IEG
Independent Evaluation Group

WORLD BANK GROUP
World Bank • IFC • MIGA

PROJECT PERFORMANCE ASSESSMENT REPORT

WHAT WORKS

CHINA

Renewable Energy Scale-Up Program: Phase One

Report No. 117156
JUNE 30, 2017

1818 H Street NW
Washington DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org

Attribution—Please cite the work as follows: World Bank. 2017. *China Renewable Energy Scale-Up Program: Phase One.* Independent Evaluation Group, Project Performance Assessment Report 117145. Washington, DC: World Bank.

Report No.: 117156

PROJECT PERFORMANCE ASSESSMENT REPORT

CHINA

CHINA RENEWABLE ENERGY SCALE-UP PROGRAM: PHASE I

June 30, 2017

Financial, Private Sector, and Sustainable Development
Independent Evaluation Group

Currency Equivalents (annual averages)

Currency Unit = yuan
2/1/2016 US$ 1.00 Y6.88

Abbreviations and Acronyms

CNREC	China National Renewable Energy Center
CRESP	China Renewable Energy Scale-up Program
CWEA	China Wind Energy Association
DRC	Development and Reform Commission
EIRR	economic internal rate of return
FY	fiscal year
GDP	gross domestic product
GEF	Global Environment Facility
GW	gigawatt (1,000 megawatts)
GWh	gigawatt-hour
IBRD	International Bank for Reconstruction and Development
ICR	Implementation Completion and Result report
IEG	Independent Evaluation Group
ISO	International Organization for Standardization
kW	kilowatt
kWh	kilowatt-hour
kWp	kilowatts-peak
Mtce	million tons of coal equivalent
MW	megawatt (1,000 kilowatts)
MWh	megawatt-hour
NDRC	National Development and Reform Commission
NEA	National Energy Administration
NOx	nitrogen oxide
PDO	project development objective
PMO	Project Management Office
REL	Renewable Energy Law
REDP	Renewable Energy Development Project (Loan 4488-CHA)
SHP	Small hydro power
SO_2	Sulfur dioxide
tce	ton of coal equivalent
UNFCC	United Nations Framework Convention on Climate Change

Fiscal Year

Government: January 1 – December 31

Director-General, Independent Evaluation	Ms. Caroline Heider
Director, Financial, Private Sector, and Sustainable Development	Mr. José C. Carbajo Martínez
Manager, Sustainable Development	Ms. Midori Makino
Task Manager	Mr. Migara Jayawardena

Contents

Tables

Appendixes

This report was prepared by Andres Liebenthal (consultant), who assessed the project in November/December 2016. Migara Jayawardena was the Task Team Leader. The report was peer reviewed by Raghavan Narayanan and panel reviewed by Alain Barbu. Sama Khan, Richard Kraus and Romayne Pereira provided administrative support.

Principal Ratings

	ICR*	ICR Review*	PPAR
Outcome	Highly Satisfactory	Moderately Satisfactory	Highly Satisfactory
Risk to development outcome	Low	Significant	Low
Bank performance	Satisfactory	Moderately Satisfactory	Satisfactory
Borrower performance	Satisfactory	Satisfactory	Satisfactory

* The Implementation Completion and Results (ICR) report is a self-evaluation by the responsible World Bank global practice. The ICR Review is an intermediate Independent Evaluation Group product that seeks to independently validate the findings of the ICR.
Note: PPAR = Project Performance Assessment Report.

Key Staff Responsible

Renewable Energy Scale-Up Program (CRESP) (P067828)

Project	Task Manager/Leader	Division Chief/ Sector Director	Country Director
Appraisal	Noureddine Berrah	Junhui Wu	David Dollar
Completion	Yanqin Song	Mark Lundell/Vijay Jagannathan	Klaus Rohland

China - Renewable Energy Scale-Up Program (CRESP) (P067625)

Project	Task Manager/Leader	Division Chief/ Sector Director	Country Director
Appraisal	Noureddine Berrah	Junhui Wu	David Dollar
Completion	Xiaodong Wang	Mark Lundell/Vijay Jagannathan	Klaus Rohland

Follow-up to China - Renewable Energy Scale-Up Program (CRESP) Phase I (096158)

Project	Task Manager/Leader	Division Chief/ Sector Director	Country Director
Appraisal	Noureddine Berrah	Junhui Wu	David Dollar
Completion	Yanqin Song	Mark Lundell/Vijay Jagannathan	Klaus Rohland

IEG Mission: Improving World Bank Group development results through excellence in independent evaluation.

About this Report

The Independent Evaluation Group (IEG) assesses the programs and activities of the World Bank for two purposes: first, to ensure the integrity of the World Bank's self-evaluation process and to verify that the World Bank's work is producing the expected results, and second, to help develop improved directions, policies, and procedures through the dissemination of lessons drawn from experience. As part of this work, IEG annually assesses 20–25 percent of the World Bank's lending operations through fieldwork. In selecting operations for assessment, preference is given to those that are innovative, large, or complex; those that are relevant to upcoming studies or country evaluations; those for which Executive Directors or World Bank management have requested assessments; and those that are likely to generate important lessons.

To prepare a Project Performance Assessment Report (PPAR), IEG staff examine project files and other documents, visit the borrowing country to discuss the operation with the government, and other in-country stakeholders, interview World Bank staff and other donor agency staff both at headquarters and in local offices as appropriate, and apply other evaluative methods as needed.

Each PPAR is subject to technical peer review, internal IEG panel review, and management approval. Once cleared internally, the PPAR is commented on by the responsible World Bank country management unit. The PPAR is also sent to the borrower for review. IEG incorporates both World Bank and borrower comments as appropriate, and the borrowers' comments are attached to the document that is sent to the World Bank's Board of Executive Directors. After an assessment report has been sent to the Board, it is disclosed to the public.

About the IEG Rating System for Public Sector Evaluations

IEG's use of multiple evaluation methods offers both rigor and a necessary level of flexibility to adapt to lending instrument, project design, or sectoral approach. IEG evaluators all apply the same basic method to arrive at their project ratings. Following is the definition and rating scale used for each evaluation criterion (additional information is available on the IEG website: http://ieg.worldbankgroup.org).

Outcome: The extent to which the operation's major relevant objectives were achieved, or are expected to be achieved, efficiently. The rating has three dimensions: relevance, efficacy, and efficiency. *Relevance* includes relevance of objectives and relevance of design. Relevance of objectives is the extent to which the project's objectives are consistent with the country's current development priorities and with current World Bank country and sectoral assistance strategies and corporate goals (expressed in poverty reduction strategy papers, Country Assistance Strategies, sector strategy papers, and operational policies). Relevance of design is the extent to which the project's design is consistent with the stated objectives. *Efficacy* is the extent to which the project's objectives were achieved, or are expected to be achieved, taking into account their relative importance. *Efficiency* is the extent to which the project achieved, or is expected to achieve, a return higher than the opportunity cost of capital and benefits at least cost compared with alternatives. The efficiency dimension is not applied to development policy operations, which provide general budget support. *Possible ratings for Outcome:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

Risk to Development Outcome: The risk, at the time of evaluation, that development outcomes (or expected outcomes) will not be maintained (or realized). *Possible ratings for Risk to Development Outcome:* High, Significant, Moderate, Negligible to Low, and Not Evaluable.

Bank Performance: The extent to which services provided by the World Bank ensured quality at entry of the operation and supported effective implementation through appropriate supervision (including ensuring adequate transition arrangements for regular operation of supported activities after loan or credit closing, toward the achievement of development outcomes. The rating has two dimensions: quality at entry and quality of supervision. *Possible Ratings for Bank Performance:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, and Highly Unsatisfactory.

Borrower Performance: The extent to which the borrower (including the government and implementing agency or agencies) ensured quality of preparation and implementation, and complied with covenants and agreements, toward the achievement of development outcomes. The rating has two dimensions: government performance and implementing agency(ies) performance. *Possible ratings for Borrower Performance:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, and Highly Unsatisfactory.

Preface

This is the Project Performance Assessment Report (PPAR) by the Independent Evaluation Group (IEG) of the World Bank Group on the China Renewable Energy Scale-up Program First Phase and Follow-up Projects (IBRD-47920, TF-54833, IBRD-48160).

This report presents findings based on a review of the project's Implementation Completion and Results Report dated June 24, 2012; project and legal documents; prior World Bank sector studies and reviews; records on file; and other relevant materials. An IEG mission visited China in November-December 2016 and held discussions with government officials, renewable energy companies and institutes, and other project stakeholders at the national level and in three of the participating provinces; Jiangsu, Zhejiang and Fujian (see Appendix C).

This project was selected for a PPAR for three main reasons: (a) five years after project closing, additional insights and information could help resolve questions about the Risk to Development Outcome raised in the ICR Review; (b) in light of current interest in Bank's experience with transformational engagements, it is important to assess the extent to which the project may have contributed to the recent transformation of China's renewable energy sector from a modest base to its current global leadership position and identify the main factors that contributed to this transformation; and (c) at a time when similar approaches have had mixed success in other countries, focusing on China's experience with the design of a successful market-based regulatory framework for renewable energy development, could provide a valuable input to IEG's major forthcoming sector evaluation on renewable energy.

The assistance and contributions of all stakeholders, including World Bank staff in the China office and Washington, DC, are gratefully acknowledged. Comments received from Raghavan Narayanan (peer reviewer), Alain Barbu (panel reviewer), Migara Jayawardena (task team leader), Varadarajan Atur (consultant) and Midori Makino (manager) are particularly appreciated.

Following standard IEG procedures, the draft PPAR was be shared with relevant government officials and agencies for their review and comment, and no comments were received.

Summary

In the decades preceding the project, China's primary energy consumption had been rapidly growing. Given China's extensive coal resources, coal's share in the energy balance had remained at about two thirds, and was expected to remain at that level for the foreseeable future. The associated environmental damages, mainly due to the impact of SO_2 and NO_x emissions on health and agriculture, had been estimated at between 3 percent and 7 percent of GDP, and could grow to 13 percent of GDP by 2020 if not properly addressed. Recognizing that such growing environmental damages were unacceptable, the government's 11th Five-Year Plan (2006–11) incorporated a multipronged energy reform strategy aiming at for example, aggressively scaling-up renewable energy use, especially for power generation.

Against this background, the World Bank and the Global Environment Facility (GEF) worked closely with the Chinese government to develop a long-term partnership in support of the goals of the 11th FYP and increase, over the longer term, the contribution of renewable energy to sustainable power generation. The China Renewable Energy Scale-up Program (CRESP) was designed to enable a long-term policy dialogue and engagement with the government to develop renewables on a national scale.

The backbone of the CRESP partnership was a three-phase program to develop a legal and policy framework and to support technology improvements, standards and certification, preparation, and implementation of innovative renewable energy projects across the country. In broad terms:

- Phase 1 was to assist with the development and implementation of the legal and regulatory framework needed to create and gradually increase the share of renewable energy–based electricity generation and support its effective implementation in four pilot provinces. Technical assistance would be provided to prepare implementation regulations for the Renewable Energy Law, which had been under preparation at the time of appraisal, and became effective in early 2006. Technical assistance also would also support technology transfer and capacity building for the adoption of international and best-practice standards in constructing and operating renewable energy–based electricity production facilities, focusing primarily on wind and biomass.
- Phase 2 would continue to support institutional development and capacity building to further decrease renewable energy cost, improve the financing framework, and provide implementation assistance in about 10 provinces.
- Phase 3 would expand the institutional development and capacity-building program to the remaining, less-developed provinces of China.

The first phase of the CRESP was designed as a programmatic and sectorwide approach to fully integrate: (a) a GEF grant 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 RE equipment manufacturing industry; and (b) two World Bank loans to support pilot investments in wind, biomass, and small hydro power in four participating provinces, namely Fujian, Inner Mongolia, Jiangsu, and Zhejiang. At negotiations, because of portfolio constraints, it was decided that the four pilot investments would be supported through two specific investment loans in separate fiscal years. As a result, the first project (Project 1),

consisting of a GEF grant (P067625) and the first IBRD loan (P067828) financing two pilot investments were approved by the Board in June 2005, while the Follow-Up Project (Project 2), consisting of a second IBRD loan (P096158) to finance two additional pilot investments, was approved by the Board in the next fiscal year, in February 2006. This PPAR covers both Project 1 and Project 2, that is, the entire first phase of CRESP.

Ratings

The development objective, and also the global environmental objective, of the three-phase CRESP was to enable commercial renewable electricity suppliers to provide energy to the electricity market efficiently, cost-effectively, and on a large scale. The relevance of this objective is rated **high**. China's primary energy consumption has risen sharply in recent years, reaching 3,606 Mtce in 2010—vs. 2,000 Mtce expected at appraisal—and 4,300 Mtce in 2015, mainly due to continued rapid economic growth and industrialization. The share of coal in the energy balance reached 69.2 percent in 2010—vs. 65 percent expected at appraisal—but declined to 64.0 percent in 2015. The biggest contributor to this decline in primary coal consumption—equivalent to 22.4 Mtce in 2015—has been the increase in renewable energies, whose share rose from 9.4 percent in 2010 to 12.0 percent in 2015—equivalent to 11.2 Mtce. Since renewable energies remain one of the major options to partially displacing the use of coal and other fossil fuels, China is committed to further increase the share of nonfossil fuels to 15 percent by 2020, as reflected in the 13th Five-Year Plan (2016–20).

