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IMPLEMENTATION COMPLETION AND RESULTS REPORT

ON A GRANT FROM THE

GLOBAL ENVIRONMENT FACILITY TRUST FUND

IN THE AMOUNT OF US$ 27.28 MILLION

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR

THE SECOND PHASE OF THE RENEWABLE ENERGY SCALE-UP PROGRAM

November 1, 2022

Energy & Extractives Global Practice
East Asia And Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective {Dec 09, 2021})

Currency Unit =	US$
CNY 6.3498 =	US$1

FISCAL YEAR
July 1 - June 30

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ABBREVIATIONS AND ACRONYMS

CCGT	Combined Cycle Gas Turbines
CF	Capacity Factor
CMA	China Meteorological Administration
COP	Conference of the Parties
CREEI	China Renewable Energy Engineering Institute
CRESP	China Renewable Energy Scale-up Program
CRESP I	CRESP Phase 1
CRESP II	CRESP Phase 2
CSP	Concentrated Solar Power
DPF	Development Policy Financing
ERI	Energy Research Institute
EU	European Union
FM	Financial Management
FYP	Five Year Plan
GEF	Global Environment Facility
GW	giga watt
GWh	gigawatt-hour (10^6 kWh)
ICR	Implementation Completion and Results Report
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
ISR	Implementation Status and Results Report
JJJ	Jing Jin Ji
kWh	kilowatt-hour
LIDAR	Light Detection and Ranging
LCOE	Levelized Cost of Electricity
NEA	National Energy Administration
M&E	Monitoring and Evaluation
MTR	Mid Term Review
Mtce	million tons coal equivalent
NDRC	National Development and Reform Commission
OP	Operational Policies
PAD	Project Appraisal Document
PDO	Project Development Objective
PMO	Project Management Office
PV	Photovoltaics
RE	Renewable Energy
REPC	Renewable Energy Power Certificate
SAC	Standardization Administration of China
TF	Trust Fund
TPF	Tiered Electricity Pricing
TWh	terawatt-hour (10^9 kWh)
US$	United States Dollar

VALCOE	Value Adjusted Levelized Cost of Electricity
WAsP	Wind Resource Assessment, Siting and Energy Yield Calculations
Wp	Watt peak

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DATA SHEET

BASIC INFORMATION

Product Information

Project ID	Project Name
P127033	China Renewable Energy Scale-Up Program Phase II
Country	**Financing Instrument**
China	Investment Project Financing
Original EA Category	**Revised EA Category**
Not Required (C)	Not Required (C)

Organizations

Borrower	Implementing Agency
People's Republic of China	National Energy Administration

Project Development Objective (PDO)

Original PDO

The objective of the CRESP program (three phases) is to enable commercial renewable electricity suppliers to provide energy to the electricity market efficiently, cost-effectively and on a large scale. The objective of CRESP Phase II is to support the ambitious renewable energy scale-up program in China with a focus on efficiency improvement and reduction of incremental costs.

FINANCING

	Original Amount (US$)	Revised Amount (US$)	Actual Disbursed (US$)
World Bank Financing			
TF-15769	27,280,000	27,271,527	27,271,527
Total	**27,280,000**	**27,271,527**	**27,271,527**
Non-World Bank Financing			
Borrower/Recipient	0	0	0
Total	**0**	**0**	**0**
Total Project Cost	**27,280,000**	**27,271,527**	**27,271,527**

KEY DATES

Approval	Effectiveness	MTR Review	Original Closing	Actual Closing
29-Oct-2013	26-Dec-2013	12-May-2017	30-Jun-2019	31-Dec-2021

RESTRUCTURING AND/OR ADDITIONAL FINANCING

Date(s)	Amount Disbursed (US$M)	Key Revisions
22-Feb-2019	14.16	Change in Results Framework Change in Loan Closing Date(s) Change in Implementation Schedule
19-Aug-2020	20.46	Change in Results Framework Change in Loan Closing Date(s) Change in Implementation Schedule

KEY RATINGS

Outcome	Bank Performance	M&E Quality
Highly Satisfactory	Satisfactory	Modest

RATINGS OF PROJECT PERFORMANCE IN ISRs

No.	Date ISR Archived	DO Rating	IP Rating	Actual Disbursements (US$M)
01	07-Mar-2014	Satisfactory	Satisfactory	0
02	11-Oct-2014	Satisfactory	Satisfactory	0
03	26-May-2015	Satisfactory	Moderately Satisfactory	2.50
04	16-Dec-2015	Moderately Satisfactory	Moderately Satisfactory	3.63
05	23-Jun-2016	Moderately Satisfactory	Moderately Satisfactory	5.78
06	16-Dec-2016	Moderately Satisfactory	Moderately Satisfactory	7.78
07	23-Jun-2017	Moderately Satisfactory	Moderately Satisfactory	7.78
08	28-Dec-2017	Moderately Satisfactory	Moderately Satisfactory	8.10
09	27-Jun-2018	Moderately Satisfactory	Moderately Satisfactory	10.33
10	16-Dec-2018	Satisfactory	Moderately Satisfactory	13.54
11	18-Jun-2019	Satisfactory	Moderately Satisfactory	15.06
12	02-Dec-2019	Satisfactory	Satisfactory	18.34
13	19-Jun-2020	Satisfactory	Satisfactory	19.84
14	11-Dec-2020	Highly Satisfactory	Satisfactory	21.56
15	24-Jun-2021	Highly Satisfactory	Satisfactory	24.28

SECTORS AND THEMES

Sectors

Major Sector/Sector	(%)
Energy and Extractives	**100**
Renewable Energy Biomass	21
Renewable Energy Geothermal	21
Public Administration - Energy and Extractives	18
Renewable Energy Solar	21
Renewable Energy Wind	19

Themes

Major Theme/ Theme (Level 2)/ Theme (Level 3)	(%)
Environment and Natural Resource Management	**100**
Climate change	84
Mitigation	84
Environmental policies and institutions	16

ADM STAFF

Role	At Approval	At ICR
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I. PROJECT CONTEXT AND DEVELOPMENT OBJECTIVES

A. CONTEXT AT APPRAISAL

Country, Sector, and Project Context[1]

1. **The China Renewable Energy Scale-Up Program (CRESP) Partnership.** CRESP is a long-term three-phase partnership program between the World Bank, the Global Environment Facility (GEF) and the Government of China (GoC) to scale-up the development of renewable energy-based electricity in the country. The partnership was envisioned to allow for continuity in policy dialog given the complex nature of addressing barriers in a sector that was rapidly evolving globally, which required a "flexible approach to adapt to the fast-changing environment and the priorities as they emerge during implementation"[2]. The long-term partnership was expected to bring international best practices to policy advice and institutional support, leverage investments, and transfer technology to improve quality and reduce costs. It would support the expansion of renewable energy at the national level and closely align with the renewable energy goals of China's Five-Year Plans (FYPs) for economic development. China's ratification of the Kyoto Protocol in 2002 made partnerships such as CRESP possible as the country shifted to a more "positive stance towards international environmental cooperation and world sustainable development"[3] and sought greater support from countries that were leading renewable energy development.

2. The backbone of the three-phases of GEF grants that fund CRESP is to develop a legal and policy framework and support technology improvements, standards and certification, and help prepare innovative renewable energy investments. The development objective of this overarching program is to enable commercial renewable electricity suppliers to provide energy to the electricity market efficiently, cost-effectively, and on a large scale. The vision was to initially provide in Phase I the policy framework for investments in large-scale renewable energy development and build-up domestic capacity by demonstrating some early successes. This would be followed by Phase II efforts to sustain the scale-up with reforms that would improve the efficiency, reduce costs and better integrate renewable energy into the power system. Phase III would then undertake energy sector reforms that are more aligned with renewable energy development taking into consideration its specific characteristics. Different phases of the program would build upon the results and lessons from previous ones and would adapt to respond to emerging needs given the highly evolving renewable energy landscape in China as well as the rest of the world.

3. **Phase I of CRESP.** The objectives of Phase I (CRESP I) were: (i) to create a legal, regulatory, and institutional environment conducive to large-scale, renewable based electricity generation; and (ii) to demonstrate early success in large-scale, renewable energy development with participating local developers in four provinces[4]. It was a blended project funded through (a) a GEF grant (US$40.22 million) aimed at supporting the development of the legal, regulatory, and policy framework needed to stimulate demand for renewable energy, improve its quality and reduce its costs, and to build a strong local renewable energy equipment manufacturing industry; and (b) two World Bank loans (US$159 million) to support pilot investments in wind, biomass, and small hydropower. The objectives of CRESP I were successfully achieved with targets being well exceeded[5]. An evaluation carried out by the Independent Evaluation Group (IEG) of the World Bank Group rated the performance of CRESP I as 'highly satisfactory', noting that "The

[1] Most of the information in this section is extracted from the Project Appraisal Documents (PADs) for CRESP Phase I and CRESP Phase II, unless otherwise noted.
[2] Project Appraisal Document (PAD) for CRESP Phase II.
[3] From a ministerial announcement after the ratification of the Kyoto Protocol in 2002, which was originally signed by China in 1998.
[4] CRESP Phase I comprised two projects: (i) CRESP Phase I (P067828/P067625); and (ii) Follow-up CRESP Phase I (P096158).
[5] ICR CRESP Phase I and Follow-up CRESP Phase I (ICR 00002077), June 24, 2012.

implementation of legal and regulatory reforms at national level, the technological improvements and pilot demonstration projects supported by CRESP have been credited with a substantial contribution to the transformation of China's renewable energy sector"[6] (See Annex 7, Context for CRESP Multi-Phase Program).

4. **Context Leading Up to Appraisal of CRESP II[7].** China began to show impressive results developing renewable energy. A declining trend where the share of renewable energy in total power generation decreased from 19.5 percent in 1990 to 14.9 percent in 2007 was reversed. By 2013, the share of renewable energy in total electricity produced reached 20.4 percent. China had also begun to diversify its development of renewable energy across technologies. Previously, most of the renewable power was generated from hydro resources, which continued to be a mainstay at 81.6 percent. However, wind power had increased to account for 12.5 percent of total electricity produced by renewable energy, with solar PV making up another 1.4 percent and other renewables representing the remaining 4.5 percent. China's unprecedented scale-up of renewable energy also had global significance. In 2013, China generated 24.0 percent of the hydropower produced globally, 21.9 percent of world's wind power and 11.5 percent of electricity from solar PV. In the same year, China installed more new renewable energy capacity than all of Europe and the rest of the Asia Pacific region[8].

5. Buoyed by progress, the GoC set ambitious targets for its 12th FYP that covered the period from 2011 to 2015. The goal was to increase the share of renewable energy to 9.5 percent of primary energy supply with continued expansion to 20 percent to be achieved at the end of the subsequent 13th FYP in 2020. Despite the successes in renewable energy development and future ambitions, the continued expansion of the sector was also beginning to face new headwinds. Some of the key challenges emerging at the time included: (a) bottlenecks with grid integration and access, and (b) the cost of the renewable energy program that has become high.

6. Integration bottlenecks included pricing of renewables that didn't fully reflect economic costs (including externalities)[9] causing disincentive to dispatch especially intermittent technologies such as the large share of wind power instead of utilizing coal[10]. In addition, the grid companies were also reluctant to integrate greater shares of variable renewable energy (VRE) technologies including distributed generation from renewable energy (RE DG) due to policy, institutional, operational, and technological barriers. Furthermore, there were also coordination failures between different agencies and levels of government that resulted in uncoordinated development of generation and grid infrastructure. The development of renewable energy, especially wind power, was not well coordinated with other generation technologies so they operate better in unison. Limited electricity trade across the geographically unevenly distributed renewable resources missed capturing efficiencies from comparative advantages. There were also multiple overlapping jurisdictions of agencies supporting the development of some renewables that stymied progress[11].

7. The high costs had arisen as the share of RE in electricity progressively grew placing pressure on the surcharge that was funding the feed-in tariff, which initially provided predictability for investing in renewable generation, but later became increasingly untenable financially[12]. There were also concerns about the design efficiency, especially for large-

[6] Project Performance Assessment Report for the *China Renewable Energy Scale-Up Program: Phase One*, IEG, World Bank Group, 2017.
[7] The statistical data in this paragraph is based on the International Energy Agency (IEA) World Energy Outlook reports published annually from 2006.
[8] Renewable Energy Prospects: China, International Renewable Energy Agency (IRENA), 2014.
[9] Including the economic value in the power system also taking into account environmental externalities.
[10] Including the un-level playing field created with prices not reflecting the environmental externalities, one-part tariffs that limits incentives for more flexible operation of coal power plants to accommodate variable renewable energy (VRER) technologies when their availability is abundant, and a tariff structure that does not transparently reflect the transmission and distribution prices.
[11] For example, approving offshore wind power required various approvals from Energy, Ocean, Maritime, Fishery, and Environment agencies in China.
[12] A World Bank study estimated that the surcharge may need to triple in order to reach the 2020 renewable energy target in the FYP.

scale wind farms/bases, which, coupled with the coordination challenges, stood to increase the cost of renewables if the issues are not adequately addressed.

8. CRESP Phase II (CRESP II) was designed to address some of these key emerging barriers so that the scale-up of renewable energy can be accelerated in the face of an evolving investment landscape in the sector. CRESP II was executed from December 26, 2013, to December 31, 2021, during which China completed the implementation of FYP12 (2011-2015) and FYP13 (2016-2020).

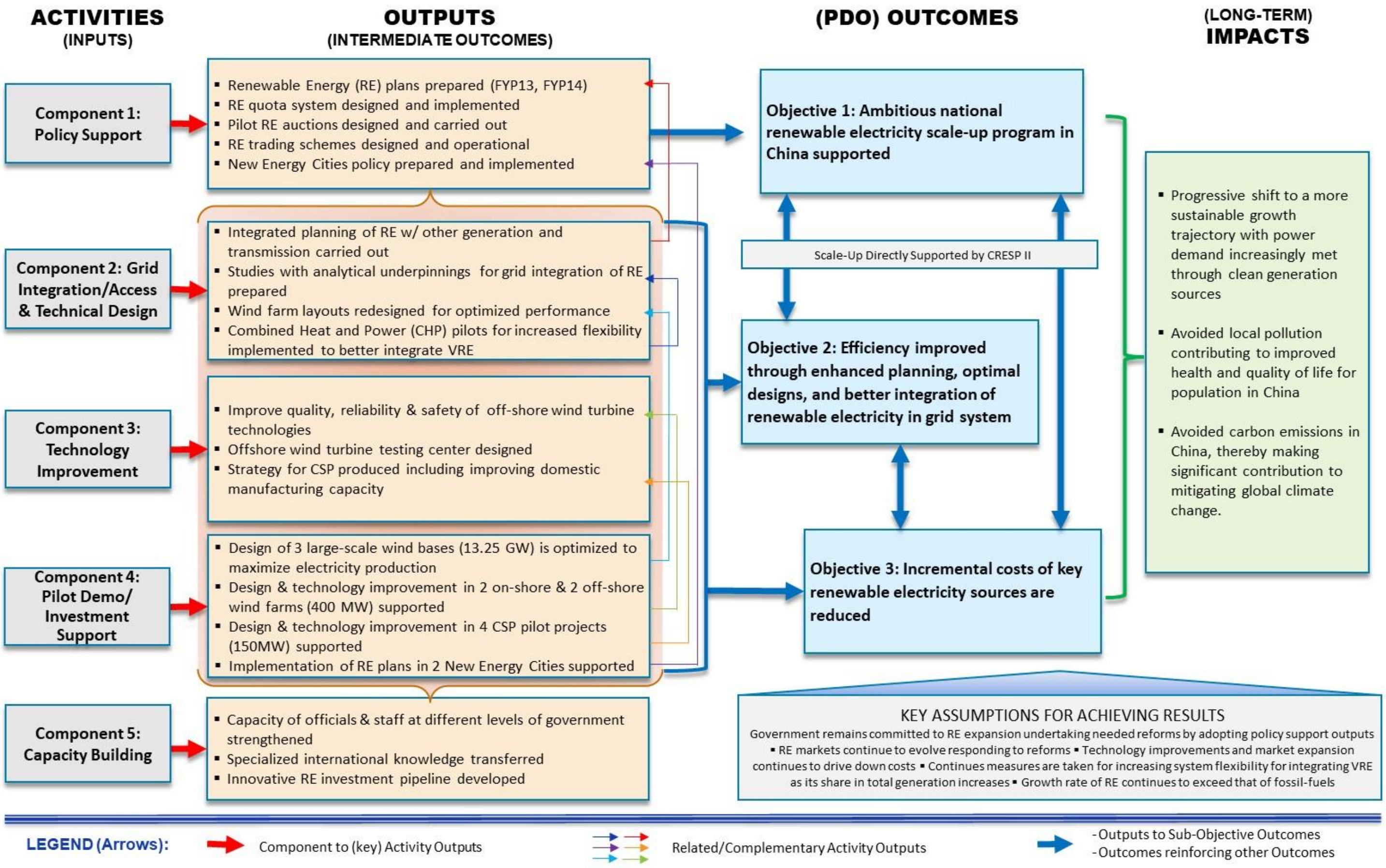
Theory of Change (Results Chain)

9. The CRESP Phase II Project Appraisal Document (PAD) does not include a formal Theory of Change (TOC), but a logical progression of cause-effect relationships from project activities to results can be inferred based on information available. The TOC for CRESP Phase II reflecting final key project results is schematically presented in Figure 1.

10. The activity supported through CRESP II funds are reflected as component *inputs* in the illustrated TOC. Together, they reflect over 100 distinct activities contracted to cover various tasks undertaken through the project, although the illustration presents only either consolidated or major *outputs* resulting from the component activities. Several outputs either facilitate or reinforce other outputs, which are reflected via multi-colored arrows. The policy outputs resulting from component 1 directly support the key outcome objective #1 (to scale-up renewable electricity), but also provide the overarching policy framework under which the results from component 2 (grid integration/access and technical design) and component 3 (technology improvement) along with component 4 (pilot demonstration/investment support) are expected to be achieved. The pilot demonstrations/investments funded under component 4 themselves are expected to support and reinforce the results of activities undertaken in components 1, 2 and 3. Finally, the outputs from component 5 (capacity building) are also cross-cutting and helps support the achievements of results from other components and sustain initiatives over time.

11. The project has three major *outcomes* reflecting the development objectives (i.e. sub-objectives derived from the CRESP II overall project development objective, as noted in upcoming paragraph 13): (a) scale-up of renewable energy in China, with a focus on (b) efficiency improvement including reducing curtailment through better integration of VRE, and (c) reduction of incremental costs. While these three (sub) objectives are equivalent by World Bank evaluation methodology, (sub) objective 1 (to support the ambitious national renewable electricity scale-up program) can be considered overarching since it reflects the ultimate goal of all interventions. The three (sub) objectives are also interdependent and mutually reinforce each other. For example, (sub) objectives 2 (i.e., improving efficiency and integrating more renewables) and 3 (reducing incremental costs) both contribute to scaling-up renewables, which is the goal of (sub) objective 1. Similarly, a major scale-up of renewable electricity, as per (sub) objective 1 can create economies of scale that can drive down costs (sub-objective 3) and improve efficiency (sub-objective 2) whereby enhancing the investment climate for further expansion. (Sub) objectives 2 and 3 also independently reinforce each other as reduced costs improve efficiency and greater integration of renewables result in market expansion that can drive down production costs. Thus, it is important to recognize the overlap and interdependency amongst the outcome (sub) objectives although they are distinctly denoted within the project design and the illustration in figure 1. It is also worth noting that each outcome (sub) objective is also supported by the project at two levels: directly through the investments supported by CRESP II (through one or a combination of efficiency improvements, integration to grid, or cost reductions), and indirectly through policy-level support that established goals, strategies, standards and other requirements that create investment incentives and guide the sector towards the intended targets. Finally, the *impacts* reflect the long-term outcomes expected from the changes resulting from project outcomes. The *key assumptions* that are outside the control of the project but are nevertheless vital for achieving outcome results are also described.

Figure 1: CRESP Phase II Theory of Change



Project Development Objectives (PDOs)

12. The development objective of the three-phase CRESP (i.e., program) is to enable commercial renewable electricity suppliers to provide energy to the electricity market efficiently, cost-effectively, and on a large scale.

13. The PDO of the CRESP Phase II project that is evaluated in this ICR was to support the ambitious renewable energy scale-up program in China with a focus on efficiency improvement and reduction of incremental costs[13].

Key Expected Outcomes and Outcome Indicators

14. Table 1 provides a comprehensive results framework that maps key outputs from project activities to higher level outcomes. Together with the TOC in figure 1, it provides a roadmap to navigate the evaluation of project performance in section B. ACHIEVEMENT OF PDOs **(EFFICACY)** (page14). The project objectives are measured through 11 outcome indicators, five of which were added at ICR stage since the initial six were insufficient to fully gauge CRESP

[13] From GEF Grant Agreement TF 015769-CN of November 27, 2013. Formulation is the same as in PAD.

II's performance. Similarly, seven key intermediate/output indicators were added to the six in the framework at project closing for a total of 13, so that the major outputs of the project can be better mapped to corresponding CRESP II outcomes. While the results framework that was formally established proved to be inadequate, a wider set of CRESP II activities and its results were monitored throughout by GoC and other project-related entities enabling project performance to be satisfactorily assessed in the ICR, as illustrated in table 1.

Table 1: Results Framework for Evaluating Project Performance

Key Outcome Indicators	Outcome Indicator Targets *(Achievement Status)*	Intermediate/Outputs Indicators from Key Project Activities *(Intermediate/Output Targets)*	Outcomes (Sub) Supported by Key Project Activity		
			Support ambitious RE scale-up program in China	Efficiency Improvements/ Integration of VRE	Reduction of Incremental Costs
[1] 13th RE FYP successfully implemented *	RE targets (for electricity) in FYP13 achieved: Hydropower: 340 GW Wind power: 210 GW Solar PV: 105 GW Bio-power: 15 GW CSP: 5 GW *(Nearly all targets met or exceeded except for CSP)*	[1] RE 13th FYP developed* *(adopted and issued)*	X		
		[2] RE quota policy designed *(policy issued)*	X		
		[3] RE auction pilot design is informed by international best practices** *(pilot auctions carried out successfully)*	X	X	X
		[4] RE certificate trading scheme developed** *(scheme adopted for implementation)*	X	X	
		[5] RE 14th FYP developed** *(Submitted to government for issuance)*	X		
[2] Additional RE-based power generation from improved design of the large wind bases	370 GWh/year additional renewable electricity generated by end of project through improved capacity factor *(Surpassed)*	[6] Improved wind base design developed based on analysis of existing base** *(Improved design applied to 13.25 GW of new wind bases)*	X	X	
[3] Additional consumption from increased RE penetration in New Energy Cities	1.31 Mtce/year (10,611 GWh/year) by end of project by increased share of RE in total energy consumption *(Surpassed)*	[7] New Energy Cities policy developed *(policy submitted for implementation)*	X		
[4] Additional RE produced from pilot auctions for solar PV and wind power carried out under project**	12,000 GWh/year from solar PV and 15,000 GWh/year from wind power *(Achieved)*	[3] RE auction pilot design is informed by international best practices** *(pilot auctions carried out successfully)*	X		
[5] Annual avoided carbon dioxide emission (directly as result of project)	3.9 Mton CO_2/year by end of project resulting from displaced generation due to project-supported activities *(Surpassed)*		X		
[6] Increased non-fossil fuel in primary energy consumption**	15% of non-fossil fuels primary energy consumption *(Achieved)*	[1] RE 13th FYP developed* ***(adopted and issued)***	**X**		
		[3] RE auction pilot design is informed by international best practices** *(pilot auctions carried out successfully)*	**X**		
		[8] # of RE investment projects supported *(4 projects at the end of CRESP Phase II)*	X	X	

		[9] # of offshore wind turbine standards accepted by Standardization Admin. of China *(1 standard accepted)*		X	X
		[10] Design of China's first offshore wind turbine testing center aligned with international best practices** *(Center approved for construction)*		X	X
[7] Reduced curtailment of wind-power**	FYP 13 target of 5%, as per FYP13 underlying objective *(Surpassed)*	[11] Grid integration studies for North and Northwest Mongolia inform approaches to reduce curtailment** *(Grid integration studies prepared)*	X	X	
[8] Combined Heat and Power (CHP) plants retrofitted for better integration of VRE, based on lessons from pilot**	133 GW target, as per FYP13 *(Mostly met with 100 GW following successful pilots)*	[12] CHP pilot completed to increase plant flexibility to better integrate VRE** *(17 GW of CHP piloted for enhanced flexibility)*		X	
[9] Increased penetration of non-hydro RE in Inner Mongolia**	16.5% of total provincial consumption by 2020, as per FYP13 mandate *(Surpassed)*	[11] Grid integration studies for North and Northwest Mongolia inform approaches to reduce curtailment** *(Grid integration studies prepared)*		X	
		[13] Increased penetration of wind power generation in Inner Mongolia *(Percentage of wind power generation in total provincial power consumption reaches 15% by 2015)*	X	X	
[10] Reduced incremental costs of wind power over coal-fired power plants	from 2.17 US cents/kWh (in 2012) to 1.25 US cents/kWh by end of project[A] *(Surpassed)*	[3] RE auction pilot design is informed by international best practices** *(Pilot auctions carried out successfully)*	X	X	X
[11] Reduced incremental costs of solar PV over coal-fired power plants	From 11.3 US cent/kWh at beginning of project to 7.0 US cent/kWh at end of project *(Surpassed)*	[3] RE auction pilot design is informed by international best practices** *(Pilot auctions carried out successfully)*	X	X	X

NOTE: Some outputs are color coded to reflect that they contribute to multiple outcome indicators.
* added through project restructuring in 2020.
** added ex-post in ICR for evaluating project performance.
[A] Adjusted through project restructuring to more accurately reflect conditions in Inner Mongolia where much of CRESP II focused.

