GEF-6 REQUEST FOR PROJECT ENDORSEMENT/APPROVAL

PROJECT TYPE: Full-sized Project
TYPE OF TRUST FUND: GEF Trust Fund

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PART I: PROJECT INFORMATION

Project Title: Integrated Adoption of New Energy Vehicles in China			
Country(ies):	China	GEF Project ID:	9226
GEF Agency(ies):	UNIDO	GEF Agency Project ID:	150157
Other Executing Partner(s):	Ministry of Industry and Information Technology (MIIT)	Submission Date: Resubmission date:	03/21/2017 04/11/2017
GEF Focal Area (s):	Climate Change	Project Duration (Months)	36
Integrated Approach Pilot	IAP-Cities ☐ IAP-Commodities ☐ IAP-Food Security ☐	Corporate Program: SGP ☐	
Name of Parent Program	NA	Agency Fee ($)	848,350

A. FOCAL AREA STRATEGY FRAMEWORK AND OTHER PROGRAM STRATEGIES

Focal Area Objectives/Programs	Focal Area Outcomes	Trust Fund	(in $)	
			GEF Project Financing	Co-financing
CCM-2 Program 3	B. Policy, planning and regulatory frameworks foster accelerated low GHG development and emissions mitigation	GEFTF	8,930,000	117,000,000
	Total project costs		8,930,000	117,000,000

B. PROJECT DESCRIPTION SUMMARY

Project Objective: Facilitation and scale-up of the integrated development of electric vehicles (EVs) with renewable energy (RE) in China

Project Components/ Programs	Financing Type	Project Outcomes	Project Outputs	Trust Fund	(in $)	
					GEF Project Financing	Confirmed Co-financing
Component 1: Policies and Programs	TA	Outcome 1: Drafted and recommended policies, technical standards, and guidelines that provide regulatory and planning elements, leading to the higher adoption of EV-RE integration schemes by city governments, vehicle manufacturers, and consumers, thus resulting in GHG emission reductions	Output 1.1: Recommended national-level policy instruments for the integration of electric vehicles (EVs) with RE available to government agencies for their consideration National level roadmap to facilitate effective EV-RE integration and scale up that attains consensus among stakeholders Suggested policies and framework that promote balancing of grid load with power generated via utilization of EVs, thus providing a foundation for scale up of EV-RE	GEFTF	1,475,000	4,000,000

			integration Proposed national-level policies to regulate and incentivize systems for the charging of EVs with RE, including those integrating either RE micro-grids or grid-based large-scale RE installations Proposed national-level policy instruments to regulate and incentivize use of retired EV batteries, which may play a key role in large-scale EV-RE integration Output 1.2: Issuance of technical standards and specifications facilitating EV-RE integration and scale up, including those for smart charging systems, vehicle to grid (V2G) systems, mobile charging systems, and use of retired EV batteries Output 1.3: Recommendations presented to transport sector authorities for incorporation of incentives for EV charging with RE in transport sector national carbon trading policies, including carbon trading rules for EVs powered by RE, to promote greater adoption of RE in the grids supplying electricity to EVs Output 1.4: City-level RE-EV integration and scale up plans, including replication plans for the adoption of best models demonstrated in Shanghai and Yancheng Output 1.5: Proposed institutional plan to establish responsibilities			

			of and coordination among various government organizations for EV-RE integration			
Component 2: Government Institutional Capacity Building	TA	Outcome 2: Increased institutional capabilities and awareness of policymakers at national and local levels on the use of integrated EV - SG (Smart Grid) - RE systems	Output 2.1: Training program for 100 city-level policy makers on EV-RE integration policies and demonstration experience Output 2.2: Four workshops conducted to validate the EV-RE integration policy and planning framework Output 2.3: International forums with participants from central government agencies and EV demonstration cities that disseminate international developments in and plans for EV-RE integration Output 2.4: Written materials on EV-RE integration strategically disseminated to policy makers	GEFTF	880,000	2,800,000
Component 3: Piloting of Technical Measures and Commercialization Approaches (Project Demos)	Inv	Outcome 3: Two city-scale projects piloted, demonstrating the integration of EVs and RE, as well as other foundational work needed to achieve large-scale EV-RE integration	Output 3.1: Demonstration of integration of EVs with the power grid, needed as basis for EVs eventually to address intermittency issues of large-scale RE power incorporation into the grid Output 3.2: Demonstration of technically and commercially effective RE micro-grids that enable distributed integration of EVs with RE Demonstration of integration of EVs into RE micro-grids, including demonstration of micro-grids	GEFTF	3,368,000	91,000,000

			incorporating wind, PV, use of retired EV batteries as storage, EVs, and buildings and a manufacturing facility Demonstration of V2G technologies and pilot commercial systems enabling EVs (or retired EV battery packs) to send power back to the micro-grid at times that it is needed Output 3.3: Demonstration of conditions and business models that can stimulate scale-up of China's EV fleet, thus laying the ground work to realize the benefits of EV-RE integration on substantial scale Demonstration of greater density of the EV stationary charging network, thus serving as a basis for scale-up of EV-RE integration Demonstration of alternatives to stationary charging stations, in particular mobile charging station vehicles, to deal with emergency needs for charging, thus increasing the feasibility of EV use and thereby supporting the scale-up of EV-RE integration Demonstration of business models to scale-up the number of EVs, thus laying the ground work to realize the benefits of EV-RE integration on substantial scale Output 3.4: Demonstration of energy management centers that collect and manage data			

			on dispersed EVs and retired EV battery packs used as storage for the grid, so that the charge and discharge of these devices can be managed			
Component 3 (continued)	TA	Outcome 3 (continued)	Output 3.5: Detailed monitoring and evaluation of project demo performance, providing insights to city planners for developing EV-RE demonstration plans for their cities Detailed monitoring and assessment of project demos of EV integration with the power grid Detailed monitoring and assessment of project demos of RE-EV micro-grids Detailed monitoring and assessment of aspects of project demos related to the use of retired EV batteries, including development of know-how with regard to use of retired EV batteries so that they can be leveraged as tools of EV-RE integration Detailed monitoring and assessment of aspects of project demos related to scale-up and increased concentration of China's EV fleet and charging infrastructure	GEFTF	1,462,000	13,000,000
Component 4: Awareness Raising and Dissemination amongst Manufacturers, Suppliers, and Consumers	TA	Outcome 4: Increased knowledge and capacity of business and consumer stakeholders, facilitating awareness, research and development, manufacture, operation, and maintenance with regard to EV-RE integration	Output 4.1: Dissemination of knowledge amongst industry players (vehicle manufacturers, charging equipment providers, power industry, and other relevant sectors) regarding EV-RE integration Forums for industry, including both domestic and international players active in the China	GEFTF	1,000,000	3,000,000

			market in the vehicle, power, and other related sectors, on EV-RE business models, technology, and demonstration results Dissemination to industry of project's EV-RE information base Meetings publicizing EV-RE related technical standards, held for vehicle OEMs, charging equipment suppliers, and other related industrial companies Technical operation and maintenance workshops related to EV-RE integration aspects held for relevant industrial organizations Establishment of industry alliance or association subcommittee for promoting and advancing EV-RE integration and liaising with government on EV-RE integration policy Output 4.2: Awareness raised among current and future potential car sharing companies of various car sharing business models and integration of EVs with RE in car sharing businesses Output 4.3: Promotion of EV-RE integration to the general public by various methods to raise awareness of and interest in EV-RE integration as a means of realizing the true environmental potential of EVs Media promotion of EV-RE integration, raising awareness of the public regarding the need to			

			incorporate RE into EV development to realize the environmental potential of EVs and educating the public on various aspects of EV-RE integration Promotion of EV-RE integration to consumers via social organizations, increasing consumers' understanding of and attraction to the concept and related opportunities Outreach on social media platforms and cooperation with social media companies to carry out promotion of EV-RE integration Output 4.4: An EV-RE integration demonstration center in Yancheng, created to raise awareness on the topic of EV-RE integration amongst consumers, companies using EVs, and industries related to RE or EV			
Component 5: Monitoring and Evaluation (M&E)	TA	Outcome 5: A robust mechanism for M&E in place to ensure the attainment of project outcomes	Output 5.1: Project monitoring plan refined and executed Output 5.2: Data and information collected to measure certain of the project's outcome and output level indicators, as well as indicators for project's Environmental and Social Management Plan (ESMP) Output 5.3: Project mid-term review and terminal evaluation conducted Output 5.4: Recommendations and agreed upon action plan for long term project sustainability as part of follow-up to terminal evaluation	GEFTF	320,000	500,000

Subtotal		8,505,000	114,300,000
Project Management Cost (PMC)	GEFTF	425,000	2,700,000
Total project costs		8,930,000	117,000,000

C. CONFIRMED SOURCES OF CO-FINANCING FOR THE PROJECT BY NAME AND BY TYPE

Please include evidence for co-financing for the project with this form.

Sources of Co-financing	Name of Co-financier	Type of Cofinancing	Amount ($)
Recipient Government	Yancheng Municipal State-Owned Asset Investment Group	Grants	18,180,000
Recipient Government	Yancheng Municipal State-Owned Asset Investment Group	In-kind	12,120,000
Private Sector	Yancheng Oriental Investment and Development Group	Grants	18,000,000
Private Sector	Yancheng Oriental Investment and Development Group	In-kind	12,000,000
Private Sector	Shanghai International Automobile City Company	Grants	33,000,000
Private Sector	Shanghai International Automobile City Company	In-kind	22,000,000
Private Sector	Society for Automotive Engineers (SAE) China	In-kind	1,200,000
GEF Agency	UNIDO	Grants	100,000
GEF Agency	UNIDO	In-kind	400,000
Total Co-financing			117,000,000

D. TRUST FUND RESOURCES REQUESTED BY AGENCY(IES), COUNTRY(IES) AND THE PROGRAMMING OF FUNDS

GEF Agency	Trust Fund	Country Name/Global	Focal Area	Programming of Funds	(in $)		
					GEF Project Financing (a)	**Agency Fee** a) (b)[2]	**Total** (c)=a+b
UNIDO	GEFTF	China	Climate Change	N/A	8,930,000	848,350	9,778,350
Total Grant Resources					8,930,000	848,350	9,778,350

E. PROJECT'S TARGET CONTRIBUTIONS TO GLOBAL ENVIRONMENTAL BENEFITS

Provide the expected project targets as appropriate.