The relevance of the project's design is rated **high.** At a broad level, the design appropriately reflected the lessons from experience, mainly that a coordinated set of institutional development, capacity building and investment activities was needed to pursue the regulatory reforms and overcome the market resistance faced by the renewable energy technologies in China. At the detail level, the design of the project also reflected important lessons from past renewable energy assistance in China, such as the need to carefully assess the renewable energy resources before the appraisal of (pilot) projects, and the importance of establishing a tariff regime that adequately reflects the economic value of renewable energies, taking their environmental benefits into account.

The efficacy of the project is rated **high.** The national and province-level stakeholders interviewed by IEG credited CRESP with a strong influence on the development of a supportive legal, policy, and regulatory framework for renewable energy in China. Perhaps most importantly, the project played an instrumental role by funding the analytical studies that supported the formulation of the feed-in tariff regulations that are the cornerstone of RE policies in China. 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. All these investments achieved or exceeded their performance targets and their success helped stimulate a vast increase in similar renewable energy investments.

The efficiency of the project is rated **substantial.** IEG found that the project-funded pilot investments had a substantial demonstration effect in terms of attracting additional investments in renewable energy generation. As recommended by the project, the applicable feed-in tariff incorporated a premium based on the benefits of avoiding the environmental damages associated

with coal fired power. Based on a recent IMF estimate (IMF, 2014) of the nationally efficient price for carbon emissions, the tariff premium that has supported the financial attractiveness and continuing replication of the CRESP-supported wind power projects is fully consistent with economic efficiency. The premium for biomass power, on the other hand, appears to be higher than justifiable based on carbon benefits alone, but can be accepted as an inducement for further technological improvement.

Overall, the project's development outcome is rated **highly satisfactory**. 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, especially the wind subsector, from an early piloting and demonstration stage to its accelerated development into a global leader in wind energy generation and the manufacture of wind power equipment. Partly as a result, between 2005 and 2010, China's installed wind power capacity increased from 1.3 GW to 29.6 GW, largely exceeding the original 11th Five-Year Plan target of 10 GW. As of 2015, installed wind capacity had reached 129.3 GW, exceeding the 12th Five-Year Plan target of 100 GW, and amounting to 22 percent of global wind power capacity.

The risk to sustaining the development outcomes of the project is **low.** The project's support for addressing the technical and financial risks associated with wind power development were eminently successful and helped China's wind power generation and manufacturing rise to a global leadership positions. At present, the main technical challenge relates to the curtailment of wind energy due to excess capacity in the power system as a whole, but this issue is being addressed in the 13th Five-Year Plan (2016–20) through cancellation and delays and eventual capping of coal-fired generation and increases in long distance transmission capacity. The scaling-up of biomass power remains a challenge, as it still requires substantial subsidies. The government, however, has reaffirmed its support by committing to increase biomass power capacity by 50 percent by 2020, in the expectation that this will drive further technological improvements with an associated reduction in the applicable feed-in tariff to a level consistent with the benefits of avoiding the environmental externalities associated with coal fired power.

The World Bank's performance is rated **satisfactory**. The extensive efforts undertaken by the World Bank, through workshops, study tours, and studies during the prolonged preparation and early implementation, to achieve consensus and cohesiveness between relevant agencies about key policy directions and reforms, are credited as an essential factor for the success of the project. While the implementation of the project encountered some delays in its early years, the underlying issues were effectively addressed at the midterm review. Finally, the successful outcome of the project could not have been achieved without the strong and consistent support of the government, implementing agencies, and pilot project investors. On this basis, the borrower's overall performance is also rated **satisfactory**.

Lessons

The main lessons that emerge from the experience of this complex project are:

Combining institutional development and investments in one package can help overcome difficult challenges. The comprehensive design of the project integrated three components in one

package: (i) institutional development and capacity building; (ii) technology improvement; and (iii) investment activities. These three components mutually supported and reinforced one another, which was essential for the success of the project. Such a multipronged approach was needed to pursue the regulatory reforms and overcome the resistance of established interests in the sector. Neither a stand-alone technical assistance nor an investment project would have been as likely to achieve the necessary momentum to successfully and simultaneously address the main identified challenges.

Adequate time and resources for preparation and consultations should be planned and allowed. The extensive efforts undertaken by the Bank, beginning with a "genesis workshop" in 1999, through workshops, study tours, and studies—supported by $1.35 million in GEF project preparation grants—during the prolonged preparation and early implementation period of the project were necessary to achieve consensus and cohesiveness about key policy directions and reforms. This early investment in partnership built trust between the World Bank team and relevant government agencies for the pursuit of key policy decisions, and the adjustment of project components needed to respond to evolving conditions, which resulted in their efficient implementation in later years.

Cost-shared grants can enhance selectivity and efficiently leverage knowledge transfer, technology improvement, and counterpart funding. The project's experience suggests that a program of cost-shared sub-grants—where the grant provides 20–25 percent of total research and development costs—can be a cost-effective tool for the improvement of technology. Such an approach leverages the value of the grant with substantially greater investments by the implementing counterparts, building ownership and commitment. The substantial counterpart funding requirement also enhances selectivity, which contributed to the mostly successful outcomes of these subgrants.

A long-term, predictable price signal can provide an effective stimulus for continuing investments in renewable energies. The NEA's issuance of a mult-year national tariff for wind and other renewable energies replaced a system whereby the feed-in tariff had been approved for each specific project based on the lowest-cost bids. This had been much riskier for investors because of the frequent technical performance problems with the cheapest-cost equipment. The establishment of long-term, predictable, and financially attractive price signal, as recommended by project-supported studies, provided an effective stimulus for continuing and expanding investments in renewable energy.

Mr. José Cándido Carbajo Martínez
Director, Financial, Private Sector, and Sustainable
Development Evaluation
Independent Evaluation Group

1. Background and Context

Sectoral and Project Context

1.1 As discussed in the project appraisal document, in the two decades preceding the project, China's primary energy consumption had been rapidly growing, from about 600 million tons of coal equivalent (Mtce) in 1980, to about 1,300 Mtce in 2000, and was expected to continue to grow to about 2,000 Mtce in 2010 and 2,900 Mtce in 2020. Given China's extensive coal resources, official studies had forecast that coal's share in the energy balance, of about 66 percent in 2000, would remain at about 65 percent in 2010 and, even under a "green scenario" of energy diversification and improved efficiency, would only decline to 60 percent by 2020. The associated environmental damages, mainly due to the impact of SO_2 and NO_x emissions on health and agriculture, had been estimated at 3–7 percent of GDP, and could grow to 13 percent of GDP by 2020 if not properly addressed. Emissions of carbon from fossil fuels combustion were also estimated to increase from about 820 million tons in 2000 to more than 1.1 billion tons in 2010 and more than 1.8 billion tons in 2020 (World Bank, 2005a).

1.2 Recognizing that these expected scenarios would lead to unacceptable environmental damages, the government's 11th Five-Year Plan (2006–11) incorporated a multipronged energy reform strategy aiming at (i) improving the efficiency of the energy sector and bringing energy intensity in line with international best practice; (ii) increasing the share of natural gas and aggressively scaling-up renewable energy use, especially for power generation; and (d) further developing clean coal technologies, such as carbon capture and storage.

1.3 Specifically, with respect to the scaling-up of renewable energy, the sectoral reform strategy supported by the 11th Five-Year Plan reflected the need to address the following major challenges:

- Rapidly growing demand for energy, with heavy reliance on coal and growing oil imports, which had reached 144 million tons in 2005, about 40 percent of China's oil consumption.
- Increasing local environmental degradation, which led to unacceptable damages to health and agriculture.
- Increasing engagement with the international community on climate change as China signed the United Nations Framework Convention on Climate Change (UNFCC), with attendant commitments to mitigate greenhouse gas emissions.
- High cost of imported renewable energy equipment and inadequate quality, reliability and capacity of domestic manufacturers.

1.4 Failure to achieve renewable energy targets during the 8th, 9th, and 10th Five-Year Plans was mainly due to resistance to the development of supportive policies and reforms from established interests in the power and coal industries. Against this background, the World Bank and the Global Environment Facility (GEF) worked closely with the Chinese government to develop a long-term partnership in support of the goals of the 11th Five-Year Plan and increase, over the longer term, the renewable energies' contribution to power generation in a sustainable way. The China Renewable Energy Scale-up Program (CRESP) was designed as a Bank/GEF/Government of China partnership to scale up renewable energy-based electricity. The

partnership was to enable a long-term policy dialogue and engagement with the government in support of renewables development on a national scale. The CRESP outcome indicators targeted the expansion of renewables capacity and production, and were closely linked with the 11th Five-Year Plan (2006–11) targets.

1.5 The backbone of the partnership was a three-phase program to develop a legal and policy framework and to support technology improvements, standards and certification, preparation and implementation of innovative renewable energy projects in all parts of the country. In broad terms, as described in the project appraisal document:

- Phase 1 was to assist with the development and implementation of the legal and regulatory framework needed to create and gradually increase the share of renewable energy-based electricity generation and support its effective implementation in four pilot provinces. Technical assistance would be provided to prepare implementation regulations for the Renewable Energy Law, which had been under preparation at the time of appraisal, and became effective in early 2006. Technical assistance also would support technology transfer and capacity building for the adoption of international and best-practice standards in constructing and operating renewable energy–based electricity production facilities, focusing primarily on wind and biomass.
- Phase 2 would continue to support institutional development and capacity building to further decrease cost, improve the financing framework and provide assistance for implementation in about 10 provinces.
- Phase 3 would expand the institutional development and capacity building program to the remaining, less developed provinces of China.

1.6 The first phase of the CRESP was designed as a programmatic and sector-wide approach to fully integrate: (i) a GEF grant 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 (ii) a World Bank loan to support pilot investments in wind, biomass, and small hydro power in four participating provinces, namely Fujian, Inner Mongolia, Jiangsu, and Zhejiang. At negotiations, because of portfolio constraints, it was decided that the four pilot investments would be supported through two specific investment loans in separate fiscal years. As a result, the first project (Project 1), consisting of a GEF grant (P067625) and the first IBRD loan (P067828, financing two pilot investments) was approved by the Board in June 2005, while the Follow-Up Project (Project 2), consisting of a second IBRD loan (P096158) to finance two additional pilot investments, was approved by the Board in the next fiscal year, in February 2006. This PPAR covers both Project 1 and Project 2, that is, the entire first phase of CRESP.

2. Objectives, Design, and Their Relevance

Objectives

2.1 As stated in the Project Appraisal Document, the development objective, and also the global environmental objective, of the three-phase CRESP was to enable commercial renewable electricity suppliers to provide energy to the electricity market efficiently, cost-effectively, and on

a large scale. In line with the three-phase program objective, the specific PDOs for the first phase of CRESP were to[1]:

> (a) create a legal, regulatory, and institutional environment conducive to large-scale, renewable-based electricity generation; and
> (b) demonstrate early success in large-scale, renewable energy development with participating local developers in four provinces.

2.2 At this point, it should be noted that the three legal agreements underpinning the financing for the first phase of CRESP have expressed the project objectives in slightly different terms. Thus, the Trust Fund Grant Agreement[2] of the GEF grant (P067625) and the Loan Agreement[3] of the first IBRD loan (P067828), which together constitute the first project (Project 1), the objective is stated as "to assist the Borrower to initiate actions to achieve the (CRESP) Program's objectives countrywide through: (i) developing a legal and regulatory framework for the Mandated Market Policy (MMP); and (ii) provide support for the implementation of said legal and regulatory framework in the Pilot Provinces."[4] In the Loan Agreement[5] of the second IBRD loan (P096158) which funded Project 2, the objective of the Project is "to assist the Borrower to demonstrate early success in large scale renewal (sic) energy development in the Pilot Provinces with participation of private sector developers."

2.3 In IEG's view, however, while these legal documents have expressed the project objective in different ways, these variant wordings are not materially different from the objective as stated in the PAD.[6] Specifically, the "Mandated Market Policy (MMP)" referenced in the legal agreements was adopted into the Renewable Energy Law issued in 2006, which formed the backbone of the "legal, regulatory, and institutional environment conducive to large-scale, renewable-based electricity generation" referenced in the project appraisal document's PDO. On this basis and for the sake of simplicity this PPAR has been based on the objectives as stated in paragraph 2.1.