Components

15. CRESP II activities were grouped into 5 project components. It is worth noting that specific activities described under project components primarily represents the first years' work program, as noted in the PAD. The activities through the remainder of the program were determined between the World Bank and the client on an ongoing basis (typically during annual reviews). This "flexibility during project implementation" was incorporated into the design so CRESP II can respond to evolving needs in a dynamically changing sector, build upon initial analyses, and incorporate lessons progressively learned from experience. Thus, the final activities reflected in the ToC (figure 1) and the ICR results framework (table 1) are more comprehensive and extend beyond the description in the PAD, and some would even be foregone for strategic reasons. However, the strategic thrusts of project component designs remained throughout. In retrospect, the design flexibility turned out to be opportune since some important project outputs that were determined during project implementation resulted in key accomplishments[14].

[14] For example, the initial study on integration led to both the identification of key solutions and selecting Inner Mongolia as a critical province to implement the reforms because of the region's acute curtailment of wind power – decisions that were afforded during implementation due to the flexibility in project design. It also helped strengthen one indicator (cost reduction)

16. **Component 1. Policy Support (Estimated US$ 5 million, Actual US$ 6.09 million)**. Component 1 would support developing and implementing RE legislations and policies to achieve cost reduction, efficiency improvement, and smooth grid integration. The policy support would focus on four sub-components. **The first sub-component** would improve the design and implementation of the RE Quota Decree and would design a RE Certificates trading scheme. **The second sub-component** would develop grid access and financial incentive policies for RE distributed generation in New Energy Cities[15]. **The third sub-component** would support the preparation for the RE 13th FYP and medium/long-term RE plan by 2030. **The fourth sub-component** was conditional of collaborating with the right Chinese counterparts, for developing potential recommendations for power pricing reforms and incorporating RE in power sector reforms.

17. **Component 2. Grid Integration/Access and Technical Design (Estimated US$ 5 million, Actual US$ 3.16 million)**. Component 2 consisted of targeted studies to ensure improved grid integration for large-scale grid-connected RE and grid access for distributed RE; and strategic and optimal deployment of key RE technologies to enhance efficiency and reduce costs. The studies would include, but not be limited to: (i) *Optimization of site layout design to decrease wake effects for GW-scale Wind Power Bases*; (ii) *Wind penetration development study* in selected provinces; (iii) *Grid access and connection study for distributed generation*; and (iv) *Grid codes study*.

18. **Component 3. Technology Improvement (Estimated US$ 7.28 million, Actual US$ 8.67 million)**. Component 3 would support quality improvement and cost reduction of renewable electricity generation by: (i) Improving the efficiency of existing wind farms; (ii) Improving the quality, reliability and safety of offshore wind turbine technologies; (iii) Supporting technology improvement for offshore wind technology; (iv) Improving efficiency of existing large-scale grid-connected solar PV farms; (v) Conducting a localization strategy study of manufacturing CSP in China, and possibly improving domestic manufacturing capacity.

19. **Component 4. Pilot Demonstration (Estimated US$ 5 million, Actual US$ 4.59 million)**. Component 4 comprises two sub-components. **The first sub-component** would support NEA/Inner Mongolia partnership to pilot and explore new ideas relating to the scale-up of RE and optimization of wind in power system. **The second sub-component** is to pilot RE distributed generation in 2 selected New Energy Cities and possibly Green Counties[16].

20. **Component 5. Capacity Building and Investment Support, and Project Management (Estimated US$ 5 million, Actual US$ 4.76 million).** This component will (a) build capacity of government officials and staff at national level and at pilot provincial/municipal levels; (b) help operationalize the China RE Training Center to be established in Shanghai; and (c) support investors by building innovative RE investment pipelines.

B. SIGNIFICANT CHANGES DURING IMPLEMENTATION

Revised PDOs and Outcome Targets

21. The PDO has not been changed during implementation.

22. The first restructuring (February 2019)[17] revised the methodology to assess achievement of the PDO indicator of reduced incremental costs of wind power over coal-fired power plants and adopt a more ambitious target. The original

through formal restructuring, and identify other targets (e.g. underlying wind curtailment target in FYP13). Another is the selection of CRESP to support the preparation of FYP14, which was not originally planned, but was later incorporated for project support because of the successful project performance in supporting FYP13.

[15] The New Energy Cities program was a part of the National New Urbanization Plan (2014-2020 Year), initiated by the National Energy Administration, aimed to promote distributed renewable energy development in select cities, and then apply the experience gained in others countrywide.

[16] Ibid.

[17] Restructuring Paper RES34044.

target (a reduction from 1.6 US cent/kWh to 1.5 US cent/kWh) was already surpassed at the time of restructuring. The new target introduced was a reduction of the incremental cost of wind electricity over coal electricity to 1.25 US cent/kWh at project closing from a higher starting point of 2.17 US cent/kWh in the base year (2012), which more accurately reflected the costs prevailing in western Inner Mongolia, where CRESP II provided considerable support for addressing integration challenges to reduce high levels of curtailment[18].

Revised PDO Indicators

23. During implementation, a sixth PDO level indicator was added to the original list: 13th RE FYP developed and adopted[19]. This outcome is a result of Component 1: Policy Support. Additional PDO indicators included for evaluating project performance in the ICR are noted previously in Table 1.

Revised Components

24. The components were not revised during implementation, although activities were progressively added/amended within the components to reflect evolving sector needs, as per original design intention.

Other Changes

25. The first level 2 restructuring was approved on February 22, 2019. The restructuring extended the closing date from June 30, 2019, to December 31, 2020, and modified the target and methodology of assessing the target for one indicator (reduced incremental costs of wind power over coal fired power plants)[20].

26. The second level 2 restructuring was approved on August 19, 2020, to further extend the closing date to December 31, 2021, and to add one PDO indicator (“RE 13th FYP developed and adopted”) and two intermediate result indicators (“RE 14th FYP developed”, and “design of China’s first offshore wind turbine testing center aligned with international best practices”). The reason for the added indicators was to assess the results of key additional activities.

Rationale for Changes and Their Implication on the Original Theory of Change

27. The first restructuring for extending the closing date by eighteen months was primarily to accommodate key new activities proposed by the government including those critical to completing the FYP13 period (2016-2020) and also request for CRESP II to help develop the RE plan and targets for the upcoming FYP14 (2021-2025). It also reflected the complex nature of implementing a project that required coordination across all levels of government and other stakeholders where developing consensus takes time (especially where RE policies are linked with overall power sector reforms), activities that required cooperation with international partners (e.g. approval of International Electrotechnical Commission (IEC) for standards requires vote of all members), and limited capacity of local authorities (e.g., two pilot energy cities). As previously noted, the extension of the closing date’s overlap with the completion of the FYP13 also enabled a more complete assessment of national-level RE results to which CRESP II made significant contributions.

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[18] The revised baseline and target constituted a more ambitious reduction by 42.4% compared with the more modest reduction of 6.3% in the initial target.

[19] Restructuring Paper RES42788 of 19 August 2020

[20] The western Inner Mongolia (IM) wind base was used for the assessment and the incremental cost target was reduced from 1.5 cent/kWh to 1.25 cent/kWh while the baseline value was changed from 1.6 cent/kWh to 2.17 cent/kWh. (2012), and the end of project target is revised from 1.5 cent/kWh to 1.25 cent/kWh.

28. The second restructuring[21] notes that the reason for the additional one-year extension was due to implementation delays caused by the impact of the COVID-19 pandemic and to accommodate key personnel changes at NEA and the State Grid – both key implementing agencies. The restructuring paper notes that at the time of the extension, all PDO and intermediate result indicators were either met or exceeded. Thus, the extension allowed for the disbursement of remaining funds for ongoing and additional activities. The addition of indicators was intended to measure the results of the additional activities.

29. Neither of the two project restructurings affected the original Theory of Change.

II. OUTCOME

A. RELEVANCE OF PDOs

Assessment of Relevance of PDOs and Rating

30. **Strategic Relevance in China.** The CRESP II project continued to be consistent with the World Bank Group's China Country Partnership Framework (CPF) throughout its implementation period. At the time of appraisal, the project objective was aligned with the FY2019-2016 strategy's effort to support "greener growth, in particular, shifting to a sustainable energy path". At project closing, the PDO continued to be aligned with the FY2020-2025 strategy[22], in particular, its Engagement Area Two: Promoting Greener Development. Of the 5 objectives in Engagement Area Two, CRESP II primarily supported Objective 1, which is Facilitating the Transition to a Lower Carbon Energy Path. This is practically synonymous with the PDO of CRESP II that aims to support the renewable energy scale-up program in China, which would displace fossil-based energy sources whereby avoiding carbon emissions. The progressively increasing share of renewable energy in the power generation mix would indeed transition the country towards a low carbon energy path. The CRESP II project played a major role in helping develop the national plan for scaling-up renewable energy in the Five-Year Plans (FYPs) that serves as blueprints for development in China and supported various measures that facilitated the implementing of these high-level priorities. It especially helped address several key constraints (i.e., the interrelated issues of efficiency, integration, and costs) that were beginning to stymie the pace of renewable energy expansion in China, which are further detailed in the section on efficacy (page 14). CRESP II also supported Objective 5 in the CPF Engagement Area Two - Promoting Low-Carbon Transport and Cities, through pilots in New Energy Cities.

31. **Global Relevance.** Supporting China's ambitious renewable energy scale-up program, as the PDO intended, also has broader global relevance. The 197 countries, including China, that signed up for the Paris Agreement on climate change have committed to limit global warming to well below 2 degrees Celsius, and preferably to 1.5 degrees Celsius compared to pre-industrial levels. This translates to the world reaching 'net zero' carbon emissions around 2050. Despite substantial expansion of renewable energy and reduction of its energy intensity, China's significant demand for energy to support its growing economy means it continues to rely on coal for 60 percent of its primary energy consumption. It is a major contributor to the country emitting nearly a quarter of global CO_2 emissions[23]. China has reaffirmed its commitment to global climate goals of reaching 'net zero' around 2050[24]. To achieve this objective, China will need to

[21] REPORT NO.: RES42788

[22] World Bank report No. 117875-CN. Country Partnership Framework for the People's Republic of China for the Period FY2020-2025, November 11, 2019.

[23] China is the world's leading emitter of CO_2 with emissions estimated at 11,385 Mt in 2020.

[24] by peaking its CO_2 emissions before 2030 and reaching net zero before 2060.

increase its energy produced from zero or low CO_2 emitting technologies (and use its energy more efficiently). Thus, it will be vital to sustain over time the clean energy transition in the country by continuing to scale-up renewable energy, especially for producing electricity. In this regard, the pivotal support provided by CRESP II in shaping the renewable energy part of the FYP14 (from 2021-2025) and the Long-Term Renewable Energy Plan to 2030 will influence sector activities for the foreseeable future well past project closing. The World Bank CPF 2020-2025 states that the "global environmental problems cannot be solved without China's engagement", recognizing the broader implication and continued relevance of the country's clean energy transition.

32. **PDO Relevance Rating.** The Relevance of the PDO is rated **High**. The project is fully aligned with a major focus of the World Bank's CPF, and directly supports China's national development strategy by shaping its energy pathway to greener development. The project's contributions also have global implications given the prominent role China will play in the international community's effort to reach net zero emissions by 2050.

B. ACHIEVEMENT OF PDOs (EFFICACY)

Assessment of Achievement of Each Objective/Outcome

33. **Dissecting the PDO.** Key sub outcomes in the stated PDO for CRESP II are to: support (i) the ambitious renewable energy scale-up program of China; with a focus on (ii) efficiency improvements; and (iii) reduction of incremental costs. Thus, the evaluation of project performance will focus on the significance of CRESP II's 'support' to achieving the targets established for scaling-up renewable energy in the country. It recognizes that expanding renewable energy at scale requires multiple stakeholders to perform in concert, and therefore, will assess the extent to which the interventions from CRESP II at multiple levels of government facilitated both public and private investments and operations in the sector. The evaluation will also assess how the 'focus' on specific activities for improving efficiency and reducing costs also contributed towards the overarching goal of increasing renewable electricity utilization. The 'efficiency' objective focuses primarily on the optimized grid integration of new renewable capacity as well as maximizing the utilization of built (i.e., existing) capacity including the reduction of curtailment, especially from VRE sources. 'Cost reduction' is primarily from improvements in technology, manufacturing, and procurement of renewable electricity supply, although costs also decrease with enhanced efficiency. Similarly, optimized integration of renewable electricity and technological improvements can also drive down costs. Therefore, it should be noted that, while there are distinctions between improving efficiency and cost reductions, as defined within the project, the associated activities can also be mutually reinforcing and overlap, and that the two objectives collectively support the broader goal of expanding renewable electricity, as illustrated in the TOC in Figure 1.

34. **Understanding the context for evaluating the PDO.** The CRESP II project's development objective need to be considered in the broader context of the overarching objective of the three-phase CRESP program, which is to enable commercial renewable electricity suppliers to provide energy to the electricity market efficiently, cost-effectively, and on a large scale. It clarifies that the CRESP program's primary focus is on renewable resources for producing electricity (rather than for wider applications in energy) mainly because of the need to displace fossil-based alternatives such as coal in power generation, which is a major cause of local and global pollution arising from China. Moreover, the program recognizes that businesses-as-usual will not organically bring about a rapid scale-up, and that interventions in the form of market mandated policies are needed to achieve the more ambitious goals sought by China[25]. It was also clear that these policies require periodic review and adjustments as the market for renewables expands and evolves. Relevant examples

[25] An example from CRESP (Phase) I is the support for issuing the Renewable Energy Law, a first of its kind in a developing country, that established various market mandates, which is credited with facilitating the substantial scale-up in China.

are the need to address integration challenges due to intermittency from VRE sources or the need to reduce incremental costs from renewables, which are two key goals of CRESP (Phase) II. Integrating larger shares of VRE need greater power system flexibility, requiring new and adjusted market mandates to incentivize the reduction of curtailed power so that increased renewable energy can be absorbed to the grid[26]. Similarly, the total incremental costs were manageable when the scale of renewables was small since it made-up a modest share of overall electricity produced in the country. However, these costs became less tenable as the overall financial burden increased due to the progressively increasing share of renewable energy in the overall power system.

35. Evaluating a strategic and complex technical assistance project that is designed to have broad, national implications over time will need to critically assess several aspects: a) multiple or multi-level interventions where investment and policy support are intended to collectively converge toward achieving higher level objectives, b) project-level support that is expected to leverage larger scale impacts, c) long-term implication of reforms and likely outcomes. In the case of multiple or multi-level interventions, the ICR will explore the attributability of project activities across the results chain to strategically come together to collectively advance a high-level objective; identify whether project support was on the critical path to achieving results; and confirm whether the goals would have been attained in a counterfactual scenario. For activities designed to leverage larger impact, the ICR evaluation will consider evidence that confirm expansion or replication beyond the specific support provided by CRESP II. Where interventions are expected to have a longer-term impact where benefits take time to accrue[27], the ICR evaluation will look beyond short-term measures and consider intermediate evidence (i.e., at project closing) that can serve as a proxy for continuity establishing sustainability of outcomes. It should be noted that one or more of these evaluative approaches may be used in the ICR to evaluate CRESP II's performance towards achieving each project outcome.

36. CRESP II is a technical assistance project that produced underlying analyses and provided guidance to improve the policy framework and facilitate investments on a nationwide basis so that renewable energy can be scaled-up in China. This indirect link from project activities to higher level outcomes call for indicators that are proxies for measuring end results arising from the utilization of project findings and application of its recommendations. The results indicators must collectively also reflect a range from national level results to investment level outcomes. Investment level interventions (e.g. pilots, one-off support) will be assessed for their subsequent expansion, replicability, or continuity. Project performance will be ultimately evaluated based on the attribution of influence that can be established from project activities to the broader objectives. In general, outcome 1 will be assessed through achievement of outputs 1 in the TOC; outcome 2 and 3 will be assessed through achievement of outputs 2, 3, and 4; outcome 1, 2, and 3 are interconnected and all achievement of output 5 has impacts on all these outputs and outcomes.

37. **Objective 1: Ambitious national renewable electricity scale-up program in China supported.** CRESP II supported China scale-up renewable electricity production by helping develop the overarching policies that determine the investment climate in the sector and through direct support to developers/manufacturers at the investment level to expand their capabilities.

Major Support to Developing Renewable Energy Policy

38. **National renewable energy planning and implementation**: The most significant policy intervention supported by CRESP II was to develop and help implement the renewable energy expansion plan that was incorporated into China's national Five-Year Plans (FYPs). The FYPs are key determinants of economic direction in the country as they set strategic

[26] Wind power and solar PV produced a modest 27 TWh at the time when the Renewable Energy Law was issued, but then saw a rapid expansion of over 450 percent to 152 TWh by the time CRESP (Phase) II was being appraised.

[27] An example is the legal framework established through the Renewable Energy Law under XRESP (Phase) 1, which continues to provide the overarching structure for the rapid scale-up of renewables in China long after the project closed in 2010. In fact, CRESP (Phase) I performance ratings improved when the project was evaluated by IEG in 2017, compared with the ratings they assigned when project performance was validated soon after close of financing.

development goals, focus the work of different levels of government, and guide the activities of market and non-market entities in China[28]. CRESP II overlapped with the completion of FYP12 (2011-2015) and FYP13 (2016-2020), the latter in its entirety. The primary project implementing agency for CRESP II, the National Energy Administration (NEA), spearheaded several integral energy planning studies at a cost totaling over $1.25 million that provided the analytical basis and evidence for establishing renewable technology specific targets, and the data supporting the outcomes incorporated into FYP13. It was the first time that extensive use of advanced modeling was undertaken to develop renewable planning, including for optimization of development[29] with specific focus on targeting intermittent wind and solar PV[30] and verification of transmission integration[31]. Some of the key features in FYP13 that CRESP II contributed to substantially were: (a) the integration of transmission and generation planning for the first time, between coal-based generation and renewables, (b) a new methodology for integrating all renewable energy technologies, and (c) regional integration of renewables including the inter-provincial transfers that are needed to reduce curtailment. In other words, CRESP II provided the analytical underpinning for strategically addressing some of the key barriers to sustaining the renewable energy scale-up in the country. Additionally, CRESP II helped build consensus when developing the FYP13 renewable energy plan by convening a variety of stakeholders[32] and widely disseminating results of studies[33] – addressing another key shortcoming identified at appraisal. The high-quality and integral inputs from CRESP II for preparing FYP13 was recognized by the government when the project was awarded first place for outstanding contribution to policy in the field of energy.

39. China successfully achieved or surpassed the ambitious targets for all major renewable power generation technologies that were set in FYP13 except for CSP, as described in Table 2. The major scale-up during FYP12 and FYP13 were wind power and solar PV, both of which substantially exceeded their targets. Wind power more than quadrupled from a modest base during FYP 12 (from 31 GW to 129 GW), and then doubled during FYP13 (to 280 GW). Solar PV that began from a small base (0.8 GW) expanded twice the target in FYP 12 (43 GW), and then accelerated its expansion fivefold (250 GW) more than doubling the ambitious target that was set in FYP13. Hydropower, which continues to have the largest installed capacity among renewable energy technologies in China achieved its FYP13 target of 340 GW. Bio-power, which makes up the smaller share of installed capacity expanded to 30 GW doubling its FYP13 target. The relatively smaller target of 5 GW was missed only in the nascent CSP industry, where CRESP II supported the development of over half of the 0.54 GW of actual installed capacity. The World Bank, in a recent publication, referred to the remarkable overall expansion and diversification of renewable generation sources during this period as China advancing from "lagger to leader"[34]. At the conclusion of FYP13, China had the largest global installed capacity of renewable energy. It far outpaced other countries and was the leading developer in hydropower, wind power, solar PV and bio-power[35]. The electricity produced from this expanded renewable capacity also doubled over the duration of CRESP II, from 1,114 TWh in 2013 to 2,222 TWh in 2020[36] at an average annual rate of 10.4 percent. The share of renewable electricity produced in total electricity generated increased from 20.4 percent in 2013 to 28.5 percent in 2020, as per Figure 2. China's share of non-fossil fuel consumption in total primary consumption was 15.9 percent primarily due to the rapid expansion of renewables,

[28] Global Policy Watch (www.globalpolicywatch.com), "China's 14th Five-Year Plan (2021-2025): Signposts for Doing Business in China", 2021.
[29] CREAM-EDO model
[30] GE MARS (MULTI Area Reliability Simulation)
[31] GE MAPS (MULTI Area Production Simulation)
[32] Stakeholders consulted included research institutes, universities, Associations, renewable energy developers, renewable energy manufacturers, national and local governments, among others.
[33] The results of studies were disseminated through workshops and other modalities of engagement, and they were publicly disclosed so that they are accessible to the widest possible audience, as per project agreement with the government.
[34] "China: 40-Year Experience in Renewable Energy Development", The World Bank, 2021.
[35] China's installed capacity compared with the 2nd ranked country were: More than 3X for hydropower compared with Brazil, more than 2X for wind power compared with the United States, nearly 3X for solar PV compared with the United States, nearly 2X for biopower compared with Brazil.
[36] From IEA World Energy Outlook information.