Corporate Results	Replenishment Targets	Project Targets
Maintain globally significant biodiversity and the ecosystem goods and services that it provides to society	Improved management of landscapes and seascapes covering 300 million hectares	*hectares*
Sustainable land management in production systems (agriculture, rangelands, and forest landscapes)	120 million hectares under sustainable land management	*hectares*
Promotion of collective management of transboundary water systems and implementation of the full range of policy, legal, and institutional reforms and investments contributing to sustainable use and maintenance of ecosystem services	Water-food-ecosystems security and conjunctive management of surface and groundwater in at least 10 freshwater basins;	*Number of freshwater basins*
	20% of globally over-exploited fisheries (by volume) moved to more sustainable levels	*Percent of fisheries, by volume*
4. Support to transformational shifts towards a low-emission and resilient development path	750 million tons of CO_{2e} mitigated (include both direct and indirect)	1,343,116 metric tons (for indirect part, used result from "bottom up" approach; see Part A.1.5)
Increase in phase-out, disposal and reduction of releases of POPs, ODS, mercury and other chemicals of global concern	Disposal of 80,000 tons of POPs (PCB, obsolete pesticides)	*metric tons*
	Reduction of 1000 tons of Mercury	*metric tons*
	Phase-out of 303.44 tons of ODP (HCFC)	*ODP tons*
Enhance capacity of countries to implement MEAs (multilateral environmental agreements) and mainstream into national and sub-national policy, planning financial and legal frameworks	Development and sectoral planning frameworks integrate measurable targets drawn from the MEAs in at least 10 countries	*Number of Countries:*
	Functional environmental information systems are established to support decision-making in at least 10 countries	*Number of Countries:*

F. DOES THE PROJECT INCLUDE A "NON-GRANT" INSTRUMENT? No

(If non-grant instruments are used, provide an indicative calendar of expected reflows to your Agency and to the GEF/LDCF/SCCF Trust Fund in Annex D).

PART II: PROJECT JUSTIFICATION

A. DESCRIBE ANY CHANGES IN ALIGNMENT WITH THE PROJECT DESIGN WITH THE ORIGINAL PIF

A.1. *Project Description*. Elaborate on: 1) the global environmental and/or adaptation problems, root causes and barriers that need to be addressed; 2) the baseline scenario or any associated baseline projects, 3) the proposed alternative scenario, GEF focal area strategies, with a brief description of expected outcomes and components of the project, 4) incremental/additional cost reasoning and expected contributions from the baseline, the GEFTF, LDCF, SCCF, and co-financing; 5) global environmental benefits (GEFTF) and/or adaptation benefits (LDCF/SCCF); and 6) innovativeness, sustainability and potential for scaling up.

RESPONSE: This section provides an update on and elaboration of content provided in the PIF for each of the six areas indicated in the instructions above. Key additions include: (a) elaboration of root causes and barriers, based largely on results of the PPG logical framework analysis workshop (in subsection A.1.1); (b) findings from PPG studies on the baseline situation of the EV market in China, EV policy in China, and EV-RE integration worldwide (in subsection A.1.2, with detailed results of these studies provided in Annexes T1, T2, and T3); (c) full description of project activities, as designed during the PPG phase (in subsection A.1.3, with detailed descriptions of project demos provided in Annex E and explanation of changes from the PIF in Annex I); and (d) adjusted results of GHG emission reduction benefits as determined through PPG work (in subsection A.1.5, with detailed methodology and calculations provided in Annex F).

A.1.1 Global Environmental Problems, Root Causes, and Barriers

The overall problem that this project aims to address is the large and growing GHG emissions from China's transport sector. The more specific problem that the project will address is that China's growing fleet of EVs, which ideally would radically reduce GHG emissions and local pollutants associated with road transport, is currently powered by grid power that is largely fossil fuel based. EVs powered by China's grid, which utilizes a high proportion of coal fuel, fall far short of their potential to reduce GHG emissions and local air pollution -- a potential that would be realized were the EVs to be powered by renewable energy based electricity. While tailpipe emissions are eliminated in EVs powered by China's grid, those emissions (both GHGs and local air pollutants, such as nitrogen oxides) are in large part shifted to fossil-fuel based power plants. In the ideal scenario, China's growing fleet of EVs would be powered by renewable energy. Yet, little if any progress has been made in this area in China; and barriers to progress are substantial. There are two main paths to renewable energy (RE) becoming the main power source for electric vehicles (EVs) and for this integration of EVs with RE to reduce GHG emissions, and corresponding local air pollutants, from China's transport sector on a large scale. One would entail the incorporation of a high proportion of renewable energy into the power grid, which in turn would power a much larger fleet of EVs than at present. The other would entail the establishment of a vast number of distributed renewable energy micro-grids to power a much expanded fleet of EVs. Both paths might be pursued concurrently. Yet, as will be discussed, both paths present substantial obstacles; and neither has been explored substantially to date in China.

<u>China's GHG emissions from energy and overall energy consumption</u>: China is the world's largest emitter of GHGs; and its GHG emissions have grown rapidly over the past few decades. Addressing China's GHG emissions is thus considered a critical component of worldwide efforts to mitigate climate change. As shown in Exhibit 1, in 2006, China surpassed the US as the world's largest emitter of carbon dioxide from energy consumption, with annual emissions of 6.26 billion tons. By 2013, China's annual emissions of CO_2 from energy consumption were 8.69 billion tons. This is 61 percent more than those in the same year of the US, the world's number two emitter of CO_2 from energy consumption. Between 2005 and 2013, China's annual CO_2 emissions from energy grew at a compound annual growth rate (CAGR) of about 5.3 percent.

Exhibit 1: Annual Carbon Dioxide Emissions from Energy Consumption (billion metric tons) – Top Five Ranked Countries

Country	2005	2006	2007	2008	2009	2010	2011	2012	2013
China	5.74	6.26	6.77	6.91	7.33	7.63	8.32	8.49	8.69
USA	6.00	5.92	6.02	5.84	5.43	5.58	5.48	5.27	5.40
India	1.18	1.28	1.37	1.45	1.64	1.78	1.66	1.78	1.89
Russia	1.59	1.64	1.58	1.63	1.48	1.71	1.73	1.83	1.73
Japan	1.24	1.24	1.25	1.22	1.11	1.20	1.19	1.25	1.26

Source: Energy Information Administration, US Department of Energy, *International Energy Statistics* (online database), accessed in August, 2016.

China's primary energy consumption exhibits a similar growth trend. Based on data shown in Exhibit 2, China's primary energy consumption had a CAGR of 6.1 percent between 2005 and 2013, first surpassing the US's primary energy consumption in 2010. By 2013, when China's primary energy consumption reached 116.7 quadrillion BTU, it was 20 percent more than the US's for the same year. The percentage gap between China and the US for CO_2 emitted from the energy sector is substantially larger than the percentage gap in primary energy consumption. This is because China has a much larger proportion of coal in its energy mix than the US; and coal, per unit energy, emits more carbon dioxide than either natural gas or petroleum.

Exhibit 2: Annual Primary Energy Consumption (quadrillion BTU) – Top Five Ranked Countries

Country	2005	2006	2007	2008	2009	2010	2011	2012	2013
China	72.7	79.4	86.0	88.9	93.6	99.7	108.2	113.0	116.7
USA	100.2	99.5	101.0	98.9	94.1	97.5	96.9	94.5	97.2
Russia	27.9	29.1	29.1	29.6	26.5	30.2	30.6	31.9	30.5
India	16.6	17.7	19.2	20.1	22.2	23.7	23.3	24.4	25.4
Japan	22.4	22.9	22.8	22.1	20.6	22.1	20.8	20.3	20.4

Source: Energy Information Administration, US Department of Energy, *International Energy Statistics* (online database), accessed in August, 2016.

Role of transport sector in China's energy consumption and in its energy sector CO_2 emissions: The share of China's transport sector in the nation's total final energy consumption has been estimated, for the year 2012, to be 14 percent. Its share in the nation's overall energy sector CO_2 emissions that year has been estimated at 8.6 percent. And, China's transport sector has been estimated to account for 9.8 percent of total global transport sector CO_2 emissions for the year 2012.[1] Experts forecast that growth rates in energy consumed by China's transport sector in coming years will exceed growth rates of energy consumption overall, so that transport's share in China's overall energy consumption will rise. Some have forecast an ultimate share of 30 percent for China's transport sector in the nation's overall energy consumption once urbanization rates have stabilized. This roughly reflects the levels found in developed countries, though there is substantial variation within that group.[2]

China's transport sector is fueled mainly by petroleum products. And, the transport sector is responsible for the majority of (currently at least 60 percent) and a rising share of China's total petroleum consumption. Reflecting increasing demand from the transport sector, China's petroleum consumption has been growing strongly in recent decades. And, growth rates for oil imports into China have exceeded growth rates in consumption, resulting in China surpassing the US as the world's largest oil importer in 2014. Exhibit 3 shows China's petroleum consumption and petroleum imports between 2005 and 2013. Total consumption in 2013 was about 10.5 million barrels per day, reflecting a CAGR of about 5.6 percent over the period since 2005. China's total consumption in 2013 was second only to the US, which consumed 19.4 million barrels per day that year. China's total petroleum imports in 2013 were about 5.9 million barrels per day,

[1] International Energy Agency as referenced in Weibin Lin, Bin Chen, Lina Xie, and Haoran Pan, "Estimating Energy Consumption of Transport Modes in China Using DEA," in *Sustainability*, April, 2015.
[2] Hailin Wang, Xi Yang, and Xunmin Ou, "A Study on Future Energy Consumption and Carbon Emissions of China's Transportation Sector," in *Low Carbon Economy*, 2014.

reflecting a CAGR between 2005 and 2013 of 8.9 percent. This compares to imports of 6.6 million barrels per day in the US that year.[3] Petroleum consumption of China's transport sector is expected to grow rapidly in coming years. BP, for example, has forecast an almost doubling of energy used for transport in China between 2015 and 2035, and a corresponding more than doubling of oil imports over the same period.[4]

Exhibit 3: China's Petroleum Consumption, Production, and Net Imports (million barrels per day)

Country	2005	2006	2007	2008	2009	2010	2011	2012	2013
Consumption	6.80	7.26	7.48	7.70	8.07	8.94	9.50	10.12	10.48
Production	3.81	3.90	3.95	4.04	4.07	4.38	4.39	4.47	4.56
Net Imports	2.99	3.36	3.53	3.66	4.00	4.56	5.11	5.65	5.92

Source: Energy Information Administration, US Department of Energy, *International Energy Statistics* (online), accessed in August, 2016.

The huge growth in China's motor vehicle market, which in 2009 resulted in the nation surpassing the US to become the nation with the world's largest auto market, is clearly the key driver in China's growing petroleum consumption. Exhibit 4 displays annual sales of light duty vehicles in China. Total light duty vehicle sales in the nation reached 24.6 million units in 2015. Growth rates, though having slowed now from 18.1 percent CAGR occurring between 2005 and 2012 to about five percent annually, appear on track to meet forecasts of achieving sales of roughly 30 million light duty vehicles in 2020 in China. China's total motor vehicle fleet size is second only to that of the US. In 2013, China had 154 million registered autos and a total of 260 million registered vehicles, including three-wheelers, motorcycles, buses, and large trucks.[5]

Exhibit 4: China's Annual Light Duty Vehicle Sales (millions of vehicles)

2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
5.9	7.1	8.3	8.9	13.3	17.3	18.0	19.3	22	23.5	24.6

Sources: Accenture, *China's Automotive Market*, 2013; Bloomberg; and Forbes reported data of China Automobile Association.