2.4 Key progress indicators to be monitored during Phase 1 were as follows:

- Issuance of implementing regulations for the Renewable Energy Law (REL) at the national level and initiation of their effective implementation in the pilot provinces;
- Improvements in quality and reductions in cost of renewable energy equipment and services, including increases in local content; and
- Increased proportion of new electricity generation coming from renewable sources in the pilot provinces.

Relevance of Objective

2.5 At the time of appraisal, the project's objective was highly relevant to the government's 11th Five-Year Plan (2006–11) and remains **high** today. China's primary energy consumption has risen sharply in recent years, reaching 3,606 Mtce in 2010—vs. 2,000 Mtce expected at appraisal—and 4,300 Mtce in 2015, mainly due to continued rapid economic growth and industrialization. As shown in table 2.1, the share of coal in the energy balance reached 69.2 percent in 2010—vs. 65 percent expected at appraisal—but declined to 64.0 percent in 2015. A major contributor to this decline in primary coal consumption—equivalent to 22.4 Mtce in 2015—has been the increase in

non-fossil energies, whose share rose from 9.4 percent in 2010 to 12.0 percent in 2015—equivalent to 11.2 Mtce. Since renewable energies remains one of the major options for at least partially displacing the use of coal and other fossil fuels, China is committed to further increase the share of non-fossil fuels to 15 percent by 2020, as reflected in the 13th Five-Year Plan (2016–20).

Table 2.1. China Primary Energy Consumption Shares (percent)

	2010	***2011***	***2012***	***2013***	***2014***	***2015***
Coal	69.2	70.2	68.5	67.4	65.6	64.0
Oil	17.4	16.8	17.0	17.1	17.4	18.1
Gas	4.0	4.6	4.8	5.3	5.7	5.9
Hydro, Nuclear, Renewables	9.4	8.4	9.7	10.2	11.3	12.0
Total Primary Energy Consumption (Mtce)	3606	3870	4021	4169	4258	4300

Source: CNREC (2016).
Note: Mtce = million tons carbon equivalent.

2.6 In addition, the project objective was fully aligned with and supportive of the China Partnership Strategy (FY13–16) Strategic Theme 1: Supporting Greener Growth—Outcome 1.1: Shifting to a sustainable energy path (World Bank, 2012b)

Project Design and Its Relevance

2.7 The project had two components: (a) an institutional development and capacity-building component (fully included in Project 1)**;** and (b) an investment component (divided between Project 1 and Project 2).

2.8 ***Component A: Institutional development and capacity building component (Project Cost: $88.82 million at appraisal; $100.22 million actual).*** This component was designed to meet national priorities and the needs of the pilot provinces and included the following:

- *Renewable Energy Law (REL)–related research and implementation support*. This included studies on the planning and preparation of REL-related regulations, particularly with respect to targets, tariff levels, policy development, sharing of incremental cost and power trading, and their long-term implementation. The main counterparts for these activities included government bodies, and the main anticipated outcomes included legislation and regulations in support of the sustained scaling-up of renewable energy;
- *Technology improvement for wind and biomass.* This included a program of small grants, cost-shared grants, or both, for wind and biomass technology development. In addition, it covered preparation of standards, development of certification and establishment of a testing center. Beneficiaries included Chinese wind and biomass equipment manufacturers, related service suppliers, government bodies dealing with standards, and testing and accreditation agencies;
- *Long-term capacity building.* This included support to selected universities for twinning arrangements with leading international universities to develop postgraduate-level or specialist renewable energy engineering and other related courses, and to offer fellowship programs to support senior specialists studying abroad.

2.9 At the provincial level, the project was to provide technical assistance for effective implementation of the REL, that included:

- *Implementation of the REL* by focusing on the tasks to make the REL effective in the pilot provinces, aimed principally at provincial government bodies and other stakeholders;
- *Support to ensure the success of the investment projects* by providing assistance in design, procurement, construction, and operations and maintenance, as needed by each project sponsor;
- *Pilot or demonstration projects* to be carried out in the pilot provinces supporting technologies other than wind, biomass, and small hydro with potential for replication in the pilot provinces;
- *Renewable resource assessments* for each of the pilot provinces;
- *Capacity building for market participants*;
- *Support for investment scale-up* with the sponsors of the investment subprojects financed under Component B; and
- *Costs of the Project Management Office (PMO).*

2.10 ***Component B: Investment component (Project Cost: $253.06 million at appraisal; $338.37 million actual).*** This had four subcomponents at four locations:

- In Fujian, Project 1 was to construct a 100 MW wind farm on Pingtan Island. The investment consisted of wind turbines, associated civil and electrical works, an extension to an existing control room, a switchyard, and a 15 km, 110 kV transmission line from the wind farm to the Beicuo substation, which was to be upgraded to meet the evacuation needs of the wind farm.
- In Jiangsu, Project 1 was to construct a 25 MW straw-fired biomass power plant at Rudong with a 110 ton per hour, high-temperature, high-pressure straw-fired boiler; one 25 MW steam turbine; and associated mechanical, electrical, and civil works.
- In Inner Mongolia, Project 2 was to develop a wind farm at Huitengxile. It was to install wind turbines with an aggregate capacity of about 100 MW and associated civil and electrical works; expand an existing switchyard and a control room; extend 110kV transmission line from the wind farm to the Desheng Substation; and upgrade the Desheng Sub-station.
- In Zhejiang, Project 2 was to carry out small hydro power (SHP) sub-projects. It was to rehabilitate about eleven small hydropower plants to increase their aggregate capacity from about 40MW to about 52MW; and to build about seven new small hydropower plants with an aggregate capacity of about 16MW.

2.11 At a broad level, the design of the project reflected a programmatic and sectorwide approach to fully blend: (i) a GEF grant that aimed at developing a legal, regulatory, and policy framework to create demand for RE and improving quality and reducing costs to build a strong local manufacturing industry to increase supply; and (ii) four investments in wind, biomass, and SHP that were among the largest renewable energy investments in China at the time. These investments were designed to demonstrate quality, efficiency, and sustainability of renewable energy investments, which were below par in China at the time—they exhibited low capacity factors and/or technical problems that hampered their connection to the grid—for dissemination

and replication in other similar projects in China. The GEF grant also supported feasibility studies and pilot demonstrations for the scale-up investments, and could also be used to help troubleshoot and resolve implementation issues. This programmatic approach was supported by a well-structured results framework with five PDO indicators and nine Intermediate Indicators, as shown in Appendix B.

2.12 The project design appropriately reflected the lessons from experience, mainly that a coordinated set of institutional development, capacity building and investment activities was needed to pursue the regulatory reforms and overcome the market resistance faced by the renewable energy technologies in China. Several key stakeholders interviewed by the IEG mission highlighted the World Bank's insistence on an integrated project design supported by, and supporting, a broad menu of policy analysis and technical inputs as a key feature underpinning its success. In their view, neither a stand-alone technical assistance or investment project would have been as likely to achieve the necessary momentum to simultaneously and successfully address the main identified challenges

2.13 At the detail level, the design of the project also reflected important lessons from past renewable energy assistance, as identified in an earlier Operations Evaluation Department (OED) evaluation of the World Bank's assistance to the energy sector in China (OED, 2005), such as:

- The renewable energy resource for individual projects must be carefully assessed and checked before (pilot) project appraisal.
- Incremental cost sharing principles and power offtake tariff agreements should be established before (pilot) project appraisal
- TA and capacity building must be coordinated with the physical implementation of the projects to ensure that the implementing agencies have adequate and timely knowledge of international best practices.

2.14 Finally, regulatory reforms supported by the project were backed by a Letter of Sector Development Policy issued by the National Development and Reform Commission(NDRC)—the main planning and regulatory agency for the energy sector (World Bank, 2005b). The Letter succinctly summarizes the sectoral context of the project, outlines the government's objectives and strategy for renewable energy development, places the CRESP at the center of international technical assistance for the strategy, and pledges the government's support for the preparation and implementation of the program.

2.15 Given this impressive combination of carefully designed and coordinated institutional development, capacity building, and investment components with high-level policy support, the relevance of project design can be rated as **high.**

3. Implementation

Institutional Framework and Implementation Arrangements

Institutional Development and Capacity Building Component

3.1 The Institutional Development and Capacity Building component was implemented as a single national program through a PMO under the Energy Bureau of the NDRC, which became the National Energy Administration (NEA) in 2008. The CRESP PMO was first formed in 2002 to undertake project preparation and gradually expanded its capacity as the project entered into its implementation phase in 2005. The PMO was responsible for all aspects of this component, including the preparation of terms of reference, the selection and contracting of consultants, and the administration of the small grants program for technology development. The PMO was also responsible for the maintenance of accounting and management information systems, progress reporting, and monitoring and evaluation.

Pilot Renewable Energy Investments Component

3.2 The development of the Pingtan wind farm in Fujian was undertaken by a special-purpose company in which the China Long Yuan Electric Power Group Corporation (Long Yuan), a subsidiary of Guodian Corporation, one of the five state-owned generation companies, was the majority shareholder. Long Yuan was also responsible for operation of the plant. This choice was based on its experience as the developer and shareholder in the 20 MW wind farm in Shanghai financed under the earlier Renewable Energy Development Project (REDP), which had demonstrated its capacity to manage the technical, commercial, and fiduciary aspects of the project.

3.3 The Rudong biomass power plant in Jiangsu was sponsored by Jiangsu Guo Xin Investment Group Ltd. (Guo Xin), which was owned by Jiangsu Province. It had established a special purpose project company to own and operate the power plant, the Jiangsu Guo Xin New Energy Development Company Ltd. Guo Xin had been a minority owner of the Yixing Pumped Storage power plant financed by the World Bank (Loan 4686-CHA) which had demonstrated its capacity to manage the technical and commercial aspects of the project as well as the financial management procedures. Technical assistance was provided to address some fiduciary weaknesses identified during the financial management assessment.

3.4 The Huitengxile wind farm in Inner Mongolia was developed by the North Long Yuan Wind Power Company (NLYWPC), a state-owned enterprise 50 percent owned by Northern Union Power Company (NUPC), a holding company owning a number of power generation companies in Inner Mongolia. The other 50 percent was owned by Long Yuan, the same entity that developed the Pingtan wind farm.

3.5 In Zhejiang, the World Bank financed the rehabilitation and new construction of selected small hydropower units. The rehabilitation projects were mainly owned by state or collectively owned county-level companies. The new projects were mostly sponsored by private companies. This component was supervised by a multi-agency project leading group of the Zhejiang provincial government, which appointed the Zhejiang Hydropower Development Management Center

(ZHPDMC) to manage the due diligence and provide technical assistance for all individual projects proposed for financing. Each project owner managed the construction of its own project.

Implementation Experience

INSTITUTIONAL DEVELOPMENT AND CAPACITY BUILDING COMPONENT

3.6 Based on a review of project documents the Institutional Development and Capacity Building component progressed slowly during the first year because of: (i) the time required to build consensus among the participating government agencies; (ii) initial lack of experience and adequate skills of PMO staff relevant to the project focus areas; and (iii) coordination difficulties between the national-level PMO and the Development and Reform Commissions (DRCs) in the participating provinces. After the first year, further delays were encountered because of (i) the long time required to process contracts; (ii) the large number of small contracts; (iii) consultants not meeting agreed deadlines and insufficient follow-up from the PMO; (iv) greater than anticipated challenges faced in the implementation of the subgrant projects; and (v) additional time required to establish and mobilize provincial management teams.

3.7 As noted in the Implementation Completion and Results report (ICR), these issues had been complicated by the NEA's heavy reliance on the China National Renewable Energy Center (CNREC) under the Energy Research Institute (ERI), which is the main organization in charge of renewable energy policy studies in China. Contracting other institutions was expected not to be able to achieve the desired impacts, because other contractors would not have had access to data, and recommendations would not have been seriously considered by the decision makers, weakening the project's impact on China's renewable energy policy development. Based on interviews with key stakeholders, IEG concluded that this approach, while it contributed to project costs, had been appropriate, as it helped internalize the analytical tools, knowledge, and findings supported by the project in the main agency that the NEA relies on for policy inputs and, given the attendant trust level, also facilitated the discussion, follow-up and implementation of the recommendations supported by the studies.

3.8 The 2009 mid-term review discussed these issues and led to agreement on a set of remedies aimed at reducing the number of activities, especially at the provincial level, and greater reliance on the cost-sharing approach with developers and institutions with strong implementation capabilities. The main recommended actions included the following:

- Speeding up implementation of the committed contracts to avoid a reduction in the relevance of the outputs because of late delivery.
- Using the uncommitted provincial resources for pipeline building, since provincial level policy and resource assessment work had become less relevant as a result of related work at the national level.
- Shifting funding from activities funded by the government or other donors to emerging high-priority activities (such as short-term wind forecast).
- Reducing the number of PMO staff to a core team with adequate knowledge of the program and an established track record in implementation—complemented by qualified experts to assist with work scope formulation, reviews and evaluation of outputs, particularly for complex technical and policy issues.

- Extending the closing date of the GEF grant (P067625) to allow implementation of all committed and planned activities.