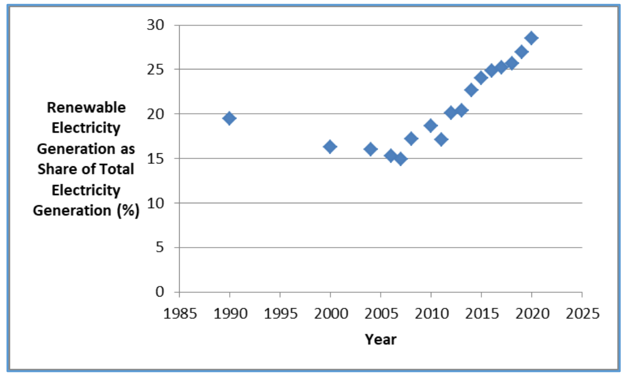
surpassing the targeted 15 percent at the end of FYP13 in 2020. Following the close of CRESP II in 2021, the NEA have taken to the airwaves to discuss the achievements of CRESP II and its results, touting that the project's support contributed to the "scale-up and sustainable development of renewable energy in China"[37].

Table 2: Renewable Power Generation Capacity Targets and Actuals (GW)

Generation Technology	2010 Actuals	FYP12 Target	2015 Actuals	FYP13 Target	2020 Actuals
Hydropower	216	290	320	340	340
Wind power	31	100	129	210	280
Solar PV	>1	21	43	105	250
Bio-power	6	13	10	15	30
CSP	0	0	0	5	0.54

Sources: FYPs, NEA

Figure 2: Share of Renewable Electricity Produced in Total Power Generation in China



Source: IEA

Support to Enhancing the Policy Framework for Renewable Energy

40. While CRESP II had a privileged position to influence national planning for renewable energy development at the highest levels of government, the project also played a significant role in helping develop policies that were collectively vital to supporting the implementation of the FYP13 and realizing its goals. Having helped prepare the national renewable energy plan, the project was well placed to understand the extent to which policy reforms were needed to sufficiently shift underlying behaviors to achieve the ambitious renewable energy targets. One such major reform was to shift away from the feed-in-tariff (FIT) that existed at the time, the surcharge for which was becoming increasingly untenable, towards implementing an alternative, more financially sustainable market mandate for achieving the FYP13 targets. CRESP II was instrumental in supporting this transition that would greatly facilitate the implementation of the renewable energy scale-up plan. It included several key strategic initiatives that established a renewable quota system (replacing the FIT), began to allocate development rights through renewable energy auctions that meet international good practices, and the formation of a renewable energy trading scheme, which collectively improved and speeded-up the expansion. These major interventions are detailed below along with the role CRESP II played in their formulation:

41. **Renewable energy quota**: The solution designed with the help of CRESP II was to transition towards a quota-based market mandate, commonly also referred to as a Renewable Portfolio Standard (RPS). A quota system would provide flexibility to source renewable electricity from the most economical generators adapting to highly dynamic markets where the costs were progressively decreasing, rather than being locked into a pre-determine FIT. The project supported the GoC design the national quota system, determined the regional and provincial allocations, helped prepare the required regulations as well as the monitoring and supervision procedures, prepared the rules and procedures for potential trading, and provided implementation support to the provinces who would have the ultimate responsibility for compliance. While renewable energy quotas are commonly imposed on power utilities, the Chinese approach placed the responsibility on "provincial governments to prepare respective plans" and the "power grid companies to organize the market entities within their business areas"[38]. The renewable electricity quotas would then be allocated to multiple stakeholders that included power grid companies, but also obliges distribution and power sales companies, industrial enterprises with

[37] Morning News on CCTV-13 and Nightly News on CCTV-1, May 2, 2022.
[38] The quota policy, as per Decree 807.

captive power plants, and users of direct purchases in power markets. This complexity required clear implementation guidelines to operationalize, which CRESP II helped prepare. Recognizing that such a transition requires time, the NEA issued an initial directive in 2016 to encourage sub-national governments to voluntarily pilot the quotas, and subsequently issued the formal decree #807 in 2019. Aide memoires indicate the World Bank team guiding the transition advising the GoC not to have concurrent formal policies for a FIT and quotas, as they would conflict and create confusion for investors, which was avoided. Based on the results of CRESP II studies, quotas for renewable electricity were allocated to all provinces with total quotas for 2020 ranging from 10.5 percent (Liaoning) to 88.5 percent (Sichuan). According to NEA data, nearly all the quota requirements for achieving the FYP13 targets were successfully met by the respective provinces[39].

42. **Renewable energy certificate trading system**: Considerable renewable resources in China are located far from major load centers. As a result, provinces such as Inner Mongolia and Xinjian overproduce electricity from wind resources, for example, while provinces in East China have struggled to meet their renewable obligations, often developing their own poorer renewable resources[40]. More electricity trade can address these imbalances resulting in a more efficient and cost-effective use of resources. However, there are some fiscal disincentives and vested interests that limit the level of inter-provincial electricity trade. To facilitate greater renewable electricity trade that would better allow provinces to more efficiently meet their renewable quota obligations, CRESP II helped the GoC develop a renewable energy certification and monitoring system[41]. These certificates could be traded under the policy framework established through the Quota Decree 807 that the project helped design. At present, nearly 33 million certificates from wind power and over 10.5 million certificates for solar PV are issued, with 12 and 65 percent respectively of those renewable energy certificates offered for sale being traded in the market. These results indicate that the renewable certificate trading scheme is actively functioning, and that it could continue to increase promoting trade as a way to incentivize the expansion of renewable power in areas of abundance for complying with provincial quota obligations in areas that are less endowed with resources.

43. **Renewable energy auctions:** The government at the national and provincial levels carried out pilot auctions for wind power and solar PV with the support of CRESP II, which helped transition from the prior market mandate that relied on the FIT with an offtake requirement. In the absence of reforms, the rapid pace of renewable energy expansion would have likely slowed down considerably, since the GoC suspended approving new solar PV projects in 2018 due to a large subsidy gap of $20 billion resulting from FIT obligations[42], as it was deemed to be untenable. The success of the pilot auctions provided an approach through which renewable development rights could be allocated and electricity procured at prices determined through competition rather than a pre-determine FIT, dissipating the pressure on subsidies. CRESP II support once again was used to design the pilot auctions based on international best-practices, which helped overcome prior efforts that had limited success. Following its success, China opted to transition all subsequent procurement of large-scale wind power and solar PV through auctions rather than by FITs. Since auctions helped reduced the incremental costs paid for renewable electricity, the section on *objective 3: reduction of incremental costs of key renewable electricity sources* provides more details about the specific support and the value-added from CRESP II.

44. **Planning renewable expansion for the future:** The value-added by CRESP II was further exemplified by the request from the GoC to extend the project closing date to additionally support the preparation of the next FYP14 and its long-term plan for renewable energy. It was in response to a critical challenge that China is facing. While the country was leading the world in scaling-up renewable power production and increasing its share in the domestic generation mix, it has also continued to substantially expand fossil-based electricity, primarily coal, to meet overall energy demand that rose

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[39] The only shortfall was in Xinjian that just missed their non-hydro renewable target by 0.6 percent.
[40] "China: 40-Year Experience in Renewable Energy Development", The World Bank, 2021.
[41] 1 renewable energy certificate = 1 MWh
[42] Reflects the gap between the incremental costs due to the FIT compared with the funds collected through the renewable surcharge.

rapidly with economic growth. As a result, China's carbon emissions from coal-based power have also swiftly expanded despite a reduction in carbon intensity, and the volume stood at 7.4 billion tons in 2020[43], far exceeding the expected increase of nearly 2 billion tons that was envisaged at the time the CRESP program began[44]. It highlights the importance of renewables since CO_2 emissions would have been even higher in the absence of clean energy as more power would have been generated from coal. There has also been a major shift in international consensus around global efforts to reduce carbon from the atmosphere. While China had not committed to any carbon reductions under the Kyoto protocol that was in effect at the time when CRESP I and II were appraised, the international community reached greater consensus when the Paris Agreement was signed at the end of 2015 with a commitment to limit global warming to below 2 degrees Celsius[45]. Subsequently, the United Nations[46] calculated that global net human-caused emissions of CO_2 would need to reach 'net zero' around 2050. To support this effort, China committed at COP 26 held in Glasgow during 2021 that it would reach peak carbon emissions by 2030 and achieve net zero before 2060.

45. The lead-up to this new commitment required revision of the FYP14 that would be in effect from 2021-2025 and the longer-term plan, as renewable development would need to be further accelerated to displace coal at an even faster pace. CRESP II allocated a total of $1.3 million to support the development and revision of the FYP14, the medium-term plan (to 2035) and the long-term energy plan (to 2050). The project funded studies and helped develop simulation models, especially for wind power and solar PV, since VRE power accommodation and integration would be key to meeting the country's energy development goals and international commitment. CRESP II support helped develop scenarios and optimize pathways for achieving the newly established objectives. The studies concluded that the renewable energy scale-up pace would need to accelerate to achieve a 20 percent primary share by 2025, five years ahead of the 2030 target China had set in its nationally determined commitment (NDC). Consequently, it was forecasted that renewable energy should be more than half of the increase in primary energy consumption by the end of FY14, with total renewable energy generating 3,300 TWh of electricity – an increase of more than 50 percent during the period. Since the expansion of VRE is expected to double under this plan, CRESP II supported studies also identified policy and investment initiatives that are needed to integrate the increased share of intermittent power. The project built on the success of similar initiatives that CRESP II supported in helping implement FYP13 that are detailed in the next section covering *objective 2: efficiency improved through enhanced planning, optimal designs and better integration of renewable electricity in the grid system*. Thus, the success of CRESP II's support to FYP13 led to an opportunity for the project to significantly influence the revamped future direction of renewable expansion in the country. As a result, the project is likely to have an impact long after it closed, contributing to sustaining renewable energy development in China for the foreseeable future.

Support to Key Renewable Energy Investments

46. CRESP II also directly supported renewable energy investments through advisory and technical assistance that contributed to the overall scale-up in the country. These include investments in on-shore and offshore wind power, solar PV (including distributed generation), Concentrated Solar Power (CSP), and electricity storage. The primary investments that were supported by CRESP II and the related project outcomes are as follows:

47. **Design improvements in wind bases:** Evidence suggested that there were inefficiencies in the design of wind farms in China. As an illustrative example, China in 2015 had twice the installed capacity of wind power compared with the United States but produced about the same volume of electricity – a difference that cannot be explained solely by the difference in wind resources in each country[47]. Therefore, an optimal scale-up of wind power should not only focus on

[43] www. Statistica.com
[44] PAD for CRESP I.
[45] The Paris Agreement, which was signed by 196 Parties, including China, agreed on December 12, 2015 to limit global warming to well below 2 degrees Celsius, preferably to 1.5 degrees Celsius compared to pre-industrial levels. The Paris Agreement entered into force on November 4, 2016[45], and China ratified the agreement on September 3, 2016[45].
[46] Intergovernmental Panel on Climate Change (IPCC), October 8, 2018.
[47] Challenges faced by China compared with the US in developing wind power, Nature Energy, 2016.

adding new capacity but also ensure that the designs are optimized to maximize electricity production. As a part of this effort, CRESP II analyzed an existing wind base in Jiuquan to assess design shortcomings and introduced advanced models and sophisticated means of wind measurement (described in more detail in section on *objective 2: efficiency improved through enhanced planning, optimal designs and better integration of renewable electricity in the grid system*), which was then applied in the design of additional windfarms with a total capacity of 13.25GW. The result was a reduction in wake effects due to the new designs that translated to a 0.93 percentage increase in plant capacity factor increasing production by an additional 1,078 GWh per year, far exceeding the CRESP II target of 370 GWh per year. The Chinese Renewable Energy Engineering Institute (CREEI), which was contracted under CRESP II to improve the windfarm designs, has since established additional wind bases with a total capacity of 50 GW applying similar enhancements extending the benefits of CRESP II. This additional replication would produce a further 4,069 GWh of electricity.

48. **Planning of New Energy Cities:** In addition to its national initiatives, the GoC wanted to promote the consumption of renewable electricity at the city-level with a bottom-up approach. The overall plan was to identify 100 New Energy Cities, of which, two were selected to be piloted. Following a competitive selection process, Hefei, which was a leading city for solar PV, and Zhangjiakou, which was slated to host the Winter Olympics, were selected for CRESP II support. The project aimed to facilitate increased grid access and enhanced incentives, particularly for scaling-up through distributed generation (RE DG). In Hefei, the project helped develop an implementation plan with targets that became the city's blueprint adopted by the local authorities, designed a trading platform that would enable direct purchase of solar PV by customers, piloted a commercial PV charging station for electric vehicles, and helped design a successful 3.4 MW solar DG operation with 1.5 MWh of energy storage. A distributed solar PV fund was also designed, but it is not yet active. Collectively, the CRESP II supported initiatives would have contributed to the share of renewable sources in final energy consumption in Hefei, although the increase was modest, from 6 to 8 percent, an increment of 0.35 million tce per year by 2018[48]. In Zhangjiakou, CRESP II also helped prepare the new energy city implementation plan that was put in place by the local authorities with targets including fully renewable operation of the Olympic village[49], inclusion of wind-biomass and geothermal for heating[50], and a model for direct trading curtailed wind power through the electricity market[51] – a first-of-its-kind in China[52]. With this support in place, Zhangjiakou experienced a substantial increase in its share of renewables in final energy consumption, from 9 percent in 2015 to 27 percent by 2019, with an additional consumption of 2.65 million tce per year[53]. While the two pilot cities collectively increased renewable energy consumption by 3 million tce per year surpassing the yearly target of 1.3 million tce at appraisal, it is less clear as to the extent to which CRESP II support played in achieving these results, making attribution difficult. Furthermore, the PAD assumes that there would be three additional New Energy Cities by fiscal year 2019, which does not appear to have materialized either. The GoC has nevertheless shown continued interest in the potential for distributed approaches for scaling-up renewable energy while overcoming transmission constraints to integration. Thus, the World Bank and GEF have continued to support distributed renewable energy through separate parallel complementary projects[54] to CRESP II, and another that is currently under preparation in the World Bank's investment pipeline[55].

49. **Wind and solar PV auctioned for development:** Unlike with the support to New Energy Cities, attribution of the success of the pilot auctions to CRESP II assistance is clear. The project helped (re) design the pilot auctions applying international experience and supported its implementation by NEA (solar PV) and provincial governments (wind). As

[48] Renewable energy in final energy consumption increased from 1.26 million tce/year to 1.61 million tce/year.
[49] Covering 23 competition venues and housing.
[50] By 2020, the heating from renewables was about 10 million m^2, below the target of 17 million m^2 established in FYP13.
[51] A 'four-party mechanism' between government, power grid company, wind developers and consumers.
[52] It resulted in 560 GWh of curtailed wind power providing heating to 470 enterprises and 6,784 residential consumers.
[53] From 1.35 million tons of coal equivalent (tce/year) in 2015 to 4.00 million tce/year in 2019.
[54] China Distributed Renewable Energy Scale-Up Project (P162299) funded by the World Bank and GEF; and Beijing Distributed Solar Photovoltaic Scale-Up Project (P125022) funded by the World Bank.
[55] China Energy Transition Towards Net Zero Emission Project.

previously noted, the success of the pilot auctions facilitated the transition from the FIT to market-based price setting that reinvigorated the expansion in wind and solar PV that was beginning to stall. The successfully conducted pilots included 10 GW of solar PV through 18 projects and 7.5 GW of wind power in a total of 7 bases. They are all operational and producing an estimated 12,000 GWh from solar PV[56] and 15,000 GWh from wind power[57]. The CRESP II supported auction designs have been replicated across the country since China, based on the success of the pilots, decided to auction all subsequent utility scale solar PV and wind projects. The electricity produced from this additional capacity would be substantially higher than the pilots.

50. **Design and technology improvements of wind and CSP projects:** CRESP II helped improve the design, technology, and operational efficiency of 2 on-shore and 2 offshore wind projects by four screened and selected developer/manufacturer companies[58] in China. Similarly, four companies[59] in the nascent CSP industry were supported through knowledge transfer of international best practices in technology and design. More details on the specific assistance provided by CRESP II are described in section on *objective 2: efficiency improved through enhanced planning, optimal designs and better integration of renewable electricity in the grid system*. The wind projects supported by CRESP II totaled an installed capacity of 400 MW, and the companies that received support have subsequently incorporated these advances in developing more than 3 GW of additional capacity. The CSP companies[60] have incorporated improved designs in developing 300 MW of capacity, which account for more than half of the total installed capacity in the country, although CSP was the only technology that fell short of the national FYP13. It is worth noting that, despite the immediate benefits accrued from technology and design improvements, these initiatives should be viewed with a long-term perspective as they become standardized and proliferate across the industry. The industry changing nature of the early CRESP program initiatives attest to this.

51. **Avoided carbon emissions from investments:** The investments discussed above that were directly supported by CRESP II displace fossil-based alternatives, and the electricity produced also helps avoids CO_2 emissions contributing to mitigating global climate change. The results framework in the CRESP II PAD set a target of 3.9 Mton CO_2 based primarily on the improvements to wind bases and increased renewable electricity in New Energy Cities. The overall avoided CO_2 from CRESP II surpassed this target considerably when taking into consideration the more comprehensive impacts of the project:

- The redesign of 13.25 GW of wind bases in the north and northwest of China resulted in 0.84 Mton CO_2 of avoided emissions. If the replication of the improvements in 50 GW of additional wind bases were to be considered, this would avoid more than 3 Mton of additional CO_2 per year.
- The support, despite the challenges with attribution, to expanding renewable consumption in New Energy Cities, resulted in yearly avoided emissions of 0.98 Mton CO_2 from 0.35 million tce in Hefei is and 7.38 Mton CO_2 from 2.65 million tce in Zhangjiakou.
- The avoided emissions from the expansion due to the successful pilot auctions of 10 GW of solar PV is 6.97 Mton CO_2 per year and of 7.5 GW of wind power is 8.71 Mton CO_2 per year[61]; with more if you consider the subsequent roll out nation-wide as the de-facto approach to procuring wind and solar PV.

[56] At 1,200 load operation hours, based on Power Industry Statistics, NEA.
[57] At 2,000 load operating hours, based on Power Industry Statistics, NEA.
[58] Companies include: Goldwind, Guohua Investment, Fujian Zhongming, Jiangsu Goldwind.
[59] Zhejiang Supcon Solar Technology, Shanghai Electric Engineering Consulting, Northwest Electric Power Design Institute Co., LTD. of China Power Engineering Consulting Group (NWEPDI), and Royal Tech CSP.
[60] Zhejiang Supcon Solar Technology, Shanghai Electric Engineering Consulting, Northwest Electric Power Design Institute Co., LTD. of China Power Engineering Consulting Group (NWEPDI), and Royal Tech CSP.
[61] Based in average grid emission factor of 0.58 tCO_{2e}/MWh in China.

- Further avoided emissions can be attributed to the incremental electricity produced from the technology improvements supported by CRESP II for wind power and CSP projects, and their subsequent replication.

52. **Rating for Objective 1:** The CRESP II support to China for achieving its ambitious national renewable electricity scale-up program is rated **'High'** as most of the major goals were achieved, and often surpassed. The project provided extensive support at all levels of government and to other stakeholders to develop an overarching strategy and policy architecture to guide the expansion, while simultaneously helping catalyze investment that contributed to growth in the industry by expanding renewable energy production and avoiding emissions. They collectively proved to be pivotal in helping China resurrect some critical aspects of the expansion that were beginning to stall and helped scale-up the utilization of renewable electricity. Furthermore, CRESP II also helped shape the future renewable energy goals for the country that are increasing even more in ambition as China strives to achieve 'net-neutrality' by 2060. The results achieved by CRESP II will also continue into the future when implementing FYP 14 plan since there is already evidence of many initiatives being replicated and expanded. A summary of each output and outcome achieved can be found in Annex 6.

53. **Objective 2: Efficiency improved through enhanced planning, optimal designs and better integration of renewable electricity in the grid system.** While China's renewable energy capacity has continued to scale-up, there was increasing evidence that it could more efficiently plan, design, and integrate renewable resources within the power system. The consequent inefficiency was leading to sub-optimal utilization of existing assets resulting in curtailment of power rather than maximizing generation potential from installed capacity. Left unaddressed, the situation could be exacerbated as the share of VRE in the generation mix progressively increased, as was the expectation based on the FYP13 targets. As a part of its response, the GoC enlisted CRESP II support to address some key barriers including sub-optimal designs that yield less electricity, inadequate planning that did not effectively coordinate renewable generation and transmission expansion, insufficient flexibility in the power system to overcome the effects from larger shares of VRE, the need for greater inter-provincial electricity trade to seize opportunities for renewable resource abundant regions to supply areas with high consumption needs.

54. CRESP II supported China improve its efficiency by making critical contributions to increase the integration of intermittent renewable technologies, such as wind power and solar PV, which were experiencing the fastest expansion of installed capacity. Figure 3 indicates that the share of intermittent renewable generation in China grew as a share of total renewable power, as can be expected given that wind power and solar PV substantially exceeded their expansion targets during FYP13, as noted when assessing objective 1. A counterfactual scenario in the absence of reforms would be a slower pace of VRE expansion or higher costs due to curtailed electricity from sub-optimal integration of generating capacity into in the power system. However, Figure 5 confirms that electricity produced from VRE sources continued to expand and even accelerated its pace during the FYP13 and CRESP II period. Figures 5 and 6 affirm the reversal of high and increasing rates of VRE curtailment from existing and new assets to a significantly lower level by 2020, which would have been a major contributor to the growing utilization of renewable electricity in the power system. Power curtailment highs of 11 percent in 2015 for solar PV and 17 percent in 2016 for wind power were both progressively reduced to around 3 percent, which surpassed the 5 percent underlying expectation targeted in FYP13[62]. The outcome constitutes a major advancement in enhancing the efficiency of producing renewable energy. The GoC credited the project in a recent news program by indicating that it "coordinated the planning and construction of wind power and solar photovoltaic (PV) together with the grid expansion, thereby effectively reducing the curtailment of both"[63]. In addition to the support to national planning, much of CRESP II's integration-specific work concentrated on the north, northeast and northwest regions where there are substantial VRE resources, but curtailment is high.

[62] FYP13 did not have an explicit national target for reducing curtailment. Instead, the underlying limiting condition when CRESP II helped the GoC established the renewable electricity expansion targets in FYP13 was for curtailment to not exceed (or decrease to) 5 percent.

[63] Morning News on CCTV-13 and Nightly News on CCTV-1, May 2, 2022.