Related local and national issues: air quality and energy security in China: Given the overall and growing role of the transport sector in China's GHG emissions, which are, in turn, the largest in the world, China's transport sector is clearly a valuable area on which to focus efforts to reduce such emissions. Win-win benefits of doing so exist at the local and national levels in China in that vehicles present increasingly serious concerns in terms of air quality and energy security. China's serious urban air pollution has been increasingly recognized by the general public and government alike as an urgent health issue. A study looking at 2013 Ministry of Environmental Protection data found that 68 of 74 Chinese cities assessed have annual average PM2.5 (small particulates that are an important indicator of health impacts) levels above the national standard of 35 micrograms per cubic meter.[6] National energy security concerns stem from China's large and rising levels of petroleum imports. Based on the data in Exhibit 3 for the year 2013, net petroleum imports that year accounted for about 56 percent of China's consumption. Should forecasts come to fruition, the share of imports in China's total petroleum consumption may rise to 75 percent by 2035.[7]

Key barriers to the integration of electric vehicles with renewable energy in China: The concept of a large electric vehicle fleet powered mainly by renewable energy presents a potential means of addressing and reversing the large and rising GHG emissions from China's transport sector. Yet, there are many barriers to achieving the integration of EVs with RE on a large scale. Despite its substantial and growing EV fleet, China has little if any experience with the integration of EVs with RE. This lack of experience and the associated lack of know-how, along with the potentially high costs of such integration and the limited share to date of renewable energy in China's electric grid, are among the most obvious key barriers to EV-RE integration in China. At the same time, a very large fleet of EVs would have the potential to address the intermittency challenges presented by the grid adopting very large shares of RE. Thus, there

[3] Energy Information Administration, US Department of Energy, *International Energy Statistics* (online database), accessed in August, 2016.
[4] British Petroleum, *BP Energy Outlook 2035 – Country Insights: China*, 2015.
[5] Based on Ministry of Public Security data.
[6] Greenpeace analysis of Ministry of Environmental Protection data for 74 cities (2014).
[7] Forecast share based on op. cit., British Petroleum, 2015.

could be strong synergies between addressing the challenges of EV-RE integration and addressing the challenges of large-scale integration of RE with the power grid. Substantial scale-up of EVs and charging infrastructure, however, would be required to leverage such synergies.

During preparation of the PIF for this project, four main areas of barriers to wide-scale EV-RE integration in China were identified: (1) policy barriers, (2) barriers with regard to the capacity and knowledge of government officials, (3) technology and market barriers, and (4) barriers with regard to the awareness and knowledge of the general public and the commercial and industrial sectors. During the PPG phase of the project, a logical framework analysis workshop was held, during which Chinese experts identified key problems within each of these areas, building on initial work during PIF preparation. The problems were then elaborated by project experts in the project design process. The problems identified in each of the four main areas are discussed below.

Policy barriers: Policy barriers are considered a critical area by experts with regard to efforts to integrate EVs with RE in China. At an overall level, there is practically a complete absence of national and local level policies, rules and regulations, standards, and plans to guide and promote the initiation and scale-up of the integrated development of EVs with RE in China. Policy barriers are divided into six general areas: (a) lack of a national plan for EV-RE integration, (b) lack of policies to regulate and incentivize key areas related to EV-RE integration, (c) lack of standards needed to support EV-RE integration, (d) lack of rules that would help leverage national carbon policy in support or EV-RE integration, (e) lack of local-level plans to promote EV-RE integration at the city level, and (f) lack of institutional coordinating mechanisms to ensure relevant government entities are involved in and working together as needed on EV-RE integration. Each of these six policy barrier areas is discussed, in turn, below.

The integration of EVs with RE is considered a completely new area in China. As a result, there is a lack of clarity among stakeholders and government about what to do, exactly, and what path to take to promote EV-RE integration. This lack of clarity includes technical, policy, and implementation aspects. In short, China lacks a plan or national "roadmap" for EV-RE integration.

There is also a lack of policies to regulate and incentivize key areas related to EV-RE integration. Three such priority areas in which policy is lacking are: (i) policies related to balancing power generated for the grid with power load; (ii) policies related to the actual use of RE to power EVs; and (iii) policies related to use of retired EV batteries, which may have an important role to play in EV-RE integration. In each of these areas, both policies to regulate and policies to incentivize initiatives are needed. The area of policies related to the balancing of power generated for the grid with power load represents an important gap. EVs have strong potential to play a role in such balancing, if only there were policies to promote it. Such balancing, in turn, can serve as a foundation for large-scale integration of RE into the power grid, facilitated by the ability of a very large fleet of EVs to modulate RE's intermittency. Sub-areas in which such load balancing policies are lacking include: policies for smart charging (which would allow vehicles to charge when there is excess power available in the grid), policies for V2G (the sending of power from vehicles back to the grid), policies for energy management centers (that could provide control coordinated with grid needs for smart charging and V2G), and policies enabling vehicles or retired batteries to sell stored power back to the grid.

With regard to the area of policies related to the actual use of RE to charge EVs, there is a lack of policies both related to using RE micro-grids to charge EVs and related to charging EVs with large-scale grid-connected RE. For RE micro-grids that charge EVs, there is the need to regulate and incentivize the use of both technologies. As for grid-connected RE, there is a need for incentives to promote smart charging strategically designed to eliminate the waste in China of significant amounts of RE power that currently goes unutilized or might have a risk of lack of utilization demand in the future.

Retired EV batteries could play a role in storing RE power for use at a later time in EVs. Or, like EVs, retired EV batteries might themselves play a role in modulating the intermittency of large amounts of RE integrated into the power grid. Yet, use of retired EV batteries is a completely new area in China. While there are some initial policies requiring manufacturers to recycle such batteries and providing them with subsidies to do so, there is a lack of regulations to provide guidance on how such retired batteries should be used. And, there is a lack of incentives to stimulate specific uses of retired EV batteries.

Given the newness of the concept of EV-RE integration in China, there is a lack of standards to support such integration. Indeed, EV-RE integration will require technical standards across a range of areas. These areas include standards for energy management centers and particularly for the protocol for communications between the grid, the charger, and the EV. Further, there is a lack of technical standards for smart charging, including both technical and safety aspects. Other areas in which standards are lacking include standards for V2G and standards for the use of retired EV batteries. For the latter, there is a need for standards for the categorization, safe use, and determination of timing of retirement of such batteries. Finally, there is a lack of technical standards for RE micro-grids designed specifically to charge EVs, especially with regard to fire protection systems.

While China has made progress in developing a national carbon trading system, given the newness of the EV-RE integration concept, this system lacks rules for providing carbon credits for EV-RE integration. If the charging of EVs with RE is to be promoted by China's carbon trading system, there will be a need to design rules for carbon dioxide emission reduction credits achieved through EV charging with RE.

Local level planning and implementation has played a key role in the realization of growth of China's EV fleet in line with national promotion policies. However, as with the national level, no city in China has yet a clear plan for promoting the integration of EVs with RE. Thus, in coordination with actions at the national level, local level EV-RE planning is needed across China's cities.

Finally, the promotion of EV-RE integration presents complications from an institutional perspective. That is, to realize EV-RE integration, different government departments will need to cooperate in ways that they have not cooperated before. While the Ministry of Industry and Information Technology (MIIT) has purview over vehicle development, energy planning, including all initiatives to promote renewable energy in China, is under the National Development and Reform Commission (NDRC) and the National Energy Administration (NEA). Further, matters related to the grid are also under these two entities. And, other agencies, such as the Ministry of Transportation, may also be relevant to EV-RE integration efforts.

Barriers with regard to the capacity and knowledge of government officials: Most government officials in China, both at the national and local levels, know little if anything about the integration of EVs with RE. At most, many may have only a vague realization that EVs in China are not as "green" as they could be, but have otherwise not given much thought to the topic. Lack of capacity and knowledge of government officials regarding EV-RE integration is a second key problem area that needs to be addressed to realize large-scale integration of EVs with RE in China. While there have been some international developments in the field of EV-RE integration to date, Chinese officials are unaware of these developments and do not have a channel for interacting with those internationally who have been active in this field. There is also a lack of high quality materials suitable to policy makers containing the data and analysis needed to convince them of the technical and economic viability of EV-RE integration. Further, Chinese officials lack ideas and know-how about planning for EV-RE integration and developing policies and standards to support such integration. Lastly, there is a lack of organized programs to promote the idea of EV-RE integration to local level officials and guide them in how to develop plans for their own cities.

Technology and market barriers: A very important problem that needs to be overcome to achieve EV-RE integration in China is that the nation lacks experience with and proof of the technical and commercial viability of the concept. As mentioned, there are two main paths or modes of EV-RE integration. These are integration of EVs with a power grid that has incorporated large amounts of RE and integration of EVs with large numbers of RE micro-grids. China lacks experience and know-how in both areas. EV-RE integration via the power grid has as its prerequisite experience and know-how in integrating EVs with the power grid in general. Yet, this too is lacking in China. Integration of EVs with the power grid, in turn, requires experience and know-how in some key areas, which are lacking in China. First, there is a lack of experience with and equipment for EV smart charging and intelligent charging management so that EVs can begin to play a role in "shaving peaks and filling valleys" created by variability in the amount of power used throughout the day and night. Second, there is a lack of experience with V2G in China, both with equipment and control methods. To date, China has only had a few simple experiments of single, isolated cars sending power back to the grid in a fashion completely uncoordinated with any specific needs of the grid. Third, China lacks experience with setting up and running energy management centers that can control smart charging and V2G activities. At present, there are some systems in place in China that monitor EVs and charging activities, but there are none that have capabilities of controlling charging or, potentially, V2G activity.

As for RE micro-grids charging EVs, China has little experience with this to date. There are a few isolated charging stations that have a simple system with PV panels providing a minority of the power used to charge vehicles at the respective station. Yet, the main power source for such charging stations is still the grid. Beyond these simple examples, China lacks experience in developing technically and commercially effective RE micro-grids that enable distributed integration of EVs with RE. Commercial micro-grids might include larger amounts of RE power capacity, ability to handle a substantial number of EVs, storage with retired EV batteries, and perhaps an additional load, such as a building, that can take advantage of extra power when it is available via V2G or discharging of the retired EV batteries.

Retired EV batteries can play a strong role in facilitating EV-RE integration, by storing RE for later use in EVs. Yet, China lacks basic experience and know-how with regard to retired EV batteries that could facilitate their being leveraged as tools in such integration. There has been no evaluation of the safety of retired EV batteries, or development of guidelines for their maintenance and repair. And, there has been no technical and economic evaluation of such batteries, including determination of their lifetime for different uses.

Lastly, the scale of China's EV fleet is too limited to enable EV-RE integration to play a significant role either in addressing the intermittency issues of large-scale RE integration with the grid or in reducing carbon dioxide emissions from road transport. That is, the scale of China's EV fleet is too small to actually demonstrate the real intended benefits of EV-RE integration. One key reason people are deterred from buying EVs in China is the lack of sufficient density of the fixed charging station network. Yet, a lack of cost benefit analysis of charging stations and a lack of profitable models for building and operating charging infrastructure deters businesses from participating in developing China's charging infrastructure on a large scale. Further, there is a lack of alternatives to fixed charging stations to deal with emergency needs for charging. Aside from the issue of lack of charging stations and alternatives to charging stations, people are also deterred from buying EVs as their current exposure to EVs is too limited. There is not a high enough density of EVs in their cities to make them confident about EVs. And, there is a lack of business models successfully demonstrating scale-up in the number of EVs.