3.9 The midterm review's action plan effectively speeded up the implementation of the institutional development and capacity-building activities leading up to this component's completion and total disbursement in 2010, as originally scheduled.

PILOT RENEWABLE ENERGY INVESTMENTS COMPONENT

3.10 The preparation, procurement, and installation of the Pingtan 100 MW wind farm in Fujian province was highly efficient. The project became fully operational by the end of 2007, and has been generating about 300 GWh/year since 2008, well above the target level of 260 GWh/year. Key contributing factors were the developer's past experience with World Bank procurement and safeguards procedures from its prior involvement with the REDP-funded windfarm in Shanghai, as well as the availability of site-specific wind speed measurement records dating back to 1987, the fruits of an early Belgium-funded technical assistance project.

3.11 The Rudong 25 MW biomass-fired power plant in Jiangsu experienced two operational problems during its startup period: a higher-than-expected moisture content of the fuel (about 200 thousand tons annually of locally sourced crop residues, mainly paddy straw and husks); and the malfunctioning of the biomass straw feeder system (not funded by the loan). The first issue was successfully addressed with technical assistance from the CRESP project. The second issue was resolved by the project sponsor, who developed an effective manual feeding system. Having resolved these issues, the plant's power generation has gradually increased from 141 GWh in 2010, corresponding to 87 percent of the target set at appraisal, to 188 GWh in 2013 and 187 GWh in 2015, about 115 percent of the target level.

3.12 The small hydro projects in Zhejiang were effectively implemented under the management of the Zhejiang Small Hydropower Development and Management Center. Two out of the 18 originally planned subprojects had to be dropped: one because of dam safety issues and another because the owner was unable to meet the project's appraisal requirements and obtained alternative financing through local banks. The total electricity generation of the remaining 16 sub-projects, of 104 GWh/year, is higher than the appraisal target of 95 GWh/year. In addition, CRESP provided technical assistance for the preparation of eight additional new and rehabilitation project. Based on the PPAR mission's interviews with provincial authorities, an important achievement was the involvement of private operators in six of the subprojects, a significant breakthrough in a previously entirely government- or communally-owned sector. Another innovation was the management of land acquisition and resettlement requirements—for the five subprojects that involved new civil works—by technically qualified contractors rather than by government officials, which contributed to their smooth implementation.

3.13 The completion of the 100 MW Huitengxile wind farm in Inner Mongolia was delayed by a year, partly as the unintended consequence of a change in the developer's ownership structure during project implementation. While the developer had been partly selected because of one of the shareholder's past experience with the REDP-financed Shanghai wind power farm, this connection was lost when this owner transferred its shares to a local power company. This change in ownership structure, and the developer's attendant lack of familiarity with the World Bank's

procurement and safeguards procedures, contributed to slow procurement at the beginning of the project and subsequent turbine supply problems. While part of the delay was mitigated by accelerated implementation during the later years, it still necessitated an extension of the closing date of Project 2 (P096158) by one year. In the event, the wind farm became operational in September 2011, selling 79.71 GWh to the grid by the end of the year.

COMMENTS ON PROJECT COST, FINANCING, AND DATES

3.14 Project Cost: Actual project costs were $440.59 million (about 22 percent more than the appraisal estimate). There were no revisions of the project components. However, reallocations were made within the Institutional Development and Capacity Building component financed by the GEF grant to meet changing priorities and requests from the government and provincial authorities. For example, at the request of the government, the scope of the technology improvement component was extended to also support one manufacturer of wind turbine shaft bearings and one manufacturer of installation equipment for intertidal areas, in addition to wind turbine manufacturers. Similarly, at the request of pilot provinces, part of the provincial budget was transferred to pilot intertidal and offshore wind projects.

3.15 Based on IEG's review of project documents and discussion with key stakeholders, the following emerge as the key drivers for the 22 percent cost overrun experienced by the project:

- The World Bank disbursed $161.68 million from the two IBRD loans, about 6.7 percent less than envisaged at appraisal, mainly due to the cancellation of two out of the 18 small hydro projects in Zhejiang. The GEF provided $40.22 million in grant financing, in line with the appraisal estimate. There were no other external sources of finance.
- The Borrower contributed $69.34 million (about 11 percent more than envisaged at appraisal), mainly due to the incremental project management costs associated with the 15-month extension of project closing.
- Local financial institutions provided $109.35 million (about 198 percent more than envisaged at appraisal), mainly to finance investment cost overruns of the pilot projects.
- Other local sources provided $57.89 million (about 19 percent more than envisaged at appraisal), mainly due to additional contributions from equipment manufacturers and other institutions participating in the technology improvement cost-shared grants program.

3.16 Dates: The closing date of the GEF grant (P067625) was extended twice: (a) from September 20, 2010, to September 30, 2011, to reallocate the grant proceeds to high priority activities, as noted above; and (b) from September 30, 2011 to December 31, 2011, to enable the PMO to disseminate lessons through, among other things, a project closing workshop. The closing date of the Follow-up Project (Project 2—P096158) was extended from September 30, 2010 to September 30, 2011, to accommodate the delayed start of the Inner Mongolia pilot.

Fiduciary Management

Procurement

3.17 Under the institutional development and capacity building component, financed by a GEF grant, procurement was carried out in accordance with World Bank procurement policies and

procedures. The prior and post review identified minor procurement issues. In May 2009, a complaint was submitted to the World Bank with regard to a Consultants' Qualifications selection performed under a provincial activity in Jiangsu Province. The case was reviewed by the Bank's EAP Regional Procurement Secretariat team, and the assignment was canceled during the project's Midterm Review. There were no major issues for the investment projects, other than the delays experienced in the completion of the bidding process in Inner Mongolia.

Financial Management

3.18 The financial management system developed for the lending and GEF projects was adequate and provided, with reasonable assurance, accurate and timely information that the loan and grant were being used for the intended purposes. The project accounting and financial reporting were in line with the regulations issued by the Ministry of Finance and the requirements specified in legal agreements. In addition, the withdrawal procedure and fund flow arrangements were appropriate throughout the project implementation.

3.19 Overall, based on the review of project documents, procurement and financial management for the institutional development and investment components of the project were carried out in accordance with applicable policies and no major issues were encountered. Five years after the project's completion, stakeholders interviewed by IEG appreciated the World Bank's training, professionalism, and consistent support in this area, while lamenting the required time and effort.

Safeguards Compliance

Environment

3.20 The implementation of the World Bank's environmental requirements for the pilot investment sub-projects in Fujian, Jiangsu, and Zhejiang encountered no significant issues. The Inner Mongolia wind farm pilot faced a problem with construction trucks driving through grassland pastures due to poor access roads, but this issue was corrected at the request of the World Bank's supervision. No further issues were identified in the course of the IEG mission, which was informed that the project had contributed to the strengthening of the country's environmental regulations with respect to the noise impact of wind farms and the avoidance of bird migration routes. The mission was also informed that the Rudong biomass power plant was installing additional pollution control equipment to bring it into compliance with China's recently updated and tighter emission standards, which had become mandatory for all power plants in 2016.

Social

3.21 The project encountered no significant issues with land acquisition and resettlement for the pilot-investment subprojects. In Inner Mongolia, the original estimate of land acquisition for access roads had to be revised and the extent of temporary and permanent land acquisition had to be clarified, but these issues were satisfactorily addressed during supervision. For the Zhejiang small hydro projects, as already noted, the World Bank's requirement that land acquisition and resettlement be managed by technically qualified contractors, rather than by government officials, was reported to have contributed to their smooth implementation.

4. Efficacy

4.1 Overall, as documented in the ICR, by the time the project closed in 2011, it had fully achieved most of the intermediate and PDO indicators specified in the results framework, as shown in Appendix B. Coming five years after the completion of the project, the IEG mission focused on validating these results, exploring the extent to which the impacts of the projects may have been sustained and extended, and identifying the key factors that contributed to its outcomes.

Project Development Objective 1: To create a legal, regulatory, and institutional environment conducive to large-scale, renewable-based electricity generation.

4.1 The GEF-funded Institutional Development and Capacity Building component included a large number of analytical outputs aimed at supporting specific policy outcomes, most of which were achieved, as summarized on Table 4.1.

Table 4.1. CRESP-Funded Analytical Outputs and Policy Outcomes

Analytical Output	***Policy Outcome***
▪ Review and update national RE objective and target ▪ Recommendations for management regulation for quota system of RE power generation ▪ Recommendations for economic/financial incentive policies for RE	▪ Partly adopted by NDRC as background document report for amendment the RE Law; ▪ Partly adopted as a background report for the State Council Decision on Accelerating the Strategic New Industries Cultivation and Development, the State Council Document, No. 32 (2010); ▪ Provided inputs to issuance of Notice on Measures for Renewable Electricity Surcharge Subsidies and Quota Trade System from October 2007 to June 2008—Ordinance Code NDRC Price No. 3052 (2008).
▪ Recommendations for management regulation on sharing RE power generation costs ▪ Recommendations for management regulation for RE development fund	▪ MOF issued Notice on Implementation Plan of Promoting Renewable Energy in Infrastructure, MOF Economic Construction No. 306 (2009). The notice is being implemented.
▪ Recommendations for wind pricing mechanism	▪ NDRC issued Notice on Improved Price Policy for Grid-Connected Wind Power, NDRC Price No. 1906 (2009). The notice is being implemented.
▪ Recommendations for management regulation on biomass energy deployment and sector development ▪ Biomass power generation cost study ▪ Technical guideline for biomass power plants	▪ MOF issued Interim Management Regulation on Subsidy for Energized Biomass, MOF Economic Construction No. 735 (2008); ▪ NDRC issued Agricultural and Forestry Biomass Generation, NDRC Price No. 1579 (2010).

	▪ NEA issued Notice on Management Regulation of Agricultural and Forestry Biomass Combustion Power generation, NEA No. 273 (2009)
▪ Recommendations for management ▪ regulations for solar PV distribution ▪ Post evaluation of grid-connected solar PV ▪ Recommendation of solar PV for the 12th FYP	▪ MOF issued Interim Management Regulations on Financial Subsidy for Solar PV on Buildings. MOF Build No. 129 (2009); ▪ MOF, MOST, and NEA issued Notice on Implementation for Golden Sun Project—Ordinance Code MOF Build No. 397 (2009)
▪ Recommendations for management regulation of Green Energy County (GEC) ▪ Suggestions for assessment standards and implementation policy of the GEC program	▪ NEA issued NEA Notice on Recommendation of Green County, NEA New Energy No. 343 (2009)

Note: RE = renewable energy; MOF = Ministry of Finance; NDRC = National Development and Reform Commission; NEA= National Energy Administration.

4.2 The national and province-level stakeholders consulted by IEG credited CRESP with a strong influence on the development of a supportive legal, policy, and regulatory framework for renewable energy in China. Perhaps most importantly, CRESP played an instrumental role by funding the analytical studies that supported the formulation of the feed-in tariff regulations that are the cornerstone of renewable energy policies in China. Thus, a CRESP-supported wind pricing study laid a solid analytical foundation for the issuance of *Notice of Improved Feed-in Tariff for Wind (2009).* Similarly, CRESP-supported biomass studies have provided critical inputs and led to the issuance the *Regulation on Subsidy for Biomass (2008)* and the *Notice of Improved Feed-in Tariff for Biomass (2010).* On this basis, the NEA has, from 2009, implemented a national feed-in tariff for wind power projects, shown in table 4.2.

Table 4.2. Feed-in tariff for wind power projects (Y/kWh)

Wind Zone	*2009*	*2015*	*2016*	*2018*
I	0.51	0.49	0.47	0.44
II	0.54	0.52	0.50	0.47
III	0.58	0.56	0.54	0.51
IV	0.61	0.61	0.60	0.58

Source: National Energy Administration

4.3 The tariff schedule is divided into four wind zones to encourage wind energy development in all provinces while accounting for interregional differences in the quality of the wind resource. While, in principle, allowing for an internal rate of return of 10 percent—periodically adjusted based on equipment cost—the schedule also reflects the policy intent to gradually phase out the implicit premium for wind energy, with the stated objective of reaching equivalence with coal fired power—currently priced at about Y0.35/kWh—by the end of the 13th Five-Year Plan period (2016–20). CRESP-funded studies also supported the development of separate tariffs for offshore wind power (currently Y0.85/kWh), intertidal wind power (currently Y0.75/kWh), biomass power (currently Y0.75/kWh) and small hydro power (average of Y0.48/kWh, based on Y0.58/kWh peak and Y0.19/kWh off-peak).

4.4 Government officials and developers informed IEG that the NEA's issuance of this national tariff had provided a major stimulus for wind power investment, mainly because it provided a stable pricing environment. It replaced a system whereby the feed-in tariff for wind power projects had been established at the provincial/local level based on the lowest-cost bid for each specific concession. This had been much riskier for investors because of the prevailing lack of adequate wind resource information and frequent technical performance problems with lower-cost equipment. With respect to the phase-out of the implicit premium, developers and manufacturers conveyed that they had been able to absorb it up to now through technological improvements, but that the objective of eliminating it by 2020 was ambitious and had recently contributed to a slowdown in new investments.

