Disbursement-linked Indicators (DLIs)	[ ] Small State(s)
[ ] Financial Intermediaries (FI)	[ ] Fragile within a non-fragile Country
[ ] Project-Based Guarantee	[ ] Conflict
[ ] Deferred Drawdown	[ ] Responding to Natural or Man-made Disaster
[ ] Alternate Procurement Arrangements (APA)	

Expected Approval Date	Expected Closing Date
03-May-2019	30-Jun-2023

Bank/IFC Collaboration

No

Proposed Development Objective(s)

Promote the scale-up of distributed renewable energy and GHG emission reduction in China through policy interventions and pilots

Components

Component Name	Cost (US$, millions)
Policy support	2.00
Pilot support	4.28
Capacity building and project management	1.00

Organizations

Borrower:	People's Republic of China
Implementing Agency:	National Energy Administration (NEA)

PROJECT FINANCING DATA (US$, Millions)

SUMMARY

Total Project Cost	75.78
Total Financing	75.78
of which IBRD/IDA	0.00
Financing Gap	0.00

DETAILS

Non-World Bank Group Financing

Counterpart Funding	68.50
Borrowing Agency	12.00
Local Sources of Borrowing Country	56.50
Trust Funds	7.28
Global Environment Facility (GEF)	7.28

Expected Disbursements (in US$, Millions)

WB Fiscal Year	2019	2020	2021	2022	2023

Annual	0.00	1.16	1.67	2.01	2.44
Cumulative	0.00	1.16	2.83	4.84	7.28

INSTITUTIONAL DATA

Practice Area (Lead)

Energy & Extractives

Contributing Practice Areas

Climate Change

Gender Tag

Does the project plan to undertake any of the following?	
a. Analysis to identify Project-relevant gaps between males and females, especially in light of country gaps identified through SCD and CPF	No
b. Specific action(s) to address the gender gaps identified in (a) and/or to improve women or men's empowerment	No
c. Include Indicators in results framework to monitor outcomes from actions identified in (b)	No

SYSTEMATIC OPERATIONS RISK-RATING TOOL (SORT)

Risk Category	Rating
1. Political and Governance	Low
2. Macroeconomic	Moderate
3. Sector Strategies and Policies	Substantial
4. Technical Design of Project or Program	Substantial
5. Institutional Capacity for Implementation and Sustainability	Moderate
6. Fiduciary	Low
7. Environment and Social	Low
8. Stakeholders	Substantial
9. Other	Low
10. Overall	Substantial

COMPLIANCE

Policy

Does the project depart from the CPF in content or in other significant respects?

[ ] Yes [✓] No

Does the project require any waivers of Bank policies?

[ ] Yes [✓] No

Safeguard Policies Triggered by the Project	Yes	No
Environmental Assessment OP/BP 4.01	✓	
Performance Standards for Private Sector Activities OP/BP 4.03		✓
Natural Habitats OP/BP 4.04		✓
Forests OP/BP 4.36		✓
Pest Management OP 4.09		✓
Physical Cultural Resources OP/BP 4.11		✓
Indigenous Peoples OP/BP 4.10		✓
Involuntary Resettlement OP/BP 4.12		✓
Safety of Dams OP/BP 4.37		✓
Projects on International Waterways OP/BP 7.50		✓
Projects in Disputed Areas OP/BP 7.60		✓

Legal Covenants

Sections and Description

Institutional Arrangements (Section I.A of Schedule 2 to the Grant Agreement)
For the purpose of carrying out the Project, the Recipient, through NEA, shall maintain, throughout Project implementation, the Project Management Office with composition, powers, functions, staffing, facilities and other resources satisfactory to the Bank, responsible for implementation, coordination, reporting, management, and monitoring and evaluation of the Project.

Sections and Description

Annual Work Plans (Section I.B.1 of Schedule 2 to the Grant Agreement)
The Recipient, through NEA, shall: (a) carry out activities under the Project during each fiscal year in accordance

with Annual Work Plans agreed with the Bank; (b) prepare and furnish to the Bank by November 15 in each year, beginning in 2019, a draft Annual Work Plan for review and comment, summarizing the implementation progress of the Project for the said year and the Project activities to be undertaken for the following calendar year, including the proposed annual budget for the Project; (c) taking into account the Bank's comments, finalize and furnish to the Bank no later than December 15 in each year, beginning in 2019, the Annual Work Plan, satisfactory to the Bank; and (d) thereafter, ensure the implementation of the Project during the following calendar year in accordance with the Annual Work Plan, in a manner satisfactory to the Bank. The Recipient, through NEA, shall not amend, suspend, abrogate, or waive said Annual Work Plans or any provision thereof without the prior approval of the Bank.

Sections and Description

Project Implementation Plan (Section I.B.1 of Schedule 2 to the Grant Agreement)
Throughout the implementation of the Project, the Recipient, through NEA, shall carry out the Project in accordance with the arrangements and procedures set out in the Project Implementation Plan in a manner satisfactory to the Bank. The Recipient, through NEA, shall not amend, suspend, or waive said Project Implementation Plan or any provision or schedule thereof, without the prior written agreement of the Bank. In the event of any inconsistency between the provisions of the Project Implementation Plan and those of this Agreement, the provisions of this Agreement shall prevail.

Sections and Description

Safeguards (Section I.C of Schedule 2 to the Grant Agreement)
Recipient, through NEA, shall implement the Safeguards Instruments in a manner and substance acceptable to the Bank; not amend, suspend, or waive the Safeguards Instruments, or any provision thereof, without the prior written concurrence of the Bank; ensure that all studies and technical assistance to be supported under the Project are carried out under terms of reference satisfactory to the Bank, and that such terms of reference are consistent with, and pay due attention to, the Bank's Safeguards Policies; regularly collect, compile, and furnish to the Bank as part of the Progress Reports information on the status of compliance with the Safeguards Instruments; and maintain policies and procedures adequate to enable it to so monitor and evaluate implementation of the Safeguards Instruments.

Sections and Description

Subprojects (Section I.D of Schedule 2 to the Grant Agreement)
The Recipient, through NEA, shall make Subproject Grants to Subproject Grant Beneficiaries in accordance with the provisions of the Annex to this Schedule.

Sections and Description

Mid-term Review (Section II.B of Schedule 2 to the Grant Agreement)
The Recipient, through NEA, shall prepare, under terms of reference satisfactory to the Bank, and furnish to the Bank no later than June 30, 2021, a mid-term review report for the Project, summarizing the result of the monitoring and evaluation activities carried out from the inception of the Project, and setting out the measures recommended to ensure the efficient completion of the Project and the achievement of the objectives thereof

during the period following such date.

Conditions

I. STRATEGIC CONTEXT

A. Country Context

1. **China has experienced fast economic growth over past decades, accompanied by a massive reduction of poverty.** Since 'reform and opening' in 1978, real income per person has increased over 16 times and more than 850 million citizens have risen from extreme poverty.[1] China reached upper-middle-income level in 2010 and has been the second largest economy (in GDP terms) since 2010.

2. **With the fast growth of the economy, challenges have emerged in meeting the continuous increase of energy demand, fueled largely by coal, and addressing the ensuing serious environmental pollution and high greenhouse gas (GHG) emissions.** China's economic growth has been accompanied by an increase in total energy consumption from 571 million tons of coal equivalent (mtce) in 1978 to 4,640 mtce in 2018. By the end of 2018, total installed power generation capacity in China amounted to 1,900 Gigawatts (GW), and total electricity consumption amounted to 6,800 TWh. The average annual growth rates of installed capacity and electricity consumption in China were 9.2 and 8.6 percent respectively from 1978 to 2018. Coal-fired power as a share of total power generation has declined from 81 percent in 2010 to 65 percent as of 2018. However the absolute amount of coal combustion continues to increase and associate particulate matter and other local pollutants take a high toll in terms of deaths, morbidity, and associated economic costs (World Bank & PRC State Council Development Research Center 2013). China emits more GHG per year than any other country, and more than the US and European Union combined.

3. **To meet the key challenges in energy sector and to reduce GHG emissions to meet its NDC target, China has embarked an energy transition program to shifting away from coal**. Carbon intensity in China declined by 46 percent from 2005 to 2017, exceeding the nationally determined contribution (NDC) target of 40–45 percent target from 2005 to 2020 ahead of time, and China is on track to achieve the target of 60–65 percent from 2005 to 2030, to which it committed under the Paris Agreement on climate change.[2] Further ambition is embodied in the Government of China's call for an "energy revolution" that encompasses radical changes toward clean energy consumption, energy supply, institutional reform, and energy technology innovation, as well as a strengthening in international cooperation. The Energy Supply and Consumption Revolution Strategy for 2016 to 2030 sets the long-term goal of having more than one-half of energy sourced from non-fossil sources by 2050, compared to current targets of 15 percent by 2020, and 20 percent by 2030. At the crux of China's energy revolution is the need to elevate clean energy source to a higher level—one that rivals and displaces coal in the energy mix.

B. Sectoral and Institutional Context

4. **With the strong support of incentive policies, centralized renewable energy (RE) generation capacity has developed fast in the last two decades.** The 2005 Renewable Energy Law and associated supporting policies mandated national and subnational mid- and long-term targets, and feed-in tariffs (FiTs) for wind, photovoltaic (PV), and biomass–subsidized by a consumer surcharge through a Renewable Energy Development Fund (REDF).[3] As a result, RE has experienced fast growth and has accounted for most of the additional generation capacity since 2005. The growth of renewable energy, especially large-scale wind and solar power, has contributed to the share of non-

[1] Based on a poverty line of US$1.90 PPP per day (WBG 2018).
[2] As part of China's NDC submitted in 2015, the government intends to reduce carbon intensity per unit of Gross Domestic Product by 40–45 percent from 2005 to 2020 and by 60–65 percent from 2005 to 2030, and for carbon emissions to peak by 2030.
[3] The renewable surcharge was ¥ 0.015/kWh in 2012 and rose to ¥ 0.019/kWh in 2016 (Lin 2018).

fossil fuel energy growing from 8.6 percent in 2010 to 14 percent in 2018, close to the government's 2020 target of 15 percent. China now has the largest hydropower, wind, solar PV, and geothermal capacity of any country. In 2013, the State Council identified solar PV as a strategically important industry, and additional policy support for solar PV was enacted that year and in subsequent years at both national and provincial levels (see Annex 2).

5. **Additional policy support led to the beginning of a fast-growing domestic market for solar PV that continued to accelerate during 2014-18.** It also led to booming solar PV production capacity that at times has exceeded both domestic and overseas demand, as well as plummeting costs. The 13th Five-Year Plan (FYP) period included a target for total solar PV installed capacity to reach at least 105 GW by 2020. This was exceeded in 2018 with 175 GW of solar PV at mostly utility-scale. The World Bank/Global Environment Facility (GEF), China Renewable Energy Development Project (REDP), China Renewable Energy Scale-Up Program (CRESP), and other related projects have provided support to the Government on these efforts.

6. **Further scaling up of RE to meet the development target is facing serious challenges as the precipitous rise in solar PV and wind capacity has been accompanied by challenges in grid integration.** Serious curtailment[4] of centralized utility-scale wind and solar PV energy took place due to transmission capacity bottlenecks and weak distribution systems. Limited system flexibility and stability issues have become concerns in provinces where wind and solar PV cover the majority of demand at certain times. Some two-thirds of China's wind and solar PV capacity is located in the north and west, far from the more populous, industrialized load centers of the east and south.

7. **Severe underuse of such capacity has resulted from institutional constraints to economic dispatch and interprovincial power trade,[5] physical constraints of the transmission bottlenecks and grid integration of intermittent viable RE.** Efforts have been made in building high and ultra-high voltage transmission lines, improving weather and RE generation forecasting, improving system flexibility through large-scale thermal power generation fleet renovation, exploring other types of use of RE for local consumption, and installing energy storage in power systems at generation, grid, and consumer level. In addition to those efforts for centralized utility-scale RE, development of distributed RE (DRE), connected to the distribution networks directly and consumed locally, has been recognized as a new direction of RE development and has been promoted by both state and provincial authorities.

8. **DREs are emerging as a potential solution for China's clean energy transition with distinct opportunities and challenges**. DRE comprises technologies and services at the level of the electric power distribution grid and its users, including generation, energy efficiency, demand response, storage, and related ICT (information and communication technology) systems (Hungerford and others 2017). The potential benefits of DRE from the perspective of the power system include, among others, avoiding the need for additional grid capacity and ancillary services to ensure quality operation of the grid. Developing DRE, particularly in China's eastern and southern provinces which are close to the load center, will greatly contribute to realizing the Government's targets to improve its energy mix and, at the same time, avoiding the concentration issues of RE in China's northern and western provinces. To promote the development of DRE, the Government established in its 13th FYP a target that by the end of 2020, the total installed capacity of DRE will reach at least 60 GW. To realize this target, a series of policies have been issued and it is expected that this target can largely be achieved.[6] To achieve the long-term objective to

[4] Some 32.8, 49.7, 42.2, and 27.7 TWh of wind and 4.66, 7.53, 8.28, and 5.49 TWh of PV were curtailed in each year from 2015 to 2018 respectively.
[5] Local governments have an incentive to encourage local power generation as they can keep 25 percent of the value-added tax (VAT) on revenues for each unit sold, while the remaining 75 percent goes to the central government. VAT is set at 13 percent for power generation.
[6] By the end of 2018, the total installed capacity of distributed solar PV has surpassed 50 GW.

make DRE an important pillar of the RE industry to meet the government's commitment on climate change, however, many barriers and challenges need to be overcome.