Figure 3: Intermittent RE as share of total RE

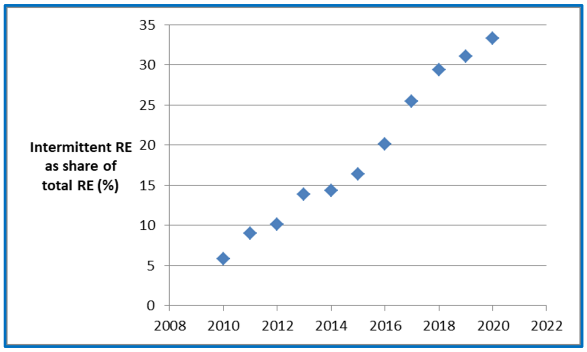


Figure 4: Intermittent RE production in China

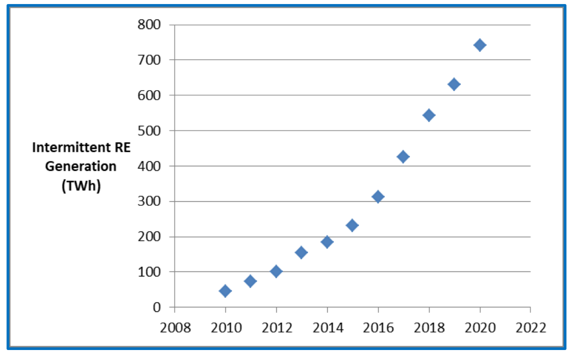


Figure 5: Solar PV curtailment rate in China

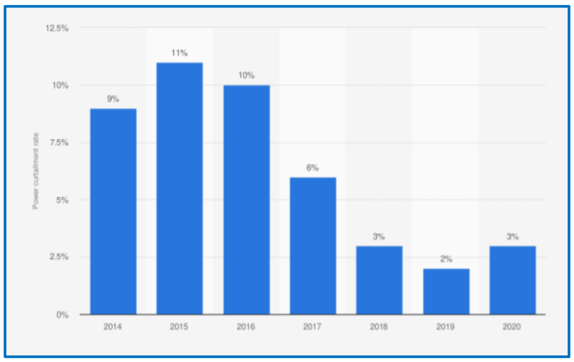
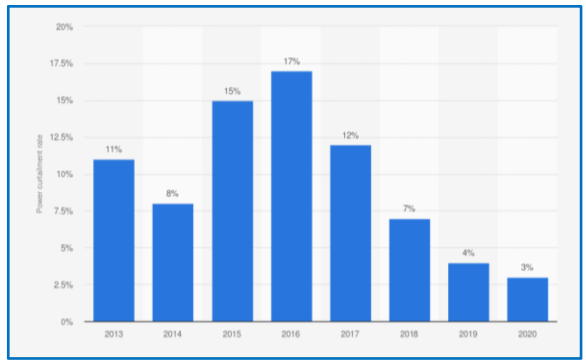


Figure 6: Wind power curtailment rate in China



Sources: Figures 4 & 5 - IEA World Energy Outlook reports
Figures 6 & 7 – Statistics via Xinhua News Agency

55. CRESP II carried out several initial diagnostic studies to assess the specific bottlenecks to integration of renewable energy and identified where efficiencies could be improved to increase utilization. Based on these results, specific support was strategically provided to maximize the impact of project interventions through improved planning, enhanced designs and reduced curtailment in the system. While the entire improvement cannot be credited to CRESP II, the strategically placed, major contributions by the project collectively had a significant effect not only on the short-term results at close of FYP13, but these reforms are expected to pay dividends over years to come. Some of these key contributions made by CRESP II are as follows:

56. **Integrated planning of renewable power with other generation and transmission:** It was previously noted that FYP13 was the first time that renewable energy development plans were integrated with other non-renewable generation and the expansion of the transmission network. This would ensure that the technological aspects of renewables would operate harmoniously with other generation sources and that adequate transmission capacity would be available for evacuating the power to demand locations. It avoids past difficulties such as when excessive wind power could not be evacuated to load centers leading to substantial curtailment.

57. **Grid integration studies with a focus on areas with substantial curtailment:** In addition to the integrated planning in FYP13, CRESP II funded a series of technical studies for better integrating renewable electricity in the North, Northeast and Northwest regions. These regions were experiencing substantial curtailment, the severity of which prompted NEA in 2016 to suspend new approvals of wind power projects in six regions. Some key recommendations from the studies were to (i) retrofit coal power plants to make them more flexible so greater VRE could be accommodated in the system, (ii) construct HDC transmission lines to evacuate power to load centers (as discussed in assessing objective 1), (iii) require

battery storage in new VRE capacity in the Northwest region where penetration is the highest, (iv) develop pumped storage hydro to supply balancing power, (v) increase export of surplus electricity through regional power trade (as discussed in assessing objective 1), and (vi) implement a pricing compensation mechanism. Many of the recommendations from the studies were then piloted before being implemented more widely. All proposed measures were implemented to varying extents except for the compensation mechanism that is still under consideration. Inner Mongolia provides a good example of the impact of the CRESP II supported work, where four technical studies were carried out with recommendations implemented to improve integration and accelerate the expansion of renewable electricity, particularly wind. They contributed to the wind power curtailment in the region decreasing from 15 percent in 2014 to 5 percent by the end of FYP13 in 2020. As a result, the non-hydro renewables accounted for 19.5 percent surpassing the mandated target of 16.5 percent. By 2018, Inner Mongolia had already reached the targeted 15 percent share of wind power generation in provincial consumption, two years ahead of the closing of CRESP II. The progress in reducing curtailment led the GoC to lift the suspension on new projects.

58. **Enhanced flexibility of heat and coal-fired co-generation (CHP) plants:** A technical study carried out with CRESP II support concluded that heat storage is technically feasible to make co-generation plants more flexible in winter[64], and financially viable under the existing financial compensation in East China – a region where curtailment was high. The study results were used to develop a pilot for 22 coal-fired power plants with a total installed capacity of 17 GW, including a design and implementation plan for integrating more wind power. The success of the CRESP II supported pilot led to expanding the program to include a larger group of CHP plants. Subsequently, 100 GW were retrofitted, falling short of the 130 GW targeted in FYP13. The value-added from CRESP II's contribution will be sustained as China expects to continue the program under FYP14 given the relatively successful pilot under the project and subsequent roll-out that enabled greater integration of wind power by reducing curtailment.

59. **Incorporating battery storage:** Intermittency of VRE generation can be reduced by incorporating battery storage so that electricity can be dispatched according to power system needs rather than resource availability. It would enable greater integration of wind power and solar PV into the power system. At the regional level, the policy recommendation from the grid integration studies supported by CRESP II led to a 10 percent storage requirement for all new wind power and solar PV capacity installed in the Northwest, enabling greater integration of VRE. CRESP II support in the New Energy Cities of Hefei and Zhangjiakou included cost-shared grant support for piloting battery storage with solar PV. In Zhangjiakou, a 200 MW PV plant pilot included a 6 MWh storage capacity, with the project providing the control strategy, primary frequency modulation, and anti-fire system optimization and design. In Hefei, a 3.4 MW distributed PV was piloted with 1.5 MWh energy storage. CRESP II helped develop the control software, tested and verified operations, and was able to demonstrate a 12 percent increase in earnings. The successful demonstration of the pilots has led both cities to plan for the expanded use of battery storage, which, if successfully deployed at scale, will enable increased integration of VRE.

60. **Improving designs to increase electricity production from wind bases:** As previously noted, evidence indicated that there was considerable scope for increasing the efficiency of wind farms, primarily by optimizing the positioning of turbines to minimize wake effects. The resulting incremental wind power was integrated into the power system to increase the utilization of electricity from renewable sources. CRESP II helped improve the commonly used software internationally for this purpose, WAsP[65], by developing an additional module more suitable for very large wind farms as envisaged in China. The new module applied Light Detection and Ranging (LIDAR) for incorporating more accurate wind speed and wind direction measurements. With the enhanced data informing the in-house upgraded software, the siting of turbines in wind bases were improved. As previously noted, CREEI designed three new wind bases with a total capacity of 13.25 MW where efficiency improvements resulted in an incremental increase of 1,078 GWh per year, with the enhancements subsequently replicated in the design of an additional 50 GW of wind power installations. Additionally,

[64] By redirecting firm power generation to heating supply at times when more wind power is available rather than curtailing.
[65] Wind Resource Assessment, Siting and Energy Yield Calculations software. https://www.wasp.dk/

four specific wind power projects totaling 400 MW that received CRESP II support to incorporate technology improvements would also yield more efficient outcomes. The further proliferation of these improvements across 3 GW by the companies that received support expands the benefits of the intervention – an indication of the true potential for industry-wide impact.

61. **Design and technology improvements of CSP projects:** It was noted previously that four companies were competitively selected so they could benefit from international best practices in CSP development, and that they went onto apply them and develop 300 MW of installed capacity. The development of the nascent CSP industry to international standards have a two-fold effect: (a) they operate more efficiently than if they were developed in the absence of the technical assistance resulting in higher electricity yield, and (b) the technology, with its storage capability, improves system flexibility to balance load shifts and intermittent supply from VRE sources. Of course, the true benefit of the CRESP II interventions is expected to be more significant over the long-term when the technology improvements are mainstreamed within the industry as it progressively expands. More details are provided about the technical assistance in the section assessing *objective 3: reduction of incremental costs of key renewable electricity sources*.

62. **Technical screening criteria incorporated in renewable energy auctions:** As noted previously, a key reason for the limited success with previous renewable auctions was that the criteria for determining winning bids were primarily based on pricing with limited scrutiny of bidders' technical qualifications. This would result in weaker technical standards amongst developers with some auctioned sites not even being developed. In fact, inefficient outcomes resulting from sub-optimal technical qualifications made the GoC hesitant to transition towards expansive use of auctions. CRESP II helped develop key criteria and redesign the auction approach to take into consideration technical qualification of bidders, in addition to the price offered. The successful procurement and development of nearly 18 GW of solar and wind power through pilots supported by the project confirm that the selection of better technically qualified developers resulted in more efficient outcomes. This is further evidenced by GoC's subsequent decision to replicate the approach in all future procurements of solar and wind power.

63. **Rating for Objective 2:** The CRESP II support for improving the efficiency in the grid system in China through enhanced planning, optimal designs, and better integration of renewable electricity is rated 'High' as renewable generation scaled-up while curtailment of VRE dramatically reduced during the project. Strategic interventions by CRESP II proved to be critical in this successful effort including high-level planning, specific investment support, and targeted interventions specifically designed to enhance system flexibility for addressing integration bottlenecks, especially in the northern regions of the country where the problems were more acute. A summary of each output and outcome achieved can be found in Annex 6.

64. **Objective 3: Reduce incremental costs of key renewable electricity sources.** The aim was to contribute towards securing lower costs and making renewables more cost-competitive so that the subsidies that were becoming untenable could become more manageable. An immediate aim was to focus on onshore wind power and solar PV, which were the two fastest growing technologies that were surpassing expansion targets whereby placing additional pressure on the surcharge for financing the subsidy fund. An additional focus with a longer-term view was to also improve the quality and reduce the cost of offshore wind power and the more nascent CSP[66], so as to improve their competitiveness vis-à-vis other technologies as they progressively scale-up.

65. In general, the incremental cost of wind power or solar PV over coal-based electricity could be reduced by lowering overall project costs for these technologies (or by increasing the cost of coal, for example, with more stringent emission requirements, carbon tax etc.) or by improving the capacity factor from more efficient operations. The goals established

[66] There were no specific actions targeting hydropower costs through CRESP II since the technology was considered to already be competitive with coal-based electricity.

in CRESP II for the end of the project was for solar PV to decrease by over 38 percent, from 11.3 US cents/kWh to 7.0 US cents/kWh[67], and for onshore wind power to decrease by over 42 percent from 2.17 US cents/kWh to 1.5 US cents/kWh[68].

66. The cost of solar PV in China reduced dramatically over the period when CRESP II was under implementation, and onshore wind power also experienced a substantial decrease in its costs. Figure 7 illustrates the average renewable energy cost trends in China and provides some future projections. The data in Table 3 from multiple sources confirm that the cost reduction of solar PV far exceeded the CRESP II target of 7.0 US cents/kWh, and that the incremental costs compared with coal has effectively disappeared. Detailed information provided by IRENA follows that the cost reduction of solar PV was the result of decreasing installed cost and to a lesser extent from increases in average capacity factor. In China, the installed cost of grid connected PV declined from 2,118 US$/kW in 2013 to 760 US$/kW in 2019, a reduction of 64 percent[69], driven by economies of scale from a rapidly growing market and manufacturing efficiencies. On the other hand, the global average weighted capacity factor of grid connected PV, which is expected to hold for China as well, increased from 16.4 percent in 2013 to 18.0 percent in 2019, a change of only 10 percent. Thus, it implies that the momentous scale-up of solar PV in China during the FYP13 period, from 43 GW to 250 GW comprising approximately a third of total global capacity, is in fact influencing international cost for the technology[70]. Such a conclusion was affirmed in a recent World Bank analysis that confirmed "The scale of the Chine market and low-cost production capacity of PV cells and modules led to an acceleration of cost reduction globally" dubbing it the "China Effect"[71].

67. Unlike with solar PV, the decrease in onshore wind power costs in China were driven by both a decrease in installed costs and improved operational efficiency. The cost of onshore wind fell by 18 percent, from a weighted average of 1.49 US$/kW in 2010 to 1.22 US$/kW in 2019[72]. During the same period, the capacity factor for onshore wind farms in China increased from an average of 26 percent in 2010 to 32 percent[73], an increase of 23 percent. As a result of the combined impact, the incremental cost of wind power has also substantially disappeared, as indicated by data from multiple sources shown in Table 5. Given that its share of global installed wind capacity is nearly 40 percent following the substantial expansion under FYP13 from 129 GW to 280 GW, the price decreases in the Chinese market has also contributed and reinforced the overall international technology cost trend[74]. Furthermore, the 0.93 percentage improvement in the capacity factor of the 13.25 GW of wind bases supported under CRESP II (which were replicated in another 50 GW of installations) represents a significant share of the overall capacity factor increase of 6 percentage points (from 26 to 32 percent). While there are multiple factors that drove the cost of wind power and solar PV down in China in recent years, it can be inferred that the substantial scale-up in both technologies (as per objective 1 of CRESP II) that catapulted the country to a globally leading status with a sizable share of the market is a significant contributor to their respective cost reductions. In the case of wind power, the CRESP II support to the improved efficiency of wind farm operations (as per objective 2 of CRESP II) would further contribute towards overall cost reductions.

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[67] levelized cost of electricity based on an 8% discount rate for solar PV compared with a representative supercritical coal-fired power plant with 2010 base-year cost estimates.

[68] levelized cost of electricity based on an 8% discount rate for a wind power project in Gansu (later revised higher with a project in Inner Mongolia where CRESP II support was more substantial given the more acute curtailment in the region) compared with a representative supercritical coal-fired power plant with 2012 base-year cost estimates.

[69] More or less in line with a 80% learning curve for PV modules and 89% for Balance of System Components. Amro M. Elshurafaa et.all. Estimating the learning curve of solar PV balance–of–system for over 20 countries: Implications and policy recommendations. Journal of Cleaner Production Volume 196, 20 September 2018, Pages 122-134.

[70] From the time of FYP12 from 2010 to 2015, the installed capacity of China's solar PV increased from less than 1 GW to 43 GW, and then expanded to 250 GW by the end of FYP13 in 2020 – all overlapping with the CRESP Program that included a variety of catalytic interventions in solar PV.

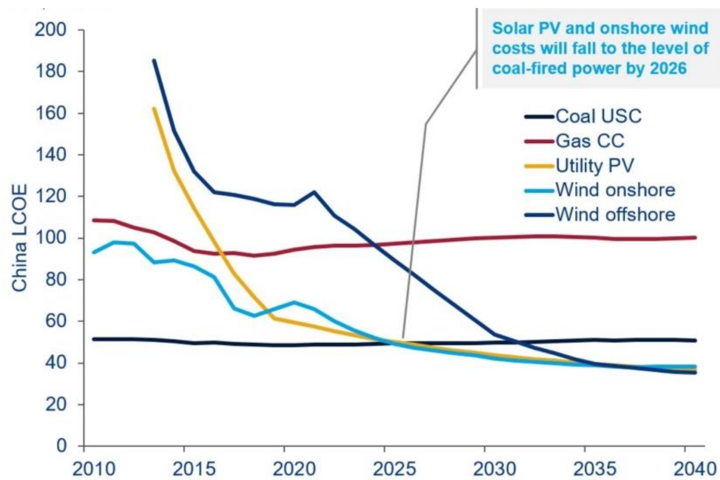
[71] "China: 40-Year Experience in Renewable Energy Development", The World Bank, 2021.

[72] IRENA (2020), Renewable Power Generation Costs in 2019, International Renewable Energy Agency, Abu Dhabi. Table 2.1.

[73] IRENA (2020), Renewable Power Generation Costs in 2019, International Renewable Energy Agency, Abu Dhabi. Table 2.2.

[74] According to "China: 40-Year Experience in Renewable Energy Development" (The World Bank, 2021), "China's wind energy development was observed on the evolution of the global price of wind turbines".

Figure 7: Average Power Generation Cost (LCOE) Trend in China (US$/MWh)



Source: Wood Mackenzie

Table 3: Incremental Cost Reduction of Solar PV (over coal-based power)

	At appraisal US cent/kWh	At project closing US cent/kWh	Reduction (%)
PAD targets	11.3 (2013)	7.0 (2020)	38%
IRENA[a] Commercial	7.9 (2013)	1.4 (2019)	82%
Wood Mackenzie[b]	10.0 (2014)	1.9 (2019)	81%*
CRESP II PMO/WB Assessment	11.9 (2013)	-0.06 (2019)	105%

Table 4: Incremental Cost Reduction of On-Shore Wind Power (over coal-based power)

	At appraisal US cent/kWh	At project closing US cent/kWh	Reduction (%)
PAD targets	2.17 (2012)	1.25 (2020)	42 %
IRENA[a]	2.2 (2010)	- 0.4 (2019)	100%
Wood Mackenzie[b]	4.0 (2013)	2.0 (2020)	50%*
CRESP II PMO/WB Assessment	1.91** (2012)	0.53 (2019)	72%

* Reduction needed by 2020 for cost to fall below coal-based electricity.

** Revised during project restructuring to reflect incremental cost in Inner Mongolia as more appropriate measure.

[a] IRENA (2020), Renewable Power Generation Costs in 2019, International Renewable Energy Agency

[b] Wood Mackenzie's China Provincial Renewables Competitiveness Report 2019

68. **Pilot renewable energy auctions for competitively procuring wind power and solar PV:** The other significant activity supported by CRESP II that helped reduced the cost of solar PV and wind power was to procure them through auctions. As previously noted, the results from the pilot auctions supported by CRESP II were catalytic in the GoC transitioning away from the increasingly untenable FIT, greatly facilitating revival of a stalling expansion to rapidly scaling-up of the two technologies. Allocating development rights through competitive tenders allowed for market-informed price discovery, which greatly contributed to the cost reduction of solar PV and wind power in China. For the 11 GW of solar PV that were auctioned by NEA during the pilot, the weighted average cost reduction was 30 percent compared with the FIT, with some transaction prices reduced by nearly 60 percent. For wind power, the weighted average reduction was more modest at around 5 percent lower than the FIT with some costing as much as 10 percent less. The shift to auctions

nevertheless allows China to apply a flexible, market-based approach to capture dynamic cost reductions experienced by the industry, with which the periodic adjustments in the FIT were unable to keep up.

69. CRESP II's support to the pilot auctions were pivotal and substantial, as the project helped design the auction approach based on international best-practices that were customized to work within the context in China. An initial set of studies provided evidence that the FIT adjustments were not keeping-up with the rapidly evolving changes in a globally dynamic market for solar PV and wind, China was lagging behind other successful countries where the trend has been to transition from FITs to more market-based approaches to secure lower costs, and it recommended that China transition towards auctions for allocating development rights for the two technologies. It was followed-up with awareness raising and consensus building workshops overseas and in China, where international experts from countries such as Germany, India, and the US along with organizations knowledgeable about the subject such as IRENA and the World Bank shared their experiences. CRESP II provided additional international expertise to help prepare several auction rounds in line with best-practice standards drawing lessons from previous experience in China. It included developing the auction guidelines/procedures, refining the evaluation criteria[75] (a key shortcoming in previous tenders some of which didn't materialize as investments), designing standard bidding documents, preparing model power purchase agreements, and incorporating multi-stage performance guarantees to ensure winning bidders comply with their obligations. It led to the issuance of formal guidelines[76]. Subsequently, NEA led the pilot auctions for solar PV while CREEI coordinated and supported the wind power pilots that were conducted by respective provincial governments.

70. **Pilot technology improvements in on-shore and offshore wind power plants:** CRESP II provided additional support to improve the design and technology of wind power with four carefully screened companies[77] by providing cost-shared grants. A total of $1 million was allocated to supported high efficiency operational control techniques and application in on-shore and offshore wind farms totaling 400 MW. Following the successful transfer of knowledge and technical capabilities, these companies applied these improvements in developing more than 3,000 MW of additional wind capacity – an expansion the companies expect to sustain into the future. While it is not straight forward to assess the full impact of the technology improvements and the subsequent propagation, it can be reasonably inferred based on evidence[78] that the proliferation of these standards across a large swathe of projects would have contributed substantially to the cost reductions the industry has experienced. Moreover, wind power is expected to grow in China under the FYP14 and beyond, implying that the benefits of these interventions will continue to accrue for years to come.

71. **Issuance of offshore wind turbine standards:** CRESP II further strengthened the technology support framework by developing internationally accepted standards for offshore wind energy, where there is still scope for improving efficiency to drive down costs. The project ended up preparing three national standards for offshore wind[79] even though the goal at appraisal was to produce a single standard. All three standards were issued by the Standardization Administration of China (SAC) and accepted internationally[80]. A fourth standard for turbine rotor blades was developed

[75] The evaluation method was aligned with international practice with allocation of about half of the weight to the proposed price and the other half to the technical capacity, financial position, experience and any other relevant factor related to the auctioneer.
[76] NEA guidelines on *"Relevant Requirements of Wind Power Construction Management"* (2018) and *"Relevant Matters of Wind Power and PV Generation Project Construction"* (2019).
[77] Companies include: Goldwind, Guohua Investment, Fujian Zhongming, Jiangsu Goldwind.
[78] One major wind turbine manufacturer reduced production costs through the development of digitized and integrated design and maintenance approaches. Following refurbishment, the efficiency increased by over four percent, which the company estimates could result in 500 GWh increase in generation when replicated across their other facilities. Another company, which replaced parts of turbines with high failure rates and debugged control systems, saw performance improve. They were proceeding to refurbish an estimated 60 percent of similar turbines operated by the company, which was estimated to improve efficiency by 3.5 percent overall generating an additional 500 GWh each year.
[79] They include: (a) *Production-based Availability of Wind Turbine* (GB/Z 35482-2017), (b) *Time-based Availability of Wind Turbine* (GB/Z 35483-2017), and (c) *Offshore Wind Turbine O&M Requirements* (GB/T 37424-2019).
[80] By the International Electrotechnical Commission (IEC).

and is expected to be issued by SAC by the end of 2022. These standards can be expected to help offshore wind equipment manufacturers, service providers, testing and accreditation agencies, and government oversight institutions[81]. An analogous effort at establishing standards for onshore wind during CRESP (Phase) I was given “substantial credit for quality and cost improvements” by IEG[82], and would have likely helped pave the way for the subsequent cost reductions experienced by the industry in China, as shown in Figure 7. Similarly, the offshore wind turbine standards can also be expected to have a comparable effect.

72. **Design offshore wind testing center:** An additional key part of the technology support framework for offshore wind was the design of a testing center that is presently under construction in Fuxin City in Fujian Province. Nearly $3 million of CRESP II funds were allocated to procure international expertise to help design the facility including developing test benches for the drivetrain and blades, and plans for commissioning and field testing. A domestic testing facility with world-class capabilities for offshore wind, similar to the one established for on-shore wind under CRESP (phase) I, is an important initiative to maintain the pace of China’s envisaged scale-up of wind power. International partnerships to test equipment overseas for large wind projects can take time, which can slow down progress. The offshore wind testing center is expected to be commissioned in 2023, providing longer-term sustained support to the fast growing offshore wind industry.

73. **Pilot technology improvements in CSP:** CSP is a comparatively more nascent industry although it is a proven technology. China aimed to initiate an expansion under FYP13 since the technology incorporates storage for solar power making it dispatchable overcoming the intermittency challenges faced by solar PV. CRESP II supported technology improvements for CSP by providing international expertise to four select companies[83] which can help reduce the investment costs of CSP by an estimated 8-10 percent. Such savings will make CSP more competitive helping develop the technology at a more rapid pace going forward making-up for the only unmet target in FYP13. CSP installations are expected to further expand under FYP14.

74. **Rating for Objective 3:** The CRESP II support to China for reducing incremental costs of renewable energy technologies is rated **‘Substantial’**. The economies of scale generated by the substantial scale-up of renewables in the country (objective 1) was simultaneously accompanied with initiatives to secure lower costs by competitively procuring more cost-effective electricity and technology improvements that reduced costs through improved efficiency (objective 3) – results that mutually reinforced each other for maximum combined impact. While the overall industry scale-up was driven by the expansion of the broader market for renewables, the strategic contributions of CRESP II towards these achievements were pivotal and substantial. A summary of each output and outcome achieved can be found in Annex 6.