4.4 Also in the regulatory area, CRESP-supported studies have led to the issuance of REL-related regulations on renewable energy targets, renewable energy quotas, cost-sharing mechanisms, power system planning, and financial incentives. For example, studies on SHP, in tandem with the Zhejiang SHP pilot investments, put SHP back on the national agenda. While China had in the past been a global leader in mini-hydro, its recent development had been constrained by the power grid's lack of interest to connect, and the local banks' unwillingness to finance, such relatively small (under 10MW) projects. Based on IEG's discussions in Zhejiang, CRESP played a major role in addressing these constraints by supporting the clarification of connection rules and appraisal standards, and demonstrating their feasibility with the pilot sub-projects it financed.

4.5 CRESP also made a major contribution to improving the technology and reducing the costs of China's renewable energy manufacturing sector, a key driver for renewable energy development in China, especially for wind energy equipment, and to a lesser extent, biomass. An important part of the strategy was the support it provided to the creation of the institutional infrastructure for the equipment manufacturing sector. Thus, CRESP studies provided the basis for the development of eight wind turbine standards based on best international practice, which were adopted as national standards by the Standardization Administration of China. CRESP also supported the establishment of two wind turbine testing centers (out of seven in the world) and two wind turbine certification centers accredited by the International Electrotechnical Commission of the International Organization for Standardization (ISO/IEC). As a result, international standard wind turbine testing and certification services are now available locally and widely used by local manufacturing industry for marketing and quality assurance.

4.6 Another leg of the technology improvement strategy involved the provision of cost-shared subgrants to equipment manufacturers and research institutes. Before CRESP, Chinese wind manufacturers were struggling to produce one-megawatt-scale wind turbines and secure international quality certification. The subgrants supported five local wind manufacturers to overcome these problems through the cost-sharing of design studies, prototype installation and testing, and other performance enhancement engineering. Partly as a result, the quality of the equipment improved to the point that four domestic wind manufacturers achieved international certification for their megawatt-scale wind turbine designs, while the cost of the turbines has greatly declined. Thus, for example, the IEG mission was informed by one of the manufacturers that the cost of its turbines had declined from about Y5000–6000/kW in 2011 to Y4000–4500/kW

in 2016. Another manufacturer informed that its cost had declined from about Y8000/kW in 2005 to Y6000/kW in 2009 and Y4000/kW in 2016.

4.7 In addition to the above, CRESP also supported, (i) a wind resource assessment and short-term wind forecasting model for Inner Mongolia, introducing methods that found wider application in other parts of China; (ii) the development of the first university curriculum on wind power engineering in China and academic and post-academic training; and (iii) biomass resource assessments and the improvement of biomass gasification technologies. Finally, CRESP also assisted renewable energy developers in identifying and preparing more than 1,000 MW of new renewable energy investments through cost-shared subgrant support for design, testing, development, and pilot investments in new technologies such as intertidal and offshore wind power, tidal power, biomass gasifiers and biogas projects in various parts of the country.

Project Development Objective 2: To demonstrate early success in large-scale renewable energy development with participating local developers in four provinces.

4.9 CRESP pursued this objective by supporting two 100 MW wind farms in Fujian and Inner Mongolia, a 25 MW biomass power plant in Jiangsu, and 16 small hydro plants in Zhejiang with a total installed capacity of 24 MW. These investments are among the first commercial-scale renewable energy investments in their categories at the time. As already noted, these investments were mostly completed on schedule – excepting only the Inner Mongolia wind farm, which was one year behind schedule—and achieved their power generation targets. IEG visited three of these subprojects to discuss the extent of their demonstration effect.

4.10 The Fujian Pingtan 100 MW wind farm was among the largest wind farm investments at the time, and demonstrated the successful design, implementation, and completion of a large-scale wind farm. While the developer—Long Yuan, as subsidiary of Guodian Corporation—already had prior experience with a 6 MW windfarm in Fujian and a 20 MW windfarm in Shanghai, the experience and results in Pingtan encouraged it to vastly expand its wind power investments, which reached 24.21 GW by 2015. As for Fujian itself, total installed wind power capacity has grown from 106 MW in late 2007, when Pingtan was commissioned, to 1720 MW in 2015 accounting for 1.3 percent of total wind power capacity and 2.4 percent of wind power generation in China (CNREC, 2016).

4.11 The Rudong 25 MW biomass-fired power plant was the first of its kind in China; earlier ones had used biomass-blend fuels. As already noted, the plant encountered some problems in its early years, related to the moisture content of the fuel and the fuel feeder system. These problems having been resolved, the project proved to be a very useful pilot for addressing the kinds of issues that can be encountered in biomass fuel supply, collection, and storage, as well as power plant operation. The plant's demonstration effect is indicated by the fact that the developer—Jiangsu Guo Xin Investment Group – has invested in three more similar plants, and other companies built an additional 12 plants, for a total capacity of about 1105 MW in Jiangsu province, accounting for 10.7 percent of total biomass power capacity and 13.6 percent of total biomass power generation in China (CNREC, 2016).

4.12 The project's support for small hydro projects in Zhejiang province was itself an important policy decision, because it helped change the authorities' minds about the relevance of the technology. Specifically, it helped overcome the power grid's lack of interest in connecting and the banks' unwillingness to lend to such relatively small (less than 10 MW) projects. CRESP-supported tariff studies also helped the provincial authorities establish a two-part feed-in tariff for SHP generation (Y0.58/kWh peak and Y0.19/kWh off-peak, averaging Y0.48/kWh) which appropriately recognizes the technology's economic value as a reliable peak power supplier to the grid, and attracted further investments. Thus, the mission was informed that the CRESP-financed 16 subprojects, totaling 23.5 MW of incremental capacity, helped stimulate a continuing run of additional SHP rehabilitation and new construction projects, totaling about 30–50 MW annually of new capacity in Zhejiang province.

4.13 Overall, on the basis that both PDOs have been achieved beyond the expected targets, the efficacy of the project can be rated as **high.**

5. Efficiency

5.1 The preparation and appraisal of the project were supported by a rigorous and innovative economic analysis that provided the economic rationale for the scale-up of renewable energy in China. The methodology estimated the optimal level of renewable energy in China based on a comparison of the costs of renewable energy options with those of coal-fired generation, including those of environmental externalities, using specific power system and environmental information for every province. The stream of environmental benefits was also used with the model to estimate the economic internal rate of return (EIRR) of the pilot investment projects at appraisal and for the ICR, as shown on Table 5.1.

Table 5.1. Pilot Investment EIRRs (percent)

Pilot Project	***Appraisal***	***ICR***	***Brief Explanation***
Fujian Wind Power	13.6	16.1	Higher annual generation Higher purchase power tariff
Jiangsu Biomass Power	20.8	11.6	Operational problems 2008-10 Higher fuel price
Zhejiang Small Hydropower	10 - 33	10 – 19.5	Increase in investment costs Rehabilitation not affected
Inner Mongolia Wind Power	12.5	9.3	Investment cost overrun Delayed project commissioning Lower power generation

Source: World Bank, 2012a.

5.2 Given the complexity of the environment and the economic model, IEG was not in a position to validate and recalculate these estimates with updated information. However, based on the findings of the mission, it is appropriate to observe the following:

- The Fujian wind project achieved and is maintaining a higher than expected level of power generation and sales. Its performance has encouraged the owner to vastly expand its wind power investments, both in Fujian and other parts of China.

- The Jiangsu biomass power project has overcome the technical problems that affected its EIRR during its initial years, and its subsequent results have encouraged the owner to invest in three additional plants, and other developers in 12 more plants.
- The Zhejiang small hydro projects helped overcome prior constraints to new investments in this technology, including the establishment of a two-part tariff that recognizes its economic value as a reliable peak power provider, which has attracted a continuing stream of investments in this sector.
- Since 2005, Inner Mongolia has become the leading province for wind production in China, with a total installed capacity of 3.1 GW in 2015.

5.3 The above findings suggest that the feed-in tariff policies introduced from 2005 onwards with the project's support have produced attractive financial returns to renewable energy investors in most if not all of China. The feed-in tariffs are shown on Table 1 for wind power, and are Y0.75/kWh for biomass power in Jiangsu. As already noted, these tariffs, reflect an implicit premium with respect to the price of coal-fired generation, currently priced at about Y0.35/kWh. The premium ranges for about Y0.12/kWh in Inner Mongolia (located in Wind Zone I, reflecting its abundant wind resource) to Y0.25/kWh in Fujian (in Wind Zone IV) and Y0.50/kWh for biomass in Jiangsu. The two-part tariff for small hydro projects in Zhejiang appropriately reflects the economic value of peak and off-peak power.

5.4 As analyzed in the CRESP-funded tariff studies, the economic rationale for such subsidies is based on the benefits of avoiding the environmental damages associated with coal fired power. In relation to the benefit of avoiding these damages, a recent study by the International Monetary Fund (IMF) concluded that for China, the nationally efficient price for carbon emissions—just one of the environmental impacts of coal fired power—should be $63/ton of CO_2, which is equivalent to about Y0.25/kWh (IMF, 2014). If this carbon externality is added to the current price of coal fired generation (Y0.35/kWh) the resulting economic cost of coal power (about Y0.60/kWh) is comparable to the national wind power feed-in tariff (see Table 4.2. On this basis, the tariff premium that has supported the financial attractiveness and continued replication of the CRESP-supported wind power projects is also fully consistent with economic efficiency. The premium for biomass power, on the other hand, appears to be higher than justifiable based on carbon benefits alone, but can be accepted as an incentive for further technological improvement.

5.5 With respect to administrative efficiency, the implementation of the project encountered some delays in its early years due to: (i) the time required to build consensus among the participating government agencies; (ii) initial lack of experience and adequate skills of PMO staff relevant to the project focus areas; and (iii) coordination difficulties between the national level PMO and the Development and Reform Commissions (DRCs) in the participating provinces. These issues were successfully addressed after the Midterm Review, but contributed to postponement of various activities, particularly those related to capacity building and policy studies. With the benefit of hindsight, it can be concluded that, while these issues had not been adequately understood during project preparation and design, these delays were unavoidable to achieve the interagency consensus, counterpart ownership, and institutional capacity necessary to ensure the nearly complete achievement of the project's expected results, and their continuing expansion and replication. That is, the benefits were at least commensurate with the costs.

5.6 Given the above, the efficiency of the project can be rated as **substantial.**

6. Outcome

6.1 Based on the underlying high ratings for relevance and efficacy, and substantial for efficiency, the project's outcome can be rated as **highly satisfactory.** Indeed, the implementation of the national-level legal and regulatory reforms, the technological improvements and pilot demonstration projects supported by CRESP have been associated with the transformation of China's renewable energy sector, especially the wind subsector, from an early piloting and demonstration stage to its accelerated development into a global leader in wind power generation and equipment manufacturing. Partly as a result, between 2005 and 2010, China's installed wind power capacity increased from 1.3 GW to 29.6 GW, greatly exceeding the original 11th Five-Year Plan target of 10 GW. As of 2015, installed wind capacity had reached 129.3 GW, exceeding the 12th Five-Year Plan target of 100 GW, and amounting to 22 percent of global wind power capacity. As a share of China's total power generation capacity, wind energy grew from negligible in 2005 to 3 percent in 2010 and 8.6 percent in 2015 (CNRECD, 2016).

6.2 Key stakeholders consulted by IEG have credited CRESP with a major contribution to this transformation. In their view, a major role can be attributed to the tariff-related studies, which provided the analytical and knowledge underpinnings for China's replacement of a project-by-project tariff-setting and concessioning system to the development of a national tariff structure that offered attractive and predictable returns to investors, while gradually phasing out the implicit premium. Other studies credited with essential contributions to modernizing and stabilizing the enabling framework for renewable energy covered the clarification of the power grid's dispatching rules, and established a methodology for the determining the economically optimal targets for renewable energy expansion in various parts of China (based on the avoided cost of environmental damages from coal-fired power).

6.3 Based on IEG's discussions with key stakeholders at the national and provincial levels, key project-related factors that facilitated the achievement of the objectives and continue to sustain them include:

- The comprehensive design of the project, which encompassed the three-way integration of institutional development and capacity building, technology improvement and pilot investment components that mutually supported and reinforced each other.
- The extensive efforts undertaken by the World Bank, beginning with a "genesis workshop" in 1999, through additional workshops, study tours, and studies during the prolonged preparation and early implementation of the project to achieve consensus and cohesiveness about key policy directions and reforms, for example, with respect to tariffs, licensing, and system planning. This was credited as an essential contribution of the project, both at the national and provincial levels.
- The project's ability, aided by the World Bank's convening power, to attract and fund the involvement of leading international experts and institutions to bring their knowledge and share the experience in other countries, both on regulatory and technical matters.
- The careful vetting and selection of grant and loan recipients through competitive processes based on qualifications and technical merit.