Barriers with regard to the awareness and knowledge of the general public and the commercial and industrial sectors: Most persons in China within relevant industry and supplier sectors, as well as the general public, have very little awareness and information with regard to EV-RE integration. Industry in China, including the vehicle, power, and other relevant sectors, while it has become much more aware of and active in the electric vehicle field than in the past, is for the most part unaware of and inactive with regard to EV-RE integration. There is a lack of materials in Chinese with which to educate industry and a lack of venues for making industry aware of EV-RE integration. Industry lacks the technical know-how with regard to potential standards for EV-RE integration and with regard to operations and maintenance issues related to that integration. Further, there is no sort of industrial alliance or association taking the lead in promoting EV-RE integration. In terms of supplier sectors, many cities now have early-stage car sharing businesses (i.e. hourly car rental) that utilize EVs. Yet, such businesses and their associated infrastructure have not achieved the scale needed to potentially facilitate wide-scale EV-RE integration. And, the businesses themselves generally possess very little knowledge and awareness of EV-RE integration. Finally, with the strong promotion of EVs in China, many members of the general public have become quite aware of them. Yet, while some may be aware that EVs are not realizing their true "green" potential, few if any have given much consideration to how renewable energy might be utilized in EV charging. The media, whether it be via video, radio, or print channels, has given little if any attention to EV-RE integration issues; and journalists generally lack knowledge about EV-RE integration. Other potential channels, such EV clubs and social media, have also not been used to promote EV-RE integration to the general public.

A.1.2 Baseline Situation, Baseline Scenario, and Baseline Projects

This subsection reviews: (i) the baseline situation, which is the situation in China at the start of the project; (ii) the baseline scenario, which is the expected situation at the end of the project, were there to be no GEF support; and (iii) baseline projects, namely, other related projects to be carried out during the same time period as the project described in this document. Information on the baseline situation covers: the current EV market in China, current EV policy and programs in China, the current RE power market in China, current RE power policy in China, the power grid and smart grid in China, current situation of China's national carbon trading framework, international and Chinese experience in EV-RE integration and related foundational aspects, and the current situation in the project's two demo cities of Yancheng and Shanghai. Of these topics, the first two (China's EV market and EV policy in China) and the next-to-the-last (experience in EV-RE integration and related foundational aspects) are the topics of studies carried out during the PPG phase of this project. While highlights are offered here, the full findings are included as Annexes T1, T2, and T3, respectively.

Current situation of the EV market in China: In 2015, China surpassed the US as the largest EV market in the world with sales of 247,482 pure electric vehicles and sales of 83,610 plug-in hybrid electric vehicles (PHEVs). These were 5.5 times and 2.8 times, respectively, the amounts sold in 2014. Based on its world-leading EV market size, China is a key nation in which to promote the new field of EV-RE integration. Those involved in the electric vehicle market and electric vehicle policy in China often refer to "new energy vehicles" (NEVs) instead of electric vehicles (EVs) alone. NEVs include hybrid vehicles (both plug-in and non-plug-in), pure battery electric vehicles, and fuel cell vehicles (though the number of fuel cell vehicles sold in China is extremely limited). The rapid growth of NEV sales in China, which reached 331,092 in 2015, is shown in Exhibit 5. China's substantial lead over all other nations in NEV sales in 2015 is shown in Exhibit 6. In 2015 in China, six domestic models constituted almost half of market share. These are (in descending order of market share): BYD Qin (a PHEV), Condi K11 (pure EV), BYD Tang (a PHEV), Beiqi E Series (pure EV), Zotye Z100 (pure EV), and Roewe 550 (a PHEV). Local market share in some cases is determined by local policies. For example, in Shanghai, where local subsidies did not discriminate between PHEVs and pure EVs, PHEVs had a larger market share. In Beijing, where subsidies favor pure EVs, pure EVs had the larger market share. As of the end of 2015, China's total cumulative production of new energy vehicles to date had reached 499,600, of which 92.8 percent was produced in 2014 and 2015. China's 2015 production of 379,000 NEVs was about 4.5 times that in 2014 and about 1.5 percent of China's total 2015 automobile output of 24,503,300.

Exhibit 5: China's Annual New Energy Vehicle Sales (in number of vehicles)

2011	2012	2013	2014	2015
8,159	12,791	17,642	78,499	331,092

Exhibit 6: Top Countries for NEV Sales in 2015 (in number of vehicles)

China	US	Japan	France	England
331,091	115,335	23,180	16,888	10,768

The bulk of China's NEVs purchased between 2011 and 2015 have been featured as part of a demonstration program established at the national level and carried out in various pilot cities, the group of which over time has increased to include 39 designated pilot cities or regions and 88 cities in all.[8] According to statistics, at the end of 2015, there had been 383,285 NEVs involved in such demonstration programs, which is 85.5 percent of the total of 448,182 NEVs sold in China between 2011 and 2015. The top five pilot cities or areas in terms of total number of NEVs "demonstrated" by the end of 2015 were: Shanghai (55,712 NEVs), Beijing (34,361 NEVs), Shenzhen (32,805 NEVs), designated group of cities in Jiangsu Province (26,289 NEVs), and designated group of cities in Zhejiang Province (25,252 NEVs).

China has made substantial technical progress in EV products and technologies, with some new items headed for globally competitive commercialization. With new battery technologies, range is increasing. For example, the range of Beiqi's EV200 is 245 km, an improvement of 80 km over its predecessor. At the same time, China's EV models tend to lag international top models in motor output power, maximum speed, acceleration performance, and other areas.

Potential EV purchasers in China, even in leading pilot cities, have concerns about the limited number of charging locations. At the same time, China's substantial achievement in developing charging infrastructure to date should be acknowledged. By the end of 2015, China had built 3,600 charging stations with 49,000 charging poles across the country. The cities of Beijing, Shanghai, Shenzhen, Hangzhou, and Hefei have already built a substantial urban

[8] The designated regions may include multiple cities; and the total number of cities encompassed in the program is 88.

charging service network. On the inter-city scale, the Suzhou-Shanghai-Hangzhou city area has preliminarily built an inter-city charging service network. And, an inter-provincial charging service network has been built along highways like the Beijing-Shanghai Highway, the Beijing-Hong Kong-Macau Highway, and the Qinghai-Yinchuan Highway, to name a few. Thus, while substantial expansion of charging infrastructure is needed to attract more people to the purchase of EVs, China has already developed city, inter-city, and inter-provincial charging infrastructure in some areas. Exhibit 7 shows the growth in the number of charging poles and charging stations in China between 2011 and 2015. Exhibit 8 compares charging infrastructure developments in China with that in other countries.

Exhibit 7: Number of Charging Poles and Charging Stations in China over Time (2011 – 2015)

Year	2011	2012	2013	2014	2015
Charging Poles	9,352	17,756	22,128	30,914	49,000
Charging Stations	253	367	492	778	3,600

Exhibit 8: Number of Charging Poles and Charging Stations by Country

Country	China	US	Japan	Germany
Year	2015	2014	2014	2015
Charging Poles	49,000	25,601 (“level 2”)	Over 10,000 public	NA
Charging Stations	3,600	NA	NA	2,100

More details on the current situation of the EV market in China can be found in Annex T1, *China’s New Energy Vehicle Market*, based on research prepared under the PPG work for this project.

Current situation of EV policies and programs in China: China’s rapidly expanding EV market has largely been driven by China’s NEV promotional policies at the national and local levels. Overall, the Government of China’s strong emphasis on NEVs is clear from both the breadth and depth of NEV policies that have been issued. Further, local level NEV policies are common and in some cases have achieved strong stimulation of the market. Policymakers at both levels thus show their recognition of the importance of NEV promotion. This background suggests that if policy makers can be convinced of the importance EV-RE integration, they will similarly put strong efforts behind policy to support its promotion.

As indicated in the review of China’s EV market above, the large majority of NEVs on the road today in China are considered to be a part of the national NEV promotion and demonstration program. Two key elements of the promotion policies are incentives for NEV purchase, provided by both the national and local levels, and plans that include specific targets for number of NEVs for the 39 cities and regions that to date have been actively encompassed within the national promotion program. Purchasers of domestically produced NEVs are eligible for national subsidies, which substantially reduce their total spend on the vehicle. Depending on local policy, national subsidies are often supplemented by local ones. In addition to purchase subsidies, there are other preferential policies, sometimes depending on the locale. In Shanghai, where to limit vehicle numbers there is an auction system that results in a hefty fee for getting a license plate, the auction and fee are waived for NEVs. In Beijing, where getting permission to buy a vehicle can entail a long waiting period and the need for luck in a lottery to obtain permission to purchase a vehicle, purchasing an EV can mean avoiding this long and uncertain wait. And, given limitations in Beijing that only allow vehicles to drive every other day based on having an odd or even last digit on the license plate, EVs are attractive in that they can be driven every day regardless of license plate number.

China’s national EV demonstration program began in 2009 with what was called the *Ten Cities, 1,000 NEVs Program*. Between 2009 and 2013, general policies were promoted by the State Council and four relevant cooperating ministries and commissions. In 2010, national subsidies for NEV purchase were tested with a pilot program in six cities. This resulted in 27,000 NEVs on the road by the end of 2012, somewhat short of targets. In September 2013, the national NEV demonstration program was expanded in its second phase to 88 cities (as encompassed by 39 designated cities and regions).

China’s NEV policies have been greatly enhanced since 2014, thus leading to very strong growth in the number of NEVs on the road as outlined above. Beginning in 2014, policies for the demonstration program were strengthened by the four relevant ministries and commissions involved. In addition, various ministries and other national agencies began to issue more specific supportive policies for NEVs in their respective domains, including tax exemptions, policies for government purchase, public transportation operation subsidies, approval for new models to enter the market, etc. In January 2014, a previously planned reduction in the level of subsidies for PHEVs and EVs was reduced in *Notice on Further Promoting the Application of New Energy Vehicles*. In June 2014, *Implementation Plan of Government Agencies' and Public Institutions' Purchase of New Energy Vehicles* was issued to clarify the targets and specific requirements for government agencies to procure NEVs. In July 2014, *Guidance on Accelerating the Popularization and Application of New Energy Vehicles* put forward numerous support measures, as well as making suitable arrangements to address needed work to be done. In March, 2015, the Ministry of Transportation issued *Implementation Opinions of the Department of Transportation on Accelerating the Popularization and Application of New Energy Vehicles in the Transportation Industry*, in which acceleration of promotional work was required, with clear promotion targets and a detailed promotion roadmap. In April and May 2015, respectively, the Ministry of Finance issued *Notice on the Financial Support Policy for the Promotion of New Energy Vehicles in the Years 2016-2020* and *Notice on Modifying Petroleum Subsidy Policies for Buses Operating in Urban Areas to Speed up the Use of New Energy Vehicles*. These notices reflect improved subsidy policies for new energy vehicles as well as decreased petroleum price subsidies for traditional ICE (internal combustion engine) urban buses.