Overall Efficacy Rating

75. The overall efficacy rating is **High**

Justification of Overall Efficacy Rating

76. The overall efficacy is rated ‘High’ because all objectives included in the PDO were achieved, as CRESP II:

- Played a pivotal role at the policy and investment levels with mutually reinforcing initiatives that facilitated the scale-up in renewable electricity, which achieved or surpassed nearly all of the targets established in national plans;

[81] It should be noted that the project also helped prepare three offshore wind farm design guidelines that were issued by NEA: (a) Offshore wind farm transformer substations design specification, (b) Offshore wind farm AC submarine cable selection and layout technical guidelines, and (c) Offshore wind farm foundations.

[82] Project Performance Assessment Report for the *China Renewable Energy Scale-Up Program: Phase One*, IEG, World Bank, 2017.

[83] included the development of 30m^2 heliostat and control systems, integrated optimization of CSP towers, development of larger aperture parabolic trough solar collector tests, and development of parabolic trough vacuum receivers.

- Helped enhance planning, optimized designs and better integrated renewable electricity improving the efficiency of the overall power system; and,
- Procured lower cost renewable electricity relying on economies-of-scale arising from the industry expansion and efficiencies generated through targeted interventions to improve quality.

C. EFFICIENCY

Assessment of Efficiency and Rating

77. Since the GEF funded CRESP II is a technical assistance project, a traditional cost-benefit analysis to evaluate the efficiency with which the funding was used is not prudent. Instead, a more appropriate set of measures could be to evaluate the project's strategic efficiency comparing project costs and outcomes with alternative benchmarks; and assess CRESP II's operational efficiency for smoothly implementing the myriad of activities and maximizing its value-added. Nevertheless, an alternate value-for-money proposition could be illustrated as follows:

78. **Comparing economic returns of direct benefits to project costs:** While strict economic valuation is not appropriate, it can be informative to compare the direct investment benefits from CRESP II with the GEF grant expenditures of $27 million, acknowledging that the full value of the project rests on the major policy initiatives it supported that are not easily quantifiable. When CRESP II provided considerable support to the scale-up of renewable electricity in the country, it resulted in a commensurate level of avoided CO_2 emissions. While it may not be appropriate to attribute the entire scale-up solely to CRESP II, the project had a more directly role in catalyzing the pilot projects it supported, such as optimizing power production in 13.25 GW of wind bases in Inner Mongolia, Qinghai and Xinjiang. The increased capacity factor that resulted from the intervention resulted in additional generation of 1,078 GWh per year and avoided emission of 0.84 Mton CO_2 per year. Taking the lower end of the guidance provided by the World Bank of $40-$80 per ton of CO_{2e} for 2020[84], the yearly benefit of this intervention alone would be $33.7 million, exceeding the cost of the GEF grant of $27.28 million. If the lifetime benefits of these wind bases or the avoided emissions from other interventions are considered, the resulting value would be even higher. Thus, the direct benefits of CRESP II alone easily justifies the use of grant funds.

79. **Strategic Efficiency/Alternate Benchmarks:** While the strategic relevance of CRESP II is already established in the section on Relevance, it is also worth assessing whether major project supported interventions were strategically targeted and the results achieved efficient outcomes.

80. **Achieving economically optimized levels of renewable electricity:** The analysis carried out during appraisal calculated the economic optimum amount of renewable electricity in China. It concluded that, with a 12 percent social discount rate, the optimal non-hydro renewable energy target for 2020 was 1,092 TWh. It noted that the GoC's non-hydro renewable energy goal at the time of 892 TWh did not exceed this level, thus economically justifying this target. The actual generation of non-hydro renewables in China by 2020 was 860 TWh, mostly achieving the GoC's economically justified target that CRESP II supported and remains within the bounds of optimization analysis results[85].

81. **Strategic targeting of project activities:** Another gauge of efficiency is to assess whether the project strategically selected and targeted its activities for maximum impact given the limited funds and a broad objective spanning the

[84] Guidance Note on the Shadow Price of Carbon in Economic Analysis, The World Bank, 2017.

[85] The scope of ICR and budget available did not afford a recalculation of the appraisal level optimization analysis, although it provides a reasonable and approved benchmark by which the project outcome could be measured. A check confirmed that during implementation the cost of coal did not increase and the environmental externalities in China were priced lower than assumed at appraisal. Only the investment cost of wind and in particular solar PV continued to decline faster than anticipated. Thus, it is unlikely that the level of non-hydro renewable development would have exceeded the originally established optimal threshold.

entirety of a large country. In the case of the policy support, CRESP II opted to support the definitive FYP planning, and a critical set of policies that were needed to collectively implement the plan (i.e., quotas, auctions, and certificate trading). With regards to investment support, the project carried out a rigorous screening to select renewable energy companies (for wind, CSP), (New Energy) cities, and regions (for improved integration of renewables) that were well placed to replicate the pilots, which was confirmed by their subsequent wider expansion across a wider portfolio, maximizing the impact of CRESP interventions (i.e., inter-(sub) project leverage). CRESP II was strategic in regional selection for addressing integration bottlenecks in the north of the country where wind curtailment was high and so is the value-added from a successful intervention. For the constructing of the Offshore Wind Testing Center, there was diligent discussions by the World Bank to confirm GoC's funding commitment, before CRESP II prepared its design, since implementation would occur after the project had closed (it is now under construction). Of the major project activities, only the key support to the two pilot New Energy Cities is pending further replication in other jurisdictions. Overall, most of the major CRESP II's investment interventions have led to these advancements being mainstreamed and replicated more widely with the expansion likely to continue under FYP14.

82. **Intervention instrument selection:** Given that CRESP II was entirely a technical assistance project with major policy interventions, it is appropriate to inquire if the effort could have been better served through a World Bank Development Policy Loan (DPL) rather than by an (grant-based) investment project. It may have been more efficient to have the GoC issue specific renewable energy policies based on prior agreements as a part of a DPL, while holding them accountable for achieving the targets they established for renewable energy. China has a general history of swiftly implementing policies once agreed. Furthermore, the project utilized considerable Chinese expertise through qualified domestic institutions that had the required capabilities to provide the required analyses. However, in the case of CRESP II, the interventions included critical and targeted transfer of knowledge and key international experiences through frequent technical assistance contracts and the expertise and guidance from a highly qualified World Bank team, which would not have been practically feasible through a DPL. Furthermore, the grant-based investment lending was better suited for securing international expertise to guide the preparation of auctions, share expertise on technology transfer, and for raising awareness amongst stakeholders to develop consensus around the reforms. It would have been highly risky to presume that such high caliber technical assistance would have been imparted by other means to underpin the policy support provided through a DPL. Therefore, the instrument selected for the CRESP II intervention was appropriate and efficient.

83. **Project management/implementation efficiency:** CRESP II implementation was spearheaded by NEA, within which a Project Management Office (PMO) was established to manage project activities. Some key aspects related to the efficiency with which the project was managed is as follows:

84. **Fragmentation of contracts:** To achieve the project's outcomes, CRESP II supported a large number of activities, totaling over 100 different contracts (see Annex 4). One of the lessons learned from CRESP I implementation[86] and the IEG review of the same[87] was that a piecemeal approach and fragmentation of policy studies is detrimental to quality and leads to higher transaction costs and lower impacts on government policy making. As documented in the PAD, CRESP II acknowledged this lesson in planning for the project. Nevertheless, for Component 1 on Policy Support, the PMO issued 45 contracts with a total value of US$ 6.47 million. The average size of a contract was US$ 144,000, which is not much bigger than the contracts issued under CRESP I if contracts to individual consultants are excluded[88]. The mid-term review of the project concluded that "same as CRESP Phase I, CRESP phase II had too many small activities. This increased workload, reduced focus, and led to sub-optimal use of the outputs."[89] Furthermore, 25 of the activities totaling over $3

[86] CRESP I ICR
[87] Project Performance Assessment Report for the *China Renewable Energy Scale-Up Program: Phase One*, IEG, World Bank Group, 2017.
[88] Excluding contracts for individual contracts the average size of policy related contracts under CRESP I was US$ 125,600.
[89] NEA/GEF/WB China Renewable Energy Scale-Up Program Phase II. Mid-Term Review Evaluation Report Prepared By CRESP PMO. Original Version June 2017. Revised Version Through January 2018.

million were contracted with two organizations – Energy Research Institute (ERI) and CREEI. Notwithstanding the need to reduce the burden of many small contracts, there may be prudence to the approach adopted by the PMO in some instances: (i) most contracts were not pre-determined as the project was specifically designed to employ a "flexible approach to adapt to the fast-changing environment and the priorities as they emerge during implementation"[90]. Thus, some of the project requirements emerged progressively during implementation. (ii) Some studies undertook precursor diagnostics, which determined the subsequent analytics that were contracted, and (iii) they may not have learned of the concentration of contracts with ERI and CREEI except in hindsight. Improvements could have been incorporated, nevertheless. Anticipating the multiple engagements with ERI and CREEI, the PMO could have considered umbrella agreements for contracts that may subsequently follow, and perhaps transferring some of the workflow management responsibilities to the two institutions from the start. Some consolidation of activities and elimination of the need for many small contracts could have reduced the management burden experienced by the PMO, as documented in aide memoires, and potentially improved project results. Such adjustments would require re-thinking the approach to procurement as well. Nevertheless, it should be recognized that the PMO did successfully bring the project to closure with most activities complete with the cancellation of only 2 contracts.

85. **Use of Cost-shared grants:** The project provided 14 cost-shared grants for a total value of $7.65 million, or about a quarter of the GEF grant. Many delivered highly effective results, incurred modest costs relative to overall investments, and leveraged additional funding from other sources. The support to four wind manufacturers, four CSP developers, piloting storage, and the offshore wind testing center were all accomplished through cost-shared grants. The use of cost-shared grants reflects a lesson from IEG's review of CRESP I, which were found to "enhance selectivity and efficiently leverage knowledge transfer, technology improvement, and counterpart funding."[91]

86. **Information dissemination and consensus building:** The PMO facilitated many successful attempts at raising awareness of project results through multi-stakeholder workshops and other purposeful information dissemination activities. Creating greater awareness of project supported analyses increases the proliferation of findings and recommendations as they are adopted by a wider set of stakeholders. While there were times when developing consensus was challenged, it addressed a critical concern raised in the PAD regarding advancing the renewable energy agenda, which the project was able to overcome in many instances. An example was the sharing of international experience related to quotas, FITs and auctions, which is documented to advance the understanding of participants that eventually led to the related reforms, which were accepted and implemented by multiple stakeholders. The project also widely disseminated project results, which were contractually stipulated under the World Bank agreements and a website was developed as a part of this effort. However, the website now appears to be defunct although the information continues to be of value for stakeholder discourse[92]. The continuity of information dissemination post-CRESP II would have been a useful consideration at project design or during implementation.

87. **Implementation delays**: The closing date of CRESP II was extended twice, for a total of 2 ½ years. The first 1 ½ year extension was due to the complexity of policy reforms, time needed to form behavioral change, capacity of local authorities, and cooperation with international partners taking more time than anticipated. While developing consensus and influencing behavioral change can take time and be unpredictable, the project could have better anticipated the limited capacity especially with local governments and the requirements to engage international partners. The initial implementation delays especially with procuring a large volume of contracts was counter to a key benefit of CRESP II, which was to accelerate the deployment of renewables in China. The second one-year extension was due to the Covid 19 pandemic, personnel changes at NEA and State Grid, and the request by the GoC to assist with preparation of FY14. Again, efficient project management would have overcome challenges of personnel changes, while the difficulties

[90] PAD for CRESP Phase II

[91] Project Performance Assessment Report for the *China Renewable Energy Scale-Up Program: Phase One*, IEG, World Bank Group, 2017.

[92] NEA is now considering re-uploading key content from the CRESP II website onto its official website.

working around the pandemic is experienced by many throughout the world. The extensions did serve a key benefit in that CRESP II was able to see through FYP13 to completion, which also greatly enhances the opportunity to better assess post-project performance. Moreover, the extension allowed CRESP II to influence China's future energy plans for accelerating the deployment of renewables to peak the country's CO_2 emissions before 2030 and reach net zero no later than 2060.

Overall Efficiency Rating

88. The overall efficiency is rated **Substantial**. There were no major shortcomings that substantially effected key project results as most were successfully achieved. Technical assistance through an investment lending operation proved to be an efficient tool for providing the range of support that was needed, including policy reforms, technology improvement, cost reduction and project support. The selectivity of interventions, regions for engagement, and companies receiving support from the project through strategic and rigorous selection processes was an efficient approach to ensuring successful outcomes while maximizing the project's immediate impact as well as subsequent replication. Combining credible analytical inputs and stakeholder engagement helped enhance awareness and develop consensus that was essential for project outputs to be accepted and implemented by relevant authorities within the country. The project did critically influence the development of renewables within the contours of what was deemed to be economically optimal levels, where the overall benefits far exceeded the relatively modest cost of the grant funds. However, the pace of the reforms could have been accelerated if not for initial implementation delays from having to successfully manage a large volume of contracts, which NEA was able to eventually overcome and deliver results.

D. JUSTIFICATION OF OVERALL OUTCOME RATING

89. The overall outcome is rated **Highly Satisfactory**, because the relevance and efficacy were rated high while the efficiency was rated substantial.

E. OTHER OUTCOMES AND IMPACTS (IF ANY)

Gender

90. There was no special focus on gender in this project and no disintegrated targets for men and woman.

Institutional Strengthening

91. CRESP II benefitted from the institutional strengthening activities implemented under CRESP I. In particular the PMO was up and running at the start of CRESP II with staff skilled from their previous experience in implementing large complex projects. The PMO may have benefitted from more procurement training, but some tardiness in this regard may have been more a function of managing a large number of fragmented contracts. Under CRESP II, the main institutions undertaking various technical assistance interventions received both specialized and on-the-job training to strengthen their capacity that will be beneficial for years to come. The agencies that benefitted included government organizations at different levels, manufacturers, research institutes and testing centers. For example, the planning studies included utilizing state of the art software applied strategically to overcome key integration issues, which is high-caliber experience that could be applied on a recurrent basis in China and elsewhere. Similarly, the software for designing wind bases were customized by CREII to be suitable for optimizing large scale operations envisaged on China. There was considerable training and transfer of knowledge for designing and implementing the pilot auctions in-line

with international standards that continue to benefit NEA (for solar PV) and provincial governments (for wind power) with follow-on applications. Wind power and CSP manufacturers benefitted from international expertise on technology improvements that they are able to replicate in their other operations. As a whole, CRESP II was able to take advantage of the high degree of skills in renewable energy development in China and strategically augment them where international experience would enhance performance, ensuring that there would be transfer of knowledge for sustained benefit.

Mobilizing Private Sector Financing

92. CRESP II directly leveraged private sector financing primarily through cost-shared grants and the pilot renewable energy auctions. The project signed 14 grant agreements with private parties covering half of the costs, including with 9 manufacturers, 4 research institutes, the China Meteorological Administration (CMA), and the Offshore Wind Turbine Testing Center. These sub-grants directly leveraged at least US$ 450 million from these entities. The pilot auctions also mobilized private investors/developers who raised financing for nearly 18GW of wind and solar PV installations.

Poverty Reduction and Shared Prosperity

93. Poverty reduction and shared prosperity was not an explicit objective of CRESP II. Increasing the share of renewable electricity in total electricity production may initially increase the cost of electricity because it can be more expensive than non-renewable electricity. The incremental cost must be recovered from tariffs, and to the extent that they are passed through to lower income consumers, this could have an adverse effect. Offsetting this impact is the cost-reductions, particularly for wind power and solar PV, that supported by the project that has nearly brought the cost of renewables to parity. Thus, future wind power and solar PV development will not involve incremental cost, although there may be other system-based costs as the share of VRE increases (e.g., storage or other balancing power investments that may be needed). Avoided local pollution also stand to benefit local populations from improved health and others impacts, which can include the poor.

Other Unintended Outcomes and Impacts

94. There are no major unintended outcomes and impacts.

III. KEY FACTORS THAT AFFECTED IMPLEMENTATION AND OUTCOME

A. KEY FACTORS DURING PREPARATION

95. CRESP II followed CRESP I and benefitted from the institutional and implementation capacity build. The PMO was in place during the preparation of CRESP II. The support that CRESP I provided for the renewable energy industry and policy development was acknowledged and well received by the government. The government sees CRESPII a natural continuation of CRESP I as the second stage of CRESP program. The good relationship established with the responsible government organizations benefited the preparation of the CRESPII.

B. KEY FACTORS DURING IMPLEMENTATION

96. During implementation emission reduction and sustainable development became more prominent in the world as a whole and for China. China ratified the Paris agreement in 2016. To reach these objectives, the 13th FYP included a

very ambitious wind and solar PV development target, the installed wind capacity was planned to increase from 129 GW in 2015 to 210 GW in 2020, an increase of 63 percent. Installed capacity of solar PV was planned to increase from 43 GW in 2015 to 105 GW in 2020, an increase of 144 percent[93]. The target of wind and solar PV in the 14th FYP is even more ambitious. During implementation the objectives of CRESP II became even more important for China and there was strong support for the successful implementation of CRESP II.

97. However, during the implementation, some key decisions took time as consensus needed to be developed among key stakeholders. This included provincial decisions whether to participate in the project and the time that was required to select the New Energy Cities for project support. Despite initial delays, most challenges were overcome during implementation.

IV. BANK PERFORMANCE, COMPLIANCE ISSUES, AND RISK TO DEVELOPMENT OUTCOME

A. QUALITY OF MONITORING AND EVALUATION (M&E)

M&E Design

98. The Results Framework that was developed for the project was insufficient for evaluating the performance of a comprehensive, complex and multi-level project. In fact, there were scant indicators to capture the national level implications of project results (objective 1), although all of it may not have been known at project appraisal. Additionally, there were no outcome level formal indicators to monitor the considerable efforts to improve efficiency and integrate more VRE (objective 2). For cost reductions (objective 3), the outcomes indicators were adequate although there wasn't a clear articulation on attribution of project results to the higher-level objectives. The associated output indicators (e.g., offshore wind turbine standards) are more aligned with long-term outcomes rather than more immediate cost reductions that were being measured as project outcomes at project closing. While the inadequacy of the results framework could have been a major challenge for evaluating project performance, fortunately, many other relevant indicators that were not formalized were being monitored by the PMO and ither implanting agencies. By considering these other indicators, the ICR was able to accurately ascertain project performance.

M&E Implementation

99. Sixteen supervision missions were carried out over the eight-year project implementation period with regular monthly meetings during the project lifetime to monitor detailed progress and provide extensive support to the PMO and other beneficiary institutions. The PMO prepared and submitted semiannual progress reports and annual progress reports. The formalized indicators were monitored throughout although they were not sufficiently comprehensive to cover key aspects of the project. The progress reports were submitted to the World Bank in a timely manner and are all of high quality. Project level data (e.g., efficiency of wind bases, technology improvements) were often independently verified by third parties to validate results, while high-level indicators were often monitored by the GoC as a part of their national and sector level statistics.

100. As part of the first restructuring (February 2019) the baseline value of one indicator was changed (reduced incremental costs of wind power over coal fired power plants). The baseline value changed from 1.60 US cent/kWh in the PAD to 2.17 US cent/kWh. The revised value is more in line with estimates from other sources. The second restructuring (August 2020) added one PDO indicator ("RE 13th FYP developed and adopted") and two intermediate

93 https://policy.asiapacificenergy.org/node/2918#:~:text=The%20plan%20proposes%20that%20by,use%20should%20fall%20by%2015%25.

result indicators ("RE 14th FYP developed", and "design of China's first offshore wind turbine testing center aligned with international best practices"). These additional indicators enhanced the results framework, but it remained inadequate for fully measuring project results. The project would have benefitted from the addition of more output and outcome indicators that better reflect what was employed by the ICR for evaluating performance (table 1). Nevertheless, CRESP II indicators were assessed by the PMO, shared with the World Bank during half yearly supervision missions and reported in the half yearly ISRs. According to the December 2018 ISR the project achieved or surpassed all formal targets that were included in the results framework.

M&E Utilization

101. The formal results indicators were utilized to monitor project progress, although they only partially covered project progress. However, many other activities including their progress and results were being monitored during regular supervision visits and through progress reports. These results turned out to be vital for evaluating project performance in preparing the ICR, although they were not included in the formal project results framework. Many of the more modest indicators were achieved following the mid-term, which was an opportunity for enhancing the monitoring framework and reflecting the dynamic and evolving nature of the project. There was an attempt to do so with the additional of several indicators during the 2020 restructuring, but many useful measures were not formally incorporated to the results framework. As a result, the M&E framework remained largely unchanged during implementation.

Justification of Overall Rating of Quality of M&E

102. The overall M&E quality rating is **Modest**. The formal results framework fell short of what was required to adequately monitor progress and evaluate performance, although the project implementing entities did informally monitor many other relevant indicators that provided the basis for the ICR assessment of project performance.

B. ENVIRONMENTAL, SOCIAL, AND FIDUCIARY COMPLIANCE

103. **Social Safeguards.** CRESP II is of technical assistance nature, with pilot demonstration support for distributed renewable energy projects in selected cities under Component 4. For pilot demonstration, CRESP II funds primarily supported the technical assistance through improved grid planning and policies and technology improvement but was not used for equipment procurement. The pilot demonstration did not involve land acquisition, resettlement, or ethnic minorities. Therefore, both OP 4.10 and OP 4.12 were not applied to the project. No complaints or grievances related to the project impacts were reported during the project implementation. The project achieved substantial social spill-over benefits by contributing to RE scale-up by targeted TA studies. The project's social performance is deemed satisfactory.

104. **Environmental Safeguards.** The project is classified as Environmental Assessment Category C according to OP 4.01, primarily consisted of policy studies, technical assistance, and capacity building related to RE development. The environmental safeguards management was considered satisfactorily undertaken in compliance with domestic regulations and OP 4.01 requirements, with no reported cases on environmental pollution, health or safety incidents, or complaints from the public.

105. **Financial Management (FM).** The FM capacity assessment conducted during appraisal concluded that the Project FM arrangements satisfy the World Bank requirements. Overall, the residual financial management risk before and after mitigation measure for the project was assessed as Moderate. The project had adequate project financial management system that provided, with reasonable assurance, accurate and timely information that the grant was being used for the intended purposes. The project accounting and financial reporting were in line with the regulations issued by MOF and

the requirements specified in grant agreement. No significant FM issues were noted throughout the project implementation and the FM related issues or weaknesses raised during FM implementation were resolved on timely basis. The project audit reports were all with unqualified audit opinions. In addition, the withdrawal procedure and funds flow arrangement were appropriate. The grant proceeds were disbursed to the project in a timely manner.

106. **Procurement.** The procurement was considered satisfactory and complying with the World Bank procurement policy and procedural requirements. The World Bank task team closely oversaw procurement and was available to assist and clarify procurement-related issues in the project life cycle. Post-reviews were carried out regularly on a sampling basis. These oversight functions were carried out efficiently and satisfactorily. The principal risk identified in the procurement capacity at appraisal was the inadequate experience of potential future new PMO staff. Fortunately, many of the CRESP I PMO staff continued working in the PMO for CRESP II and the staffing of PMO has maintained relatively stable during implementation. As a result, the implementation of CRESP II has benefited a lot from the knowledge and expertise these staff had gained from the phase I project. Majority of the procurement under this project was selection of small consultancy services, while there were also a few large contracts using complex selection method, for which the PMO staff had no precedent experience, and the implementation experienced some delays at the initial stage. In addition to traditional procurement, a different mechanism for sub-grants has been brought into the project. The new mechanism, comprising of two categories, namely Cost Sharing Facility and Competitive Grant Facility, was involving specific procurement arrangements, which were clearly documented and formalized in the Sub-grant Guidelines. The procurement under the sub-grants followed the stipulations in the Sub-grant guidelines[94].