- The World Bank team's support for trials and experimentation in pursuit of clear objectives, rather than specific targets, underpinned by extensive preparatory studies and discussions.
- The existence of precursor projects (most immediately the REDP and several bilateral technical assistance projects) whose learnings and lessons were reflected in the design of CRESP.
- The timing of the project, when the government had become seriously concerned about the environmental impacts of coal-fired power generation and committed to address them through increasing engagement and leadership within the international community.

6.4 During the same period, the Chinese wind manufacturing industry has leapfrogged from a marginal status in megawatt-scale wind turbines manufacturing at the beginning of the project to a position of global leadership. The increased demand in wind power equipment has led many internationally recognized vendors to establish manufacturing capacity in China, which in turn has stimulated quality improvements by domestic manufacturers. Today, five out of the top 10 global wind manufacturers are Chinese, accounting for 28.2 percent of the market (Navigant, 2016). Manufacturers and technical institutes consulted by the mission attributed substantial credit for the quality and cost improvements that made this transformation possible to CRESP's technology development subgrants program. Though a precise attribution would be difficult to establish with accuracy, stakeholders highlighted the following contributing factors:

- The project's support for preparatory research and studies, which helped structure and focus the technology development subgrants for maximum leverage on the key issues and most promising options;
- the availability of financing for imported expertise and technology, which had not been possible with government grants (CRESP grants funded about 20–25 percent of the total cost of prototype design, manufacturing, erection and testing);
- the World Bank program's openness to support the taking of risks, and acceptance of trial and error;
- the reputational benefit of associating with the World Bank, both for attracting technology partners and expertise, as well a subsequent marketing purposes;
- the project's support for the creation and development of a comprehensive technology support framework, including the establishment of technical standards, wind turbine testing and certification services, and graduate-level renewable energy technology training programs, which had not existed before.

7. Risk to Development Outcome

7.1 A number of issues may be raised with respect to the technical, financial, and stakeholder risks associated with the outcomes of the project. These are discussed in turn.

7.2 The technical risks relate to the challenges faced in the development of the wind and biomass technologies supported by the project. As already noted, the project's support for wind technology was eminently successful and helped China's manufacturers rise to a global leadership position in terms of cost and quality.

7.3 At present, the main technical challenge facing wind power in China relates to the curtailment of wind energy production due to excess capacity in the power system as a whole, and to inadequate coordination between wind, coal and other sources of energy. As of 2015, wind power curtailment had reached 15 percent (of total wind energy potential) at the national level. The issue is most serious in northern China, where wind and coal resources are most abundant, but also where the power grid's capacity and density are more limited because populations are smaller. While the NEA allocates incremental capacity and energy balance targets at the provincial level, local expansion quotas—based on negotiations between the provinces and individual suppliers—are not always optimal due to the challenge of balancing cost minimization with renewable energy objectives. Based on the mission's discussions with national-level stakeholders, this issue is being addressed in the 13th Five-Year Plan through cancellations/delays, and eventual capping of coal-fired generation and increases in long-distance transmission capacity.

7.4 Biomass power, on the other hand, remains a challenge, because it still requires substantial subsidies to remain viable. Based on IEG's discussions with relevant stakeholders, the key issues are not technical, but economic. Thus, while the biomass pilot encountered problems with fuel quality and the feeder system, these challenges were eventually overcome, and the plant's performance has been satisfactory, encouraging additional investments. The main constraint is the cost of collecting the fuel (mainly paddy straw and husks), which is mainly done at harvest time, and of storing it for year-round use. As a result, only about 7–8 percent of the potentially available fuel can be used by the power plant. Though this poses a challenge in terms of the long-term need to reduce the subsidies to a level consistent with the benefits of avoiding the environmental externalities associated with coal-fired power, it does not represent a technical risk for the results of the pilot project.

7.5 The financial and stakeholder risks relate to the Government's continued commitment to support its renewable energy targets through the provision of tariff subsidies. Thus, the recent energy sector's 13th Five-Year Plan, reaffirmed the government's commitment to further increase the share of non-fossil fuels to 15 percent by 2020. The underlying targets include increasing wind power capacity to 210 GW by 2020 (from 129 GW in 2015) and 15 GW for biofuels (from 10 GW in 2015). Renewable energies, mainly wind and solar, have been incorporated as the main non-fossil option in face of a slowdown and growing environmental and social challenges faced by hydropower and acceptance issues encountered by nuclear power (NDRC, 2016).

7.6 The extent to which these targets may be achievable while reducing or eliminating the wind energy premium in the tariff remains problematic due to the uncertainty of continued equipment cost reductions. Thus, the NEA is planning to gradually phase out the premium for wind energy, with the objective of reaching equivalence with coal fired power by 2020. Manufacturers and developers consulted by the mission indicated that this objective was already putting pressure on manufacturers and reducing the attractiveness of potential new investments. On the other hand, as already noted, the current premium already appears to be within the economically equivalent range based on the benefits of avoiding the environmental damages associated with coal-fired generation.

7.7 Based on the above, it can be concluded that the risk to sustaining the development outcomes of the project is **low.**

8. World Bank Performance

Quality at Entry

8.1 As already noted, the design of the project appropriately reflected the lessons from experience, mainly that a coordinated set of institutional development, capacity building, and investment activities was needed to pursue the regulatory reforms and overcome the market resistance faced by renewable energy technologies in China. At the detail level, the design of the project also reflected important lessons from past RE assistance in China, both World Bank–supported and bilateral. Perhaps most importantly, extensive studies and analytical and knowledge transfer activities carried out during the preparation stage helped focus the government's attention on renewable energies, and led to building consensus and ownership of the design, eventually resulting in coordinated and consistent—and enduring—support for the project at both national and provincial levels.

8.2 Based on the IEG mission's discussions with the relevant technical counterparts, both wind and biomass technologies were at the early stages of piloting and experimentation during the early 2000's—that is, at the time of the project's preparation—and it was not clear where the risks were greatest. So CRESP was designed to support resource assessments, capacity building, and technical improvements in both areas. While in the course of implementation, more resources than planned had to be allocated to addressing biomass-related issues, this was not evident from the start. Thus, the quality at entry of the project can be rated as s**atisfactory.**

Quality of Supervision

8.3 While the implementation of the project encountered some delays in its early years, the underlying issues were effectively addressed at the Midterm Review, and the project was successfully completed with only a one-year extension. In the course of the IEG mission, the project counterparts were uniformly appreciative of the World Bank team's technical knowledge and professionalism, and its balance between focus on "big-picture" results and willingness to be flexible and accept some risks in pursuing them. Three examples are worth mentioning: (i) a reallocation of funds initially planned for resources assessment studies to other priority tasks when the government increased its funding for such activities originally included in the project; (ii) the increased focus on biomass technologies and fuel supply issues after the problems encountered by the biomass pilot project and other biomass projects in the country; and (iii) an increase in funding for technology improvement sub-grants as they proved to be more results-oriented than studies and analytical work at the provincial level. On this basis, the quality of supervision is rated as **satisfactory.**

8.4 Overall, the Bank performance is rated as **satisfactory.**

9. Borrower Performance

9.1 The highly satisfactory outcome of the project could not have been achieved without the strong and consistent support of the government and the implementing agencies, both at the national and provincial level. The ICR documents the key instances where government support played an essential role, from the Letter of Sector Development Policy issued by the NDRC for

the appraisal of the project, to its full implementation of the remedial actions agreed in the course of the midterm review, and the subsequent enactment and implementation of tariff and system planning regulations as recommended by project studies. The importance of these indications of high-level Borrower support was confirmed by the stakeholders in the course of the IEG mission. They also highlighted that, aside from the stimulus and focus elicited by the project's assistance, the high priority given by the government was driven by its concerns about the environmental impacts of coal-fired power as well as its international commitments on climate change. Given this, the government's performance should be rated as **satisfactory**.

9.2 The performance of the pilot project investors can also be deemed as **satisfactory**, as all four of them managed to deliver their projects in compliance with World Bank requirements, within budget and, with the exception of the Inner Mongolia wind pilot, within the original schedule. Finally, the investors and provincial agencies consulted by the PPAR mission also acknowledged the quality and effectiveness of the PMO's guidance as a key factor enabling their satisfactory performance.

9.3 On this basis, the borrower's overall performance is rated as **satisfactory.**

10. Monitoring and Evaluation

Monitoring Design and Implementation

10.1 The project design included a well-structured Results Framework with five PDO indicators and nine Intermediate Indicators, as shown in Appendix B. The indicators were relevant and appropriately defined in relation to the development objectives and outcomes expected from the institutional/policy development and investment components. The target metrics were monitorable and specified three milestones for the Midterm Review and two milestones of readiness for Phase 2 of CRESP.

10.2 Six of the institutional/policy development targets were monitored through qualitative indicators defined as "substantial evidence," which could be regarded as a soft metric. Nevertheless, the actual results of the project, in terms of the issuance of laws, implementing regulations, and technical standards, have clearly satisfied the standard of "substantial evidence." Key stakeholders also appreciated the fact that the project supported the formulation of these measures on the basis of addressing issues and priorities, rather than hard (quantitative) targets. Given this feedback, and with the benefit of hindsight, the qualitative definition of the institutional and policy targets is deemed to have been entirely appropriate.

10.3 For one of the PDO indicators—"improved quality and reduced cost among manufacturers and service providers in wind and biomass"—the target of "substantial evidence" had been difficult to document. Reasons included (i) a lack of Chinese indices for renewable energy equipment and service costs, and (ii) the difficulty of gathering data on such costs, given concerns over commercial sensitivity. On this basis, it was appropriate for the ICR to simply record the increase of national and internationally certified wind turbines manufactured in China, and their growing penetration in international markets, as well as the diminishing operational problems of biomass units.

10.4 Five years after the completion of the project, the IEG mission was able to further substantiate the achievement of this target:

- The two project-supported manufacturers informed the mission that their costs of their wind turbines has substantially declined, in one case from about Y5000–6000/kW in 2011 to Y4000–4500/kW in 2016, and in another from about Y8000/kW in 2005 to Y6000/kW in 2009 and Y4000/kW in 2016.
- In tandem with this reduction in equipment costs, the wind power feed-in tariff was also being gradually reduced, as shown in table 1, and is expected to continue to decline.
- The pilot biomass power plant's initial problems have been satisfactorily resolved, and its operational performance has been above design parameters for the past five years.

Utilization

10.5 As a complement to the monitoring associated with the results framework, the project also included a beneficiary survey and a stakeholder workshop, both upon the completion of the project. While the survey was limited to subgrant recipients, the feedback provided a useful complement to the monitoring indicators, especially with respect to key factors that affected the outcome of the project.

10.6 The survey and workshop participants highlighted the following factors:

- The cost-sharing grants provided by the project reduced the considerable financial risks of product development, quality improvement, and investment project preparation, making it possible to advance some ideas and projects that would not otherwise have been done.
- The World Bank's financing facilitated the procurement of international expertise, instruments, and equipment, which improved the technology development capacity of domestic manufacturers, and introduced participating manufacturers to technology transfer mechanisms and international certification processes.
- The reputational benefit of World Bank support increased credibility and confidence, both internally within the recipients' organizations and externally with prospective clients and investors.
- Among the areas for improvement, the most frequently raised was about the time required to meet the World Bank's processing needs. In some respondents' view, the delays that were encountered could have been reduced or averted with more intensive involvement of the project team.

10.7 Overall, the feedback was very similar to that obtained by the IEG mission five years after the project's completion. The fact that the survey and the workshop were undertaken as inputs for the ICR allowed for these views to be incorporated in the ICR, which demonstrated a systematic and balanced understanding of the project.

11. Lessons

The main lessons that emerge from the experience of this complex project relate to the following:

Combining institutional development and investments in one package can help overcome difficult challenges: The comprehensive design of the project integrated three components in one package: (i) institutional development and capacity building; (ii) technology improvement; and (iii) investment activities. These three components mutually supported and reinforced one another, which was essential for the success of the project. Such a multipronged approach was needed to pursue the regulatory reforms and overcome the resistance of established interests in the sector. Neither a standalone technical assistance nor an investment project would have been so likely to achieve the necessary momentum to successful and simultaneously address the main identified challenges.

Adequate time and resources for preparation and consultations should be planned and allowed: The extensive efforts undertaken by the World Bank, beginning with a "genesis workshop" in 1999, through workshops, study tours and studies—supported by $1.35 million in GEF project preparation grants—during the preparation and early implementation period of the project were necessary to achieve consensus and cohesiveness about key policy directions and reforms. This early investment in partnership built trust between the World Bank team and relevant government agencies for the pursuit of key policy decisions, and the adjustment of project components needed to respond to evolving conditions, which resulted in their efficient implementation in the later years.