9. **Harnessing the potential of DRE for China's clean energy transition requires further efforts to address market and policy challenges**. These challenges include, among others: (a) Limited enabling policies; (b) lack of planning guidance; (c) lack of technical standards and specifications; (d) limited proven and scalable business model; (e) lack of access to financing. While utility-scale PV continues to flourish in China, these challenges apply specifically to DRE.
   - **(a)** ***Limited enabling policies.*** The development of DRE is facing a number of barriers, such as the lack of national, provincial, and even local enabling policies for distributed electricity generators, including: (i) grid access; (ii) direct contracting between generators and users;[7] (iii) wheeling charges at distribution level; (iv) arrangements for sharing costs for the distribution grid upgrade to accommodate high penetration of DRE; (v) microgrids pricing when exporting excess power to the grids; (vi) building safety standards; and (vii) incorporation of DRE into urban planning. The government has begun to address these barriers through working on relevant policies, such as grid access, wheeling charges, and technical standards for DRE and microgrids, however, the level of policy development and implementation is still far from what is needed, and further policies for DRE under the context of power sector reform are also required. The reduction and planned elimination of subsidies for RE in coming years highlights the importance of establishing a policy and regulatory framework that can sustain market-oriented development of DRE over time.
   - **(b)** ***Lack of planning guidance.*** Effective development of DRE requires frameworks to understand the tradeoffs between distributed and centralized energy resources and to assess the optimal scale of deployment and location of DRE. Such frameworks are at an early stage of development in advanced markets such as New York and California in the US. Work to develop and roll out such a framework in China through DRE planning could provide a foundation for grid companies, local authorities, project developers, and end-users to identify specific locations where DRE will add the most economic value.
   - **(c)** ***Lack of technical standards and specifications.*** Technical barriers relate mainly to the nonconformity of required technical standards due to quick development of distributed solar PV in vast areas, as well as inadequate capacity of the distribution networks. With the fast growth of distributed solar PV in China, a substandard level of quality and performance of this installed capacity may downgrade the effectiveness of the investment. Improved maintenance practices, enhanced and more flexible distribution networks, and improved dispatch of DRE with installation of energy storage would be required to scale up DRE in China.
   - **(d)** ***Limited proven and scalable business models, and difficult access to rooftop space.*** There are a limited number of business, institutional, and ownership models for proven, viable, and scalable DRE. Most DRE developed so far follows a few standard models, for example third-party developers own, install, and maintain solar PV on roofs of industrial buildings, or large enterprises install solar PV on clusters of buildings under their single ownership. The single most difficult challenge is that project developers have trouble securing permission or long-term leases for use of roof space from the building occupants (or from local governments that may own commercial or industrial buildings). Developers need to obtain consent and the willingness of multiple actors in commercial buildings where there is a split incentive between the owners and the tenants who typically pay energy bills. Developers also need to address owners' concerns about potential safety issues of rooftop PV. Other barriers that hinder diversification of business models include the short time-scale of rooftop leasing, ownership or access consent, and alignment with a typical PV project lifetime.
   - **(e)** ***lack of access to financing.*** To date, a very limited and narrow set of financing models have been used in developing DRE projects in China. These existing models are either limited in scale-up potential, or accessible only to a limited number of developers, precluding other models from opening the market to a wider range of

[7] A pilot RE power market trading scheme is underway but is behind schedule.

developers and scale-up potential of DRE development. There is a need to develop scalable financing models that could demonstrate viability of much larger projects and attract developers, banks, landholders, energy services businesses, consumers, and a broad array of other stakeholders. For example, there is potential for DRE developers to include small and medium-sized enterprises (SMEs), which face unique barriers in accessing financing regardless of the sector, because of their inherent low creditworthiness resulting from limited collateral. Most local banks usually rely on balance sheet financing which requires that borrowers either have good credit ratings or high levels of collateral which, in turn, favors large-scale borrowers. The end result is that the customers who may benefit most from financing are typically not creditworthy.

10. **Ongoing World Bank engagement in China includes support for DRE in different ways with various limits on the target municipality, province, policy area, or type of activity financed (see Annex 2 for details).** Lessons learned from these engagements are also described below. Building on these recent and ongoing activities, especially guidance and lessons for scalable models and approaches, this project will support scalable and complementary policies and pilots for innovative DRE usage at national, provincial, and municipal levels. This project complements the China Renewable Energy and Battery Storage Promotion (R&B) Project which is under preparation in parallel for a proposed Bank loan of US$300 million to a financial intermediary bank (Huaxia Bank) which will provide counterpart funding of US$450 million to lend to battery storage facilities and DRE projects, by focusing specifically on policies and enabling regulatory environment, viable business models development and piloting, and pipeline project development for DREs. By using the same Project Management Office (PMO) and Bank team as the current CRESP Phase II, the project will maximize synergies with other activities.

C. Relevance to Higher Level Objectives

11. **China's 13th FYP of Economic and Social Development (2016-2020) includes specific provisions on RE.** These include: (a) accelerating the development of distributed wind and solar PV power in the central, eastern, and southern regions; (b) building the national new integrated-energy demonstration zone in Ningxia and developing demonstration zones for RE such as those in Qinghai and Hebei; (c) facilitating the comprehensive use of distributed new energy technologies; and (d) promoting the large-scale development of related techniques and equipment.[8] These complement higher-level objectives of the 13th FYP to: (a) pursue productivity and innovation-driven development; (b) continue to rebalance towards consumption and services and further open up the economy; (c) improve equitable access to basic public services; and (e) reverse environmental degradation and curtail carbon emissions. RE, including that from distributed sources, is also expected to contribute significantly to China's NDC as described above.

12. **By strengthening policies to scale-up clean energy, the project aligns with higher-level objectives to meet the challenges of pollution and climate change under the World Bank Group (WBG) partnership with China.** This focus area is identified as a priority in the WBG Country Partnership Strategy (Report 67566-CN), discussed by the Board in November 2012; and it was reaffirmed in the Performance and Learning Review (Report 95709-CN), discussed by the Board in January 2016. In addition, making fuller use of market mechanisms to promote green growth is one of the five priorities identified in the 2018 China Strategic Country Diagnostic (Report 113092-CN).

13. **The project is also consistent with the WBG's overarching commitment to increasing lending for transformative impact in the energy sector**. DRE and energy storage bring associated climate co-benefits and therefore contribute to goals of ending extreme poverty and boosting shared prosperity. The project forms part of a broader program of

[8] The term 'new energy' in this context is understood to refer mainly to wind and PV, along with other non-fossil fuel sources.

engagement that includes a strong focus on sector reform and enabling environment improvement with an emphasis on establishing more efficient and better regulated markets. In this respect, the project is consistent with the principles of maximizing finance for development by helping to address binding policy constraints in a way that is expected to unlock private solutions.

14. **The proposed project is aligned with the Climate Change Mitigation goal of the GEF-6 program–that is, to support developing countries and economies in transition to make transformational shifts towards a low-emission, resilient development path.** In particular, it supports GEF's Program 1: Promote the timely development, demonstration, and financing of low-carbon technologies and mitigation options through policy interventions and pilots on DRE. The policy work will include studies on pricing mechanisms, regulations and standards, planning, information and communication mechanism, and investment pipeline development–particularly DRE and DRE-related battery storage. The pilot work will support emerging technologies activities; business models and financial models for new use-cases; policy ideas; and investment pipeline development. In addition, other technical assistance (TA) such as coordination of key stakeholders and knowledge exchange and dissemination will also be carried out in the project.

II. PROJECT DESCRIPTION

A. Project Development Objective (PDO)

15. **The PDO is to promote the scale-up of distributed renewable energy and GHG emission reduction in China through policy interventions and pilots.**

16. **The PDO indicators are as follows:**
- **PDO Indicator 1: Incremental installed capacity of DRE enabled by the project**. Baseline: Nil. End target: 10 GW.[9]
- **PDO Indicator 2: Incremental avoided GHG emissions enabled by the project.** Baseline: Nil. End target: 7 million metric tons carbon dioxide (CO_2) equivalent.[10]
- **PDO Indicator 3: New policies for DRE developed with project support.** Baseline: Nil. End target: Seven.
- **PDO Indicator 4: New plans or targets for DRE at provincial or national level developed with project support.** Baseline: Nil. End target: Four.
- **PDO Indicator 5: Innovative, scalable new use-cases[11] for DRE developed and piloted under the project.** Baseline: Nil. Target: Six.
- **PDO Indicator 6: Monitoring and evaluation (M&E) of market perceptions toward DRE in sample areas**. Baseline: No M&E system in place. Year 1 target: Initial M&E system in place and sample baseline metrics established. Mid-term target: M&E system in place and trial measurement of key indicators in sample areas. End target: M&E system refined with complete measurement of key indicators in sample areas and improved values relative to baseline.

[9] Installed capacity here refers only to RE generation, not including energy storage capacity.
[10] The avoided emissions do not consider the curtailment and battery storage impact. If taking the storage impact into account, 5 percent losses in emission reduction can be considered.
[11] Use cases is a comprehensive concept and includes the combination of grid integration, system dispatch, financing model, business model/contract arrangement with the facility owner, and pricing mechanism.

17. **The PDO indicators are consistent with GEF guidelines.** Target values are informed by national-level modelling by the Government (Energy Research Institute/ERI and China National Renewable Energy Center/CNREC 2018) which specifically measures distributed PV. Equivalent values for other types of distributed energy resources are not available but will be estimated as part of the project's M&E system. For this project, the DRE excludes hydropower.

B. Project Components

18. **The project comprises GEF grant funding of US$7,278,600 from 2019 to 2023 for policy support, pilot support, and capacity building and project management.**[12] Although it is a stand-alone project, it is jointly designed, and will be implemented in parallel, with the Bank-supported R&B project to support DRE development in China. The project has a dual focus on national and subnational activities. While it will support the NEA on policy and regulations for DRE at the national level, activities in all areas of China will be considered–subject to selection criteria (described in Annex 3) and with particular attention to local government commitment for DRE. Government agencies in several provinces (Jiangsu, Zhejiang, Guangdong, Henan, and Shanxi) have expressed interest and proposed potential activities during preparation.

19. **Component 1: Policy Support (GEF US$2.0m, counterpart funding US$2.0m). This component will involve carrying out selected studies to inform and develop policies and regulations at national or provincial level to scaling up DRE.** This may include:
    - **(a)** grid access to allow direct contracting between the DRE generators and end users;
    - **(b)** pricing schemes to account for the economic value of DRE to different actors at given times and locations;
    - **(c)** standards and certification schemes such as for safety, security, technical parameters, and building-integrated solar PV;
    - **(d)** urban planning that incorporates DREs at city and township levels;
    - **(e)** information and communication mechanisms, including technology platforms, access, privacy, and cybersecurity risk management;
    - **(f)** battery storage, particularly that used for DRE, related policy, regulation, and standards, especially on safety, environmental management, and reuse and disposal to support and leverage the investments in DRE and battery storage under the R&B project.

20. **Policy studies will involve policy institutions and world-class consultants to be jointly determined by the NEA PMO and the World Bank.** Activities will be selected to directly inform actual strategies, plans, pilots, targets, or regulations being developed at national or local level that facilitate the scale-up of various use-cases of DREs (see Annex 6). A key criterion will be evidence of commitment by government authorities for the corresponding policy area.

21. **Component 2: Pilot Support (GEF US$4,278,600, counterpart funding US$66 million). This component will involve acquisition of technical assistance, including carrying out selected studies, and support for pilots, both in relation to innovative and scalable use-cases of DRE.** Use-cases may involve a combination of technology, business models, financing models, and association policies, and be located in various parts of China. Activities under this component will support development and demonstration in specific locations (for example, a given city, district or industrial park) of specific use-cases for which the techno-economic potential is otherwise already proven. In other words, pilot support is not intended to demonstrate individual technologies, but rather to prove financial, institutional, and

[12] A project cost of US$7,278,600 plus an agency fee of US$691,400 to the World Bank brings the total cost to US$7,970,000 financed by GEF.

business-model viability for scale-up. The pilot may also support integration of multiple technologies to prove the economic effectiveness of such integration.

22. **Subgrants will be awarded to government agencies, industry associations, companies, or other eligible actors.** Activities that will be supported include: (a) the deployment of emerging technologies; (b) development of business models and financial models for new use-cases; (c) piloting of policy ideas such as those developed under Component 1; (d) development of investment pipeline including cost-shared prefeasibility and feasibility studies to leverage investments under the R&B project; and (e) other TA such as coordination of key stakeholders, financing from various sources (both public and private), and knowledge exchange and dissemination for replication elsewhere of successful policy and pilot results. Selection criteria for subgrants include completeness, innovation, feasibility, and scalability of the use-case with an overall view to displacing consumption of grid electricity and thereby reducing GHG emissions. The intermediary result indicator is:

    IO Indicator: Co-financing mobilized for pilot activities. Baseline: Nil. Target: US$56.5 million.

23. <u>Component 3: Capacity Building and Project Management</u> **(GEF US$1.0 million, counterpart funding US$0.5 million). This component involves provision of support for: (a) carrying out studies and training, capacity building activities for key stakeholders in relation to DRE policies and regulations; (b) project management, implementation, and M&E activities; and (c) project-related donor and other key stakeholder coordination.** Project management support includes covering the incremental operating costs of the NEA as the implementing agency. Communications and outreach will foster a pipeline of subproject proposals, and disseminate best practice across project activities, with at least one inception and one dissemination workshop in each target province, in addition to other platforms to share knowledge.

24. **The M&E framework, guidelines, and metrics for measuring market confidence and expectations related to DRE in sample areas will be the indicators related to this component.** Under this component's baseline, there is no M&E system in place, while establishment of an initial M&E system and baseline metrics are the Year One target. The mid-term target is a refined M&E system with improved metrics relative to baseline, and trial capturing (measuring) of market metrics in sample areas, while the end target is to finalize an M&E system with complete capture (measurement) of market metrics in sample areas. The intermediate result indicator is:

    IO Indicator: Capacity building and project management. Baseline: Nil. End target: Eight training and experience sharing workshops across provinces with participants from various types of stakeholder.

25. **Innovation of the project**: **DRE has experienced fast growth in 2017 and 2018, but most of the increase is in large industrial and commercial electricity consumers under a narrow range of business models, primarily those that involve high shares of self-consumption and little or no export of power to the grid.** Some projects are also in rural areas subsidized under the solar PV for Solar Energy for Poverty Alleviation Program (SEPAP) which receives central government subsidy without delay in most cases.[13] A very limited number of projects have been developed in other sectors, particularly in the public sector or community. A limited type of business model was applied with the exception of the traditional energy service company model. This project will focus on some other emerging and innovative uses of DRE, for example, non-rooftop locations, such as surrounding landscaping, parking structures and grounds, rights-of-way, waste water treatment plant, agriculture facilities, large public infrastructure buildings, and other non-conventional locations.

[13] Other commercial projects suffer significant delay in getting government subsidy.

26. **Scaling up of the project: Although DRE experienced fast development in the last two years, as discussed above, most of these projects are in industry and commercial sites with a limited range of business models.** Further scale-up still faces some barriers in policy, regulation, and standards related to sector planning, grid integration, wheeling charges, technical specifications, financing model, and business model. To promote the further development and scale-up of DRE, this project will support studies in the area of planning, grid access, pricing, market design, and business models. Based on these studies, the responsible government departments can be better equipped to prepare policies and regulations on pricing, planning, grid integration, and others in line with power sector reform to create an enabling environment for the scaling up of DRE.

C. Project Beneficiaries

27. **Project beneficiaries include the following:**
    (a) government agencies and subgrant recipients who receive financial support to undertake DRE policy and pilot activities;
    (b) all economic agents[14] in the sector value chain, including project developers, investors, utilities, equipment manufacturers and related service suppliers, as well as end-users;
    (c) resident populations of geographic areas where DREs displace polluting sources of electricity and of heating under the project; and
    (d) the global community in terms of avoided GHG emissions and climate change mitigation.