In addition to subsidies and targets, preferential tax policies for NEVs in China are now substantial and have been shown to have played an important role in stimulating the market. The main taxes levied on automotive products in China are: consumption tax, value-added tax, tariffs (on imported cars and parts), vehicle purchase tax, and vehicle and vessel usage tax. Now, new energy vehicles enjoy full or partial relief from all of these taxes except the value added tax. (The waiver of the consumption tax applies only to pure electric vehicles or fuel cell vehicles.) While the aforementioned subsidies for NEV purchase apply only to domestically made vehicles, preferential tax treatment applies to imports as well. Further, import tariffs are waived on NEVs.

In terms of policy for the industrial sector with regard to NEV development, the Ministry of Industry and Information Technology (MIIT), the National Development and Reform Commission (NDRC), and the Ministry of Transportation have all played a role. Safety standards, policies for approval of vehicles, and policies emphasizing roles and responsibilities in the handling and use of discarded EV batteries have all been issued.

There has also been significant support for scientific and technological innovation in the NEV field. Policies promoting research work have been led by the Ministry of Science and Technology (MOST), but MIIT, NDRC, and MOF policies have provided support for more applied projects. The government has worked to identify priority directions for research and innovation. Support has also been provided directly to industry. BYD's Qin model is an example of a model that received government support for innovation in engineering and eventually became a best-selling model in the market.

As for charging infrastructure, a number of promotional policies and regulations have been issued. Specific tasks related to developing charging infrastructure are first outlined in the State Council issued *Planning of Energy Saving and New Energy Vehicle Industry Development（2012-2020）* in June 2012 and then elaborated in July 2014 in *Guidance on Accelerating the Popularization and Use of New Energy Vehicles*. Documents more specifically related to charging infrastructure and charging have been issued since. These include the State Council's September 2015 *Guiding Opinions of the General Office of the State Council on Accelerating the Construction of Charging Infrastructure for Electric Vehicles* and its companion document *Development Guide of Electric Vehicle Charging Infrastructure (2016-2020)*, which puts forward specific targets and locations/ routes for construction of charging infrastructure. The Ministry of Finance and four other departments had earlier issued in November 2014 *Notice on the Construction of New Energy Vehicle Charging Facilities*, which provides central government funding for charging infrastructure in cities that have done well with their NEV demonstration program, but lack targeted funding for charging infrastructure.

The majority of cities included in the national NEV demonstration program have some local level policies corresponding to the national level ones. Yet, research during the PPG phase revealed that these policies are rarely as comprehensive as they ideally would be. In some cases, a city's NEV policies may address just one area, such as industrial development and not touch on others, such as incentives for EV purchase. In other cases, a city may have just copied the policy of another city or the national level policy, rather than developing one tailor-made to their own situation. And, in a minority of cases, cities completely lack any local level policy to enhance implementation of the national policy.

Review of local NEV policies reveals a range of policy types. Many cities have put in place NEV industrial development policies, aiming for their locale to benefit economically from the growing NEV market. They may also have developed local standards and requirements to ensure safety of operation of NEVs. Some cities have established charging pole standards to fill in a gap in national standards. In Shanghai and Shenzhen, policies have been established that require manufacturers to provide for recycling of retired EV batteries and provide them with a 20 yuan subsidy per kWh for doing so. Cities involved in the national NEV demonstration program are required to develop local level plans for implementing the program. Notable examples are *Shanghai Implementation Program for New Energy Vehicles (2013-2015)* and the *Nanjing Government's Suggestions on Further Supportive Work for the Popularization and Use of New Energy Vehicles*. In addition to local purchase subsidies that supplement national-level purchase subsidies for NEVs, local governments may provide special conveniences and discounts for NEVs, such as preferential parking and parking discounts. Some cities, concerned about the impact of limited charging infrastructure on the NEV market, are providing subsidies or other incentives to those that are willing to construct charging stations.

Research conducted during the PPG phase found that a few types of local incentive policies have had a particularly strong impact on NEV sales. These are: (1) Policies restricting the number of ICEVs purchased, but not the number of EVs purchased. These include Shanghai's auction of a limited number of license plates for ICEV sedans and Beijing's lottery for a limited number of plates for the same. Such policies are now being implemented in eight Chinese cities. (2) Policies restricting the driving of ICEV sedans on certain days in certain locations, but not restricting the driving of EVs. Such policies may be applied by limiting the days on which vehicles with odd numbered or even numbered plates may be driven. In the case of Beijing, such a policy, once waived for EVs, resulted in a surge of NEV purchases.

While research findings did not show local subsidies for NEV purchase (which are applied on top of national subsidies) to be decisive in stimulating NEV purchase, these may be considered an important baseline factor that, when combined with the aforementioned types of local policies, make NEVs an attractive option. Without additional incentive policies, it appears that local-level purchase subsides are not enough to convince ordinary consumers to buy NEVs. Cities without such additional policies, that is, have not seen very robust EV sales. This is because NEVs, even with national and local subsidies, cost consumers more than equivalent models of ICEVs. Yet, when purchase subsidies are combined with the ability to avoid expensive auctions or restrictions in vehicle purchase and restrictions on travel, the full policy package becomes attractive to ordinary consumers.

Research also identified three other types of local-level NEV policy that appear to be quite positive developments and indicative of cities with the most advanced NEV promotion policies. These are: (1) Subsidies for the recycling of retired EV batteries. (2) An online management system for charging facility services. Such a system allows users to identify and reserve available charging locations. Shanghai is currently implementing this type of system. (3) Having an "express window/ one-stop shop" for approval of charging infrastructure construction proposals. Such a system is currently available in Shanghai, Beijing, and Shenzhen.

In general, while China has now named 88 NEV demonstration cities (encompassed in the designated 39 demo cities and regions), the results obtained vary a lot among cities. Thirty-four of the cities have not implemented any incentive policy at all; and the other 54 have achieved quite varied results. Shanghai is considered to have achieved the highest level of NEV sales due to its very comprehensive and meticulous local NEV policy. Hangzhou and Beijing are second and third in sales. Hangzhou benefits from a unique rental business model, while Beijing benefits from the lifting of purchase restrictions and travel restrictions in the case of NEVs (as compared to ICEVs, which are restricted). A few cities, such as Hefei and Changsha have achievements in NEV sales due to the promotion policies of local enterprises, rather than those of local governments. Some cities, such as Xian, which has more local level incentive policies than any other city but very low NEV sales, lack policy and planning tailored to the local situation and concrete demonstration initiated by the public sector that potential private purchasers of NEVs can observe.

More details on the current situation of China's policies and programs for NEVs can be found in Annex T2, *China's Policies for Promoting NEVs*, based on research prepared under the PPG work for this project and the partner UNIDO-MIIT-CICETE EV R&D Project.

Current RE power market in China: China has achieved remarkable growth in its RE power sector over the past decade or so. Annual installations continue to propel the nation to new highs of installed RE power capacity, surpassing other nations in many areas. Based on 2015 data, China ranks first in the world in total installed RE power capacity, whether including or excluding hydropower. It ranks first in total installations of each of the major RE power areas of wind, PV, and hydropower, as well.[9] China also ranks first in annual capacity additions of RE power and annual investments in RE power, based on the most recently available data (2014) and excluding hydropower installations of over 50 MW.[10] Thus, considering not only that it has the largest EV market in the world, but also that it has the largest installed capacity of RE power and the largest annual RE power installation market, China appears to be a very appropriate nation in which to promote the new field of EV-RE integration.

Exhibit 9: China's RE Power Capacity (both with and without hydropower) and Share of RE Power in Total Power Capacity

Item	2010	2011	2012	2013	2014	2015
Wind power (total capacity)	45 GW	62 GW	76 GW	92 GW	115 GW	145 GW
PV power (total capacity)	0.9 GW	2.9 GW	6.5 GW	19 GW	28 GW	43 GW
Bio power (total capacity)	5.5 GW	7.0 GW	7.7 GW	8.7 GW	9.5 GW	10 GW
Total RE power capacity (not including hydro)	**51 GW**	**72 GW**	**90 GW**	**120 GW**	**153 GW**	**198 GW**
Annual additions in RE power capacity (not including hydro)	*+21 GW*	*+21 GW*	*+18 GW*	*+30 GW*	*+33 GW*	*+46 GW*
Share of RE (not including hydro) in total power capacity	5.2%	6.6%	7.7%	9.5%	11.2%	13.1%
Hydropower (total capacity)	216 GW	233 GW	249 GW	280 GW	301 GW	321 GW
Total RE capacity (including hydro)	**267 GW**	**305 GW**	**339 GW**	**400 GW**	**454 GW**	**520 GW**
Share of RE (including hydro) in total power capacity	27.1%	28.1%	28.9%	31.8%	33.3%	34.5%
Total power capacity	987 GW	1,085 GW	1,174 GW	1,258 GW	1,365 GW	1,507 GW

Sources: *IRENA Renewable Energy Capacity Statistics 2016*, IRENA, Abu Dhabi, 2016, for all RE capacity data. Energy Information Administration, US Department of Energy, *International Energy Statistics* (online database), accessed in August, 2016, for 2010, 2011, 2012, and 2013 total power capacity data. China National Energy Administration, as referenced by Reuters for 2014 and 2015 total power capacity data.

China's total installed renewable power capacity (excluding hydropower) was 198 GW in 2015, consisting of wind power (145 GW), PV power (43 GW), and bio-power (10 GW). This total RE power capacity (excluding hydro) at the end of 2015 was 68 percent more than that of the US (117 GW), which ranked second worldwide in installed RE power capacity. Data in Exhibit 9 shows the strong growth in RE power installations in China over the past five years. It provides data on China's aggregate installed RE power capacity for the years 2010 to 2015, both overall and for the specific technologies of wind, PV, bio-power, and hydropower. Overall figures are given both for the case excluding hydropower and for that including it. Exhibit 9 also shows the share of RE power in overall power capacity. Based on the data, the CAGR of China's RE power capacity (not including hydro) was 31 percent between 2010 and 2015. Also during this period, RE power's share (excluding hydro) in total power capacity grew from 5.2 percent to 13.1 percent. Including hydro, the share grew from 27.1 percent to 34.5 percent. In both cases, this represents an increased share of over seven percentage points. Exhibit 10 shows China's sizable and growing investments in RE (both power and fuels), which reached USD83 billion in 2014 (including USD15.6 billion invested in hydropower facilities of all sizes). This is over double the 2014 investment of the US, the second ranked country, which invested about USD38 billion in RE that year. Based on the data, the CAGR of China's investment in RE between 2004 and 2014 is 39 percent.

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[9] IRENA, *IRENA Renewable Energy Capacity Statistics 2016*, Abu Dhabi, 2016.

[10] REN21 (Renewable Energy Policy Network for the 21st Century), *Renewables 2015: Global Status Report*, Christine Lins et al, 2016.

Exhibit 10: Annual Investment in RE Power and RE Fuels in China (in billion USD) (including hydropower†)

2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
3.0	8.2	11.1	16.6	25.7	39.5	38.7	49.1	62.8	62.6	83.3

†As an example of share of hydropower in total investment, 2014 total includes USD15.6 billion invested in hydropower installations of all sizes. Source: Op. cit., REN 21, 2016.