Cost-shared grants enhance selectivity and efficiently leverage knowledge transfer, technology improvement, and counterpart funding: The project's experience suggests that a program of cost-shared subgrants—where the grant provides 20–25 percent of total research and development costs—can be a cost-effective tool for the improvement of technology. Such an approach leverages the value of the grant with substantially greater investments by the implementing counterparts, building ownership and commitment. The substantial counterpart funding requirement also enhances selectivity, which contributed to the mostly successful outcomes of these subgrants.

A long-term, predictable price signal can provide an effective stimulus for continuing investments in renewable energies. The NEA's issuance of a multiyear national tariff for wind and other renewable energies replaced a previous system whereby the feed-in tariff had been approved for each specific project based on the lowest-cost bids. This had been much riskier for investors because of the frequent technical performance problems with the cheapest-cost equipment. The establishment of long-term, predictable, and financially attractive price signal, as recommended by project-supported studies, provided an effective stimulus for continuing and expanding investments in renewable energy.

References

China National Renewable Energy Center (CNREC). 2016. "Renewable Energy Data Book 2016". Beijing, China.

China Wind Energy Association (CWEA). 2016. "2015 China Wind Power Industry Map". Beijing, China

Global Environment Facility (GEF). 2005. "Global Environment Facility Trust Fund Grant Agreement (Renewable Energy Scale-up Program – Phase I) between People's Republic of China and International Bank for Reconstruction and Development." August 11, 2005.

Independent Evaluation Group (IEG). 2010. "Project Performance Assessment Report: People's Republic of China – Renewable Energy Development Project." Report No.: 54860, Independent Evaluation Group, World Bank. Washington, DC.

----------. 2014. "ICR Review: People's Republic of China - Renewable Energy Scale-up Program (CRESP)". World Bank, Washington, DC.

International Monetary Fund (IMF). 2014. "How Much Carbon Pricing is in the Countries' Own Interests? The Critical Role of Co-Benefits." IMF Working Paper WP/14/174. Washington, DC.

National Development and Reform Commission (NDRC). 2007. "Medium and Long-term Development Plan for Renewable Energy in China." Beijing, China.

----------. 2016. "13th Five Year Plan for Power Sector Development." Beijing, China.

Navigant Research. 2016. "World Wind Energy Market Update 2016."

Operations Evaluation Department (OED). 2005. "The Bank's Assistance to China's Energy Sector." Report No. 32898. Operations Evaluation Department, World Bank, Washington, DC.

World Bank. 2005a. "Project Appraisal Document: People's Republic of China - The First Phase of the Renewable Energy Scale-up Program." Report No. 30698-CN, World Bank, Washington, DC.

----------2005b. "Loan Agreement (Renewable Energy Scale-up Program – Phase I) between People's Republic of China and International Bank for Reconstruction and Development." August 11, 2005.

----------.2006a. "Project Appraisal Document: People's Republic of China - The Follow Up Project to the First Phase of the Renewable Energy Scale-up Program." Report No. 33018-CN, World Bank, Washington, DC.

----------2006b. "Loan Agreement (Follow-up Project to the Phase I for the Renewable Energy Scale-up Program) between People's Republic of China and International Bank for Reconstruction and Development." April 26, 2006.

----------. 2012a. "Implementation Completion and Results Report: People's Republic of China - The First Phase of the Renewable Energy Scale-up Program and The Follow Up Project to the First Phase of the Renewable Energy Scale-up Program." Report No. ICR00002077-CN, World Bank, Washington, DC.

----------.2012b. "Country Partnership Strategy for the People's Republic of China for the Period FY2013-FY2016". Report No. 67566-CN, World Bank, Washington, DC.

[1] World Bank (2005a).

[2] GEF (2005).

[3] World Bank (2005b).

[4] The Mandated Market Policy (MMP) is defined in these documents to mean a policy aimed at building demand by mandated electricity suppliers to meet some of their electricity needs from renewable sources.

[5] World Bank (2006b).

[6] World Bank (2005a).

Appendix A. Basic Data Sheet

Project Costs and Financing

(a) Project Cost by Component (in US$ Million equivalent)

Renewable Energy Scale-up Program (CRESP)—P067828			
Components	**Appraisal Estimate (US$ millions)**	**Actual/Latest Estimate (US$ millions)**	**Percentage of Appraisal**
Institutional Strengthening and Capacity Building	**88.82**	**100.22**	**113**
Support for Wind and biomass in Pilot Provinces	**130.53**	**177.87**	**136**
Total Baseline Cost	219.35		
Physical Contingencies	5.03		
Price Contingencies	0.00		
Total Project Costs	224.38		
IDC	3.71		
Front-end fee IBRD	0.74		
Total Financing Required	**228.82**	**278.09**	**122**

Follow-up to the China—Renewable Energy Scale-up Program (CRESP)—P096158			
Components	**Appraisal Estimate (US$ millions)**	**Actual/Latest Estimate (US$ millions)**	**Percentage of Appraisal**
Huitingxile wind farm	**94.73**	**126.68**	**134**
Zhejiang SHP plant	**27.80**	**33.82**	**122**
Total Baseline Cost	122.53		
Physical Contingencies	4.72		
Price Contingencies	2.25		
Total Project Costs	**129.49**		

IDC	2.70		
Front-end fee IBRD	0.22		
Total Financing Required	**132.41**	**162.50**	**123**

(b) Financing

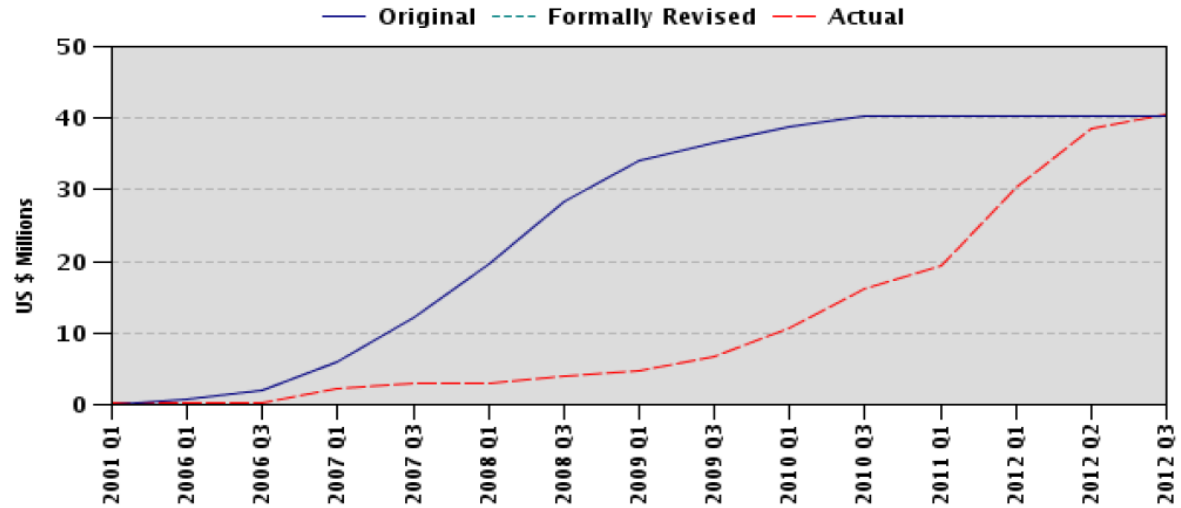
P067828—Renewable Energy Scale-up Program (CRESP)				
Source of Funds	**Type of Financing**	**Appraisal Estimate (US$ millions)**	**Actual/Latest Estimate (US$ millions)**	**Percentage of Appraisal**
Borrower		32.36	34.89	108
International Bank for Reconstruction and Development		87.00	77.00	88.5
Local Financial Institutions		20.64	65.98	320

P067625—China—Renewable Energy Scale-up Program (CRESP)				
Source of Funds	**Type of Financing**	**Appraisal Estimate (US$ millions)**	**Actual/Latest Estimate (US$ millions)**	**Percentage of Appraisal**
GEF		40.22	40.22	100
Local Sources in Borrowing Country		48.60	57.89	119

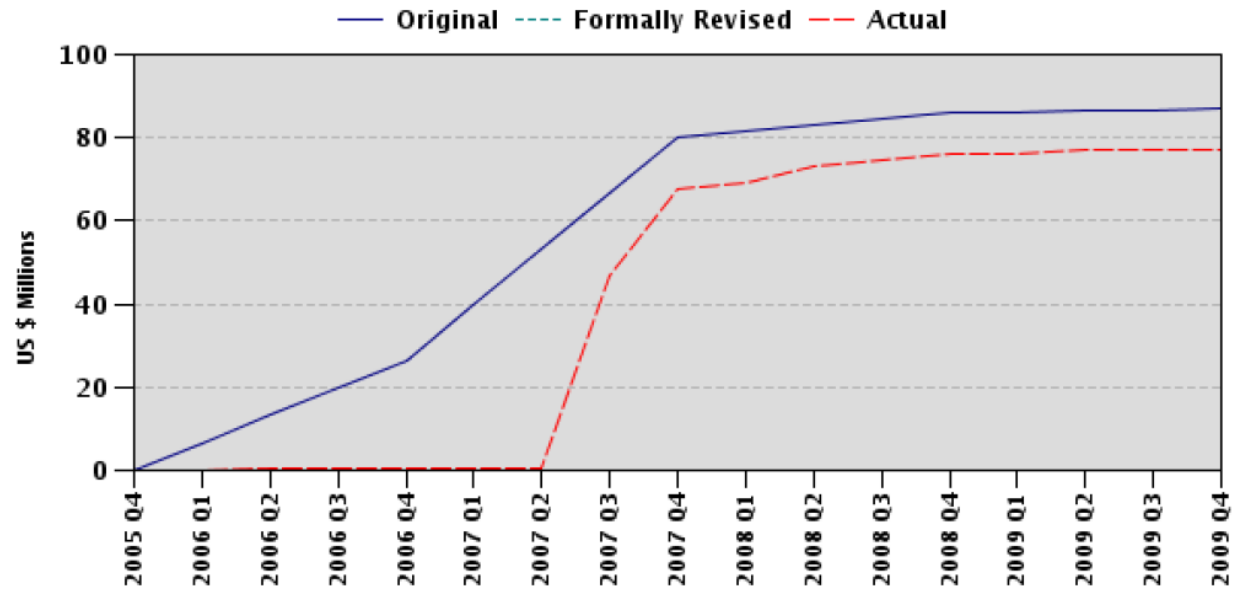
P096158—Follow-up Project to the China Renewable Energy Scale-up Program (CRESP)				
Source of Funds	**Type of Financing**	**Appraisal Estimate (US$ millions)**	**Actual/Latest Estimate (US$ millions)**	**Percentage of Appraisal**
Borrower		30.08	34.45	115
International Bank for Reconstruction and Development		86.33	84.68	98
Local Financial Institutions		16.01	43.37	271

DISBURSEMENT PROFILES

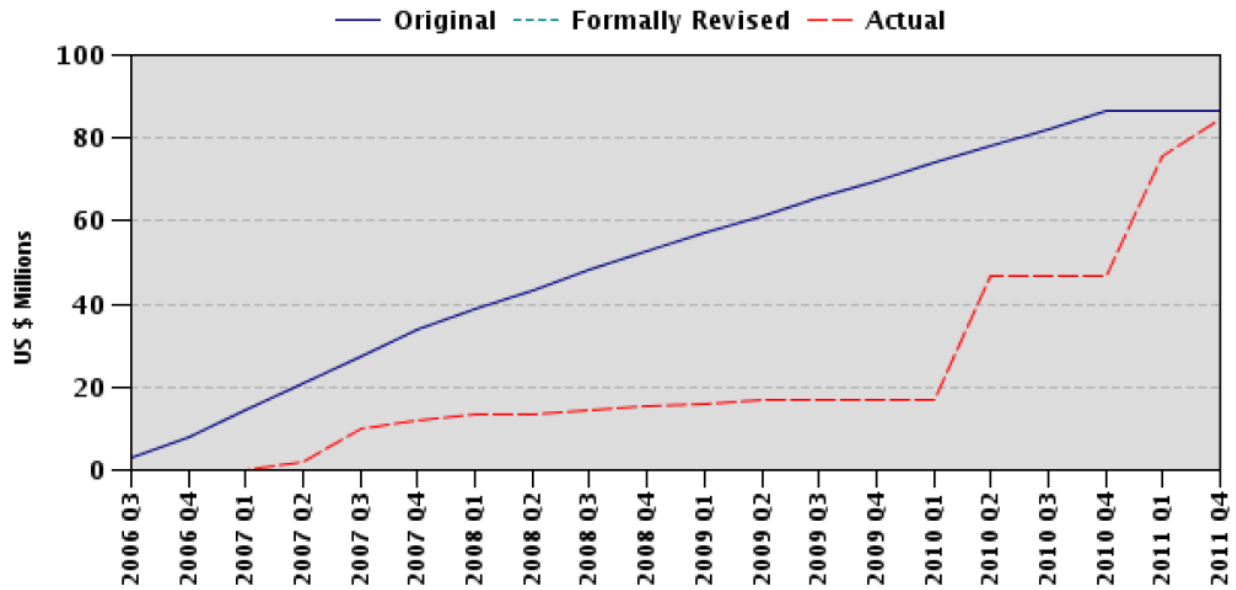
P067625



P067828



P096158



PROJECT DATES

Renewable Energy Scale-up Program (CRESP)—P067828				
Process	**Date**	**Process**	**Original Date**	**Revised / Actual Date(s)**
Concept Review:	08/07/2000	Effectiveness:	11/30/2005	11/30/2005
Appraisal:	12/01/2004	Restructuring(s):		
Approval:	06/16/2005	Midterm Review:	03/09/2009	05/15/2009
		Closing:	09/30/2010	09/30/2010