    In addition, other developing countries pursuing DRE should be able to benefit from the project experience through knowledge exchange. In all components, opportunities will be identified to assess, encourage and showcase the participation of SMEs and households as end-users and beneficiaries of DRE, as well as economic agents in the DRE value chain who are women.

D. Results Chain

28. **The project results chain is the logical link from the current situation to activities, outputs, and outcomes (Figure 1).** In summary, the starting point is that DRE is a viable solution to help cut GHG. DRE deployment in China is constrained by weaknesses with respect to policy frameworks, institutional arrangements, planning, market entry and design, pricing, standards, stakeholder participation, and access to information and finance. To address these weaknesses, the project will provide grant funding for TA to carry out national and subnational studies and pilot activities for new use-cases of DRE in selected provinces that are economically and financially viable and have strong potential for scale-up. Outputs of these activities will include both policy analysis and advice directed at piloting policy frameworks that can be adopted later both regionally or nationally, as well as the delivery of support for piloting and proving the viability of DRE and associated technology, business models, and finance mechanisms.

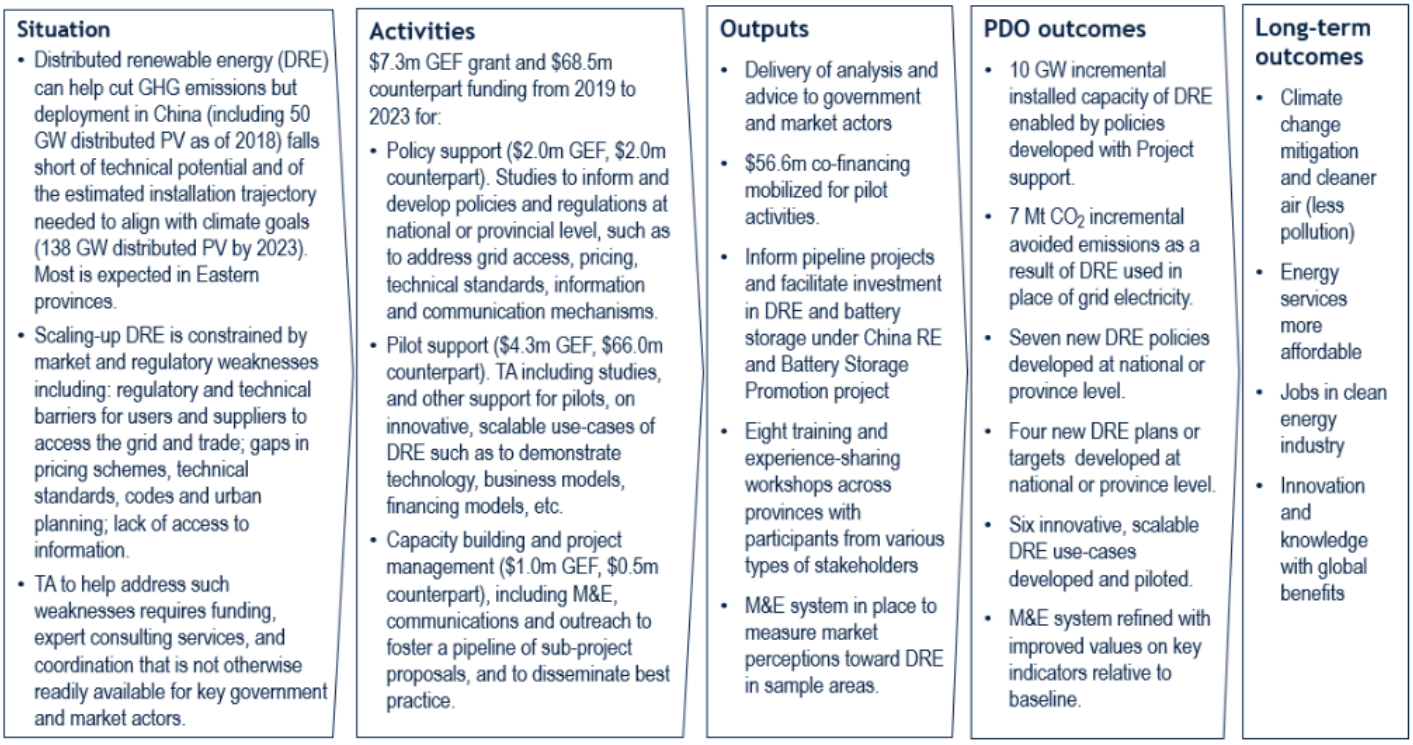
29. **By involving committed government agencies in the selection of activities, the policy studies will result in intermediate outcomes for the development of at least seven new policies for DRE and battery storage at the national level (for example, the NDRC, the NEA and SGCC),[15] and four new plans or targets for DRE at national level and subnational levels.** The number of pilot use-cases supported will be around six across respective provinces. In addition, the project will provide training to build the capacity of government and market actors to undertake the above activities, disseminate information in workshops and reports, and monitor and evaluate market confidence and expectations over time to inform selection and implementation of activities. The

[14] Such as a person or company that has an effect on the economy of a country–for example, by buying, selling, or investing.
[15] NDRC: National Development and Reform Commission; SGCC: State Grid Corporation of China. The project will also endeavor to support at least one study to inform a policy of the SGCC.

intermediate outcome with respect to this latter component would be an observable increase in market confidence and expectations to invest in the DRE sector in each province or municipality supported by the project.

30. **Project activities will have an incremental benefit by helping to improve policies to enable DRE markets to grow.** Full-scale implementation of supported policies and pilots is out of scope, however, supporting policies and pilots will help to remove barriers to allow integration of DREs into the power system, support development of DRE and meet government targets for RE development. The benchmark of ambition for the scale-up of DRE is informed by Government of China modelling for scenarios of RE development under current stated policies as compared to potentially more ambitious policies (ERI and CNREC 2017). As a baseline under current stated policies and standard business models, total installed capacity of distributed PV is expected to increase by some 60 GW over the project implementation period from 2019 to 2023 (with an average of around 15 GW/year). In a more ambitious scenario with the impact of policies to be supported by the Project, as determined through consultation with experts and officials of the National Energy Agency, the distributed PV capacity added over the same time period is forecast to be 80 GW (at an average of 20 GW/year). This equates to 20 GW additional installed capacity for the year 2023 compared to the baseline of 60 GW. Assuming a 50% causality factor of attribution to policies supported by GEF, the target for the PDO Outcome Indicator 1 is taken to be half of this amount, equivalent to 10 GW additional installed capacity compared to the baseline for the year 2023. A proportional increase in power generated and consumed from the DRE capacity will reduce GHG emissions over its lifetime relative to the carbon intensity of grid electricity that would otherwise have been generated and consumed in the absence of the targeted DRE. Through development of national-level policy, regulation, and standards on DRE and battery storage, the project will inform and facilitate the investment in DRE and battery storage under the R&B project and beyond.

Figure 1: Project Results Chain



Source: World Bank staff.

31. **The PDO outcomes are reported at national level on the basis that national policy, and pilots in the selected provinces, will have an influence beyond a single set of provinces.** In this respect, activities to share knowledge beyond the provinces that receive direct policy and pilot support are an integral part of the project design, including a focus on having project results increase measurable business confidence and expectations within and beyond the project provinces. These activities include at least one workshop to share experiences and lessons among provinces, business-to-business exchanges, and participation in a major industry conference on distributed energy. These activities will also harness expertise from the broader World Bank portfolio of engagement in China, covering several provinces as listed in Annex 2.

32. **A number of key assumptions underpin the results chain:**
    (a) **First, it is assumed that there is sufficient demand from potential subgrant recipients to use all available funds by the project closing date.** It is also assumed that the number and contractual structure of activities is kept within manageable limits, given that the transaction costs of administering each subgrant are substantial. The project design considers the latter by providing for no more than 14 subgrants, each a minimum of US$400,000, and making only US$500,000 available for smaller subgrants. During project preparation, the NEA and World Bank team have received a number of proposals that align with this scale of activity. This also serves to demonstrate demand for support of the kind that the project will provide.
    (b) **Second, it is assumed that power from newly installed DRE capacity is generated and used at standard capacity factors (utilization rates),** resulting from a high quality of design and implementation in both technical and policy terms, as well as a context of strong economic incentives for the economic agents involved.
    (c) **Third, it is assumed that relevant government authorities commit to DRE and associated reforms in line with high-level mandates as embodied in stated and successive policies under China's 13th and forthcoming 14th FYPs,** reflecting a progression of effort over time and the country's highest possible ambition for contributing to global climate goals in light of national capabilities and circumstances.

E. Rationale for Bank Involvement and Role of Partners

33. **TA can help address policy and market weaknesses for DRE and this requires funding and expert consultants who are not readily available to key government and market actors in China at national, provincial and municipal levels.** The World Bank has an extensive RE portfolio globally and its energy portfolio in China has focused on energy efficiency and RE since the 1990s. These projects have been generally satisfactory. The Bank has an ongoing and close working relationship with the Government in the field of energy efficiency and RE, dating back to the GEF's establishment.

34. **Over many years, the Bank has established a long-term close working relationship with Chinese institutions on RE development.** This was initially through the China Renewable Energy Development Project (1999-2007), which provided US$27 million for solar PV cost reduction, quality enhancement, technology improvement, after-sales system development, standards and certification, and direct subsidies for deployment in lagging north-western provinces, and then through CRESP Phases I and II (2003-2019). The World Bank team has strong expertise in conceiving, preparing, supervising implementation, and monitoring of RE projects, including with respect to DRE.

35. **Synergy with other Bank-financed projects and alternatives has been considered and the project will build on existing and forthcoming activities related to DRE under the R&B project, CRESP II, and other World Bank engagements as described in Annex 2.** This project has significant synergy with the R&B project which is under preparation, especially the policy and institutional strengthening component covering battery safety, environmental management, recycling, project financing, risk-sharing mechanism, potential investment projects pipeline

development, and leveraging the financing available under the R&B project to mobilize private investments in DRE and battery storage. Blending the two projects into one was considered, however, given the constraint of project approval procedures and timing, it is better to proceed with the preparation of it as a stand-alone GEF project as presented to the GEF Council at the concept stage, but to ensure a strong linkage and synergy of the activities under both projects. Finally, as the GEF-funded stand-alone CRESP II supports all types of RE development, including DRE, structuring the proposed project as an additional financing instrument for CRESP II has been considered. After consultation with the client, however, it was decided to proceed with a new, stand-alone project on the basis that DRE has unique characteristics, is at a critical stage of development, and needs a dedicated set of policy mechanisms to be scaled up.

F. Lessons Learned and Reflected in the Project Design

36. **The project design reflects lessons from previous and ongoing renewable projects in China and other countries, in particular:**
    - **(a) Coordinated institutional development and capacity building is needed to pursue the regulatory reforms and overcome the market resistance faced by RE technologies in China.** The NEA as the implementing agency has a key role in convening and consulting with other relevant agencies and actors in the sector, and capacity-building activities are incorporated into the project design.
    - **(b) Cost-shared grants can enhance selectivity and efficiently leverage knowledge transfer, technology improvement, and counterpart commitment and funding.** The project can cover up to 50 percent of the total project cost, but project experience shows that the grant coverage is around 20–25 percent of total project costs. This suggests that the cost-shared subgrants can be a cost-effective tool for the improvement of technology and commitment of subgrants.
    - **(c) Careful assessment is needed of RE resources in the target locality, the willingness of the local government to engage with the project, and commitment from the grid company to provide necessary support before appraisal of pilot activities.** This will be reflected in activities to develop a pipeline of subgrant proposals, and in the eligibility criteria of such proposals.
    - **(d) Establishment of an appropriate pricing regime is important to adequately reflect the economic value of resources, taking their environmental benefits into account.** A long-term, predictable price signal can provide an effective stimulus for continuing investments in RE. Pricing arrangements are expected to be a key focus of the policy and pilot support.
    - **(e) Adequate time and resources for preparation and consultations should be planned and allowed.**
    - **(f) Limiting the number of contracts can help to focus on major issues.**
    - **(g) A core project management team, with contributions from world-class international and Chinese experts is most cost effective.**
    - **(h) An adequate survey on resource and load profile is important to ensure the project is financially viable at a given tariff regime and all concerned parties in the project have incentives to make it happen.**

III. IMPLEMENTATION ARRANGEMENTS

A. Institutional and Implementation Arrangements

37. **The project will be implemented by the NEA's New and Renewable Energy Department which is in charge of RE policy in China.** The PMO under the NEA, housed within the NDRC's ERI, has been implementing CRESP since 2005

and is, therefore, very familiar with the Bank's procurement, financial management, environmental and social safeguards, and project management procedures and requirements. Given the synergy between, and complementarity of, the proposed project and the CRESP II project, it was agreed from the outset that the two projects would be implemented on behalf of the NEA by the same PMO. The implementation of CRESP II is on track and the PMO staff are, after years of continuous experience, very familiar with the Bank rules and procedures and can take on the management of the proposed projects with the assistance of high caliber experts to strengthen the quality review of activities during implementation and after completion.

38. **The NEA and the Bank teams assessed the workload, discussed with the PMO staff and concluded that there will be no need to recruit new PMO staff and that temporary overload works could be handled through short-term local or international consultants.** The project will complement CRESP II funds to enhance the quality of design, implementation, and reporting of the activities supported by the respective projects. The Bank's social and environmental safeguards policies, including the objective of encouraging civil society organization participation and protection of the interests of minority stakeholders, will be strictly followed in selecting and implementing project activities.

B. Results Monitoring and Evaluation Arrangements

39. **Monitoring the implementation of the proposed project will involve: (a) the performance indicators included in the results framework; (b) annual progress reports; and (c) a midterm review of implementation progress.** The PMO will be responsible for overall monitoring and systematic evaluation of implementation progress including collection of project performance information and reporting on the impact and results of the project. A key aspect of project design is to establish, with the aid of qualified experts through a consulting assignment, an M&E system with metrics of use-case diversity and scalability, along with business confidence and expectations, to be reported at entry, mid-term, and project completion. This M&E system will be crucial for informing project implementation and scalability within and beyond project timelines. The measures of industry and user confidence will include special consideration for women and small or low-income users. M&E will refer to available data on gender equality in access to work in the industry; retention issues in related sectors of science, technology, engineering and mathematics; and measurable benefits expected from women's equal participation in the energy sector (see Annex 1).[16]

C. Sustainability

40. **There is a substantial likelihood that the project will be sustainable, commensurate with risks as described further below.** The government's strong commitment to scaling up DRE is clearly demonstrated in targets for the 13th FYP period and beyond, and associated policies and programs under development. Project activities target policy support, technical studies, technology improvements, pilot demonstration, and capacity building, designed to ensure sustainability and replication of the proposed interventions to achieve an efficient and sustainable growth of DRE in China.