107. **Disbursement.** The grant has been hundred percent disbursed by end of the grace period, April 30, 2022.

108. **Fiduciary Risk Rating.** At appraisal the fiduciary risk rating was Moderate. During implementation (December 2020) this was reduced to low.

C. BANK PERFORMANCE

Quality at Entry

109. CRESP II followed from CRESP I and addressed a priority objective of the Government of China, the World Bank and the world. As such it built upon the project architecture of CRESP I, which was rated highly satisfactory by IEG, and was a natural continuation. At the same time, CRESP II was specifically designed to address two key obstacles that have arisen – the need to more efficiently integrate renewables and lower costs – while maintaining the overarching ambition of scaling-up. The project design also continued the use of "market mandates" (e.g., quotas) to shift behaviors towards the desired project outcomes – an approach that has proved to be successful. While the strategic thrusts of the project were clear up-front and remained throughout the project, CRESP II was also designed to be flexible and evolve in terms of the activities it supported so that the project could meet the needs of a changing market. This design feature does place greater responsibility on the project team to manage the dynamism of the project including the approval of project-supported activities. In this regard, the World Bank team also included highly qualified global experts on renewable energy, who were able oversee project implementation relying on an experienced counterpart team. To ensure the widest impact from project activities, the disclosure and dissemination of project reports was legally obliged. The evolving nature of project activities could lead to strategic fragmentation and increase the burden on the PMO, if it is not adequately managed. As previously noted, the results framework that was formulated at appraisal was inadequate to measure the results against the PDO. Despite these shortcomings, the overall design of CRESP II was fit for purpose to support China overcome key

[94] No pilot demonstration investment support (subproject) under Component 4 directly involved solar PV or wind turbine procurement. Pilot demonstration investment support activities (subprojects), which were indirectly associated with solar PV and wind turbine energy equipment procurement, were all completed by December 2020.

barriers and scale-up renewable energy, and the activities of the first year of implementation have also been well designed, directly serving for the achievement of the PDO.

Quality of Supervision

110. The supervision of the project was mostly carried out by the same World Bank TTL that led project design and preparation, which provided for continuity. Furthermore, the project was managed from the World Bank China office, which enabled more frequent informal engagement with clients and oversight of project activities. As previously noted, the World Bank team included seasoned experts on renewable energy who supported the project throughout its implementation. The project was also formally supervised through missions twice each year which was teamed by all necessary specialists for reviewing project progress, guiding implementation, and resolving issue that may arise. supporting the client. The supervision missions were highly detailed, documenting extensive substantive discussions with a focus was on quality of deliverables, timely production of the deliverables and overall disbursement progress. In each mission, the World Bank team undertook detailed technical reviews of the analytical work and guided the reforms that were being informed by the CRESP II supported studies based on the World Bank's own international experience and technical expertise. Such intervention was required because most of the studies carried out were decided during implementation. Regular field trips were made to subgrant project sites to verify the implementation status, ensure deliverable quality, and validate project results. In some cases, a third-party validation/verification were arranged to independently ensure the quality of the deliverables. one issue that was not properly addressed during supervision is that the team could have better adjusted the results framework as project activities evolved, which would have better captured project performance that informing supervision. Project implementation progress and guidance provided by the World Bank team were detailed in the ISRs and aide memoires.

Justification of Overall Rating of Bank Performance

111. Overall Bank performance is rated **satisfactory**. There were only minor issues with quality at entry and quality of supervision.

D. RISK TO DEVELOPMENT OUTCOME

112. Risks to development outcome are rated **Negligible to Low.**

113. The risk to development outcome could arise from two sources: a) the national drive in China and political commitment to scale-up renewable energy wanes, and/or b) the project level reforms implemented under CRESP II does not take hold post-project. Therefore, to assess the risk to the project's PDO, the ICR evaluation will consider evidence that indicate whether or not there will be continuity of the overall renewable energy transition and the likelihood of project level initiatives being progressively mainstreamed.

114. The strongest evidence that confirms continuity of the transition is China's ratification of the Paris Agreement on climate change in 2016 and the subsequent commitment it made at the 2021 COP26 in Glasgow. These obligations imply that the electricity generated from renewable energy will need to increase from 2,222 TWh/year in 2020 to 4,540 TWh by 2030 (44.4 percent of total electricity generation) and 8,076 TWh in 2050 (61.2 percent of total electricity generation). Moreover, a roadmap for achieving these goals was formally adopted by the GoC in 2022 when it issued the FYP14 for renewable energy and the corresponding Long-Term Renewable Energy Plan 2030, both of which were prepared with support from CRESPII. It directs the sector to undertake necessary measures to chart a trajectory scaling-up renewable energy in support of achieving 'net zero' before 2060. There are also indications that the overall power sector reforms that were stalled at appraisal, are beginning to progress based on actions taken thus far following State Council Decree 9: Deepening Reform of the Power Sector. Taken together other key bottlenecks to renewable expansion that were

addressed in many ways through CRESP II (i.e., integration of VRE, cost reduction of solar PV and wind power), there is a high degree of confidence that the commitment to the renewable energy transition will continue at the national level with the commensurate reforms as China would want to maintain its globally leading position.

115. There is already evidence that the specific major initiatives supported by CRESP II are being mainstreamed, even though the benefits of this type of project accrue over the longer-term. At the policy level, the key reform transitioning to quotas, auctioning development rights to secure lower costs, and inter-provincial trade of renewables have already shepherded the successful achievement of FYP13 goals. This policy architecture continues to underwrite the investment climate for renewable in China. Many interventions such as auctions, increased flexibility of coal and incorporation of battery storage to integrate greater shares of VRE are expected to continue since they are mainstreamed under FYP14 renewables program. The project's contribution to developing FYP14 itself is a statement of continuity. There is also evidence that the design and technology improvements in wind and solar CSP are already being replicated and expanded – further indications of the impact of the project being sustained. One area where CRESP II made a significant contribution is with offshore wind power, establishing multiple internationally recognized standards and designing a turbine testing center. The true impact of these interventions will take time to ascertain based on how the industry will improve and expand over the coming years as a result. In this regard, CRESP I may serve as a guide since similar interventions it supported for onshore wind proved to be of high value in the industry expansion that occurred after the project that ended up contributing to the technology exceeding the FYP13 targets.

V. LESSONS AND RECOMMENDATIONS

116. Lessons learned and recommendations for similar future projects are provided in Table 5, with some carried over from implementing CRESP I.

Table 5: Lessons Learned and Recommendations for Future Similar Projects

	Lesson	Recommendation
1	Technical assistance projects can have large scale 'national' impacts when they are designed within a framework to comprehensively address the goals, interventions are strategically designed to be on critical path for maximizing impacts, the approach is sufficiently flexible to respond to evolving needs, and has high-level commitment from clients to implement the reforms. CRESP II (and CRESP I as well) is a good example where the project attempted to tackle major barriers with the goal of nationally scaling-up the deployment of renewables, incorporated a flexible design to evolve with the shifts in markets as well as the needs of the client, and secured the GoC's commitment for the major reforms by providing the underlying analytical work to justify interventions and align them with the country's development objectives. It is worth noting that designing and supervising the implementation of such complex and evolving operations require a high-capacity World Bank as well as counterpart teams that can guide the project throughout including adequately managing operational matters (e.g., procurement, M&E).	Technical assistance projects that aim to have large-scale, nation-wide impacts should ensure some critical pre-conditions such as: ▪ Secure high-level counterpart commitment for reforms, including through analytical work to obtain buy-in; ▪ Overall project framework is sufficiently comprehensive to address national-level challenges that are being addressed; ▪ Selected interventions are strategic to leverage maximum impact towards achieving project objectives; ▪ Project design is sufficiently flexible to adapt to evolving circumstances so that objectives can be successfully achieved; and, ▪ Adequate team capabilities to guide implementation decisions and oversee operational aspects of a complex and flexibly designed project.
2	CRESP II provides good examples of how power systems can be made more flexible for integrating VRE technologies through specific interventions that are based on solutions developed	CRESP II provides a good example for informing other similar interventions that may be attempting to address VRE integration issues through: a) solid analytical

	through sound analytics. The project, with the benefit of its design flexibility, undertook key studies that identified solutions, which led to key decisions and generated buy-in for committed subsequent implementation of reforms. Solutions to integration challenges will become increasingly more relevant in other developing countries as their share of VRE progressively larger. Addressing the integration issue was a major emerging challenge that was found in an IEG major evaluation on renewable energy[95] to be an area where the World Bank's applied experience was limited.	underpinning, which b) facilitate client decisions and strengthen commitment to reforms, and c) examples, when applicable, such as: ▪ Integrated power system planning for coordinated transmission and renewable generation; ▪ Mechanisms and incentives for inter-regional (jurisdictional) energy trade; ▪ Expansion of distributed generation that can bypass transmission bottlenecks; ▪ Enhanced flexibility (retrofits) of CHP power plants; ▪ Requirement of battery storage when expanding VRE capacity; ▪ Pumped storage hydropower capacity for balancing power; and, ▪ Price compensation mechanisms.
3	Multi-level, complex technical assistance projects that aim to have national implications require a well-articulated TOC/logical framework that clarifies how project level actions strategically lead to high-level results through attribution. The fact that CRESP II interventions were designed to evolve implies that such an articulation would also need to be iteratively revised and documented during project implementation. At the time of CRESP II appraisal, the World Bank operational policy did not require a ToC, but it is now an integral part of project design that could address this issue with adequate quality-control scrutiny.	Design a well-articulated ToC at appraisal and progressively adjust it during project implementation as needed documenting the attributability from project activities to multi-level outcome results.
4	The monitoring and evaluation (M&E) framework should be sufficiently comprehensive and include indicators to gauge project performance at different levels. The CRESP II formal results framework was inadequate to ascertain project performance, and could have better evolved to reflect some of its key results. Fortunately, the PMO and other implementing agencies monitored many non-formal indicators that enabled an accurate assessment of project performance. In its absence, the project ratings could have suffered, not due to performance, but because of a lack of adequate M&E.	Design a sufficiently comprehensive results framework that can dynamically evolve and work hand-in-hand with the ToC for evaluating project performance.
5	Find a balance between the comprehensive nature of project interventions and fragmentation through multiple contracts. Despite the World Bank and IEG lessons from CRESP I to limit fragmentation of contracts, CRESP II was not quite successful attempting to manage over 100 contract that placed pressure on the PMO and slowed down implementation at times. The evolving nature of project activities made it particularly challenging since many contracts could not be anticipated up-front.	Consider entering into umbrella agreements with key vendors or other similar approaches so that progressive assignments could be quickly assigned and negotiated.

[95] Evaluation of the World Bank Group's support for electricity supply from renewable energy resources, IEG, 2020.

6	The implementing agencies' significant knowledge related to renewable energy and the high degree of expertise within the World Bank supervision team enabled the project to technically perform at a high-level with international experiences strategically mobilized where there are gaps (i.e., auctions, technology improvement).	A high performing client with sufficient capacity provides a basis for designing and successfully implanting complex projects.
7	Many impacts of policy reform may only be felt after a number of years, as was the case with CRESP I. Many aspects of CRESP II are likely to be the same. Therefore, it is important to not only ascertain short-term results (i.e., by project closing), but consider proxy indicators that substantiate the likelihood of reforms taking hold and having a long-term impact (e.g., the renewable energy pilots leading to approach being adopted country-wide; standards for offshore wind).	Long-term impacts can be proxied during the project implementation period based on evidence of expansion, replication, and measures of continuity.

ANNEX 1. RESULTS FRAMEWORK AND KEY OUTPUTS

A. RESULTS INDICATORS

A.1 PDO Indicators

Objective/Outcome: support the ambitious renewable energy scale-up program in China

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Additional RE-based power generation from improved design of the large wind bases (GWh)	Gigawatt-hour (GWh)	0.00 31-Jan-2013	370.00 30-Jun-2019		1,078.00 15-Jun-2021

Comments (achievements against targets):
Optimizing the siting of wind turbines in large wind farms will minimize the wake effect and maximize the potential electricity generation. Although the improvement in wind farm capacity factor is relatively small, because of the size of the wind farms the additional electricity generation will be large. CRESP II supported the development of an improved version of the widely used wind turbine siting software WAsP. Based on information provided by the consultant, the PMO estimated the potential annual additional electricity generation for 4 wind farms with a total capacity of 13.25 GW as a result of using the improved version of WAsP at 1,078 GWh per year. At a LCOE for on-shore wind of 50 US$/MWh (see Figure 9) this represents a value of US$ 51.2 million per year. The additional electricity generation exceeded the target (370 GWh/year) at 177 percent.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Additional RE consumption	Metric ton	0.00	1.31		3.90

from increased RE penetration in New Energy Cities (Mtce)		31-Jan-2013	30-Jun-2019		15-Jun-2021

Comments (achievements against targets):
According to the PMO, CRESP II supported two pilot New Energy Cities: Zhangjiakou increased its RE penetration in the final energy consumption from 9 percent in 2015 (equivalent to 1.35 million tons of coal equivalent (tce/year) to 27 percent by 2019 (equivalent to 4.00 million tce/year). The additional RE consumption in Zhangjiakou is 2.65 million tce/year. This information is based on information provided by Zhangjiakou. Hefei increased its RE share in the energy consumption from 6 percent in 2015 (equivalent to 1.26 million tce/year) to 7 percent by 2018 (equivalent to 1.61 million tce/year). The additional RE consumption in Hefei is 0.35 million tce/year. The data is based on information provided by Hefei. The total additional increased RE consumption from both Zhangjiakou and Hefei is 3.00 million tce/year. Herewith the target (1.31 Mtce/year) is exceeded at 129 percent. The reasons for exceeding the target are: (i) far higher energy consumption than average (Zhangjiakou about 15 Mtce/year and Hefei about 22 Mtce/year); and (ii) a large increase in the RE share in total energy consumption in Zhangjiakou (from 9% to 27%). Exceeding the total targets hides the fact that Zhangjiakou exceeded expectations while the RE penetration in the New Energy City of Hefei disappoints.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Annual avoided carbon dioxide emission reduction(million tons)	Tons/year	0.00 31-Jan-2013	3.90 30-Jun-2019		9.20 15-Jun-2021

Comments (achievements against targets):
The avoided CO2 emissions are the avoided CO2 emissions as a result of progress towards the first two indicators. Because the targets of the first two indicators are both surpassed, also the target for annual avoided CO2 emissions is surpassed. Annual avoided CO2 emissions are calculated using emission factors 858 ton CO2/GWh (based on coal consumption rate of typical coal-fired power plants at 311 gce/kWh by 2019) and 2.76 ton CO2/tce. This results in an annual avoided CO2 emission of 0.317 Mton CO2 as a result from improved wind turbine siting and 3.616 Mton CO2 as a result from increasing the renewable energy share in New Energy Cities.

1,078 GWh/year * 0.000858 Mton CO2/GWh + 3.00 Mtce/year * 2.76 Mton CO2/Mtce = 9.20 Mton CO2/year. The target (3.9 Mton CO2/year) has been exceeded at 136 percent.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Reduced incremental costs of wind power over coal-fired power plants (cent/kWh USD)	Amount(USD)	2.17 30-Nov-2012	0.16 14-Aug-2020		0.16 14-Aug-2020

Comments (achievements against targets):
According to the PMO, the incremental cost of wind power over coal-fired power plants reduced from 2.17 US cent/kWh at appraisal to 0.16 US cent/kWh at project closure. This is in good agreement with literature information on the LCOE of on-shore wind in China. The target was a reduction to 1.25 US cent/kWh representing a reduction of 0.92 US cent/kWh. In reality the reduction was 2.01 US cent/kWh. The target was, therefore exceeded by 118 percent.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Reduced incremental costs of solar PV over coal-fired power plants (cent/kWh USD)	Amount(USD)	11.30 30-Nov-2012	0.61 14-Aug-2020		0.61 14-Aug-2020

Comments (achievements against targets):
The incremental cost of solar PV power over coal-fired power plants is estimated at 0.61 US cent/kWh in 2019 while it was 11.3 US cent/kWh at appraisal. The actual reduction 10.7 US cent/kWh was much more than the targeted reduction of 4.3 US cent/kWh. The larger than expected reduction of the

incremental cost of solar PV over coal is thanks to the dramatic decline of solar PV investment costs in recent years. The target was exceeded by 149 percent.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
RE 13th FYP developed and adopted	Date	31-Jan-2013 31-Jan-2013	16-Dec-2016 16-Dec-2016		20-Nov-2020 16-Dec-2016

Comments (achievements against targets):
The RE 13th was adopted on 16 December 2016. Target achieved.

https://policy.asiapacificenergy.org/node/2837/portal

A.2 Intermediate Results Indicators

Component: Component 1. Policy Support

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
RE quota policy issued	Date	31-Jan-2013 31-Jan-2013	15-May-2019 15-May-2019		20-Nov-2020 15-May-2019

Comments (achievements against targets):

The National Development and Reform Commission (NDRC) and the National Energy Administration (NEA) formally issued RE quota policy Decree No. 807 on May 15, 2019. Target achieved

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
RE 14th FYP developed	Date	31-Jan-2013 31-Jan-2013	15-Jun-2021 15-Jun-2021		15-Jun-2021 15-Jun-2021

Comments (achievements against targets):
Draft completed and submitted to NEA and Plan issued. Target achieved.

Component: Component 2. Grid Integration/Access and Technical Design

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Increased penetration of wind power generation in Inner Mongolia (percentage of wind power generation in total provincial power consumption)	Percentage	13.00 31-Jan-2013	15.00 30-Jun-2019		15.00 15-Jun-2021

Comments (achievements against targets):

Target was 15 percent (from 13 percent). According to the PMO the target has been achieved. Achievement of the target could not be verified as provincial statistics are confidential. Target achieved.

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Design for China's first off-shore wind testing center aligned with international best practices	Yes/No	No 31-Jan-2013	Yes 30-Jun-2019		No 15-Jun-2021

Comments (achievements against targets):
Design completed. Target achieved

Component: Component 3. Technology Improvement

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Number of Chinese off-shore wind turbine standards accepted by Standardization Administration of China	Number	0.00 31-Jan-2013	1.00 30-Jun-2019		3.00 15-Jun-2021

Comments (achievements against targets):

Three standards were issued by the Standardization Administration of China (SAC): (i) Production-based Availability of Wind Turbine (GB/Z 35482-2017) and (ii) Time-based Availability of Wind Turbine (GB/Z 35483-2017) on December 29, 2017, and (iii) Offshore Wind Turbine O&M Requirements (GB/T 37424-2019) on May 10, 2018.

One additional standard of Wind Turbine-Rotor Blades (IEC 61400-5), supported by CRESP II, was submitted to the IEC Committee and unanimously approved in April 2020, and released on June 16, 2020. The CRESP supported Working Group intends to converse this international standard into national standard, a draft of which has been submitted to the National Technical Committee for Standardization of Wind Power in September 2021 [PMO please confirm.]. Furthermore, CRESP has supported the revision of the "Offshore Wind Turbine Design Requirements", a draft has been submitted to the National Standards Review Department of (SAC) for approval in April 2021. Target achieved and significantly exceeded by 200 percent (target 1, actual 3).

Component: Component 4. Pilot Demonstration

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
New Energy City policy submitted	Date	31-Jan-2013 31-Jan-2013	15-Feb-2016 15-Feb-2016		20-Nov-2020 15-Feb-2016

Comments (achievements against targets):
The New Energy City policy was submitted in 2015. Target achieved.

Component: Component 5. Capacity Building and Investment Support, and Project Management

Indicator Name	Unit of Measure	Baseline	Original Target	Formally Revised Target	Actual Achieved at Completion
Number of RE investment	Number	0.00	4.00		12.00

projects supported		31-Jan-2013	30-Jun-2019		15-Jun-2021

Comments (achievements against targets):

CRESP has supported 12 RE investment projects: (a) optimizing the design of the layout of the three large-scale wind bases of a total installed capacity of 13.25 GW in Inner Mongolia, Qinghai, and Xinjiang to maximize wind electricity generation; (b) supporting the design of technology improvement to increase electricity generation of two on-shore wind farms with a total installed capacity of 200 MW in Shanxi and Hebei; (c) supporting the design of technology improvement to improve off-shore wind technologies for two off-shore wind farms with a total installed capacity of 200 MW in Fujian and Jiangsu; (d) supporting the design of technology improvement to improve CSP technologies for three CSP pilot projects with a total installed capacity of 150 MW in Inner Mongolia, Qinghai, and Xinjiang; and (e) supporting the technical design of two Energy Storage and Distributed RE Pilot projects with a total installed capacity of 203 MW PV and 7.5 MW battery storage in Shanxi and Anhui. This target has been achieved and significantly exceeded by 200 percent (target 4 projects, actual 12 projects).

B. KEY OUTPUTS BY COMPONENT

Objective/Outcome 1: Ambitious national renewable electricity scale-up program in China supported		
Component	**Outcome Indicators**	**Achievements**
Component 1	13th RE FYP successfully implemented**	RE targets (for electricity) in FYP13 achieved: Hydropower: 340 GW Wind power: 210 GW Solar PV: 105 GW Bio-power: 15 GW CSP: 5 GW (Nearly all targets met or exceeded except for CSP)
	Additional RE produced from pilot auctions for solar PV and wind power carried out under project	12,000 GWh/year from solar PV and 15,000 GWh/year from wind power (Achieved)
	Increased non-fossil fuel in primary energy consumption*	15% of non-fossil fuels primary energy consumption (Achieved)
	Reduced curtailment of wind-power*	FYP 13 target of 5%, as per FYP13 underlying objective (Surpassed)
Component 2	Additional RE-based power generation from improved design of the large wind bases*	370 GWh/year additional renewable electricity generated by end of project through improved capacity factor (Surpassed)
Component 3	Reduced incremental costs of wind power over coal-fired power plants**	from 2.17 US cents/kWh (in 2012) to 1.25 US cents/kWh by end of project. (Surpassed)
	Reduced incremental costs of solar PV over coal-fired power plants**	From 11.3 US cent/kWh at beginning of project to 7.0 US cent/kWh at end of project (Surpassed)
	Additional consumption from increased RE penetration in New Energy Cities	1.31 Mtce/year (10,611 GWh/year) by end of project by increased share of RE in total energy consumption (Surpassed)

Component 4	Annual avoided carbon dioxide emission (directly as result of project)	3.9 Mton CO2/year by end of project resulting from displaced generation due to project-supported activities
	Increased penetration of non-hydro RE in Inner Mongolia*	16.5% of total provincial consumption by 2020, as per FYP13 mandate (Surpassed)
Component	**Intermediate Results Indicators**	**Achievements**
Component 1	RE 13th FYP developed	adopted and issued
	RE quota policy designed	policy issued
	RE auction pilot design is informed by international best practices**	pilot auctions carried out successfully
	RE certificate trading scheme developed *	scheme adopted for implementation
	RE 14th FYP developed	Submitted to government for issuance
	RE auction pilot design is informed by international best practices	pilot auctions carried out successfully
	RE 13th FYP developed	adopted and issued
	RE auction pilot design is informed by international best practices	pilot auctions carried out successfully
	RE auction pilot design is informed by international best practices **	Pilot auctions carried out successfully
	RE auction pilot design is informed by international best practices **	Pilot auctions carried out successfully
Component 2	Number of RE investment projects supported*	4 projects at the end of CRESP Phase II
Component 3	Improved wind base design developed based on analysis of existing base*	Improved design applied to 13.25 GW of new wind bases
	Grid integration studies for North and Northwest Mongolia inform approaches to reduce curtailment*	Grid integration studies prepared
Component 4	New Energy Cities policy developed	policy submitted for implementation

	Increased penetration of wind power generation in Inner Mongolia*	percentage of wind power generation in total provincial power consumption reaches 15% by 2015
Objective/Outcome 2: Efficiency improved through enhanced planning, optimal designs and better integration of renewable electricity in the grid system		
Component	**Outcome Indicator**	**Achievement**
Component 3	Combined Heat and Power (CHP) plants retrofitted for better integration of VRE, based on lessons from pilot	133 GW target, as per FYP13 (Mostly met with 100 GW following successful pilots)
Component	**Intermediate Results Indicator**	**Achievement**
Component 2	Number of offshore wind turbine standards accepted by Standardization Admin. of China***	1 standard accepted
	Design of China's first offshore wind turbine testing center aligned with international best practices ***	Center approved for construction
Component 3	CHP pilot completed to increase plant flexibility to better integrate VRE	17 GW of CHP piloted for enhanced flexibility
Component 4	Grid integration studies for North and Northwest Mongolia inform approaches to reduce curtailment	Grid integration studies prepared
Objective/Outcome 3: Reduction of Incremental Costs		
Outcome and output indicators contribute to Objective/Outcome 3 were all listed above with sign *, **, and ***		

Note: * contribute to both objective 1 and 2;
** contribute to all objective 1, 2, and 3;
*** contribute to both of objective 2 and 3.