China—Renewable Energy Scale-up Program (CRESP)—P067625				
Process	**Date**	**Process**	**Original Date**	**Revised / Actual Date(s)**
Concept Review:	08/07/2000	Effectiveness:	11/30/2005	11/30/2005
Appraisal:	12/01/2004	Restructuring(s):		08/28/2007 09/24/2010 09/27/2011
Approval:	06/16/2005	Midterm Review:	03/09/2009	05/15/2009
		Closing:	09/30/2010	12/31/2011

STAFF TIME AND COST

P067828		
Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	US$ Thousands (including travel and consultant costs)
Lending		
FY2000	22.51	70.56
FY2001	22.93	98.05
FY2002	12.81	61.45
FY2003	6.28	30.21
FY2004	15.84	140.46
FY2005	17.10	108.38
Total:	97.47	509.13
Supervision/ICR		
FY2006		
FY2007	10.25	73.05
FY2008	7.20	54.86
FY2009	13.81	88.09
FY2010	10.34	58.11
FY2011	12.49	67.72
FY2012	1.60	3.39
Total:	55.69	345.22

P067625		
Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	US$ Thousands (including travel and consultant costs)
Lending		
Total:	0.00	0.00
Supervision/ICR		
FY2006	4.45	40.10
FY2007	2.0	30.60
Fy2008	0.0	27.95
FY2009	11.68	35.24
FY2010	14.2	89.72
FY2011	14.49	91.34
FY2012	7.46	59.79
Total:	54.28	374.74

P096158		
Stage of Project Cycle	Staff Time and Cost (Bank Budget Only)	
	No. of staff weeks	US$ Thousands (including travel and consultant costs)
Lending		
FY2006	6.8	50.95
Total:	6.8	50.95
Supervision/ICR		
FY2007	8.45	86.98
FY2008	3.81	28.18
FY2009	10.46	46.31
FY2010	13.48	110.63
FY2011	18.46	83.15
FY2012	7.06	39.43
Total:	61.72	394.68

Staff Time and Cost

	Staff time and cost (World Bank budget only)	
Stage of project cycle	***Staff weeks** (no.)*	***Cost, including travel and consultant costs** (US$, thousands)*
Lending		
FY99	--	76.10
FY00	52	175.56
Total	52	251.66
Supervision/ICR		
FY99	n.a.	0.00
FY00	n.a.	0.00
FY01	19	71.22
FY02	21	154.76
FY03	25	129.26
FY04	33	133.88
FY05	20	82.89
FY06	16	97.40
FY07	12	89.13
FY08	10	58.09
FY09	1	0.00
Total	157	816.63

Note: FY = fiscal year; ICR = Implementation Completion and Results Report.

TASK TEAM MEMBERS

Names	Title	Unit	Responsibility/ Specialty
Lending			
Noureddine Berrah	Lead Energy Specialist	EASEG	TTL
Richard Spencer	Senior Energy Specialist	EASEG	
Susan Bogach	Senior Energy Specialist	EASEG	Economist
Leiping Wang	Senior Energy Specialist	EASEG	
Xiaodong Wang	Energy Specialist	EASEG	
Carlos Escudero	Lead Counsel	LEGEA	Lawyer
Mei Wang	Senior Counsel	LEGEA	Lawyer
Xiaoping Li	Procurement Specialist	EAPCO	Procurement
Haixia Li	Financial Management Specialist	EAPCO	Financial Management
Ximing Peng	Energy Specialist	EASEG	
Bernard Baratz	Environment Specialist (Consultant)	EASEG	
Clifford Garstang	Legal (Consultant)	LEGEA	Lawyer
Enno Heijndermans	Renewable Energy Specialist (Consultant)	EASEG	
Youxuan Zhu	Resettlement Specialist (Consultant)	EASEG	Resettlement
Miao Hong	Renewable Energy Specialist (Consultant)	EASEG	
Weigong Cao	Consultant	EASEG	Power Engineer
Cristina Hernandez	Program Assistant	EASEG	Project Processing
Chunxiang Zhang	Program Assistant	EASEG	Project Processing

Supervision/ICR			
Richard Jeremy Spencer	Lead Energy Specialist	EASVS	TTL
Ranjit J. Lamech	Sector Leader	EASIN	TTL
Dejan Ostojic	Sector Leader	EASIN	TTL
Xiaodong Wang	Senior Energy Specialist	EASIN	TTL
Yanqin Song	Energy Specialist	EASCS	TTL
Ximing Peng	Senior Energy Specialist	EASCS	
Defne Gencer	Energy Specialist	EASIN	
Noureddine Berrah	Consultant	EASCS	
Enno Heijndermans	Renewable Energy Specialist (Consultant)	EASIN	
Fang Zhang	Financial Management Specialist	EAPFM	Financial Management
Guoping Yu	Procurement Specialist	EAPPR	Procurement
Jingrong He	Procurement Analyst	EAPPR	Procurement
Mei Wang	Senior Counsel	LEGES	Lawyer
Weigong Cao	Consultant	EASCS	Power Engineer
Xiaoping Li	Senior Procurement Specialist	EAPCO	Procurement
Xin Ren	Environmental Specialist	EASCS	Environmental
Bernard Baratz	Consultant	EASCS	Environmental
Youxuan Zhu	Consultant	EASCS	Resettlement
Cristina Hernandez	Program Assistant	EASIN	Project Processing
Kun Cao	Program Assistant	EACCF	Project Processing

Follow-on operations

Operation	***Grant no.***	***Amount*** *(US$, million)*	***Board date***
The Second Phase of the Renewable Energy Scale-up Program	GEF TF15769-127033	27.3	29-Oct-2013

Appendix B. Results Framework

(a) PDO Indicators

Indicator	Baseline Value	Original Target Values	Formally Revised Target Values	Actual Value Achieved at Completion or Target Year
Indicator 1:	Market framework in pilot provinces established through laws and regulations			
Value	None	Substantial Evidence	Not revised	• RE Law enacted • Implementing regulations issued
Indicator 2:	Environment for development of renewables improved in pilot provinces			
Value	None	Substantial Evidence	Not revised	• China committed to momentous RE development targets • Targets allocated to all provinces • National and provincial incentives for RE development established
Indicator 3:	Improved quality and reduced cost among manufacturers and service providers in wind and biomass			
Value	None	Substantial Evidence	Not revised	• Increased nationally and internationally certified wind turbines • Diminishing operational problems of malfunctioning of biomass units • China wind manufacturers are among the world's leading manufacturers
Indicator 4:	Increased renewable electricity over baseline (TWh/year), and increased renewable capacity over baseline (GW).			
Value	7 GW 35 TWh/year	11.9 GW 60 TWh/year	Not revised	50 GW 146 TWh/year
Indicator 5:	Reduced annual emissions (million tons): Carbon NO_x SO_x			

	Particulates			
Value	0 tons carbon 0 tons NO_x 0 tons SO_x 0 tons particulates	23 million tons carbon 171,000 tons NO_x 852,000 tons SO_x 23,000 tons particulates	Not revised	32 million tons carbon 336,000 tons NO_x 307,000 tons SO_x 146,000 tons particulates

(b) Intermediate Outcome Indicator(s)

Indicator	Baseline Value	Original Target Values	Formally Revised Target Values	Actual Value Achieved at Completion or Target Year
Indicator 1:	Enactment of RE Law and issuing of regulations to implement the law at national level by 2009			
Value	None	100%	Not revised	100%
Indicator 2:	Issuing of regulations for implementation of RE Law and their effective implementation in pilot provinces (Fujian, Inner Mongolia, Jiangsu, and Zhejiang) by 2009			
Value	None	Full	Not revised	Full
Indicator 3:	Issuing of national standards for wind turbines, availability of testing facilities, and certification by 2009			
Value	Partial	Full	No revised	Full
Indicator 4:	Companies participating in cost-shared technology and services development activities (with emphasis on biomass and wind) by 2009.			
Value	0	15	Not revised	23
Indicator 5:	Pipeline of renewable energy projects under development in the provinces by 2009.			
Value	0	400 MW	Not revised	1,329 MW
Indicator 6:	100 MW wind farm at Changjiangao, Pingtan Island, Fujian, selling 260 GWh/year into local grid by 2008.			

Value	0	100 MW 260 GWh/year	Not revised	100 MW 300 GWh/year
Indicator 7:	25 MW straw-fired biomass power plant at Yinxing Village, Rudong County, Jiangsu selling 162 GWh/year into local grid by 2009.			
Value	0	25 MW 162 GWh/year	Not revised	25 MW 141.2 GWh/year
Indicator 8:	100 MW wind farm at Huitengxile, Desheng County, Inner Mongolia selling 245 GWh/year into local grid by 2008.			
Value	0	100 MW 245 GWh/year	Not revised	100 MW 79 GWh/year
Indicator 9:	28 MW of capacity of SHP in Zhejiang built or rehabilitated, selling an incremental 95 GWh/year to local grids.			
Value	0	28 MW additional capacity 95 GWh/year additional electricity production	Not revised	23.5 MW additional capacity 103.78 GWh/year (in 2010) additional electricity production

Appendix C. List of Persons Met

National Stakeholders - Beijing

National Development and Reform Commission - National Energy Administration

Liang Zhipeng	Deputy Director General, Dept. of Renewable and New Energy
Luo Zhihong	Executive Director, Project Management Office – China Renewable Energy Scale-up Program

Energy Research Institute

Zhao Yongqiang	China National Renewable Energy Center

China Electric Power Research Institute

Qin Shiyao	Deputy Director, Renewable Energy Research Center

China Wind Energy Association/ China General Certification

Liu Mingliang	General Manager, Research Center
Wang Wei	Deputy Director, National Energy Key Center for Wind and Solar Simulation, Testing and Certification

Goldwind Science and Technology Co., Ltd

Jiang Tongju	Manager, Product Plan and Management Department
Yi Yang	Manager, External Relations

Jiangsu Province Stakeholders

Jiangsu Provincial Development and Reform Commission – Energy Bureau

Xu Ruilin	(Ex-)Manager, Jiangsu Renewable Energy Scale-up Program Project Management Office

Jiangsu Guoxin Investment Group

Zhang Jun	Deputy General Manager, Jiangsu New Energy Development Company
Bai Yang	General Manager, Jiangsu Rudong Biomass Power Generation Co. Ltd.
Fu Dongmei	Director, Comprehensive Office of Jiangsu Rudong Biomass Power Generation Co .Ltd

Nanjing Agricultural University

Wang Xiaohua	Professor, College of Engineering
Zhao Yanwen	Professor, Resources and Environment Department of

Zhejiang Province Stakeholders

Zhejiang Provincial Development and Reform Commission – Energy Bureau

Zhang Fuping	Director, Division of Electric Power and New Energy
Wang Guoqing	Energy Bureau of Zhejiang Development and Reform Commission
Zhou Yaner	Energy Bureau of Zhejiang Development and Reform Commission

Zhejiang Provincial Hydropower Management Center

Chen Xiaojian	Deputy Chief Engineer
Zhou Weidi	Deputy Director

East China (Huadong) Water and Hydropower Survey and Design Institute

Fang Tao	Director
Jiang Zhenqiang	Deputy Director, Offshore Wind Power Project Manager

Zhejiang Windey Co. Ltd.

Yang Zhenyu	Chairman of the Board
Ye Hangye	Deputy General Manager & Chief Engineer, Laboratory of Wind Power System
Wang Qing	Deputy General Manager & Senior Engineer
Wang Wenhui	Zhejiang Windey Co. Ltd.

Fujian Province Stakeholders

Fujian Provincial Development and Reform Commission – Energy Bureau

Lin Jianan	Director
Zhang Zhidong	Deputy Director
Su Jie	(Ex-)Manager, Fujian Renewable Energy Scale-up Program Project Management Office

Fujian Zhongmin Off-shore Wind Power Development Co. Ltd.

Geng Kehong	General Manager

Fujian Longyuan Power Company - Pingtan Wind Power Farm

Zheng Jun	Director
Liu Xingfeng	Deputy Economist-General
Zeng Sheng	Deputy Director, Finance and Property Management Division
Wang Changxun	Chief of Maintenance Team
Xue Wenxing	Chief of Operation and Supervision Team