[16] See for example usaid.gov/energy/gender/agent-women-energy-sector

IV. PROJECT APPRAISAL SUMMARY

A. Technical, Economic and Financial Analysis

41. **The project contributes to ongoing efforts by the public and private sector to increase DRE in China.** The economic benefits include cost-effective electricity supply in tandem with reduced negative externalities of GHGs and local air pollution. The technical and economic viability of various DRE technologies, particularly solar PV, is evident from multiple technical studies as well as experiences to date in China and other countries around the world (Hungerford and others 2017; ERI and CNREC 2017; World Bank 2013; Li 2018).

42. **Government of China modelling used to inform this project (ERI and CNREC 2017) conservatively assumes that the investment cost for distributed PV will fall to an average of ¥ 5/watt in 2020 and ¥ 4.4/watt in 2030.** While this is ¥ 0.2/watt more expensive than their assumed average cost of utility-scale PV, the different context of application and distinct benefits of DRE mean that distributed and utility-scale generation are not substitute goods and thus represent different markets.

43. **Based on the above cost estimates, the total investment required to achieve 70 GW of new distributed PV capacity from 2019 to 2023 would be in the order of ¥ 300 billion or US$50 billion.** Costs for other aspects of DRE and system integration would be additional to this. Finance for these would come from developers, investors, and national and local governments independently of the project. The model also demonstrates net economic benefits from scaling up RE, including DRE in China. Economic benefits increase in proportion to the assumed social cost of carbon, values of which for the above studies are below the values recommended in World Bank guidance for consideration in the economic analysis of investment projects.[17]

44. **An important (gross) cost associated with the scale-up of DRE is that they should displace other existing forms of energy generation and transmission.** Measures to accommodate the orderly and equitable transition of labor and capital from a high-carbon to low-carbon economy are beyond the scope of this project but are being addressed by the government with World Bank support.[18] Positive financial returns for distributed investments are highly sensitive to different business models, regulatory environments and available financial incentives. Assessing financial viability and designing policy and pilot use-cases to achieve financial viability are the focus of project activities–such as by applying world-leading modelling developed by the MIT Energy Initiative.

45. **Some proposals on policy studies (policy/regulation/standards) and recommendations of demonstration projects (piloting different grid integration approaches, business models, financing models, demand-side management, and other disruptive technologies, such as battery storage, electric vehicles, and other IT technologies) were received by the PMO and are under consideration for grant support (See Boxes 1 and 2, and Annexes 4 and 5).**

[17] ERI and CNREC (2017) assume a price of ¥ 30/t CO_2 in 2017, ¥ 50/t in 2020, and ¥ 100/t in 2030, under both their 'stated policies' and 'below 2C' scenarios. Analysis for the CRESP PAD applied a carbon price of US$30/t CO_2e to demonstrate that the government's 13th FYP targets for RE were economically justified. World Bank guidance recommends US$30/t$CO_2$ in 2015 and US$8/t$CO_2$ in 2050.

[18] ERI and CNREC (2017) find that development of the RE sector helps to shape a heathier economy where sustainable industries such as power electronics, advanced materials, study and development, and others can be promoted. The government needs to prepare the transition for such industries as the labor force in coal mining and transport will need to be reduced quickly. This transition from old industries to new industries needs careful attention to minimize obstacles for the necessary energy transition process. Furthermore, within a 35-year timeframe, the scenarios indicate a significant shift will have to occur in terms of the creation of alternative employment opportunities for a large segment of the workforce. The positive message is that the growth in RE energy deployment will generate a strong need for growth in employment and the policy challenge is, therefore, to ensure that the future workforce is equipped with the right skills for the new energy system and that workers leaving declining industries are supported–including through retraining to find other opportunities.

Box 1: Proposed China DRE Grid Integration Road Map Study

The study aims to ensure that grids are ready to integrate large-scale DRE through development of technical specifications, management, and implementation procedures. The road map will show the capacity of grids at various voltages for accommodating DRE, providing a signal to potential investors where and when it is more favorable to develop DRE projects which will be more grid friendly and with high penetration. The study will also focus on the policy mechanism and management measures needed to balance the interests of different players along the supply chain. Pilot provinces will be selected to demonstrate the feasibility of the road map.

Main Outputs:

- DRE resources assessment report;
- Specifications on capacity and marginal condition for grid at different voltage levels to accommodate DRE;
- DRE management measures on system planning, project construction, operation, and performance evaluation; and
- Pilot projects in selected provinces to demonstrate the road map.

Box 2: Sample Pilot Projects on Technology and Standards and Regulations

Proposal from Energy Efficiency and Clean Energy Co. Ltd., China South Grid Corporation

Main Areas of the Study

- Study on large-scale utilization of decommissioned power batteries from electric vehicles for energy storage;
- Coordinated control of DRE, multiload and energy storage system connected to distribution network;
- Influence of large-scale DRE grid integration on distribution network;
- Policy and planning study for optimizing large-scale utilization of DRE based on data analysis;
- Contribution of DRE to participation of ancillary services; and
- Adopt best practice from other advanced countries on battery disposal and recycling.

Main Methodology of the Study

Based on the characteristics of DRE, this applicant will carry out empirical analysis and study on 20 DRE projects, with high self-consumption, low self-consumption, and no self-consumption throughout Guangdong. See the list of the 20 projects in Annex 4.

Main Deliverables of the Study

- The criterion of sorting, testing, and selecting reusable decommissioned power batteries for further utilization;
- Analysis of decommissioned power battery life cycle and performance in different control strategies;
- Study on Power Battery Energy Storage Demonstration Project participating in auxiliary service of electric power;

- Technical code for safety management of decommissioned power battery utilization;
- Report on technical and economic post-evaluation of Power Battery Energy Storage Demonstration Project; and
- Case study on battery disposal management.

Develop an Intelligent Multi-energy Operation and Dispatch Management Platform Multilevel Security System

- Report on the consumption of the DRE system;
- Technical and economic feasibility report of Energy Storage System for Improving Renewable Energy utilization;
- Design idea and report of control strategy for multi-energy regulation and control system; and
- Technical and economic post-evaluation report on multi-energy regulation and control system.

Influence of DRE Large-scale Access on Distribution Network

- Influence, reason and solution of DRE connected to user power network; and
- Influence and proposal for large-scale DRE connected to distributed power grid.

Policy and Planning Study for Optimizing Large-scale DRE Utilization Based on Data Analysis

- Solar Energy Resources Monitor and Evaluation Report in Guangdong Province;
- Report of Operation and Economic Evaluation of DRE Energy Projects;
- Study Report on Market Trading and Green Certificate Trading of DRE;
- Study Report on DRE Industry Equipment Technology Development; and
- Planning of Large-scale DRE Application Industry in Guangdong Province and suggestions on supporting policies.

B. Fiduciary

46. **The PMO implemented GEF CRESP I and is carrying out GEF CRESP II.** It is familiar with the Bank's financial management and procurement policies and procedures and its performance under the precedent project was deemed satisfactory. In view of the similarity of the project design between this project and the precedent projects, the PMO has adequate knowledge and expertise to carry out the financial management and procurement activities under this project efficiently.

Financial Management

47. **Bank grant proceeds and the Designated Account (DA) will be managed by the NEA.** A financial management capacity assessment of the PMO established under the NEA determined that all project management staff–including chief project financial staff–have accumulated extensive experience with Bank operations from CRESP I and II projects. As this is the first time that the NEA (rather than the Ministry of Finance) has managed the DA, there may be additional risk of delayed payments. To address the key financial management risk, the following risk management measures have been agreed: (a) updates of a Financial Management Manual, acceptable to the Bank, to standardize working procedures and to clearly define roles and responsibilities between the PMO and the NEA as well as position duty assignments in respect to internal approval; and (b) extensive financial management training for new staff from the Bank. These proposed financial management arrangements will satisfy the World Bank's requirements.

Procurement

48. **The overall procurement risk for the proposed project is assessed as Low.** The Project Procurement Strategy for Development (PPSD) specifies that the project activities under this project be mostly consultancy services. The consultants would be selected through a competitive process to achieve value for money. The NEA's New and Renewable Energy Department will be accountable for coordinating and monitoring the overall project management and implementation. All procurement functions under this project will be carried out by the existing PMO managing CRESPII, housed within the ERI. It is familiar with the Bank's procurement policies and procedures and its performance under the precedent project was deemed satisfactory. In view of the similarity in the project design between this project and the precedent projects, the PMO has adequate knowledge and expertise to manage procurement under this project.

C. Safeguards

Environmental Safeguards

49. **The proposed project has been assigned a Category B under the World Bank's Operational Policy 4.01 on Environmental Assessment, mainly because the GEF funding would be used to support preparation of the feasibility study for the proposed pilot subproject and their implementation under Component 2.** The limited pilot demonstration subprojects will be in a variety of provinces to be determined (as described above), and potentially including Zhejiang and Guangdong. These activities are envisaged as limited in scale and will be further determined during the project implementation.

50. **According to the study and piloting demonstration plans proposed to the PMO by Zhejiang and Guangdong Energy Administrations, most investments associated with DRE are rooftop solar PV in existing enterprises and industrial parks.** The pilot activities would mainly involve installation of equipment and perhaps related very limited civil works. It is envisaged that the project activity will have minor environmental and social impacts. The key concerns would be mainly installation-related issues, such as worker and community safety, noise nuisance, and solid waste management. These potential impacts will be thoroughly assessed and avoided and mitigated with good construction practice and management measures.

51. **Most subprojects under Component 2 will be proposed to the PMO after approval of the grant in the project implementation stage.** An Environmental Management Framework (EMF) was, therefore, prepared by the PMO to ensure proper environmental assessment is carried out and appropriate mitigation measures are in place–including adequate management and monitoring arrangements and meeting the Bank's requirements before the pilot subprojects are approved. The EMF provides a framework for environmental management throughout the project implementation, including: (a) environmental screening; (b) due diligence review of existing environmental management practice; (c) generic environmental code of practices (ECOPs); (d) implementation arrangements; (e) review and approval procedure; and (f) stakeholder engagement and information disclosure.[19]

Social Safeguards

52. **Most proposed activities for consideration under the proposed project will be policy studies, business and financing model studies, and capacity building related to DRE scale-up development**. These activities will not involve new land acquisition, resettlement, and indigenous people. Even for the pilot projects for DRE, in most cases, the projects will be within the boundary of existing facilities. There will be no land acquisition, resettlement, and indigenous people involved. The pilot project selection criteria will take this into account.

[19] The Chinese language EMF was disclosed by the PMO on its website: *http://www.cresp.org.cn/index.php?m=content&c=index&a=lists&catid=13* on November 2, 2018. The Bank disclosed the EMF on its website on November 5, 2018.

Stakeholder Engagement

53. **Stakeholder consultation has been conducted during the preparation stage with governments at national and provincial level.** Government officials, research institutes, industry associations, companies (state-owned and private), financing institutes and NGOs, and donors (embassies) were consulted during the workshop and site visits in selected pilot provinces. Gaps in the area of policy, regulation, standards, planning, business model, financing model, and grid integration were identified to serve for the design and implementation of the project activities.

54. **A variety of activities to engage key stakeholders and directly address concerns in the design and implementation of policy and pilot support components will be undertaken during project implementation.** Component 3 will include a number of capacity-building activities to build awareness and confidence among key stakeholders in relation to DRE policies and technologies. The demonstration subprojects receiving support from this project will be requested to carry out stakeholder consultation. This will be reflected in the subgrant agreement in the case of subprojects leading to construction activities.

Gender

55. **To enhance gender equality, the following measures are considered by the PMO: (a) grant recipient of the pilot projects will be required to include in their subgrant application information on the share of female employment in technical and managerial roles in their organizations; and (b) the PMO will arrange training to its staff and subgrant recipients on international best practices in improving gender equality.** The proposed actions and interventions to address gender issues are consistent with the World Bank Group Gender Strategy 2016-2023. They are not linked to an indicator in the Results Framework and, as such, the project does not meet the World Bank corporate requirements for a gender tag. During implementation, and as part of the mid-term review, the Bank team will monitor and evaluate the implementation of the above measures to identify opportunities to strengthen them as appropriate.

Other Safeguards

56. No other safeguard policies are triggered for the project.

Grievance Redress Mechanisms

57. **Communities and individuals who believe that they are adversely affected by a World Bank-supported project may submit complaints to existing project-level grievance redress mechanisms or the World Bank's Grievance Redress Service (GRS).** The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project-affected communities and individuals may submit their complaint to the Bank's independent Inspection Panel which determines whether harm occurred, or could occur, as a result of the Bank's noncompliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the World Bank's attention and Bank management has been given an opportunity to respond Information on how to submit complaints to the World Bank's corporate GRS is available at *www.worldbank.org/en/projects-operations/products-and-services/grievance-redress-service* while information on how to submit complaints to the World Bank Inspection Panel can be sourced from *www.inspectionpanel.org*.

V. KEY RISKS

58. **The project is rated as having substantial overall risk**. This is based primarily on substantial risk for three factors: (a) sector strategies and policies; (b) technical design; and (c) stakeholders. Other risk factors are rated as moderate or low, as described below. The project will support comprehensive measures of policy recommendations, technical

strategic studies, pilot demonstrations, and capacity building and knowledge management to mitigate these risks and ensure achievement of the PDO.

59. **There is a substantial risk of adverse impact on the PDO stemming from inadequate sector strategies and policies**. On the positive side, the government's overall sector framework is based on a clear strategy for scaling up DRE consistent with the country's development strategy and objectives and with technically sound targets. Sector policy and governance have significant shortcomings, however, including fragmented decision making and weak coordination among concerned departments. In recent years, DRE has depended on subsidies that are financially unsustainable, and future funding is uncertain. Limited progress has been made to implement long-standing high-level commitments for reform toward more efficient prices and markets in the power sector at large. Achievement of the PDO would be greatly enhanced from such reforms but is not dependent upon them. The project's policy support activities are specifically intended to address policy gaps related to DRE. NEA's position as the project's implementing agency and authority affiliated to the National Development and Reform Commission, with partnerships in all provinces, provides a solid basis for policy impact through the project activities. A share of funding will be reserved for use at the latter end of the project, subject to appropriate timelines, to offer competitive selection of a higher-benefit project should such reforms be implemented within the project implementation period.

60. **There is a substantial likelihood that factors related to the technical design of the program or project may adversely impact the achievement of the PDO.** The design incorporates or relies on technologies and processes that, in some cases, have been successfully used elsewhere but are mostly new to China. The economic benefits of scaling up DRE significantly depend on external factors that cannot be controlled through the operational design. This risk is mitigated by the fact that the technical complexity of the operation is only moderate, the client and the Bank has extensive experience with similar operations, the project has a small number of components and has built-in limits on the number of subcomponents, and it has been informed by adequate analytical work.