Wind power and its curtailment: Stimulated by policy, China's installed wind power capacity has expanded rapidly. Aside from hydropower, wind represents China's largest RE power source. In addition, China has the largest total installed wind capacity of any nation in the world. In 2015, China's installed wind capacity, at 145 GW, was about double that of the US (73 GW), the nation with the second largest wind capacity, and about one-third of world capacity (432 GW).[11] Exhibit 11 shows annual additions of wind power capacity in China between 2007 and 2015. While growth in annual additions has not been steady, with an early peak in 2010 not surpassed until 2014, the overall trend of high growth from low base results in a CAGR of 32 percent during the eight-year period.

Exhibit 11: China's Annual Additions of Wind Power Capacity (in GW)

2007	2008	2009	2010	2011	2012	2013	2014	2015
3.3	6.1	13.8	18.9	17.7	13.3	16.1	22.8	30.5

Sources: IRENA, op. cit., 2016, and calculations by the PPG team.

Exhibit 12: China's Percent Wind Power Curtailment in Six Provinces with Greatest Curtailment

Province	Total Grid-Connected Wind Power Installed at End of 2015	Wind Power Curtailment Rate (percentage of energy wasted)	
		2014	2015
Gansu	12.52 GW	11%	39%
Xinjiang	16.11 GW	15%	32%
Jilin	4.44 GW	15%	32%
Heilongjiang	5.03 GW	12%	21%
Inner Mongolia	24.25 GW	9%	18%
Ningxia	8.22 GW	0%	13%

Source: China National Energy Administration as referenced in *Inside Climate News* and prepared by Paul Horn, op. cit., 2016.

Despite the impressive growth of China's wind sector, the nation faces significant problems of wind power curtailment. While curtailment is largely due to overexpansion of the power sector in general and issues of transmitting power from windy places to population centers, time of day issues (i.e. when the wind blows versus when there is a need for power) and the related preference of grid operators for fossil fuel power suppliers also play a role. Curtailment thus presents an important motivation and opportunity for EV-RE integration. Smart charging (or V2G) of EVs that synchronizes EV charging with times when the wind blows could allow for the uptake of currently curtailed power and for a reduction in the amount of new fossil fuel power capacity that comes online in the future. Exhibit 12 shows the level of curtailed wind power in China for the six provinces, all in North China, in which curtailment is the greatest. Overall in 2015, fifteen percent of wind power generated in China was curtailed, up from eight percent in 2014.[12]

Stimulated by the large domestic market for wind power installations, China has developed a substantial wind turbine manufacturing sector. China's top four manufacturers are estimated to have had a 21.4 percent share of the world turbine market (as measured by wind power capacity) in 2014. Of these, Goldwind, with 9.0 percent market share, was ranked third in the world after Vestas and Siemens, while United Power (4.8 percent), Mingyang (3.9 percent), and Envision (3.7 percent) were all ranked in the top ten worldwide. Overcapacity in the Chinese wind turbine market has

[11] IRENA, op. cit., 2016.
[12] China National Energy Administration as referenced in *Inside Climate News* and prepared by Paul Horn in Coco Liu, "Facing Grid Constraints, China Puts a Chill on New Wind Projects," March, 2016, accessed at https://insideclimatenews.org/news/28032016/china-wind-energy-projects-suspends-clean-energy-climate-change in April, 2016.

been a problem over the years, leading to intense competition and a resulting drop in the number of Chinese turbine manufacturers from 80 in 2009 to 30 by the end of 2014.[13]

PV power: China's installed PV power capacity, now benefiting from attractive policies and dropping PV module prices began to take off significantly later than its installed wind power capacity. In 2015, with 43 GW of total installed PV power capacity, China surpassed Germany, which had about 40 GW and was previously ranked first in the world. Japan (33 GW) and the US (27 GW) rank third and fourth in total installed PV capacity. Exhibit 13 shows China's annual additions of PV power capacity between 2007 and 2015, with the annual amount installed first reaching the GW level in 2011. The CAGR of the amount of PV installed annually was 127 percent during the period. In 2015, 15 GW of PV was installed in China, more than in any other country. This compares to Japan, which installed 10 GW that year and ranked second in annual additions, and the US, which installed 7.4 GW and ranked third. [14]

Exhibit 13: China's Annual Additions of PV Power Capacity

2007	2008	2009	2010	2011	2012	2013	2014	2015
21 MW	39 MW	144 MW	580 MW	2.1 GW	3.6 GW	12.1 GW	9.5 GW	15 GW

Sources: IRENA, op. cit., 2016, and calculations by the PPG team.

China began dominating world PV module production in 2009 and continues to do so. China's rise to be the world's top PV manufacturer was driven by the export market opportunity, particularly in Europe, and took place before China's own annual PV installations reached GW scale. In 2014, China accounted for 64 percent of world production of PV modules. Among the largest PV module manufacturers in the world, the majority are Chinese, including: Trina, Yingli, Canadian Solar, and Jinko Solar. Due to overcapacity, competition has resulted in a number of Chinese PV manufacturers going out of business, including four that went bankrupt in 2014. Chinese manufacturers also face challenges due to anti-dumping restrictions from the US and have begun to build overseas plants to avoid these.[15]

Other types of RE power installations: Hydropower and bio-power are the two other main types of RE power installations in China. Analysts sometimes exclude hydropower from RE statistics due to sustainability concerns with regard to large dams or to its not being considered a "new" technology. Of China's 321.2 GW of hydro capacity at the end of 2015, 26 GW was of small hydro installations of less than 1 MW each, 83 GW was of medium installations of 1 to 10 MW each, and 189.2 GW was of large installations over 10 MW each. In each of these categories (small hydro less than 1 MW, medium hydro between 1 and 10 MW, and large hydro over 10 MW), as well as in hydro overall, China ranked first in the world in installed capacity at the end of 2015. Worldwide, bio-power (power plants using biological materials as fuel) is much less developed than hydropower or wind and, with 103 GW installed worldwide in 2015, has somewhat less than half the worldwide installed capacity of PV (227 GW). China had a total installed bio-power capacity of 10.3 GW in 2015, ranking third worldwide, after the US (13.8 GW) and Brazil (13.4 GW). China is not a very significant player in geothermal, for which worldwide capacity was 13 GW in 2015, or in the more newly developing field of marine power, for which worldwide capacity was 547 MW in 2015.[16]

Current RE power policy in China: The remarkable growth of wind power and PV power in China's renewable energy power sector has largely been driven by policies. These include China's *Renewable Energy Law*, passed in 2005 (amended in 2009), and the implementing regulations associated with the law that have been issued since. They also include the ongoing targets set by the government in national renewable energy plans developed as sub-plans to the nation's five-year plans. The *Renewable Energy Law* allows for a feed-in tariff, whereby providers of RE power will receive a power price higher than that paid for fossil fuel based electricity. Shortly after passage of the law, implementing regulations and a feed-in tariff for wind were designated, stimulating installations of wind farms. The country also implemented a concession and bidding system at certain sites for wind power. Implementing regulations for PV at the time were not that comprehensive, but more recently became so. Thus, PV installations did not take off in China as early as wind did, but PV has now been similarly stimulated. China has recently reduced its feed-in tariffs for

[13] REN21, op. cit., 2015.
[14] IRENA, op. cit., 2016.
[15] REN21, op. cit., 2015.
[16] IRENA, op. cit., 2016.

onshore wind, though at the same time has added feed-in tariff designations for newer areas, namely offshore wind and small-scale distributed PV.[17] Despite continued support and promotion of RE power, there has also been some reaction in policy to recent problems. In particular, due to the abovementioned wind power curtailment issue, the Government of China in 2016 put a temporary moratorium on the development of new wind farms in North China provinces.[18]

A new development in policies to promote RE power in China is that detailed in *Guiding Opinions on Establishing Renewable Energy Portfolio Standards*, issued by the National Energy Administration (NEA) in early 2016.[19] This policy requires each province to meet targets for share of non-hydro RE power (mainly wind, PV, and biomass) in total generation used. Targets are set at between two and 13 percent, depending on the province's resources. A key aim of this policy is to encourage the main grid operators (State Grid and Southern Grid) to accept more wind and PV for connection to the grid.[20] The NEA has indicated it targets non-hydro renewables to account for nine percent of consumed electricity by 2020. (It is noted that the proportion offered in Exhibit 9, though already having reached 13 percent, is for share of power capacity rather than share of consumed electricity.) Provincial targets are designed accordingly, so that this target can be met. Yet, some analysts have suggested that the nine percent target, along with the provincial portfolio standard targets, is not ambitious enough, given current installed capacity and growth targets. NEA also targets for all non-fossil fuel sources to account for 15 percent by 2020 and 20 percent by 2030. [21]

Exhibit 14: China's 2020 Targets for RE Power and Comparison to Current Installed Capacity

Type of RE power	End of 2015 level	13th Five Year Plan – most recent draft 2020 target	Strategic Energy Action Plan (2014-2020) – earlier 2020 target
Wind power (total installed capacity)	145 GW	250 GW	*200 GW*
PV power (total installed capacity)	43 GW	160 GW	*100 GW*
Hydropower (total installed capacity)	321 GW	340 GW	*350 GW*

Sources: Wang Cheng, op. cit., 2016, and Ma Tianjie, op. cit., 2016.

Recent capacity targets issued in 2016 in a draft energy plan for China's 13th Five Year Plan (2016 – 2020) are fairly ambitious, targeting almost a quadrupling of installed PV capacity and 72 percent growth in installed wind capacity. These targets call for 250 GW of installed wind capacity by 2020 (as compared to 145 GW at the end of 2015), 160 GW of installed PV capacity by 2020 (as compared to 43 GW at the end of 2015), and 340 GW of installed hydro capacity (as compared to 321 GW at the end of 2015). These amounts appear to be increases over the amounts issued earlier in China's *Strategic Energy Action Plan* for 2014 to 2020. Targets for 2020 of both plans, as well as comparison to current installed capacity, are shown in Exhibit 14.[22]

<u>The power grid and smart grid in China</u>: Among nations, China is the largest consumer of electricity in the world. China has two main grid companies, China State Grid and China Southern Grid. Both are state-owned companies. Under these two entities are local grid companies at different levels (e.g. regional, provincial, and municipal).

While China does not have specific plans for EV-RE integration, it does have ambitious targets and large planned budgetary allocations for upgrading its power grid, including incorporation of smart grid aspects. These smart grid aspects, in turn, could be quite important in establishing the foundation needed to achieve large-scale EV-RE integration in China. While definitions of smart grid vary, it is generally agreed that smart grid adds information technology to traditional grids and allows for the bi-directional flow of power and information. It also allows consumers of power to make choices about their power use (and potentially about sale of power back to the grid) based on pricing signals.

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[17] REN21, op. cit., 2015.
[18] *Inside Climate News*, op. cit., 2016.
[19] Wang Cheng, "China Announces Renewables Quota, but is it Enough?," posted on China Energy Storage Alliance (CNESA) website, March 8, 2016, accessed in August 2016 at http://en.cnesa.org/featured-stories/2016/3/8/china-renewables-quota .
[20] The Climate Group, *RE 100 China Analysis*, April, 2015.
[21] Wang Cheng, op. cit., 2016.
[22] Wang Cheng, op. cit., 2016 and Ma Tianjie, "All Eyes on China's 13th Five-Year Plan for Energy," *China Dialogue*, July 25, 2016 accessed in August 2016 at https://www.chinadialogue.net/blog/9113-All-eyes-on-China-s-13th-Five-Year-Plan-for-energy/en .