ANNEX 2. BANK LENDING AND IMPLEMENTATION SUPPORT/SUPERVISION

A. TASK TEAM MEMBERS

Name	Role
Preparation	
Xiaodong Wang	Task Team Leader(s)
Xiaowei Guo	Procurement Specialist(s)
Fang Zhang	Financial Management Specialist
Youxuan Zhu	Social Specialist
Pei Shen Wang	Social Specialist
Supervision/ICR	
Yanqin Song, Xiaodong Wang	Task Team Leader(s)
Zheng Liu	Procurement Specialist(s)
Fang Zhang	Financial Management Specialist
Yan Zhang	Procurement Team
Yongli Wang	Environmental Specialist
Shanshan Ye	Team Member
Na Han	Team Member
Kai Shang	Social Specialist

B. STAFF TIME AND COST

Stage of Project Cycle	Staff Time and Cost	
	No. of staff weeks	US$ (including travel and consultant costs)
Preparation		
FY12	8.356	71,174.44
FY13	20.350	229,911.88
FY14	8.939	68,303.42

FY15	2.717	46,917.01
FY16	3.131	40,329.05
Total	**43.49**	**456,635.80**
Supervision/ICR		
FY14	.565	72,200.79
FY15	8.785	121,897.43
FY16	8.804	148,969.61
FY17	20.140	258,758.05
FY18	8.492	127,252.90
FY19	1.575	34,072.88
FY20	.125	11,305.35
FY21	.925	12,334.42
FY22	1.600	45,141.29
FY23	1.475	18,107.79
Total	**52.49**	**850,040.51**

ANNEX 3. PROJECT COST BY COMPONENT

Components	Amount at Approval (US$M)	Actual at Project Closing (US$M)	Percentage of Approval (%)
Component 1. Policy Support	5.00	6.09	121.8%
Component 2. Grid Integration/Access and Technical Design	5.00	3.16	63.2%
Component 3. Technology Improvement	7.28	8.67	119.1%
Component 4. Pilot Demonstration	5.00	4.59	91.8%
Component 5. Capacity Building and Investment Support, and Project Management	5.00	4.76	95.2%
Total	**27.28**	**27.27**	**99.9%**

ANNEX 4. EFFICIENCY ANALYSIS

Table 4.1: CRESP Phase II Activities/Contracts

#	Description of Assignment	Budget	Selection Method	Period	Contractor	Deliverable
Part 1: Policy study						
--Five year plan of RE						
1.1	Study on overall RE plan and long-term plan	215,450	CQ	2015/04-2016/04	Energy Research Institute of NDRC (ERI)	RE plan of 13FYP
1.2	Study on wind and solar power development plan in major regions	190,000	CQ	2015/03-2016/03	Chinese Renewable Energy Engineering Institute (CREEI)	Study report on wind and solar power development plan of 13FYP
1.3	Wind and solar power transmission and integration on 13th five years plan	495,000	CQ	2015/11-2016/05	Electric Power Planning Engineering Institute (EPPEI)	Study report Wind and solar power transmission and integration on 13th five years plan
1.4	Study on 13th five years ocean energy development strategy	50,000	CQ	2015/02-2016/02	National Ocean Technology Development Center (NOTDC)	13th five years ocean energy development strategy
1.5	Study on 13th five years solar heating plan	81,000	CQ	2015/04-2016/04	ERI	13th five years solar heating plan
1.6	Geothermal study and plan	100,000	SSS	2015/04-2016/04	National Geothermal Technology Research Center	13th five years Geothermal plan
1.7	Synthesizing 13th FYP biomass development plan	35,000	CQ	2015/11-2016/06	ERI	13th FYP biomass development plan
1.8	Developing the 13th FYP biomass development by technology	85,000	CQ	2015/11-2016/06	CECEP Consulting CO.,LTD	Study report of 13th FYP biomass development plan
1.9	Development of 14 FYP of RE	200,000	CQ	2019/08-2021/06	ERI	Study report of Development of 14 FYP of RE
1.11	Development of 14 FYP of Solar	200,000	CQ	2019/09-2021/08	CREEI	Suggestion report of 14 FYP of Wind and Solar
1.12	Development of 14 FYP of Biomass	150,000	CQ	2019/09-2021/08	CREEI	Suggestion report of 14 FYP of Biomass
1.13	Development of of 14 FYP of geothermal	100,000	CQ	2019/09-	CREEI	Suggestion report of 14 FYP of Biomass

#	Description of Assignment	Budget	Selection Method	Period	Contractor	Deliverable
				2021/06		
1.14	Development of Wind and solar power transmission and integration of 14FYP	200,000	CQ	2019/09-2021/11	EPPEI	Study report of Wind and solar power transmission and integration of 14FYP
1.15	Economic and social benefits evaluation of RE-led Energy revolution	250,000	CQ	2019/09-2020/10	Tsingihua University	Economic and social benefits evaluation report of RE-led Energy revolution
1.16	The macro-economic research for the strategy and policies to enable the renewable energy-led energy revolution promoting China's economy transformation and upgrading.	250,000	CQ	2019/09-2020/10	China Association of Productivity Science	The macro-economic research report for the strategy and policies to enable the renewable energy-led energy revolution promoting China's economy transformation and upgrading
1.17	RE grid integration policy study without RE subsidy during the 14th FYP	200,000	CQ	2019/12-2020/12	ERI	Policy suggestion report of RE grid integration policy study without RE subsidy during the 14th FYP
1.18	wind/PV development management methods study during the 14th FYP	100,000	CQ	2021/07-2021/11	CREEI	wind/PV development management methods
--RE Quota policy study						
1.19	Developing the regulation(s) of measuring, supervising and assessing procedures for RE quota system	60,170	CQ	2013/10-2015/12	ERI	Regulation(s) of measuring, supervising and assessing procedures for RE quota system
1.20	Development of RE power certification and trade system	220,000	CQ	2017/01-2017/12	CREEI	RE power certification and trade system software
1.21	RE quota policies and allocation study	100,000	CQ	2018/04-2019/04	ERI	RE quota policies and allocation study report
1.22	Development of Implementation Rules and Management System for RE Certification trading	200,000	SSS	2018/07-2019/12	CREEI	Implementation Rule for RE Certification trading
1.23	Detailed regulation for RE Quota implementation	150,000	CQ	2019/01-2019/12	ERI	China RE Quota implementation plan
1.24	RE quota policy implementation in selected provinces and monitoring of RE quota policy in 2020	100,000	CQ	2021/08-2021/12	ERI	Monitoring report of RE quota policy in 2020
--RE Pricing policy study						
1.25	Study on Laws and Regulations suggestion to promote RE Integration.	50,000	CQ	2015/03-2015/12	Chinese Energy Research Society	Study report on Laws and Regulations suggestion to promote RE Integration

#	Description of Assignment	Budget	Selection Method	Period	Contractor	Deliverable
					(CERS)	
1.26	Compensation mechanism for further peaking of coal power plants	100,000	CQ	2015/01-2016/05	Huajian Power Design and Research Institute (BHPDRI)	Compensation plan for further peaking of coal power plants Closed
1.27	Study of the fixed subsidy policy for RE	130,000	CQ	2016/05-2017/05	National Development School, Peking university	Study report of the fixed subsidy policy for RE
1.28	EU RE pricing mechanism and power market development international study tour	39,000	CQ	2017/05-2017/07	Pricing Research Institute, NDRC	Study tour report
1.29	Develop transmission wheeling charges for RE developers	100,000	CQ	2018/07-2019/06	EPPEI	Transmission wheeling charges suggestion
1.30	Biogas subsidy study	100,000	CQ	2019/10-2021/06	CREEI	Biogas subsidy study report
1.31	Study of economic analysis and pricing police of energy storage	200,000	CQ	2021/08-2021/12	EPPEI	Study report of economic analysis Pricing police suggestion of energy storage
RE auction						
1.32	Development of RE pilot (PV and wind) auctions plan based on international best practices	100,000	CQ	2018/05-2019/12	CREEI (hired 2 international expert)	RE pilot (PV and wind) auctions plan
1.33	Provide model PPAs for NEA	100,000	CQ	2018/05-2019/12	CREEI	PPA template
--RE policy Study						
1.34	Refining Concept of New Energy Demonstration City Program in China	200,070	CQ	2013/10-2014/12	ERI	Work plan of New Energy Demonstration City Program
1.36	Non-electric RE statistic system study and design	120,000	CQ	2016/12-2017/12	ERI	Non-electric RE statistic method
1.37	Mechanism innovation and demonstrations for local digestion of districted solar PV in Jiangsu Province	200,000	CQ	2017/01-2020/06	Jiangsu Engineering Consulting Center	Regulation of local digestion of districted solar PV in Jiangsu Province
1.38	Development of national implement plan of promoting RE heating	100,000	CQ	2017/03-2017/12	ERI	National implement plan of promoting RE heating
1.39	Developing RE regulation objective, method and procedure	150,000	CQ	2018/11-2019/07	CERS	Study report of RE regulation objective, method and procedure

#	Description of Assignment	Budget	Selection Method	Period	Contractor	Deliverable
1.40	Long-term RE planning to 2035	200,000	CQ	2018/06-2019/06	ERI	Suggestion report of Long-term RE planning
1.41	Policy and mechanism study for RE participate in power market reform	298,000	CQ	2018/10-2019/12	EPPEI	Suggestion for RE participate in power market reform Closed
1.42	Policy research for RE storage system and development in market	150,000	CQ	2018/11-2019/06	EPPEI	Policy suggestion for RE storage system and development in market Closed
1.43	RE policy framework without RE subsidy	100,000	CQ	2019/04-2020/04	ERI	Suggestion of RE policy framework without RE subsidy
1.44	Policy and Mechanism reform study for Energy transformation in 14 FYP	150,000	CQ	2021/08-2021/12	EPPEI	Study report of policy and Mechanism reform for Energy transformation in 14 FYP
1.45	Work plan and policy study for hybrid RE (hydro power, wind and solar) development in 14 FYP	150,000	CQ	2021/07-2021/11	CREEI	Work plan for hybrid RE (hydro power, wind and solar) development in 14 FYP
Part 2: RE Grid integration						
2.1	Study of heat storage to make CHP plants more flexible in the winter	210,000	CQ	2015/01-2016/12	State grid company Beijing Huajian Power design and Research institute	Study report of heat storage to make CHP plants more flexible in the winter
2.2	Develop work plan of CHP install heat storage system pilot project	100,000	CQ	2016/12-2017/10	State grid company Beijing Huajian Power design and Research institute	work plan of CHP install heat storage system pilot project
2.3	Optimal dispatch of wind, solar, and coal power in Hami generation base	275,000	SSS	2015/03-2016/11	CREEI	Solution of optimal dispatch of wind, solar, and coal power in Hami generation base
2.4	Development of distributed RE integration technical and management Specification	260,000	CQ	2017/04-2018/11	EPPEI	Management Specification of distributed RE integration technical
2.5	Wind Base Layout Optimization study (phase II)	500,000	SSS	2018/04-2020/08	CREEI	Wind Base Layout Optimization work plan and method
2.6	RE grid integration study in Northwest Grid	498,000	Single source selection	2019/06-2021/05	CEPRI	Work plan of RE grid integration study in Northwest Grid in 2021-2025
2.7	The technical support of the third part for the RE grid integration study in Northwest Grid	100,000	CQ	2019/09-2020/06	Hua zhong Sieniece Technology University	Study report of technical support

#	Description of Assignment	Budget	Selection Method	Period	Contractor	Deliverable
Part 3: RE Technology Improvement						
3.1	Development of standard for offshore wind farm design， offshore wind farm transformer, offshore wind farm transmission cable	400,000	QCBS	2017/03-2018/02	CREEI and DNV	International compare study report of standard for offshore wind farm design，offshore wind farm transformer, offshore wind farm transmission cable
3.2	Development of technology standard of offshore wind turbine	330,000	IC	2014/12-2021/11	Expert group (including 1 international expert)	1. GB/Z 35482-2017 Time-based Availability of Wind Turbine 2. GB/Z 35483-2017 Production-based Availability of Wind Turbine 3. GB/T 37424-2019 Offshore Wind Turbine - O&M Requirements 4. GB/T Offshore Wind Turbine Design Requirements 5. IEC 61400-5: Wind Turbine - Rotor Blades
3.3	Field test of offshore wind turbine operation and maintain technical standard.	45,000	CQ	2018/02-2018/05	China General Certification Center	Field test report of Offshore Wind Turbine - O&M Requirements
3.4	System specification study for offshore wind DC into power grid	280,000	CQ	2018/09-2019/12	Tsinghua University	System specification for offshore wind DC into power grid
3.5	Offshore wind development status monitoring and evaluation	150,000	CQ	2018/12-2019/12	CREEI	Offshore wind development status monitoring and evaluation report
3.6	Development guideline of offshore wind grid inter-connection	250,000	CQ	2019/09-2020/10	State grid company Beijing Economic Research Institute	Guideline of offshore wind grid inter-connection
3.7	Design of testing bench for the offshore wind power testing center	1,875,000	QCBS	2020/10-2021/12	IDOM and CENER	Design drawing of testing bench for the offshore wind power testing center
3.8	Establishment of the testing technology system and personnel training for the offshore wind power testing center	781,250	QCBS	2020/10-2021/12	IDOM and CENER	Guidebook of the testing technology system
3.9	Develop standard of micro grid design and plan	160,000	CQ	2016/04-2019/01	Xi'an Jiaotong University	Standard of micro grid design and plan
3.10	Develop standard of micro grid control and operation	160,000	CQ	2016/04-2019/01	North China Electric Power University	Standard of micro grid control and operation
3.11	Technical specification study for overall	80,000	CQ	2018/06-	CQC	Technical specification study for overall

#	Description of Assignment	Budget	Selection Method	Period	Contractor	Deliverable
	process quality supervision of CSP vacuum			2019/12		process quality supervision of CSP vacuum
3.12	CSP development strategy study	5	CQ	2016/04-2016/09	EPPEI	study report of CSP development strategy
3.13	CSP technical design training	50	CQ	2018/06-2019/12	3 international CSP expert	Training report
Part 4: RE pilot						
--Inner Mongolia						
4.1	Adaptation of RE policies to pilot spot market in Inner Mongolia (policy framework study)	260,000	CQ	2019/01-2020/06	Tsingihua University	Policy framework of RE to pilot spot market in Inner Mongolia
4.2	Stocktaking of approved projects in 2012 and planned for 2015 in context of grid absorption in Inner Mongolia	100,000	CQ	2013/10-2014/06	Qinghua University	Stocktaking report
4.3	Automatic systems to manage RE penetration in Inner Mongolia grid company	280,000	CQ	2014/12-2016/04	Zhongkefurui Technical Company	Automatic systems pilot to manage RE penetration in Inner Mongolia grid company
4.4	Security assessment method research and application for high share RE connected to power grid in West Inner Mongolia	350,000	SSS	2016/05-2019/01	Beijing Tsingsoft Technology Co.,Ltd.	Security assessment system for high share RE connected to power grid in West Inner Mongolia
4.5	Development of Arhorchin of Inner Mongolia green county work plan	100,000	CQ	2017/03-2017/11	CECEP Consulting CO.,LTD	Arhorchin of Inner Mongolia green county work plan
4.6	Development of Arhorchin of Inner Mongolia biogas work plan	100,000	CQ	2017/03-2017/11	CECEP Consulting CO.,LTD	Arhorchin of Inner Mongolia biogas work plan
--RE pilot city						
4.7	Development of Hefei New Energy City Implementation Work Plan	150,000	CQ	2017/04-2018/07	CECEP Consulting CO.,LTD	Hefei New Energy City Implementation Work Plan
4.8	Development of Hefei Distributed PV financial mechanism	100,000	CQ	2017/04-2018/07	Beijing Jipeng Investment Information & Consultant Ltd	Suggestion report of Hefei Distributed PV financial mechanism
4.9	Development of Hefei mechanism innovation for local integration of distributed RE	238,000	CQ	2018/01-2018/12	Nanjing Branch of CEPRI	Hefei work plan for local integration of distributed RE
4.10	Development of Hefei business model of	100,000	CQ	2017/06-	Shanghai Jiaotong	Hefei business model pilot of PV charging

#	Description of Assignment	Budget	Selection Method	Period	Contractor	Deliverable
	PV charging station for electric vehicle			2018/07	University	station for electric vehicle
4.11	Development of Zhangjiakou new energy city implementation work plan	150,000	CQ	2017/04-2018/11	ERI	Zhangjiakou new energy city implementation work plan
4.12	Development of Zhangjiakou RE heating work plan	160,000	CQ	2017/04-2018/06	EPPEI	Zhangjiakou RE heating work plan
	Designed implement mechanisms to four-party agreement to use curtailed wind power for Heating (Zhangjiakou)	100,000		2017/04-2018/06	EPPEI	Add the task to 4.12
4.13	Developing Energy transformation work plan for Shanxi	298,000	CQ	2018/03-2019/06	ERI	Energy transformation work plan for Shanxi
4.14	Innovative mechanisms to pilot hybrid RE grid integration for RE integrated in Burqin,	290,000	CQ	2018/06-2019/12	EPPEI	Pilot for hybrid RE grid integration for RE integrated in Burq
4.15	Development of Suzhou energy transition implementation plan	100,000	CQ	2018/12-2019/12	State Grid Company City Energy Research Institute	Suzhou energy transition implementation plan
4.16	Development work plan of PV industry of Hefei	200,000	CQ	2018/12-2019/09	Hefei industry University	Work plan of PV industry of Hefei
4.17	Four-party agreement to use curtailed wind for clean heating in JJJ	200,000	CQ	2019/06-2020/10	North China Electric Power University	Regulation of using curtailed wind for clean heating in JJJ
4.18	Shanxi Energy transition and green Growth project preparation for national level	45,000	SSS	2019/04-2019/10	REI	Study report
4.19	Shanxi Energy transition and Green Growth project preparation for provincial level	35,000	SSS	2019/04-2019/10	Shanxi Sustainable Development Society	Study report
--Large-scale Biogas						
4.20	Large-scale biogas incentive police study	100,000	CQ	2016/11-2017/07	CECEP Consulting CO.,LTD	Suggestion for incentive police of Large-scale biogas
4.21	Provincial Work plan of large-scale biogas	50,000	CQ	2016/11-2017/05	CREEI	Work plan of large-scale biogas
4.22	County pilot on large-scale biogas	298,000	CQ	2017/01-2018/08	CREEI	Project design specification of County pilot on large-scale biogas
4.23	Development of large-scale biogas technical standards.	150,000	CQ	2016/11-2019/12	China University of Petroleum Beijing Institute of New Energy Co., Ltd	Transmission standard of large-scale biogas

#	Description of Assignment	Budget	Selection Method	Period	Contractor	Deliverable
Part 5：Capacity Building						
5.1	Local Financing Platform Mechanism Study for Distributive Solar PV Pilot	100,000	CQ	2016/02-2017/05	CREIA	Closed
5.2	Development of RE consumption monitoring and pre-warning system	290,000	CQ	2018/09-2019/06	EPPEI	RE consumption monitoring and pre-warning system
5.3	Making biomass power monitoring and assessment system and developing monitoring platform	100,000	CQ	2018/10-2019/06	CREEI	Closed
5.4	CRESP summary and promotion design and implementation	200,000	CQ	2021/03-2021/12	Beijing Longshi Culture Company	CRESP phase II promotional video, photo album, and awareness-raising material
5.5	Biogas policies and training	100,000	CQ	2021/07-2021/12	BEIPA	Training materials, training summary report
5.6	CRESP website operation and maintain	16,000	CQ	2015/02-2021/07		CRESP website
Total amount						

Table 4.2: Sub Grants

No.	Description of Assignment	Estimated CRESP Contribution (US$)	No of Sub-grant / Agreements	Period	Contractor
1	Wind base layout optimization (Phase I)	526,000	1	2014/04-2017/06	CREEI
2	High efficiency operation control technique and application for wind farms	500,000	1	2016/07-2019/11	Goldwind Company
3	High efficiency operation control technique and application for wind farms	500,000	1	2018/04-2019/10	Guohua Investment Company
4	High accuracy weather forecasting for West Mongolia grid company	400,000	1	2015/05-2018/05	Public Service Center of CMA
5	Solar PV: develop smart monitoring and diagnostic systems for precautious maintenance	400,000	1	2017/09-2019/06	Nanjing Branch of CEPRI
6	TA for CSP technology development	275,000	1	2018/06-2019/09	Zhejiang Supcon Solar Technologies Co., Ltd
7	TA for CSP technology development	250,000	1	2018/06-2019/09	Royal Tech CSP, Ltd
8	TA for CSP technology development	350,000	1	2018/06-2020/11	Northwest Electric Power Institute Co, Ltd
9	TA for CSP technology development	250,000	1	2018/09-2019/12	Shanghai Electric

10	Offshore wind turbine testing center	3,000,000	1	2019/09-2022/12	CEPRI
11	Pilot for battery storage in RE project in Datong	200,000	1	2019/08-2020/12	TR Energy and Environment Research Institute
12	Pilot for battery storage in RE project in Hefei	200,000	1	2019/06-2021/02	Hefei Youo Electronic Technology Co., Ltd. Sungrow Power Supply Co., Ltd.
13	TA for RE investor (offshore wind)	300,000	1	2018/06-2019/06	Fujian Zhongming Company
14	TA for RE investor (offshore wind)	500,000	1	2018/06-2019/09	Jiangsu Goldwind Company

Table 4.2: Some Key Policies Issued by the Government of China for which CRESPII Provided Support for Preparation--- Quoted by Third Part Public Media