61. **Opposition from certain stakeholders could have a negative impact on the achievement of the PDO, and the likelihood and impact of this opposition is substantial**. Scaling up DRE involves fundamental changes to the traditional energy system. The objectives of clean energy receive wide public discussion in China but the value proposition of DRE is not always correctly represented or understood. Distributed and RE resources have different interpretations and associated costs and benefits vary with significant uncertainties for new use-cases (Marshall and others 2018).

62. **Large, influential stakeholders include incumbent central power generators, grid operators, and local governments, each of which may variously experience gains and losses from the scale-up of DRE, and net impacts will be highly context-specific.** Knowledge about distributed energy solutions is not yet comprehensive or widespread. The project will mitigate the risk of stakeholder opposition through activities to engage key stakeholders and directly address concerns in the design and implementation of policy and pilot support components. On the positive side, few donors have competing or overlapping operations. Ongoing efforts to coordinate and share knowledge will help avoid duplication and inconsistency.

63. **There is a moderate likelihood that political and governance factors could adversely impact the PDO.** The political context is stable and the government has a clear set of development priorities consistent with the project. While the government is characterized by modest commitment to transparency, accountability, and participation, these principles have been successfully adopted and implemented in related operational engagement. Project success does not depend on political commitment at the highest level, although it would benefit from it. Some political

decisions (including approval of laws and regulations) that underpin the operation have been taken, while others that the project is intended to support have not yet been taken and could be reversed easily.

64. **There is a moderate likelihood that institutional capacity for implementing and sustaining the operation may adversely impact the PDO.** The operation involves a single implementing agency which has the capacity to implement the operation with some assistance from external consultants, however, the operation includes different levels of government and activities yet to be determined in different locations over a wide geographical area with more than a dozen subproject grant recipients. This risk is mitigated by the coordinating role of the implementing agency which has operational rules, processes, and systems that are comprehensive and generally enforced efficiently. Oversight and control mechanisms for implementation operations are adequate, and instances of operational-level fraud or corruption are rare. The institutional decision-making structure is clearly defined and functioning well and there is adequate capacity to ensure the operation's sustainability.

65. **Exogenous environmental or social risks are unlikely to adversely affect the achievement and sustainability of PDO results.** The operation is expected to have a small direct footprint and is designed to mitigate GHGs through support for policy and pilots to scale up DRE, however, scaling up distributed energy systems carries a moderate risk of some adverse environmental or social impacts.

66. **In particular, the main safety risks associated with distributed energy (identified by Hungerford and others 2017: 99-100) are as follows:**
    (a) **Personal and equipment safety risk increases as new SMEs and individuals with little experience in electrical equipment operation enter distributed energy activities.** These can be addressed by appropriate standards.
    (b) **Grid operational risks may increase with high penetration of DRE.** These risks can be addressed with appropriate planning and design and enforcement of technical standards from both the utility and user side.
    (c) **Digital technologies associated with distributed energy resources provide new entry points for cyberattacks targeting the main power system.** These risks can be mitigated through planning and design of technological and institutional measures including: (i) establishing "cyber-safe" areas with isolation points; (ii) promoting professional enterprises to operate distributed systems on behalf of SMEs and individuals; and (iii) strengthening safety regulations and associated training and enforcement.

67. **Macroeconomic and fiduciary risks are rated as low**. Macroeconomic policy supports an economic environment that is conducive for the project/program. The overall fiduciary environment is strong.

VI. RESULTS FRAMEWORK AND MONITORING

Results Framework

COUNTRY: China

China Distributed Renewable Energy Scale-Up Project

Project Development Objectives(s)

Promote the scale-up of distributed renewable energy and GHG emission reduction in China through policy interventions and pilots

Project Development Objective Indicators

Indicator Name	DLI	Baseline	Intermediate Targets	End Target
			1	
Promote scale-up of DRE and GHG emission reduction in China through policy interventions and pilots				
Incremental installed capacity of DRE enabled by the project. (Gigawatt)		0.00		10.00
Incremental avoided GHG emissions enabled by the project. (Metric ton)		0.00		7,000,000.00
New policies for DRE developed with the support of the project (Number)		0.00		7.00
New plans or targets at province or national level developed for DRE with the support of the project (Number)		0.00		4.00
Innovative, scalable new use-case for DRE developed and piloted under the project (Number)		0.00		6.00
Monitoring and evalution of market perceptions towards distributed renewable energy in sample areas. (Text)		No M&E system in place.	M&E system in place and trial measurement of key indicators in sample areas.	M&E system refined with complete measurement of key indicators in sample areas and improved values relative to

Indicator Name	DLI	Baseline	Intermediate Targets	End Target
			1	
				baseline.

Intermediate Results Indicators by Components

Indicator Name	DLI	Baseline	End Target
Capacity building and project management			
Capacity building and training. (Number)		0.00	8.00
Co-financing mobilized for pilot activities (Amount(USD))		0.00	56,500,000.00

Monitoring & Evaluation Plan: PDO Indicators

Indicator Name	Definition/Description	Frequency	Datasource	Methodology for Data Collection	Responsibility for Data Collection
Incremental installed capacity of DRE enabled by the project.	The project target is absolute incremental installed capacity of DRE against the baseline scenario (business as usual) over the four years of project implementation.				
Incremental avoided GHG emissions enabled by the project.	The incremental annual avoided emission enabled				

	by the project .				
New policies for DRE developed with the support of the project	Policies, regulations, and standards related pricing, planning, and grid integration of DRE will developed in this project. In addition, policies, regulations, and standards related DRE used battery storage on safety, environment management, reuse, and recycling will also be covered. Most of the policies, regulations, and standards will be developed in the later stage of the project.				
New plans or targets at province or national level developed for DRE with the support of the project	It is expected that one national level development and three province level development plan will be developed. Will evaluate by project closing.				
Innovative, scalable new use-case for DRE developed and piloted under the project	The application of use-case will be evaluated annually.				
Monitoring and evalution of market perceptions towards distributed renewable energy in sample areas.	This indicator refers to industry and user confidence in clean distributed energy resources, including for women and small or low-	At least three times, at outset (2019), mid-term (2021), and	Primary and secondary data collected in select cities and	Consulting firm	NEA

	income users.	completion (2023).	provinces of China with a focus on those supported by the project activities.		

Monitoring & Evaluation Plan: Intermediate Results Indicators					
Indicator Name	**Definition/Description**	**Frequency**	**Datasource**	**Methodology for Data Collection**	**Responsibility for Data Collection**
Capacity building and training.	8 training and experience sharing workshops across provinces with participants from various type of stakholders				
Co-financing mobilized for pilot activities	At least $56.5 million on pilot project activities is to be mobilized from local sources including private companies.				

Annex 1: Implementation Arrangements and Support Plan

Project Institutional and Implementation Arrangements

1. **The financial management capacity assessment concluded that the project's financial management arrangements satisfy Bank requirements and identified one principal risk: the NEA lacks experience of managing a DA which may bring additional risk for project implementation.** Mitigation measures to address this risk have been agreed: (a) update of an Financial Management Manual, acceptable to the Bank, to standardize working procedures and to clearly define roles and responsibilities between the PMO and the NEA as well as to position duty assignments in respect to internal approval; and (b) extensive financial management training for new staff from the Bank. Overall, the residual financial management risk before and after these mitigation measures is assessed as Moderate.

Budgeting

2. **The annual project implementation plan will be prepared by the PMO.** The PMO will be responsible for daily management of the project's finances, including project accounting and financial reporting. The GEF grant proceeds will flow from the Bank into project DAs to be set up at, and managed by, the NEA. Budget variance analysis will be conducted on a semi-annual basis by the PMO and necessary actions will be taken to make sure the project is implemented as planned. The NEA will be directly responsible for the management, maintenance, and reconciliation of the DA activities. Supporting documents required for Bank disbursements will be prepared and submitted by the PMO to the NEA for review and disbursement processing. Original accounting documents will be retained by the PMO.

3. **The administration, accounting and reporting of the project will be set up in accordance with Circular #13: "Accounting Regulations for World Bank Financed Projects" issued in January 2000 by the Ministry of Finance (MoF).** The standard set of project financial statements has been agreed between the World Bank and MoF. The related accounting policy, procedures and regulations were issued by MoF and an FMM concurred with the Bank will be issued to standardize and regularize the financial management and disbursement requirements.

4. **The project's financial statements will be prepared by the PMO and will be submitted to the Bank for review and comment on a regular basis.** The unaudited project interim financial reports will be prepared and submitted to the Bank by the PMO no later than 60 days following the end of each semester (the due dates will be August 30 and March 1), in a form and substance satisfactory to the Bank.

5. **The Audit Service Center of the China National Audit Office (CNAO) for Foreign Loan and Assistance Projects has been identified as the project auditor.** The CNAO has extensive experience with Bank-financed operations. According to the World Bank Policy on Access to Information, the audit reports for all investment lending operations for which the invitation to negotiate was issued on or after July 1, 2010 need to be made publicly available in a timely fashion and in a manner acceptable to the Bank. Audit reports will be made publicly available on the website of CNAO. Following the World Bank's formal receipt of the audited financial statements from the borrower, the World Bank will also make them available to the public in accordance with the World Bank Policy on Access to Information. The audit report due date is June 30 of each calendar year.

Disbursements

6. **Four disbursement methods are available for the project: advance, reimbursement, direct payment, and special commitment.** Supporting documents required for Bank disbursement under different disbursement methods will be documented in the Disbursement Letter issued by the Bank. One DA in US dollars will be opened at a commercial bank acceptable to the Bank and will be managed by the NEA. The ceiling of the DA is documented in the Disbursement and Financial Information Letter.

7. **The GEF grant will be disbursed to finance 100 percent of eligible expenditures (inclusive of taxes and duties) consisting of goods, non-consulting services, consulting services, subproject grants, training and workshops, and incremental operating costs.** All advance contracting contracts will be subject to the Bank's prior review. Payments will be made only for contracts procured in accordance with the applicable Bank procurement procedures. Retroactive financing will be permitted under this project but only within the limits specified in the grant agreement.

8. **The GEF grant may be disbursed in the form of subgrants to the beneficiaries selected in accordance with the procedures defined in the Subgrants Guideline prepared by the PMO and agreed by the Bank.** The PMO will enter into a subgrant agreement with the beneficiaries which lays out the eligible activities, expenditure, performance indicators and disbursement arrangement. The grant will finance actual expenditures up to the subgrant amount and against defined milestone achievements and based on evidence of actual expenditure. The supervision approach for this project is based on its financial management risk rating which will be evaluated on a regular basis by the finance managers. The initial financial supervision will focus on financial staff training and compliance with the Bank's financial management and disbursement-related requirements, as well as the quality and timeliness of project accounting.

Applicable Procurement Rules and Procedures

9. **Procurement under the project will be carried out in accordance with the "World Bank Procurement Regulations for Recipients under Investment Project Financing", dated July 1, 2016, and hereafter referred to as "Procurement Regulations".** The "Guidelines on Preventing and Combating Fraud and Corruption in Projects Financed by IBRD Loans and IDA Credits and Grants" dated July 1, 2016, shall apply to the project.

Institutional Arrangement

10. **The existing PMO, housed within the ERI, will be responsible for carrying out day-to-day project implementation and management, including the procurement.** The ERI is a public institution affiliated to NDRC and officially receiving operational guidance from the NEA. The stakeholders, including subnational energy authorities, may provide TA in defining the terms of reference or be involved in the selection process as the case may be.

11. **The principal risk identified in the procurement capacity and risk assessment was that obsolete knowledge and experience on procurement under Bank-financed projects may lead to inefficiency or obstacles to achieve the value for money agreed.** Mitigation measures include the following actions: (a) continuous training for the PMO's procurement staff to update their knowledge on procurement during the project life cycle; (b) the project's Implementation Plan incorporating the lessons learned from the precedent projects, prepared by the PMO and agreed with the Bank prior to project effectiveness; and (c) the PPSD is being prepared by the PMO to describe how procurement supports the PDOs and delivers outputs. It will be updated periodically as necessary.

12. **Procurement/Consultant Selection under Subgrants**: **Designated government-owned universities and research institutes and think tanks that will be beneficiaries under the Cost-sharing Subgrant Facility (CSF) will be required**

to carry out the selection and procurement of consultants in accordance with the relevant Bank regulations when they procure goods and services. The application procedures for the subgrants, the eligibility criteria, and the procurement/selection methods to be used by beneficiaries, record keeping, verification and audit requirements will be elaborated in the Subgrant Guideline which will be finalized by negotiation and detailed in each subgrant agreement. Manufacturers of RE technology, RE investors, companies and other commercial entities for pilot demonstration, prefeasibility and/or feasibility studies under Component 2 (Pilot Support) and Component 3 (Capacity Building and Project Management) will be selected competitively for subgrants under the Competitive Subgrant Facility (CGF).

13. **The procurement of goods, consulting, and non-consulting services financed by the subgrants under the CGF may be carried out by the respective beneficiaries in accordance with well-established private sector procurement methods or commercial practices acceptable to the Bank.** The beneficiaries of the subgrants under the CGF shall not award contracts to their parent or affiliate companies unless there is an established arms-length arrangement. The Subgrant Guideline shall describe the principles and acceptable procedures applicable to the subgrants under both the CSF and the CGF. The Subgrant Guideline will be finalized by negotiation and shall define the main responsibilities of the PMO, such as: (a) reviewing the proposals; (b) assessing reasonableness of cost; (c) approving acceptable plans for the procurement of goods; (d) consulting and non-consulting services; (e) verification requirements; and (f) maintaining all relevant records for the Bank's post-review and audits when requested.

14. **Procurement Strategy: A PPSD is under preparation by the Borrower covering the aspects of operational context, capacity assessment, market analysis, procurement risk analysis and so forth.** The PPSD will be finalized and agreed with the Bank by negotiation. It will specify that project activities are mostly consultancy services which are of a similar nature to the precedent projects carried out by the same PMO. For the consultancy services, there are adequate potential consultants with the required experience and expertise to undertake the contract. On the basis of the terms of reference, the PMO anticipates the size of most contracts would be small (usually less than US$300,000). The consultant will be selected through open competition by approaching the national market.[20] Moreover, the project is expected to include subgrants for designated government-owned universities and research institutes and think tanks as well as manufacturers of RE technology, RE investors, companies and other commercial entities.

15. **Grant recipients are required to share at least 50 percent of the total expenses of subgrants.** If the beneficiary of a subgrant is a public institution, the consultant will be selected through open competition, however, if the beneficiary is a manufacturer, investor, company or other commercial entity, the selection of consultant will be based on well-established private sector procurement methods or commercial practices acceptable to the Bank. Based on the experience and lessons learned from the precedent projects, the PMO will prepare subgrant guidelines detailing the procurement arrangement for the subgrant with reference to the similar guidelines in use under the ongoing project.