China leads the world in its annual investments in a range of smart grid technologies, including substantial deployment of smart meters.[23] Smart grid is seen by China as a way to incorporate more renewable energy into the grid and to be able to transmit the renewable energy based power to faraway population centers. It is also seen as a way to support energy efficiency initiatives and increase the safety and reliability of the grid. In addition to facilitating the incorporation of large-scale renewable energy and distributed RE micro-grids into the main grid, smart grid technology can facilitate efforts in shaving peak demand and filling the valleys of low demand. China often refers to a "strong and smart grid." The "strong" part means that the power grid should be able to transmit large amounts of electricity reliably over long distances.[24]

Chinese entities have announced large planned investments in smart grid and other grid upgrading. NDRC, for example, has indicated that China is planning substantial investments in long-distance transmission networks and dynamic distribution networks in order to make maximum use of available hydro, wind, and solar resources.[25] State Grid has estimated that China will spend 820 billion yuan (USD128 billion) between 2016 and 2030 on smart grid and related infrastructure. As an example of an important regional initiative, it has been reported that between 2016 and 2020 inclusive, China will allocate 200 billion RMB (31 billion USD) to the local grid company of Xinjiang Province (Xinjiang Electric Power Company) to construct power grid networks to connect the province with neighboring countries, including Pakistan, and China's Eastern Provinces. Funds will be used for integration of renewable energy and installation of power lines.[26]

Current situation of China's national carbon trading framework: China has been developing an ambitious carbon trading framework. Yet, EV-RE integration is not currently a part of the carbon trading framework's system of rules. Instead, the current focus on the newly designed system is on industrial energy users. Yet, this carbon trading framework offers a potential future source of stimulation to the EV-RE market. China, in fact, is planning to have the largest carbon trading market in the world. The nation has indicated that it will launch a national cap and trade program for carbon dioxide emissions in 2017, though sources indicate skepticism it will be ready by that time to do so. The program will begin with China's six largest carbon emitting industrial sectors. The first of these will be coal fired power generation. The system will allow those that cannot cut emissions as needed to buy emissions reduction credits from those that are able to cut emissions more than they are required.

International and Chinese experience with EV-RE integration and foundational aspects to date: Despite the perception held by many that EVs are associated with clean energy, international progress and experience in integrating EVs with RE and in key related foundational technologies, such as smart charging and V2G, is quite limited and just getting started. Yet, internationally, including in Europe, Japan, and the US, there have been significant demonstrations. China has also had some initial demonstrations of relevance, though the limited nature of and challenges faced by these initial efforts call out for a stronger, more concerted effort in China, as proposed in this document.

In terms of international experience, one example of note is the EDISON Project, carried out on Denmark's Bornholm Island between 2009 and 2013. The project demonstrated the integration of 15 EVs with the island's power grid, which includes 30 percent wind power. The project is meant to be a model for the future powering of 200,000 EVs in Denmark with wind power by 2020. The project also successfully demonstrated V2G. For this, the EVs, which it was found were parked for much of the day, stored power when the wind blew and sent it back to the grid when demand was high.

Japan has done a lot of work in the "smart community" and smart city area. Japan's Smart City Project combines several "smart" elements, including a local RE power grid, a smart home, storage, and smart transportation, including EVs. A community energy management system integrates the technologies. Some of the Japanese demos combine EVs

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[23] US International Trade Administration, "2016 Top Market Report Smart Grid Country Case Study: China," a part of *2016 ITA Smart Grid Top Markets Report*.
[24] Feng Xiufeng, "Smart Grids in China: Industry Regulation and Foreign Direct Investment" in *Energy Law Journal*, May 16, 2016.
[25] Bloomberg, "China Eyes Safe Smart-Grid System by 2020 to push Clean Energy," July 6, 2015.
[26] Metering and Smart Energy International, "China to Invest USD21 Billion in Provincial Smart Grid by 2020," Nov. 6, 2015, accessed at https://www.metering.com/china-to-invest-us31bn-in-provincial-smart-grid-by-2020/ in September 2016.

and homes, which together make use of PV systems and storage. Some demos also demonstrate V2G and secondary use of retired EV batteries.

In the US, there are notable efforts in areas that could serve as foundational aspects of EV-RE integration. For example, at Los Angeles Air Force Base, the US Department of Defense is demonstrating V2G with 42 cars. Compared to other efforts worldwide, the scale of V2G in this demo is quite large. The purpose of the project is to show that the extra cost of EVs can be offset or perhaps more than offset by economic benefits of providing services (including power factor correction) to the power grid. The US Department of Defense, which has a large share of electric vehicles, decided to get involved in this demo based on the opportunity to generate income via V2G. Previously in the US, V2G efforts had been undertaken on the research scale, such as initiatives with around six vehicles as carried out by the University of Delaware. Smart charging is another area in which increasingly substantial demonstrations are being carried out in the US. In the area of actual EV-RE integration, some initial efforts are now being seen in this area. BYD for example, via its US team, is assisting some US municipal public transit companies in setting up EV-RE integration projects for their buses. They argue that public electric buses powered by RE offer one of the highest returns in terms of greenhouse gas emissions and total kWh of EV-RE integration, both because of the size of the buses and because they are driven many more hours daily, on average, than cars. BYD finds public bus facilities in colder areas, where there are large indoor bus facilities, an ideal location for such projects. Such locations have enough roof area for PV modules to provide 100 percent RE charging of buses, when used in combination with lithium batteries in containers for storage.[27]

In China, limited efforts related to EV-RE integration have in most cases not involved many EVs. For example, State Grid has been involved in a demonstration in Beijing known as Gaoantun Electric Vehicle Charging and Battery Replacing Station, which began operation in March 2012. The demo was constructed as a battery exchange station. The power is from municipal solid waste generated power and solar PV. There are 1,044 vehicle charging poles with a total capacity of 10, 080 kW at the station. Yet, despite such impressive scale, so far there are almost no vehicles using the station. It was built quite far from center city and is rarely used. In Xian, at the city's International Horticultural Exhibition, there is a demonstration combining PV, battery storage, and vehicles. Yet, in the end, it turns out the EV charging station that is part of this demo is not powered by the RE micro-grid and instead is powered by the main grid. And, as in Beijing, because the location is far from the city, it is rarely used to charge EVs. These two demos present a common issue in that the RE micro-grids are located far from central areas of the city, in places where EVs rarely go. Operation of the Xian demo began in 2011. It was set up by Shaanxi Electric Power Company.

<u>Current situation in the project's demo cities</u>: The project will be conducting demos on EV-RE integration and related foundational aspects in Yancheng, Jiangsu Province, and Shanghai. The baseline situation (present situation before project launch) in each city is discussed below.

Yancheng: Yancheng is known for its wind power resources. The city currently has substantial land-based wind power generation capacity and plans for development of offshore wind capacity. In 2015, the RE power (mostly wind) generated in Yancheng was equivalent to 16 percent of the power used by the city. This number is expected to increases to 20 percent in 2016. The municipal government is very enthusiastic and supportive of RE power development. Yet, currently, as mentioned, about ten percent of Yancheng's generation of wind power is curtailed due to inability of the grid to make use of it. In practice, this means that the grid company asks local wind farms to disconnect a certain number of their turbines from the grid.

Yancheng is also proactive in developing new energy vehicles (with activities in both EVs and fuel cell vehicles) and renewable energy. The city's economic development zone has set up an NEV Park, to which they hope to attract more and more companies over time. Yancheng already has a strong auto industry ecosystem in that the Korean multinational Kia has set up its China manufacturing facilities in Yancheng, where it manufactures about 600,000 vehicles annually for the China market. Many Kia suppliers have come to Yancheng to be near Kia's plants there. Kia has produced some test model EVs in Yancheng and plans to sell EVs commercially in China by the end of 2016. Aoxin is a new, NEV-focused company based in Yancheng, producing both EVs and fuel cell vehicles. Aoxin focuses on radically different design, with an emphasis on lightweight materials.

[27]PPG team interview with BYD Americas, May 2016.

Yancheng also has subsidiaries of leading Chinese renewable energy equipment providers. Trina Solar, China's largest PV module manufacturer, has recently set up a facility in Yancheng with an annual production capacity of 600 MW of solar panels. (Trina PV module capacity at its headquarters in Changzhou is 3.5 GW.) Goldwind, China's largest wind turbine producer has a micro-grid development subsidiary that has done a project in Yancheng. The micro-grid project integrates wind and PV into a micro-grid and sells the power to a manufacturing facility next door at a price lower than the facility pays to the grid for power. There are no EVs integrated into the micro-grid at present.

The City of Yancheng has begun to put efforts into developing an EV fleet. The total fleet belonging to the city numbers 230 EVs, of which delivery trucks are the most numerous. Broken down by type of vehicle, there are 200 delivery truck EVs, ten electric buses, and 20 electric sedans. Many of these EVs park at night in the same government building parking lot.

Shanghai: Shanghai, as has been noted, is the Chinese city with the largest electric vehicle fleet. In contrast to the situation in some other countries where EV owners are attracted by the novelty or environmental responsibility aspects of EVs, individual EV sedan owners in Shanghai often indicate that they are attracted by the preferential policies that make an EV cheaper for them than an ICEV. This may not be true in all other Chinese cities, but in Shanghai, elimination of the auction fee for purchasing a license plate, in combination with other benefits, such as waiving of taxes and national and local subsides, can make a small domestically manufactured EV an economic option. Shanghai had 55,712 EVs as of the end of 2015. This compares to the second ranked city, Shenzhen, which had 34,361, and Beijing, which had 32,805. Analysis during the PPG stage of this project shows that Shanghai's polices to promote EVs are comprehensive and effective in promoting EV sales. Shanghai is also the most proactive city in monitoring and studying its EV fleet. The city has a dedicated EV monitoring center, located within Shanghai International Auto City (SIAC), for this purpose. The monitoring center collects information on which EVs are in use or charging at any given time and which charging poles are being used.

Shanghai International Auto City is an important player in Shanghai's EV promotion. SIAC is promoting EVs in the city via car sharing (hourly rental), car rental, and bus rental. Currently (before launch of this project and at the end of August 2016), SIAC has 1,650 EVs in total. These consist of 1,600 passenger cars used for car sharing (hourly rental) or daily rental and 50 e-buses, also used for rental. SIAC also runs an EV test driving site. The company is located in Jiading, a district of Shanghai known for its auto industry. Jiading is also an important center of Shanghai's EV promotion.