Policy	Start	End	Agency	Note
CHINA: 13th Five Year Plan for Renewable Energy Development ... power price. ***Energy***, Power, Industry, Multi-Sector Coal, Oil, Power, Gas, ***Renewable***, Bioenergy, ... provide clean and ***renewable energy*** for industrial production, schools, hospitals, hotels, office buildings ... ***energy***.---By 2020, all kinds of ***renewable energy*** heating and civil fuels should replace 150 million tons of ... fossil fuels.---[...] By 2020, the proportion of non-hydro ***renewable energy*** generation and coal-fired	2016	2020	National Development and Reform Commission	
CHINA: Notice No. 625 of 2016 on Measures for the Guaranteed Full Purchase of Renewable Electricity ... Administration of the Guaranteed Buyout of Electricity Generated by ***Renewable Energy*** Resources (EN) [...] ... that the grid companies should purchase a certain amount of electricity of ***renewable energy*** power, in ... accordance with the state-determined ***renewable energy*** feed-in tariff and the guaranteed buyout number of ... purchased from the ***renewable energy*** power generation in the areas where the ***renewable energy*** resources are	2016		National Development and Reform Commission	
CHINA: Notice No. 2729 of 2016 on On-grid Solar PV Power and Onshore Wind Power Benchmark Price (Feed-in-Tariffs) ... grid settlement; higher subsidize part by the National ***Renewable Energy*** Development Fund. Second, the ... part by the National ***Renewable Energy*** Development Fund. Third, encourage the identification of new ... higher part to be subsidized by the National ***Renewable Energy*** Development Fund. Fourth, other relevant ... should strengthen the implementation of tariff and regulation of new and ***renewable energy*** development	2017		National Development and Reform Commission	
CHINA: 13th Five-Year Plan for Solar Power Development ... power ratio.---Construct micro-grid for the ***renewable energy*** in the areas where the distributed ... ***renewable energy*** penetration rate is higher or the multiple complementary conditions of building are good. ... [...]explore the construction of micro-grid 100% transporting various kinds of ***renewable energy*** ... Construct ***renewable energy*** smart grid, using for replacing diesel generator group and reducing power cost,	2016	2020	National Energy Administration	
CHINA: Draft Notice on the Implementation of the Renewable Electricity Obligation ... and sets ***renewable energy*** quotas for electricity consumption for a trial period of 2018-2020. 1. Set ... ***renewable energy*** quotas for electricity consumption. [...] 2. Determine quota indicators according to ... [...] ***Renewable Energy*** Law No. 33 of 2006 ... **国家**发展改革委 **国家能源局关于**实行 **可再生能源**电力配额制的通知 （**征求意**见稿） Yes No 2018 2018 National Other Power Power, ***Renewable***	Draft Year: 2018		National Development and Reform Commission, National Energy Administration	
CHINA: 13th Five-Year Plan for the Geothermal Energy Development ... ***Renewable Energy*** Center： In order to promote the sustained and healthy development of the geothermal ***energy*** ... accordance with the requirements of the "***Renewable Energy*** Law", on the basis of the "13th	2017	2020	National Development and Reform Commission	

Five ... Year Development Plan for ***energy***" and the "13th Five Year Development plan for ***renewable*** ... January 2017 Foreword Geothermal ***energy*** is a green and low-carbon, sustainable ***renewable energy***, with			P.R.C.	
CHINA: 13th Five-Year Plan for Energy Technology Innovation ... Power, Gas, Nuclear, ***Renewable***, Bioenergy, Hydropower, Solar, Wind National ***Energy*** Administration 附件 ... 能源技术创新"十三五"规划 No No 2016 2016 2020 National Plan/Strategy ***Energy***, Power, Industry Coal, Oil,	2016	2020	National Energy Administration	
CHINA: 13th Five-Year Plan for Biomass Energy Development ... Year Plan for ***Renewable Energy*** Development 13th Five-Year Plan for ***Energy*** Development 13th Five-Year ... , Bioenergy National ***Energy*** Administration 附件： 生物质能发展"十三五"规划 国家能源局 2016 年 10 月 前 ... 年，生物质能产业年销售收入约1200亿元，提供就业岗位400万个，农民收入增加200亿元，经济和社会效益明显。 No official English version available China ***Energy*** ... ***energy*** development status, and clarifies the bioenergy development guidelines, principles, targets and	2016	2020	National Energy Administration	
CHINA: 13th Five-Year Plan for Hydro Power Development ... Five-Year Plan for ***Energy*** Development 13th Five Year Plan for ***Renewable Energy*** Development ... , Hydropower National ***Energy*** Administration By 2020, the conventional hydro power in the western region will ... "期间，水电建设将带动水泥、钢材的消费。水电建设和运行期间还将为地方经济社会发展增加大量的税费收入，初步测算，"十三五"期间新投产水电运行期年均税费可达 300 亿元。此外，电站建设对改善当地基础设施建设、拉动就业、促进城镇化发展都具有积极作用。 Build the "West to East" ***energy*** base in south ... trillion kWh. National ***Energy*** Administration (CH) 13th Five-Year Plan for Hydro Power Development (CH）	2016	2020	National Energy Administration	
CHINA: Notice on Trial Implementation of Renewable Energy Green Power Certificate Issuance and Voluntary Subscription Transaction System ... Implementation of ***Renewable Energy*** Green Power Certificate Issuance and Voluntary Subscription Transaction System ... generation. 1. Establish a voluntary subscription system for ***renewable energy*** green power certificates. The ... ***renewable energy*** green power certificate trading system is a major measure to improve the ***renewable energy*** ... power consumption.According to the market subscription situation, the ***renewable energy*** power quota	2017		National Development and Reform Commission, Ministry of Finance and National Energy Administratio	
CHINA: Measures for Resolving Curtailment of Hydro, Wind and PV Power Generation ... concepts of green ***energy*** development and of prioritized development and utilization of ***renewable energy*** ... "***Renewable Energy*** Law", and under the premise of ensuring the safety and stability of the power grid, ... market in the allocation of resources, and encourage the full consumption of ***renewable energy*** through	2017		National Development and Reform Commission	

... ***energy*** in administrative areas where ***renewable*** power is produced, accelerate electrification to replace				
CHINA: Notice on Solar Thermal Power Generation Benchmark Tariff Policy ... 标杆上网电价政策的通知 No No 2016 National Other Power ***Renewable***, Solar National Development and Reform ... organized and implemented by the National ***Energy*** Authority in 2016。 2. Solar thermal power projects put into ... Reform Commission August 29, 2016 National Development and Reform Commission (CH) China ***Renewable*** ... ***Energy*** Information Portal (EN) Notice on Solar Thermal Power Generation Benchmark Tariff Policy (CH).pdf	2016		National Development and Reform Commission	
CHINA: Notice No. 19 of 2019 on Actively Promoting the Non-Subsidized Generation of Wind and PV Power ... below-grid-parity projects)。Under the premise of being in accordance with the ***renewable energy*** construction plans of ... ***renewable energy*** monitoring and evaluation system, monitor the curtailment of wind and PV projects。If there ... and PV grid-parity and below-grid-parity projects may, for those tradable ***renewable energy*** green ... electricity certificates obtained in accordance with the national ***renewable energy*** green electricity	2019		National Development and Reform Commission	
CHINA: Notice No. 807 of 2019 on the Establishment of a Safeguard Mechanism for Renewable Electricity Consumption ('Renewable Electricity Portfolio') ... 5.未纳入消纳责任权重考核的市场主体不参与消纳量交易。西藏自治区不实行消纳责任权重考核，除国家另有规定外区域内市场主体不参与消纳量交易。 No English translation available National ***Energy*** Administration (CH) China ***Energy*** Portal ... (CH&EN) Notice No. 807 of 2019 on the ***Renewable*** Electricity Portfolio (CH) Notice No. 807 of 2019 on the ... ***Renewable*** Electricity Portfolio (CH&EN) The Notice No. 807 of 2019 on the Establishment of a Safeguard ... Mechanism for ***Renewable*** Electricity Consumption ('***Renewable*** Electricity Portfolio') sets up ***renewable***	2019		National Energy Administration	CRESP II contributed to this
CHINA: Notice No. 823 of 2018 on Matters Relevant to PV Power Generation in 2018 ... for solar PV (link). National Development and Reform Commission Ministry of Finance National ***Energy*** ... Administration Notice on matters relevant to PV power generation in 2018 NDRC ***Energy***〔2018〕No. 823 To the ... Development and Reform Commissions, Departments of Finance, ***Energy*** Bureaus, and Pricing Bureaus of provinces, ... quality。Provincial-level ***energy*** authorities shall promptly provide a copy of lists of projects determined in competitive	2018		National Development and Reform Commission	

Source: https://asiapacificenergy.org/

ANNEX 5. BORROWER, CO-FINANCIER AND OTHER PARTNER/STAKEHOLDER COMMENTS

The National Energy Administration fully agree with the ICR. The Vice Administrator responsible for CRESPII highly commented the ICR and requested his staff translate the ICR into Chinese and distribute it in relevant departments.

ANNEX 6. SUMMARY OF PROJECT RESULTS

1. **Objective 1: Ambitious national renewable electricity scale-up program in China supported.**

A summary of the key **outputs** (intermediate outcomes) that were produced with CRESP II support and contributed to the project outcomes are:

- The RE 13th FYP was developed and adopted by the GoC;
- The RE 14th FYP was prepared and adapted to achieve the 'net zero' long-term target of the country. It has been approved by the GoC and issued publicly;
- RE quota policy was developed and issued as a 'market-mandate mechanism' for scaling-up the sector across stakeholders;
- An RE certificate scheme was successfully implemented to facilitate renewable energy trade and compliance with RE quotas, with evidence showing issuance and transfer of certificates;
- RE auction pilots for over 17.5 GW of wind power and solar PV were successfully carried out, with its results prompting the government to adopt the approach for all RE transactions for the two technologies, greatly facilitating the implementation of the quota decree and replacing the previous FIT scheme;
- New Energy City policy was submitted with implementing plans and related policies for two pilot cities (as targeted at appraisal) of Hefei and Zhangjiakou that were accepted by the respective local authorities, although the attributable impact of these policies is less clear;
- Improved wind base design was implemented in three bases for a total capacity of 13.25 GW, as targeted, in Inner Mongolia, Qinghai and Xinjiang; and,
- While CRESP II at appraisal planned to provide technology and design support to 4 project, actual assistance exceeded this goal with a total of 4 wind-power project, 4 CSP investments, and 25 auctioned projects supported.

A summary of the major project **outcomes** resulting from the above outputs are:

- The goals for scaling-up renewable electricity in the 13th RE FYP was successfully met or exceeded for all major technologies. The cumulative expansion resulted in China having the world's largest installed capacity, including for each of the major technologies: hydropower, wind power, solar PV, and bio-power;
- China's non-fossil fuel in primary energy consumption increased to 15.9 percent by 2020, surpassing the FYP13 goal of 15 percent;
- The additional power from 13.25 GW of new wind bases was 1,078 GWh/year, far exceeding the 370 GWh/year targeted at appraisal, due to greater improvement in capacity factor from efficiencies gained;
- The additional renewable consumption from increased penetration in New Energy Cities was 3 million Mtce/year, more than doubling the target of 1.31 Mtce/year set at appraisal, primarily due to the expansion in Zhangjiakou;
- The solar PV and wind power pilot auctions collectively produce an additional total of 27,000 GWh/year of electricity; and,
- Given the substantially higher utilization of renewable energy, as noted above, the avoided CO_2 emissions from these initiatives directly supported by the project also significantly exceeded the 3.9 Mton CO_2/year targeted at appraisal, with an outcome of over 24.9 Mton CO_2/year.

2. **Objective 2: Efficiency improved through enhanced planning, optimal designs and better integration of renewable electricity in the grid system.**

A summary of the key **outputs** (intermediate outcomes) that were produced with CRESP II support and contributed to the project outcomes are:

- Integrated planning where renewable sites selected for development were coordinated with planned expansion of transmission network so that the electricity produced can be more efficiently integrated into the power grid;
- Carried out multiple grid integration studies to inform reforms with a focus on the northern regions in China including Inner Mongolia that are renewable resource rich but where power curtailment was acute;
- Supported a pilot for 22 CHP plants with a total of 17GW to be retrofitted to increase their flexibility so that renewables from VRE sources can be better accommodated in grid, which were then scaled-up to an additional 100 GW, with the program continuing going forward under FYP14;
- Incorporated battery storage to improve grid flexibility by requiring a 10 percent storage requirement for newly installed wind and solar PV capacity based on recommendation from study, and piloted a 200 MW PV plant pilot included a 6 MWh storage capacity and 3.4 MW distributed PV with 1.5 MWH, which proved to be an efficient solution for increased grid integration and reduced costs;
- Improved wind base designs were applied in three bases totaling 13.25 GW and further replicated in 50 GW, with incremental electricity being supplied to the grid as a result;
- Design and technology improvements were implemented for more efficient deployment of wind power projects initially totaling 400 MW, with the developers replicating the efficiency enhancements in an additional 3 GW.
- Design and technology improvements were implemented for more efficient deployment of CSP projects totaling 300 MW that also have storage for dispatch flexibility for improved grid integration of VRE; and,
- Technical screening criteria was incorporated into solar PV and wind power auctions so that selected bidders met stringent technical capabilities consistent with industry standards.

A summary of the major project **outcomes** resulting from the above outputs are:

- The additional electricity produced through increased efficiency and integration of more renewables from improved wind-base designs and expansion of RE DG in two New Energy Cities are substantial, surpassing targets. The increase in the capacity factor of wind bases by 0.98 percentage points resulted in 1,078 GWh/year of additional electricity supplied to the grid, higher than the targeted 370 GWh/year. The additional renewable consumption from increased penetration of renewables in the two New Energy Cities was 3 million Mtce/year, surpassing the 1.31 Mtce/year set at appraisal. The solar PV and wind power pilots alone are estimated to produce an additional 27,000 GWH/year. Additional electricity was utilized as a result of the technology improvements piloted in wind power and CSP project. Thus, it can be concluded that the project directly supported improvements in the efficiency of technologies, designs, procurement, and other processes that contributed to the increased utilization of electricity.
- The wind and solar PV curtailment reduced from between 15-20 percent to around 3 percent nationally, surpassing the FYP13's underlying limiting factor of 5 percent, primarily due to the efficiency improvements and enhanced grid flexibility that helped integrate more renewable electricity to the grid.
- Increased penetration of non-hydro renewables in Inner Mongolia reached 19.5 percent by 2020, exceeding the 16.5 percent mandate from FYP13, reflecting a region where CRESP II provided considerable support to reduce high levels of curtailment and improve integration of electricity from VRE resources.

3. **Objective 3: Reduce incremental costs of key renewable electricity sources.**

A summary of the key **outputs** (intermediate outcomes) that were produced with CRESP II support and contributed to the project outcomes are:

- The transition to renewable energy auctions piloted with the support of CRESP II, and then later expanded, procured substantially lower-cost electricity (compared with the alternative FIT) from solar PV and wind power developers. The auctions incorporated stringent technical criteria to ensure construction and operational efficiency from selected developers while the overall renewable market expansion drove down investment costs through manufacturing efficiencies;

- CRESP II helped develop a technology support framework for improving the quality and further reducing the costs of key renewable technologies that are likely to be increasingly impactful over time:
  - 4 on-shore and offshore wind power projects (400 MW) and 4 CSP investments (300 MW) improved its performance, surpassing the appraisal-stage target of 4 projects (a total of 10 projects were supported by CRESP II if the two battery storage investments are considered, and more if the auctioned transactions and redesigned wind bases are included);
  - Three internationally accepted offshore wind turbine standards were issued nationally, with an additional one expected soon. The target at appraisal was to issue a single standard;
  - Designed China's first offshore wind testing center in alignment with international standards, which is presently under construction based on the CRESP provided designs.

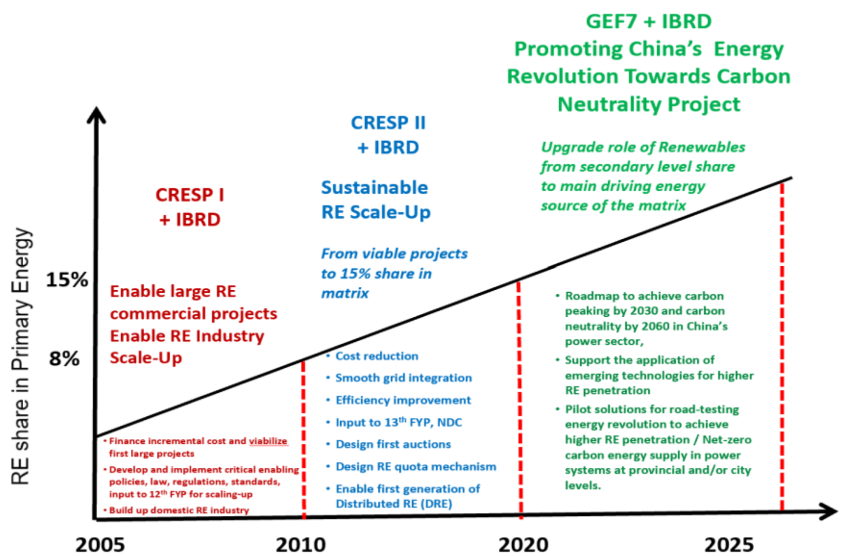
A summary of the major project **outcomes** resulting from the above outputs are:

- The incremental costs of solar PV reduced substantially exceeding the target of 7.0 US cents/kWh set at appraisal;
- The incremental costs of on-shore wind power has practically disappeared, decreasing beyond the 1.25 US cents/kWh targeted at appraisal; and,
- There is evidence that the significant cost reduction in China combined with its substantial worldwide share of solar PV and wind power have influenced global prices for the two technologies.

ANNEX 7. CONTEXT FOR CRESP MULTI-PHASE PROGRAM

1. **The China Renewable Energy Scale-Up Program (CRESP) Partnership.** CRESP is a long-term three-phase partnership program between the World Bank, the Global Environment Facility (GEF) and the Government of China (GoC) to scale-up the development of renewable energy-based electricity in the country. The partnership was envisioned to allow for continuity in policy dialog given the complex nature of addressing barriers in a sector that was rapidly evolving globally, which required a "flexible approach to adapt to the fast-changing environment and the priorities as they emerge during implementation"[96]. The long-term partnership was expected to bring international best practices to policy advice and institutional support, leverage investments, and transfer technology to improve quality and reduce costs. It would support the expansion of renewable energy at the national level and closely align with the renewable energy goals of China's Five-Year Plans (FYPs) for economic development. China's ratification of the Kyoto Protocol in 2002 made partnerships such as CRESP possible as the country shifted to a more "positive stance towards international environmental cooperation and world sustainable development"[97] and sought greater support from countries that were leading renewable energy development.

Figure 1. Vision of the Three-Phase China Renewable Energy Scale-Up Program



2. The backbone of the three-phases of GEF grants that fund CRESP is to develop a legal and policy framework and support technology improvements, standards and certification, and help prepare innovative renewable energy investments. The development objective of this overarching program is to enable commercial renewable electricity suppliers to provide energy to the electricity market efficiently, cost-effectively, and on a large scale. The vision was to initially provide in Phase I the policy framework for investments in large-scale renewable energy development and build-up domestic capacity by demonstrating some early successes. This would be followed by Phase II efforts to sustain the scale-up with reforms that would improve the efficiency, reduce costs and better integrate renewable energy into the power system. Phase III would then undertake energy sector reforms that are more aligned with renewable energy development taking into consideration its specific characteristics. Different phases of the program would build upon the

[96] Project Appraisal Document (PAD) for CRESP Phase II.
[97] From a ministerial announcement after the ratification of the Kyoto Protocol in 2002, which was originally signed by China in 1998.

results and lessons from previous ones and would adapt to respond to emerging needs given the highly evolving renewable energy landscape in China as well as the rest of the world.

3. **Phase I of CRESP.** The objectives of Phase I (CRESP I) were: (i) to create a legal, regulatory, and institutional environment conducive to large-scale, renewable based electricity generation; and (ii) to demonstrate early success in large-scale, renewable energy development with participating local developers in four provinces[98]. It was a blended project funded through (a) a GEF grant (US$40.22 million) aimed at supporting the development of the legal, regulatory, and policy framework needed to stimulate demand for renewable energy, improve its quality and reduce its costs, and to build a strong local renewable energy equipment manufacturing industry; and (b) two World Bank loans (US$159 million) to support pilot investments in wind, biomass, and small hydropower. The objectives of CRESP I were successfully achieved with targets being well exceeded[99].

4. An evaluation carried out by the Independent Evaluation Group (IEG) of the World Bank Group rated the performance of CRESP I as 'highly satisfactory'[100], noting that "The implementation of legal and regulatory reforms at national level, the technological improvements and pilot demonstration projects supported by CRESP have been credited with a substantial contribution to the transformation of China's renewable energy sector"[101]. According to the IEG evaluation "national and province-level stakeholders interviewed…credited CRESP with a strong influence on the development of a supportive legal, policy, and regulatory framework for renewable energy in China." It further noted that "the project also made a major contribution to improving the technology and reducing the costs of China's renewable energy manufacturing sector, especially for wind energy equipment and, to a lesser extent, biomass. Finally, the project-supported pilot investments in the four provinces." The IEG report concluded that the resulting "investments achieved or exceeded their performance targets and their success helped stimulate a vast increase in similar renewable energy investments

5. **Phase II of CRESP.** The objective of CRESP Phase II, which is evaluated in this ICR, was to support the ambitious renewable energy scale-up program in China with a focus on efficiency improvement and reduction of incremental costs. This second phase allowed the overall CRESP program to build upon the success of Phase I and address ongoing need for reforms that was needed to continue China's rapid expansion of renewables and also adapt to the dynamic and evolving investment landscape for the industry in China as well as globally. This ICR, which represents a self-evaluation of project performance found CRESP II achievement of its development objective to be highly satisfactory, as most major project targets were met or exceeded.

6. **Phase III of CRESP.** The original strategic intent of the third phase of the CRESP program was to build on the scale-up of renewable energy through the first two phases where reforms around market mandates played a central role, and transition towards fully integrating renewables in open and competitive markets in China[102]. While these goals remain, a decision was made by the GEF-World Bank-GoC partners to adapt what would be the third phase of CRESP, to broaden its goals to meet the objectives of recent commitment to achieve carbon neutrality by 2060, according to a recent World Bank publication[103]. It notes that innovations that drove down the cost of renewable energy, the progressively wider deployment of power storage, accompanied by energy efficiency and new business models (e.g. distributed solar PV) have transformative potential to accelerate the displacement of coal. As a result, the GEF-World Bank-GoC partnership is being

[98] CRESP Phase I comprised two projects: (i) CRESP Phase I (P067828/P067625); and (ii) Follow-up CRESP Phase I (P096158).
[99] ICR CRESP Phase I and Follow-up CRESP Phase I (ICR 00002077), June 24, 2012.
[100] PPAR, October 2017, https://worldbankgroup.sharepoint.com/sites/wbsites/wbggef/SitePages/Detail.aspx/Blogs/mode=view?_Id=14&SiteURL=/sites/wbsites/wbggef
[101] Project Performance Assessment Report for the *China Renewable Energy Scale-Up Program: Phase One*, IEG, World Bank Group, 2017.
[102] CRESP II PAD.
[103] "China: 40-Year Experience in Renewable Energy Development", The World Bank, 2021.

renewed to more broadly support this 'Energy Revolution', The same report states that the aim of the renewed partnership is as follows:

- Extending and broadening the GEF support to bring about investments in disruptive technologies, replacing the third phase of CRESP by a new broader program named Promoting China's Energy Revolution Towards Carbon Neutrality Project, now aimed at supporting the Energy Revolution and paving the way toward carbon neutrality by 2060;
- Supporting the phasing-out of coal to free up space for RE in the energy matrix, including facilitating the economic and energy transition of provinces specialized in coal production and use toward a less coal-dependent economy, such as the Shanxi Province; and,
- Supporting the scale-up of new technologies needed to facilitate the increase of the share of RE such as distributed renewable energy, utility-scale and behind-the-meter battery storage, and electrification of conventional use of fossil fuel, such as transport and space heating, using renewable energy.

7. The World Bank notes that the strategic direction of this new partnership aims to replicate the successes achieved during the last two decades, especially regarding the wind and PV energy, to help develop and disseminate the new supply and demand technologies that are needed for RE to progressively become the dominant source in the energy mix. This new project is presently under preparation as a part of the World Bank's investment lending pipeline.