16. **Systematic Tracking of Exchanges in Procurement (STEP): STEP is the Bank's online procurement planning and tracking tool and will be used to prepare, clear and update the procurement plans and conduct all procurement transactions for the project.** It is a comprehensive and mandatory end-to-end procurement processing system applicable to all investment project financing operations that allows the Bank and the Borrower to track and manage all procurement-related exchanges through the procurement cycle. Contracts expected to be signed in advance of grant signing would be identified in the agreed procurement plan for the project. Payments made under such

[20] This is the terminology that is used for indicating what was previously known as national competitive bidding.

contracts before the date of signing of the Grant Agreement will be eligible for retroactive financing within the limits specified in the Grant Agreement.

Strategy and Approach for Implementation Support

17. **Most team members will be located in the Beijing-based China Country Office to ensure a rapid and effective response to clients' needs for implementation support.** In addition, a few Washington-based staff and international consultants would also be part of the task team to bring global experiences to the project. Formal supervision and field visits covering all aspects of project implementation will be carried out semi-annually during the early stage of project implementation, complemented by occasional visits by small missions on an as-needed basis. The estimated input from different specialists at different stages of project implementation are outlined below.

Implementation Support Plan and Resource Requirements

18. **Technical: A quality assurance expert group will be set up to evaluate the project proposals for consulting services and cost-shared subgrants.** The experts may also participate in project supervision and field visits during the implementation. Implementation support missions will be carried out semi-annually to review progress during the implementation phase of the project.

19. **Environmental and Social Safeguards: Experienced environmental and social specialists on the task team will monitor and evaluate the implementation effectiveness of the agreed Environmental Management Plan in case the concerned policy is triggered.** Formal supervision will be carried out bi-annually and continuous support is available as required by the client.

20. **Fiduciary Requirements and Inputs: Supervision of project financial management and procurement will be performed on a risk-based approach.** During implementation and in coordination with the task team, the procurement and financial management specialist will conduct annual reviews, including reviewing of requisite reports as per the project Implementation Plan, checking for compliance with agreed procurement and financial management procedures, identifying potential capacity gaps, and evaluating the adequacy of documentation and record-keeping arrangements. Formal supervision will be carried out at least twice per year, and continuous support will be made available by the specialists of the Bank team as required by the client.

Table 1A.1: Skills Mix and Resources Required

Skills Needed	Number of Staff Weeks	Number of Trips	Comments
Task Team Leader/s	8 staff weeks annually	2 trips annually, field visits as required	Country-office based and/or DC-based
Power System Engineer	4 staff weeks annually	2 trips annually	Local or international
Environmental Specialist	2 staff weeks annually	1 trip annually	Country-office based
Social Safeguards Specialist	2 staff weeks annually	1 trip annually	Country-office based
Financial Management Specialist	2 staff weeks annually	Field visits as required	Country-office based
Procurement Specialist	3 staff weeks first year, then 1 staff week annually in the following years	Field visits as required	Country-office based
Financial Analyst	2 staff weeks annually	Field visits as required	
Operational Support	4 staff weeks annually	Field visits as required	

Annex 2: Sector Analysis for Distributed Energy Resources

1. **Various kinds of DRE are emerging in many countries as innovative and cost-effective ways to serve power demand while reducing emissions.** DRE contrasts with traditional central power plants that are located at a distance from users and, therefore, require high voltage transmission grids. Such traditional power systems have been designed to serve infrequent peaks at every voltage level of the grid, with customers that are largely inflexible and blind to costs and benefits of their decisions, resulting in costly and underused facilities. Cost-effective DRE and smarter electricity consumption could save billions of dollars by improving the use of electricity infrastructure, complementary with centralized systems (MIT Energy Initiative 2016).

2. **First-generation DRE markets emerged in the early 2000s, mostly in Europe (Germany and Spain in particular) and the United States, driven by a variety of strong fiscal incentives for solar PV.** A second generation of more commercial DRE markets developed over the past several years across a much broader array of countries, notably Australia, Italy, Japan, specific U.S. states (California, Hawaii, New York, and Texas), and the United Kingdom. This second generation has been driven by continued strong policy support, particularly FiTs and net metering, but also by reduced technology costs that have made solar PV more competitive with retail electricity prices. Utilities have become more sophisticated at integrating increasing shares of intermittent RE into the grid, including DRE. There has also been a growing maturity of the solar industry along with large-scale finance and new business models.

3. **A third generation is now emerging as fiscal incentives decline, focused on: (a) direct economic competitiveness and integration with energy storage (batteries); (b) new business models and technologies that allow DRE to be aggregated in large numbers to provide a variety of services to the central grid; (c) more autonomous local power systems such as microgrids, local energy markets and trading; and (d) direct self-consumption without exporting to the grid.** China and other developing countries have begun to develop DRE in recent years as part of this third generation. While rural off-grid DRE has been prevalent in China since the 1990s and particularly grew as part of the "Golden Sun" program from 2009-2012, China had virtually no domestic solar PV market for grid-based systems until the introduction of support policies starting in 2011. Virtually all of the solar PV from 2011-14 was for centralized utility-scale, and DRE has only emerged in the past few years, with total national capacity increasing from 3 GW in 2014 to 10 GW in 2016, to 30 GW in 2017, and then to 50 GW in 2018. These increases were driven by FiTs for utility-scale solar PV and per-kWh (kilowatt hour) subsidies for smaller-scale distributed solar PV, both of which began in 2013. These fiscal incentives are now declining and planned for elimination.[21]

4. **This third-generation surge of DRE in China is helping to meet growing electricity demand while reducing emissions but is highly contingent on addressing institutional, economic, and technical barriers as will be discussed further below.** DRE applications in China are currently less diverse than those occurring in developed countries. Distributed solar PV is scaling up strongly among large industrial and commercial electricity consumers in China under a narrow range of business models, primarily those that involve high shares of self-consumption and little or no export of power to the grid.

5. **Many other use-cases that are now common in other countries are not yet prevalent (for example applications in public and residential buildings), so there remains a large opportunity and potential to accelerate the scale-up of other use-cases.** This includes a growing trend in China for microgrids employed in industrial parks and urban districts, and local trading and power-purchase agreements with third-party DRE developers (local merchant

[21] Distributed solar PV subsidies declined from ¥ 0.42/kWh in 2013 to ¥ 0.32/kWh in mid-2018.

generators). The scale-up of some of these other use-cases may be supported by further policy development, initially through provincial-level or local-level policy pilots. For example, the Government of China has drafted management guidelines for local energy trading platforms that could provide support for a variety of new use-cases.

6. **Achieving the scale-up potential of DRE in China involves both opportunities and challenges for users, utilities, and governments, and requires new approaches to analysis, policy, and planning.**
   (a) **From the general perspective of users, DRE can reduce the need to purchase grid electricity, and optimize energy services and economic returns in the context of grid conditions.** This can be done with 'smart' devices, such as smart meters that enable real-time price signals and smart inverters that enable DRE operational decisions based on grid conditions. Users' incentives to deploy DRE, therefore, depend on grid electricity price signals, and the quality of services that DRE can provide to both end-users and to the grid itself vis-à-vis the costs.
   (b) **For utilities, DRE may either decrease or increase the need for, and cost of, grid infrastructure investments like transmission and distribution (T&D), and large-scale generation, depending on how well DRE is planned, priced, and integrated.** A growing service sector in China, as well as a rapid rise of electric vehicles that is as yet unrivaled anywhere else in the world means energy demand is increasingly distributed among office complexes, smaller industrial facilities, and electric vehicle charging stations, as compared to large centralized loads of heavy industry (Hungerford and others 2017). Distribution companies may have positive grounds to delay or forego investments to increase a distribution circuit's capacity, but only if they planned or existing DRE constrains net peak load on that circuit for the period of an investment plan. Beyond that, a very high share of distributed generation could even lead to net surplus power (negative load) on a circuit, such as when a factory with rooftop PV stops work at lunchtime. While exporting power to higher voltage levels of the grid is technically feasible, it may require upgrading transformers to do so efficiently and safely. Even then, distributed generation to the grid will not offset the need for capacity to supply from elsewhere unless its scale, predictability, and reliability is sufficient. Moreover, high shares of basic solar PV or wind can disturb grid voltage and alternating current frequency. Technical solutions, such as appropriately programmed invertor electronics ("smart inverters"), are not yet widespread in China but are presently emerging elsewhere in the world. The considerations are many, and associated costs need to be considered from a system perspective.
   (c) **For governments, DRE needs further regulatory frameworks and provisions to match the increased complexity of both technical power systems and the business and institutional arrangements.** Nevertheless, China, like most countries, lacks a comprehensive approach to efficient prices and regulated charges for electricity services. DRE will also have fiscal impacts depending on tax and subsidy arrangements. For all these reasons, DRE is prompting a global rethink of sector institutions and models (MIT Energy Initiative 2016).

7. **To date, DRE business models around the world have been driven less by technology than by country-specific policy and regulatory factors**. Most DRE business models today fit into one of a few types. In China, services tend to be for either energy supply or energy management for end-users. Revenue may come from power sales at a price that undercuts conventional power prices from the central grid (typically 10 percent lower in many existing contractual arrangements), or from subscription fees or brokerage fees structured as shared savings arrangements. The range of business models is more diverse in the European Union and the United States where they also include providing firm capacity with operating reserves. Some serve regulated utilities or system operators and some brokerage fees are structured as payments earned in markets.

8. **In China and many other countries, business models may depend on unsustainable subsidies in the form of FiTs.** Given continued cost declines, technological innovation, and changing policy and regulatory landscapes, DRE business models in the future may well look very different from today. Market-oriented policies should help

businesses to adapt to evolving circumstances but determinants of success may include executional capabilities, culture, and other aspects that would need further research for distinct country contexts. One general consideration in this respect is that more men than women work and have leadership positions in the energy industry. This has implications for management and industry development, especially given that women tend to have a stronger influence over energy habits than men (Broussard 2016).

9. **The Government of China has made sudden cuts to distributed PV (DPV) subsidies and quotas as costs decline and REDF revenue is squeezed.** Since 2011, new grid-connected wind and utility-scale (grid-export) solar PV projects have benefited from national FiTs subsidized by the REDF at set rates for their lifetime of energy generation with some quotas. Additional national and subnational subsidies for DPV (end-user projects) which only apply to the proportion of power generation that is self-consumed by the end-user were introduced starting in 2013 as a way to support local PV manufacturers and help meet local clean energy targets. For the national FiT, power companies pay up to the local coal-fired benchmark price, and the REDF covers the FiT premium.[22]

10. **In 2018, subsidies for DPV were limited by a 10 GW capacity cap, down from a capacity cap of 20 GW in 2017.** In 2017, 30 GW of DPV was added, demonstrating that 10 GW was viable in 2017 without subsidies. According to the statistics, in 2018, about 21 GW of DPV was added which implies that 11 GW of newly added DPV was not eligible for subsidies. For utility-scale solar PV, current rates for the national PV FiT were amended on May 31, 2018 with immediate effect, ¥ 0.05/kWh less than respective rates effective from January 2018 (which were in turn ¥ 0.05 to ¥ 0.10/kWh less than rates in 2017). The May 2018 cut sent shockwaves through the global PV industry, with an anticipated cancellation of 20 GW in new utility-scale PV in China, but a corollary that PV module prices may fall faster in the coming years.

11. **Even without subsidies, some DPV users with relatively high electricity prices and good solar irradiation can already achieve parity with grid electricity.** Analysis suggests that the FiT subsidy levels have been within conservative estimates of external social costs of carbon and other pollutants (World Bank 2013), although not necessarily at optimal levels (Zhang and others 2016). Moreover, the unanticipated success of the FiTs has put pressure on the REDF without a commensurate increase in the consumer surcharge. In 2017, REDF was short by ¥ 80 billion (Lin 2018). As of 2017 in China, PV modules cost as little as ¥ 2-3/watt (compared to ¥ 10/watt in 2012), entire PV systems cost less than ¥ 6/watt, and PV energy costs an average of about ¥ 0.5/kWh, a drop of 75 percent from 2010 (Li 2018, Lin 2018, Yuan and others 2018). As an example, a typical DPV prosumer project in Shanghai might receive a 9 percent financial internal rate of return (IRR) assuming ¥ 5/watt system cost, and 83 percent self-use of power at the price of 90 percent of the average grid price of ¥ 0.9/kWh (Li 2018).

12. **DRE application opportunities vary significantly, however, across different use-cases and application situations.** Chinese cities are dominated by tall narrow buildings, where solar PV on the roof and even the side of the building could only meet a small fraction of the building's energy needs, in contrast to single houses or low-level warehouses with large roof areas that are more common in peri-urban areas. This suggests that DPV innovations and new

[22] For DPV prosumer projects (in Chinese 自发自用、余电上网), the national FiT is ¥ 0.32/kWh for all generation–whether self-used or sent to the grid. Self-used energy is exempt from grid-related fees (PRC 2018). Alternatively, DPV projects can choose to send all generation to the grid (全额上网), in which case their FiT is the same as for utility-scale PV, now ¥ 0.5 to ¥ 0.7/kWh. Prosumers are allowed to become solely suppliers to the grid, but not vice versa (PRC 2015). For wind power the national FiT for 2018 projects ranges from ¥ 0.44 to ¥ 0.58/kWh (PRC 2015) depending on the province, with no quota and no distinction for prosumer projects. The pricing policy does not define DPV but implies that it involves potential self-consumption. Ten provinces or municipalities, 36 prefecture-level cities, and 10 county-level cities or regions add their own subsidies for DPV, ranging from ¥ 0.05 to ¥ 0.55/kWh, and lasting from 2-20 years after commissioning (Yuan and others 2018). All rates cited include tax.

scalable use-cases will include non-rooftop locations such as surrounding landscaping, parking structures and grounds, rights-of-way, and other nonconventional surfaces. Examples of all of these are emerging in China.

13. **Avoided retail pricing from the grid can also vary by location and different types of DRE can have different economies of scale.** For example, small-scale solar PV costs more than large-scale solar PV installations due to economies of scale which are not as inherent to other DRE such as electric vehicles and flexible loads which may be able to provide the same service as DPV. DRE thus warrants careful planning and much greater experience from a variety of pilot projects to maximize net benefits to society. Greater information transparency can also support new use-cases. Chinese grid companies currently map the location of grid constraints and investment plans to address such constraints but do not make this information publicly available to inform project developers and end-users as is common practice in other countries.

14. **DRE could also help spur long-stalled sector market reforms which, in turn, should enable greater use of DRE**. Research suggests that fully capturing the potential of DRE requires clear price signals based on location- and time-specific marginal costs of supply as could be revealed through well-regulated market competition (MIT Energy Initiative 2016). Achieving this to a much higher penetration scale for DRE would be more complex than greater market orientation for standard wholesale and retail markets but in the long-term all three sectors need to advance together. Limited, incremental progress has been made in the direction of power sector market reforms that have been repeatedly announced since the early 2000s.

15. **State-oriented oligopolies dominate the sector and new consolidations are reversing previous unbundling.**[23] Incumbent utilities may prefer to provide and control DRE services rather than allow a new class of service providers to cooperate and potentially compete with them. Nevertheless, market reform pilots have already proven effective at reducing RE curtailment which provides a basis for cautious optimism for some expansion. The government also encourages, but does not require, local competitive bidding to allocate DPV projects to help increase the role of markets (PRC 2018). The SGCC has announced plans to operate 'smart grids' by 2020 which will further enable market-oriented pricing and new business models for DRE operation–such as aggregation of large numbers of DRE facilities by single aggregator businesses.

16. **General electricity pricing arrangements in China provide only modest incentives for DRE, which vary by province and technology type.** Electricity prices in China are set by the Government to reflect the circumstances of each province, autonomous region, and municipality, with no published method or roadmap. Household prices are heavily cross-subsidized by industry and commercial consumers which gives industrial and commercial consumers more incentive to consider DRE.[24] Tiered, dynamic or multipart pricing designs and demand response programs are

[23] Five large state-owned corporations together control 40 percent of total installed capacity, while most of the 4,000 plus smaller generation companies are also government-controlled. Transmission is dominated by two large state-owned companies that buy all wholesale power and are responsible for system operation: SGCC accounts for 80 percent of the power market, and China Southern Grid (CSG) accounts for 20 percent. Among more than 3,000 provincial, prefecture, and county-level distribution companies, one-third are affiliated to SGCC and CSG. The NEA fulfills a quasi-regulator role. State Council Degree No. 9 in 2015 specifies the introduction of competition at the generation and retail levels, "gradually" phasing out the coal power generation quota, allowing direct contracting between generators and large users, and reforming T&D pricing. In 2017, the largest power generation and coal mining corporations were merged, and further mergers have been reported as likely.

[24] Economies of scale make it less costly to supply large users than small users with grid electricity. The ratio of residential to industrial electricity price in China, around 0.8–0.9 in 2007, is significantly lower than the average of 1.5–2 in most developed countries. National tiered pricing introduced in 2012 preserves the lowest two tiers for around 80 percent of households. The first tier varies from ¥ 0.3771/kWh for up to 150 kWh/month in Qinghai, to ¥ 0.6083/kWh for up to 160 kWh/month in Hainan (in summer)(See Wang and others 2017). In 2018 the government lowered tariffs for industrial and commercial consumers by 10 percent without increasing household rates (Lin 2018).

still at an early level of use.[25] At least five high-income localities in eastern and central China currently have time-of-use tariffs to reflect high daytime demand and low overnight demand ('peak and valley'). DRE can reduce or shift load from the peak period (such as with batteries that charge at night. The incentive for this is proportional to the peak-valley price difference which is particularly great in Jiangsu and Zhejiang provinces.[26] Carbon pricing may also incentivize DRE, and while China is taking steps toward a national emissions trading scheme, the impact of pilot schemes to date has been limited.

17. **From a social perspective, low-income households and small enterprises may face specific, additional barriers to participating in DRE.** International experience shows that most DREs are owned by relatively wealthy users who have more access to finance for the capital. As is the case with most countries, current pricing arrangements in China mainly recover system costs through energy sales. Without pricing reform or other measures, increased use of DRE by wealthier users will shift the burden of recovering costs to other users, resulting in a regressive redistribution of income.

18. **The Government has made major efforts to deploy DRE in combination with social policy objectives, through the Solar Energy for Poverty Alleviation Program (SEPAP) announced in 2014.** SEPAP aims to add over 10 GW capacity in distributed or medium-scale solar PV and ¥ 3,000/year extra income for each of more than two million households from around 35,000 villages across China by 2020. Most such activities are not commercially bankable, however, and rely instead on government subsidies and corporate philanthropy which are difficult to secure. SEPAP systems receive a FiT of ¥ 0.42/kWh and by the end of 2017 ¥ 50 billion had been approved but not yet distributed (Energy Trend 2018). Project maintenance and accountability are additional challenges. Whereas SEPAP explicitly aims to combine industrial policy, environment, and social development objectives, further research is needed to consider what governance structures or institutions may serve these multiple policy purposes well (Geall and others 2017).

19. **The World Bank has gained experience from early support for DRE in a number of projects in China and other countries.** Many experiences and lessons can be learnt from other Bank-supported projects in China, such as the Beijing Distributed Solar PV Scale-Up Project which addressed public buildings (Table 2A.1). A significant challenge illustrated by that project is that the developers had trouble securing roof-top spaces from the building owners. Developers need to obtain consent and willingness from multiple owners in most commercial buildings who are not interested in roof-top solar PV since energy costs are a small share of operating costs and tenants typically pay for the energy bills anyway. Furthermore, decision makers in government and other public buildings are concerned about potential safety issues of roof-top solar PV and have no incentive to save the energy bill because it will be covered by the government's fiscal budget. Cities like Beijing have mostly skyscrapers where solar PV on the roof and even the side of the building can only meet a small fraction of the building's energy needs, in contrast to single houses or low-level warehouses with large roof-top spaces in developed countries.

20. **Some conclusions can be drawn from studies supported by these projects:**
    - **distributed generation, particularly renewable generation, is different to large utility-scale generation. It should be located close to the load center and directly serve particular loads by aligning the generation and load profile as much as possible; and**

[25] Investment in smart meters has not been matched by investments in consumer-based technologies such as automated control and energy management systems. Apart from several pilot cities, no formal demand-side mechanism has been established to recover participant costs such as opportunity costs and investments in consumer-based technologies. Users are not keen to join 'smart demand response programs' due to limited financial benefits and ineffective consumer engagement (Guo and others 2017).

[26] For example, as of 2018, Jiangsu charges large industry (1-10 kV) ¥ 0.3139/kWh from 0:00-8:00 and ¥ 1.0697/kWh from 8:00-12:00 and 17:00-21:00. In Shanghai, Jiangxi, Fujian, and Sichuan, the difference is less (See Wang and others 2017).

- **multi technologies and resources need to be considered to compensate each other and improve the cost effectiveness of the energy supply system at various scenarios.**

21. **Experiences and lessons learnt from these projects have been considered when designing the proposed project.** For example, the business model and financing model for industrial parks are comparatively mature and successful in China, therefore, the proposed project will not share resources for studying the policies, business, and financing model, or grid connection issues related to industry, but on other types of uses.

Table 2A.1: Current World Bank-supported Distributed Energy Resources Projects

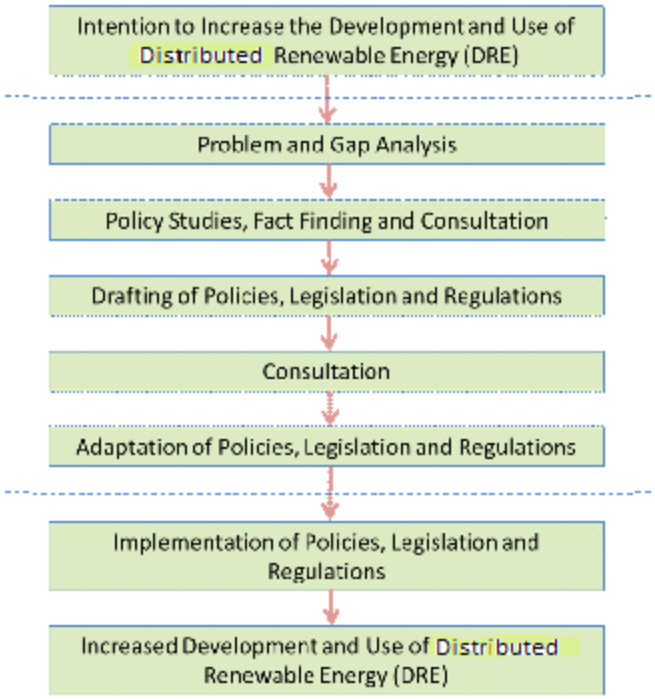
Project Name (Code)	Implementing Agency	WB Finance (US$ millions)	Closing Date	Elements Related to DRE
Green Energy Schemes for Low-carbon City in Shanghai, China (P127035)	Bank of Shanghai, Bank of Pudong	100.00 IBRD	Dec 2018	Community-level distributed energy system design and analysis: Shanghai.
Urban Scale Building Energy Efficiency and Renewable Energy (P130786)	Ministry of Housing and Urban-Rural Development; Beijing and Ningbo Municipalities	12.00 GEF	Dec 2018 (with possible extension)	City-level distributed energy system design and analysis and commercial PV support in Beijing; Ningbo (Zhejiang); Qingdao (Shandong), Taiyuan (Shanxi), Fengxi (Shaanxi), Zhuzhou (Hunan).
China Renewable Energy Scale-Up Program Phase II (P127033)	National Energy Agency	27.28 GEF	June 2019 (with possible extension)	City-level distributed energy planning and analysis: Hefei (Anhui), Zhangjiakou (Hebei); Province-level design of wheeling charges for distributed PV: Jiangsu; General microgrid guidelines and reform plan for market-oriented DRE grid integration; Pilot green county and DRE in rural areas; Series of RE for heating– case studies, implementation plan, four-party agreements, building applications, statistics, etc.; Series of support to biogas– policy, standards, and pilots
Beijing Distributed Solar Photovoltaic Scale-Up Project (P125022)	Beijing Municipality, Yuanshen Company	105.00 IBRD	Dec 2019	Investment finance in PV in 5 sectors: Beijing.
Innovative Financing for Air Pollution Control in Jing-Jin-Ji Area (P154669)	Huaxia Bank	500.00 IBRD	June 2022	Investment finance for 5 DRE projects including innovative model of PV along highways: provinces of Beijing, Hebei, Tianjin, Shandong, Shanxi, Hebei, Henan.

Annex 3: Policy and Demonstration Projects Selection Criteria

Component 1 Project Evaluation Criteria

1. **The objective of the Policy Support Component (Component 1) is to develop an enabling policy environment for DRE at national and pilot provinces level.** Planners and developers in China generally lack a framework to understand the tradeoffs between distributed and centralized energy resources and to assess the optimal scale of deployment and location of DREs. Such a framework has only recently begun to be applied even in developed markets. Work to develop and roll out such a framework in China could provide a foundation for grid companies, local authorities, project developers, and end-users to identify specific locations where DREs will add the most value for all concerned. The process to go from the current situation (intention to increase the development and use of DRE) to the desired situation is schematically presented in Figure 3A.1. The Policy Support Component can support all activities between the dotted lines as long as the ultimate objective of an enabling policy, legislative and regulatory environment for DRE development and use is clearly defined.

Figure 3A.1: Schematic Presentation of DRE Policy Development



Source: World Bank staff.

2. **The government has begun to address a number of relevant policies such as grid access, wheeling charges, and technical standards for DRE and microgrids.** The level of policy development and implementation is still far from what is needed, however, and further policies for DRE under the context of power sector reform are also required. There continues to be a lack of national, provincial, and even local enabling policies for distributed electricity generators, including grid access under direct contracting between generators and users, wheeling charges at distribution level, arrangements for sharing costs for the distribution grid upgrade to accommodate high penetration of DRE, microgrids pricing when exporting excess power to the grids, building safety standards, and

incorporation of DRE into urban planning. The reduction in subsidies highlights the importance of establishing a policy and regulatory framework that can sustain market development of DREs over time.

3. **Policies, legislation and regulations are envisaged that:**
   - **(a) provide grid access under direct contracting between the generators and other end-users;**
   - **(b) specify pricing schemes to account for the economic value of DRE to different actors and at given times and locations,** especially in the context of power sector reform, including tariffs for excess power exported to the grid, peak demand charges for DRE suppliers, distribution-level wheeling charges, cost recovery for grid upgrades to accommodate high penetration of DRE, and the benefit of avoided investments for centralized generation displaced by DRE;
   - **(c) establish technical standards and certification schemes such as codes for integrating DRE into buildings;**
   - **(d) regulate urban planning that incorporates DRE at city and township levels; and**
   - **(e) establish information and communication mechanisms including technology platforms, access, privacy, and cybersecurity risk management.**

4. **Proposals submitted will be evaluated using the following parameters:**
   - **(a) Evidence of national or provincial government commitment.**
   - **(b) Soundness of the Theory of Change (how will the proposed project increase the development and use of DRE).**
   - **(c) Likely contribution to achieving Component 1 objectives and indicators (in the end, will there be a new policy, law or regulation that promotes DRE development and use).**
   - **(d) Approach (how will the project objective be achieved).**
   - **(e) Cost effectiveness (value for money which will increase with contributions from other sources).**

Component 2 Pilot Activity Evaluation Criteria

1. **For a pilot activity to be awarded a subgrant under the Pilot Support Component (Component 2) it must be:**
   - **Complete;**
   - **Innovative;**
   - **Scalable; and**
   - **Feasible.**

Complete

2. **A pilot activity proposal is complete when it details:**
   - **(a) Technology configuration and integration** (not an individual technology, but a system);
   - **(b) System level,** for example, building, microgrid, district or zone;
   - **(c) Business model,** for example that an enterprise is seriously considering but has not yet applied a business model due to some barrier for given customer types and energy service levels, with a demonstrated rate of return and profitability.
   - **(d) Finance model,** which may involve state or private bank credits, or equity investors, or RE service contract, or financing leasing with the potential to be viable with commercial interest rates; and
   - **(e) Minimum enabling government policies,** which may or may not involve a change from present policy at national or subnational level.

Innovative

3. **Application concepts should extend or go beyond those already becoming common in China, or for which proof of concept already exists. Innovative applications could include, among other possibilities:**
   (a) Integration of DRE with heating or cooling; energy storage; demand response; demand-side energy efficiency; electric vehicle charging; or the built environment (materials, architecture, urban planning).
   (b) DRE applications that allow trading.
   (c) DRE sources other than solar PV.

Scalable

4. **Scalable means that it has the potential to be replicated in China at a scale that contributes substantially to the increased use of RE in place of high-carbon energy (and, therefore, contributes substantially to related energy and emissions targets at national or subnational levels).** For example, the concept is applicable throughout a significant proportion of China, or in most cities of a specific geographic or climatic zone. *Risks* to scalability should be clearly identified and defined (for example, institutional situation, policy context, business model), along with measures to mitigate these risks. Government commitment to enact and sustain appropriate enabling policies and grid operation arrangements are key considerations in demonstrating scalability.

Feasible

5. **A pilot activity is feasible when it is likely to be realized as proposed.** Have the risks been identified and can the risks be sufficiently mitigated? This includes the application of the business and financing model and connection to the distribution grid system. Eligible subprojects will be required to demonstrate a high likelihood that implementation will, by a given year, directly result in a certain amount of investment (million Chinese Yuan), installed capacity of DRE (megawatts), and associated emissions reductions (tons of carbon dioxide equivalent using an established methodology), and that such an investment is cost-effective.

Annex 4: List of example investments for prospective pilot support

The following demonstration subprojects have been identified by China South Grid Corporation and its subsidiary Energy Efficiency and Clean Energy Co. Ltd. as candidates for pilot support.

#	Name of Subproject	Investment (US$ millions)
1	Midea Environment Appliances Renewable Energy Comprehensive Utilization Project	17.62
2	Weiling Electronic Appliance Co. Ltd. Renewable Energy Comprehensive Utilization Project	4.48
3	Midea Wuhu Renewable Energy Comprehensive Utilization Project	16.42
4	Yunfu Hydrogen Industrial Park Renewable Energy Comprehensive Utilization Project/Energy Demand-side Storage Demand-responsive Demonstration Project	8.20
5	Demand-side Energy *Hisense* Corporation Shunde Workshop Renewable Energy Comprehensive Utilization Project /Storage Responsive to Load & Grid Ancillary Service Demand Project Demonstration Project	11.76
6	Hanteng Auto Renewable Energy Comprehensive Utilization Project	27.70
7	Great Wall Motor Tianjin Branch Renewable Energy Comprehensive Utilization Project	27.71
8	Dongfeng Motor Corporation Passenger Vehicle Company Dalian Workshop Renewable Energy Comprehensive Utilization Project	14.47
9	Jatco Renewable Energy Comprehensive Utilization Project/ Demand-side Energy Storage Responsive to Load & Grid Ancillary Service Demand Project Demonstration Project	12.21
10	Citroen Shenzhen Renewable Energy Comprehensive Utilization Project	18.18
11	Dongfeng-Honda Spare Parts Workshop Renewable Energy Comprehensive Utilization Project	10.57
12	Wenchong Shipyard, Huangpu Renewable Energy Comprehensive Utilization Project/ Demand-side Energy Storage Responsive to Load & Grid Ancillary Service Demand Project Demonstration Project	7.52
13	Dongfeng Motor Corporation Passenger Vehicle Company, Wuhan Workshop, New Energy Workshop Renewable Energy Comprehensive Utilization Project	13.71
14	Great Wall Motor Xushui Branch Renewable Energy Comprehensive Utilization Project	33.20
15	Galanz Zhongshan Renewable Energy Comprehensive Utilization Project	3.34
16	Midea Shunde Renewable Energy Comprehensive Utilization Project	1.41
17	Great Wall Motor, Xushui Chassis Workshop Renewable Energy Comprehensive Utilization Project	3.66
18	Great Wall Motor, Shunping Workshop Renewable Energy Comprehensive Utilization Project	3.20
19	Xuwen Renewable Energy Scale-up Utilization Demonstration Project	46.81
20	BAK Battery Workshop Demand-side Energy Storage Responsive to Load & Grid Ancillary Service Demand Project Demonstration Project	2.12
Total		**284.29**

Annex 5: Financial details of two example investments for prospective pilot support

The following demonstration subprojects have been identified by China South Grid Corporation Energy Efficiency and Clean Energy Co. Ltd. as candidates for prospective pilot support. Both relate to DRE integrated applications.

1. **Distributed Photovoltaic Power Project of Dongfeng Nissan Passenger Vehicle Company in Huadu District of Guangzhou (30MWp):**
   - (a) **This project built a 30 peak megawatt grid-connected photovoltaic power station in the parking lot and on the roof of some workshops of Dongfeng Nissan Passenger Vehicle Company.** The roof of the workshop is covered with colored steel tiles and a new carport was built in the parking lot. Photovoltaic modules are installed on the colored steel tiles and carport.
   - (b) **The project will generate 31.5 million kWh without occlusion in the first year, and the cumulative generation through 25 years is estimated to be 716.34 million kWh while the average annual generation should be 28.65 million kWh.** According to the actual situation, the consumption ratio of the DRE has exceeded 90 percent.
   - (c) **The full utilization of the project in the first year is about 1,050 hours.** According to the average annual generating capacity of 28.65 million kWh, the project can reduce CO_2 by 23,000 tons per year on average and by 570,000 tons over 25 years. Significant environmental-protection benefits are obtained in the whole life cycle of the project.
   - (d) **Dongfeng-Nissan provides us with the sites needed for photovoltaic power generation free of charge, and the investor is responsible for investment, construction and operation.** During the contract period, the property rights of photovoltaic power stations belong to us, and the project operation period is 25 years. By agreement of both parties, during the term of the contract, the investor shall charge 90 percent of mains electricity prices to the building owner (power consumer) during the actual generation period.
   - (e) **The unit investment price of this project is about ¥ 7.8/ peak watt, the total investment is about ¥ 230 million, the IRR through the full life circle (25 years) is about 8.2 percent.**

2. **Distributed Solar PV Project of GAC New Energy Vehicles Company in Panyu District of Guangzhou (16 peak megawatt)**:
   - (a) **The project has built a grid-connected Solar PV system with a capacity of 16.24 peak megawatt including solar PV roof power generation system, car shed and the corresponding supporting grid facilities.** The full utilization of the project in the first year is about 1,020 hours.
   - (b) **The project will generate 16.49 million kWh without occlusion in the first year, and the cumulative generation through 25 years is estimated to be 374.91 million kWh while the average annual generation should be 15 million kWh.** According to the actual situation, the consumption ratio of the DRE is about 80 percent.
   - (c) **According to the average annual generating capacity of 16.49 million kWh, the project can reduce CO_2 emissions by 13,000 tons per year on average and by 300,000 tons over 25 years.** Significant environmental-protection benefits are obtained in the whole life cycle of the project.
   - (d) **GAC New Energy Vehicles Company provides us with the sites needed for photovoltaic power generation free of charge, and we are responsible for investment, construction and operation.** During the contract period, the property rights of photovoltaic power stations belong to the investor, and the project operation period is 25 years. By agreement of both parties, during the term of the contract, the investor shall charge 80 percent of mains electricity prices to the building owner (power consumer) during the actual generation period, and 50 percent of the remaining on-grid energy shall be shared with the building owner.

(e) The unit investment price of this project is about ¥ 5.2/ peak watt, the total investment is about ¥ 83 million, the IRR through the full life circle (25 years) is about 8.0 percent.

Annex 6: Indicative Policy (Policy/Regulation/Standards) Studies

1. Study on key technology and business model on the optimization of the integration of DRE and battery storage.
2. Key technology to improve the performance of DRE generation.
3. Applying advanced IT to improve the configuration of the DRE system design and performance control.
4. Control and active management of high penetration DRE system.
5. Multisource virtual power plant business model and pricing mechanism.
6. Methodology on pricing the services provided by battery storage in the grid and development plan of battery storage in a given grid.
7. DRE billing and trading technology and policy study.
8. DRE scaling up and road map for phasing out subsidies.
9. Investment policy and green financing model for promoting DRE.
10. Key technology on assessment of the capacity of a given distribution network for accommodating electric vehicles for charging and self-planning.
11. Study on the tipping point and fundamental change towards a new energy dominating power system.
12. Study technical design and evaluation system of DRE with storage and smart grid.

Annex 7: Incremental Costs Analysis

Table 7A.1: Incremental Cost Analysis

Scenario	Target /Costs (GEF)	Domestic Benefits	Global Environmental Benefits
Baseline Scenario (Government DRE targets without GEF-supported project)	60 GW DRE increased installation in 2023 from 2019. No innovative pilots.	Less reduction of local pollution.	Baseline
Alternative Scenario (Government DRE targets with GEF-supported project)	80 GW DRE increased installation in 2023 from 2019. Component 1: Policy support (GEF US$2.0m, counterpart funding US$2.0m). Component 2: Pilot support (GEF US$4.286m, counterpart funding US$66.0m). Component 3: Capacity Building and Project Management (GEF US$1.0m, counterpart funding US$0.5m).	More reduction of local pollution. Incentive policy enhanced, grid integration standards/wheeling charge pricing developed, and development target and subsidy scheme updated. More proven business, financing model demonstrated and promoted; more disruptive technology to manage the DRE piloted from both grid side and customer side. Implementing agency's capacity increased at least in managing the DRE program.	With incremental benefit
Incremental	10 GW DRE installation in 2023 (20 GW with 50% attributable to GEF policy support).	More local pollution reduction.	112 Mt CO_2e indirect and 0.8 Mt CO_2e direct lifetime emissions reduction.

Avoided Emission Calculation

For grid-connected photovoltaic and wind projects, the emissions factor of grid electricity is the sum of operation margin and build margin with weights of 0.75 and 0.25 respectively. According to latest official data for the year 2017, the lowest average emission factor was China Southern Grid at 0.6894 kg CO_2e/kWh. As projects may occur anywhere in China, this provides a conservative basis for a national emissions factor as it would understand potential emissions reduction from projects in other provinces. Historic declines in the minimum emissions intensity of CSG electricity from 2012 to 2017 imply an annual reduction of approximately 2.8 percent (Table 7A.2). This is also the most aggressive emission reduction for that time period of any other regional grid in China and provides the basis for a conservative dynamic forward-looking scenario. Emission intensity is assumed to decline from 0.65 kg CO_2/kWh in 2019 to 0.58 kg CO_2/kWh in 2023 and 0.34 kg CO_2/kWh in 2042. By the year 2042, the DRE capacity installed in the final year of project implementation (2023) would have reached the end of a standard 20-year economic life.

Table 7A.2: Grid Electricity Emissions Factor of China Southern Grid (grams of CO_2/Wh)

Factor	2012	2017	Inferred Annual Reduction (between 2012 and 2017)	Forecast to 2019	Forecast to 2023	Forecast to 2042
Operating Margin (OM)	0.9344	0.8367	n.a.	n.a.	n.a.	n.a.
Build Margin (BM)	0.3791	0.2476	n.a.	n.a.	n.a.	n.a.
Combined (0.75 x OM + 0.25 x BM)	0.7956	0.6894	2.8%	0.6510	0.5806	0.3369

Assuming a default DRE output of 1,200 full capacity equivalent hours per year (that is, 14 percent capacity factor, typical of PV projects in China), the estimated emissions reduction impacts from the pilots and policies supported by the project are displayed in Table 7A.3.

Table 7A.3: Estimated DRE Capacity and Inferred GHG Emissions Reduction Under the Project

		Cumulative DRE capacity (MW) added until 2023					DRE output (full capacity equivalent h/y)	Assumed EF for Project (kgCO2/kWh)	CO2 reduction (kt)			
	Year	GEF Pilot	National stated policies scenario	National with new policies	National with new policies (50% causality)	National GEF increment			GEF Pilot	National stated policies scenario	National with GEF	National with GEF increment
Project period	2019	0	0	0	0	0	1200	0.6510	-	-		-
	2020	10	18000	19000	18500	500	1200	0.6327	8	13,665	14,045	380
	2021	25	34000	38000	36000	2000	1200	0.6148	18	25,084	26,559	1,476
	2022	45	48000	58000	53000	5000	1200	0.5974	32	34,412	37,997	3,585
	2023	75	60000	80000	70000	10000	1200	0.5806	52	41,801	48,768	**6,967**
Economic lifetime after project closing	2024	75	60000	80000	70000	10000	1200	0.5642	51	40,621	47,391	6,770
	2025	75	60000	80000	70000	10000	1200	0.5482	49	39,474	46,053	6,579
	2026	75	60000	80000	70000	10000	1200	0.5328	48	38,359	44,752	6,393
	2027	75	60000	80000	70000	10000	1200	0.5177	47	37,276	43,489	6,213
	2028	75	60000	80000	70000	10000	1200	0.5031	45	36,224	42,261	6,037
	2029	75	60000	80000	70000	10000	1200	0.4889	44	35,201	41,068	5,867
	2030	75	60000	80000	70000	10000	1200	0.4751	43	34,207	39,908	5,701
	2031	75	60000	80000	70000	10000	1200	0.4617	42	33,241	38,781	5,540
	2032	75	60000	80000	70000	10000	1200	0.4486	40	32,303	37,686	5,384
	2033	75	60000	80000	70000	10000	1200	0.4360	39	31,391	36,622	5,232
	2034	75	60000	80000	70000	10000	1200	0.4237	38	30,504	35,588	5,084
	2035	75	60000	80000	70000	10000	1200	0.4117	37	29,643	34,583	4,940
	2036	75	60000	80000	70000	10000	1200	0.4001	36	28,806	33,607	4,801
	2037	75	60000	80000	70000	10000	1200	0.3888	35	27,993	32,658	4,665
	2038	75	60000	80000	70000	10000	1200	0.3778	34	27,202	31,736	4,534
	2039	75	60000	80000	70000	10000	1200	0.3671	33	26,434	30,840	4,406
	2040	65	60000	80000	70000	10000	1200	0.3568	28	25,688	29,969	4,281
	2041	40	42000	61000	51500	9500	1200	0.3467	17	17,474	21,426	3,952
	2042	0	8000	23000	15500	7500	1200	0.3369	-	3,234	6,267	3,032
TOTAL PROJECT PERIOD									111	114,963	127,369	12,407
TOTAL EQUIPMENT LIFETIME									**816**	690,236	802,055	**111,819**

References

EnergyTrend. 2018. “PV Demand in the Chinese Market May Drop in 2018 due to New Notification Released by NEA.” https://pv.energytrend.com/research/20180611-12331.html

Geall, S., W. Shen, and Gongbuzeren. 2017. “Solar PV and poverty alleviation in China: Rhetoric and reality.” STEPS Working Paper 93. Brighton: STEPS Centre.

Hungerford, Z., Y. Liu, Z. Lyu, S. Mueller, Z. Ran, and X. Sun. 2017 and others. “Prospects for distributed energy systems in China.” Paris: International Energy Agency.

MIT Energy Initiative. 2016. “Utility of the Future: An MIT Energy Initiative response to an industry in transition.” energy.mit.edu/uof

PRC National Development and Reform Commission. 2015. 关于完善陆上风电光伏发电上网标杆电价政策的通知 [Notice of improving onshore wind power and PV power grid benchmarking price policy]. Issued 22 December 2015. http://www.ndrc.gov.cn/gzdt/201512/t20151224_768582.html

PRC National Development and Reform Commission, Ministry of Finance and National Energy Board. 2018. 关于2018年光伏发电有关事项的通知 [Notice on matters related to PV generation in 2018]. Issued 31 May 2018. http://www.ndrc.gov.cn/zcfb/zcfbtz/201806/t20180601_888637.html

Yuan, M., M. Hong, and M. Zhang. 2018. “Distributed Solar PV in China: Growth and Challenges.” Washington DC: World Resources Institute. https://www.wri.org/blog/2018/08/distributed-solar-pv-china-growth-and-challenges

Zhang, M.M., D.Q. Zhou, P. Zhou, and G.Q. Liu. 2016. “Optimal feed-in tariff for solar photovoltaic power generation in China: A real options analysis.” *Energy Policy* 97: 181-92. doi.org/10.1016/j.enpol.2016.07.028