Baseline scenario: The baseline scenario is the scenario at the end of the targeted duration of the project (2017-2019) that would occur were there to be no project. To date, China has had little progress in EV-RE integration, with the projects that have occurred failing to deliver substantial demonstration results. Also, aside from this proposed project, there is no other significant organized effort to promote EV-RE integration and foundational areas in a comprehensive way. (Foundational areas are those that would support EV-RE integration, such as smart charging and V2G.) In the absence of the proposed project, then, it is expected that at the end of 2019, little progress will have been made in EV-RE integration and related foundational areas. There will continue to be no substantial and successful demonstrations of EV-RE integration, smart charging, and V2G in China. Some GHG emission reductions will continue to be achieved by the replacement of ICEVs with EVs. Yet, because grid power will continue to provide charging for all but a few EVs in China, GHG emission reductions will be much less than they might be otherwise.

In terms of policy, in the baseline scenario, China, despite copious policies related to EVs, will continue to lack policies that specifically promote and regulate EV-RE integration and related, foundational areas. China will also continue to lack roadmaps and plans for EV-RE integration at both the national and local levels. And, it will continue to lack many of the standards needed for successful EV-RE integration.

In this kind of baseline scenario, the policymakers in the government entities that are relevant to EV-RE integration will continue to have a low awareness of this area and related foundational areas. They will remain unconvinced of the feasibility of initiatives related to EV-RE integration. And, there will be little coordination among the relevant government entities on topics related to EV-RE integration.

The general public and companies in relevant industries will also continue to lack awareness of the topic of EV-RE integration. Companies will also lack the knowledge that may allow them to take part in this emerging area. In the baseline scenario, the City of Yancheng and Shanghai International Auto City (SIAC) will continue to grow their EV numbers and number of fixed charging poles and stations, but will not take on a more accelerated growth path to EV expansion. It is estimated that, in the absence of the project, Yancheng's EV fleet will, by 2019, grow from 230 EVs at present to 340 EVs. This growth will consist of additions of 100 trucks and ten fleet sedans, but no taxis or car sharing/ rental sedans will be added. SIAC's fleet of EVs, in the baseline scenario, will grow from 1,650 at the end of August 2016 to 6,200 in 2019. The additions will consist of 4,400 sedans for the car sharing/ rental business and 150 e-buses. In the baseline scenario, neither Yancheng nor Shanghai will demonstrate EV-RE integration on significant scale. Shanghai will continue to have a few charging stations that boast PV panels, but these will continue to be such that PV provides only a small portion of total EV charging power used at the station.

Baseline projects: In addition to the gradual growth of Yancheng and Shanghai's EV fleets in the baseline scenario between 2017 and 2019, there will be other relevant "baseline projects" carried out during this period. Here, baseline projects are defined as those relevant to the proposed project, but independent of that project. A critical and very large-scale baseline project is China's EV demonstration promotion program, which is officially designated to encompass 39 cities and areas, with a total of 88 cities in all. This program will continue to promote EV uptake between 2017 and 2019. Yet, if the environmental benefits of EVs do not improve from the current level obtained with EVs charging from a fossil fuel dominated grid, policy makers may lose confidence in this program in the long run. Another baseline project, especially important to the proposed project, is the China EV R&D Project (formally named "Vehicle Technologies in China"), being carried out by CICETE (an institution under China's Ministry of Commerce), China's Society of Automotive Engineers (SAE), and UNIDO, which is a two-year project. Its second year will overlap with the first year of the proposed project. The R&D project is considered a partner project to the proposed project. Synergies between the two projects have already been leveraged during the proposed project's PPG phase, in which research and analysis from the R&D project were used in design of the GEF project. The R&D project addresses the promotion of China's EV sector more generally, rather than EV-RE integration in particular.

A.1.3 Proposed Alternative Scenario, GEF Focal Area Strategies, and Description of Expected Outcomes and Components

This subsection first introduces the overall vision of intended project results. This is the "alternative scenario," in which the project is carried out and results in a different situation than if it had not been carried out. The subsection then reviews the project's fit with GEF focal areas strategies. The next part, the main part of the sub-section, describes the project framework, including the project's goal, objective, outcomes, outputs, and activities. The outcomes, outputs, and activities are divided into four components. For each component, a summary description is provided and then followed by a detailed listing of outputs and activities. Review of the component summaries alone may be useful to the reader who does not wish to review the activities in detail. This sub-section closes with comments on changes in the framework from the original version presented in the PIF. Details on such changes can be found in Annex I.

Alternative scenario - overall vision of project results: In the alternative scenario, by the end of 2019, EV-RE integration has been firmly established as a field in China and a priority area for development. Successful demonstrations of smart charging with the main grid and of RE micro-grids featuring EVs, secondary use of retired EV batteries, and building loads have convinced policy makers of the economic and technical viability of EV-RE integration. In the case of smart charging, successful demonstration has paved the way for plans to use smart charging to integrate larger amounts of renewable energy into the power grid and reduce curtailment of wind power. V2G has also been well-demonstrated, resulting in plans for expanded demonstration and use. Greenhouse gas emissions reductions, particularly from smart charging facilitating the uptake of more renewable energy by EVs and from RE micro-grid charging of EVs, are achieved and verified. Because of the success of the project pilots, policy makers are further encouraged to continue with China's 88 city NEV demonstration program and begin to look for ways to incorporate EV-RE integration into that program.

Many new policies, plans, and standards (adopted or in the approval pipeline) are creating a conducive environment to the orderly expansion of EV-RE efforts in China. There are incentive policies and regulations to promote and regulate:

balancing of load and power demand, smart charging, V2G, use of RE micro-grids to charge EVs, and the uptake of power from grid-based large-scale RE installations by EVs. Chinese officials have reached consensus at the national level on a road map for EV-RE integration. Shanghai and Yancheng, as well as six other localities, have adopted comprehensive local-level EV-RE integration plans. Institutionally, the government is moving towards a cross-institutional mechanism to ensure the accelerated and smooth development of EV-RE integration.

Awareness and knowledge among policymakers, the public and relevant companies about EV-RE integration and foundational areas is substantially increased. Policy makers feel equipped to understand demo results and design EV-RE plans for their own cities. Many members of the general public become conversant about EV-RE integration and are positive about it. Companies become interested in the market related to EV-RE integration and begin to participate in relevant initiatives.

Overall, China becomes a leader in the EV-RE integration field. Other countries learn from China's experience; and China begins to cooperate with other countries in EV-RE integration. Given the rise in confidence in EV-RE integration among Chinese government officials, plans begin to be made to use EV-RE integration to incorporate greater amounts of large-scale RE into the grid. In addition, micro-grids suppling RE power to EVs and buildings and making use of secondary EV batteries begin to proliferate in China.

Fit with GEF focal area strategy: The project is proposed under the GEF climate change mitigation ("CCM") focal area. The relevant focal area strategy is CCM-2, Program 3, "promote integrated, low-carbon systems." CCM-2, Program 3, according to *GEF 6 Programming Directions*, "targets urban interventions with significant climate change mitigation potential, to help cities shift towards low-carbon urban development." The project is a strong fit for this focal area strategy, as it integrates two key aspects of urban energy use, transport and electric power. And, it enables the integration of renewable energy into both at a much larger scale than seen to date. While including national level policy work, the project also puts strong emphasis on capacity building for city-level officials and on the design of city-level plans for EV-RE integration. The focal area outcome associated with this program that the project targets are: "B. Policy, planning, and regulatory frameworks foster accelerated low GHG development and emissions mitigation."

Description of Expected Outcomes and Components: This subsection presents the full project framework including: goal, objective, components, outcomes, and detailed activity descriptions. To achieve its aim of holistically promoting EV-RE integration in China, the project is organized into four components: (1) policy related to EV-RE integration, (2) capacity building for government officials on EV-RE integration related topics, (3) demonstration and monitoring of EV-RE integration demos, and (4) awareness raising and knowledge enhancement for the public and relevant companies on topics related to EV-RE integration. To facilitate identification of the project framework within the long text of this document, a line of asterisks is included atop the framework and following its end. Within the text for the framework, a summary of each component is given. Reviewing these component summaries, located at the top of the text associated with each component, may be useful for the reader who wishes first to get an overall picture of the project before diving into the details. The project demos are a key aspect of the project. While demo activities are outlined under Component 3, a much fuller treatment of the project demos is included in Annex E, *Detailed Demo Descriptions*, attached to this document.

Project Objective

Objective: Facilitation and scale-up of the integrated development of electric vehicles (EVs) with renewable energy (RE) in China.

Project Components, Outcomes, Outputs, and Activities

Component 1: Policies and Programs: Component 1 will focus on developing policy recommendations, technical standards, and plans at the national and local levels to promote the integration of electric vehicles with renewable energy in China. Targeted national level policy instruments will include: (1) a national level roadmap for EV-RE integration, (2) policies to promote the use of EVs for balancing power load with available power generation, (3) incentives for renewable energy based changing of EVs (including charging of EVs both via RE micro-grids and via large-scale grid connected RE), and (4) incentives to make use of batteries that have been retired from EVs. Targeted national-level standards will include those for: (1) energy management centers to control the timing of charging of EVs and V2G transmissions, (2) EV smart charging equipment, (3) V2G equipment, (4) use of batteries that have been retired from EVs, (3) mobile EV charging station vehicles, and (5) RE micro-grids set up to charge EVs. Also at the national level, the component will aim, within the nation's carbon trading framework, to propose rules for allocating carbon credits for the charging of EVs with RE. Local level EV-RE integration plans for the project's demo cities, including but not limited to replication and scale-up of the demos will be developed. Local level EV-RE plans for other cities across China, including but not limited to replication of the project demos, will also be developed. Finally, Component 1 will include the design and promotion of an institutional plan to establish responsibilities of and coordination among various government organizations for EV-RE integration.

<u>Outcome 1: Drafted and recommended policies, technical standards, and guidelines that provide regulatory and planning elements, leading to the higher adoption of EV-RE integration schemes by city governments, vehicle manufacturers, and consumers, thus resulting in GHG emission reductions.</u>

<u>Output 1.1</u>: Recommended national-level policy instruments for the integration of electric vehicles (EVs) with RE available to government agencies for their consideration.

<u>Output 1.1A</u>: National level roadmap to facilitate effective EV-RE integration and scale up that attains consensus among stakeholders.

Activity 1.1A.1: Research/analysis for and design of a national level roadmap for the integrated development of EVs with RE. The national roadmap will cover technical, policy, and implementation aspects. It will include five-year and ten-year targets, as well as a 15-year vision.

Activity 1.1A.2: Conducting of one-on-one meetings with individual government decision-makers on the national level roadmap for EV-RE integration (as developed via Activity 1.1A.1). The purpose of the meetings will be to present the draft roadmap, seek feedback for revisions, and reach consensus on a finalized version.

Activity 1.1A.3: Submission of the finalized national level roadmap for EV-RE integration to relevant ministries.

<u>Output 1.1B</u>: Suggested policies and framework that promote balancing of grid load with power generated via utilization of EVs, thus providing a foundation for scale up of EV-RE integration.

Activity 1.1B.1: Conducting of relevant research and analysis on load balancing and potential smart charging related regulations, including a review of domestic and international experience. Design of policy guidelines and incentives regarding EV smart charging and EV smart charging infrastructure.

Activity 1.1B.2: Conducting of relevant research and analysis on potential policies for energy management centers for managing EV integration with the grid. Design of regulations and incentives for establishing energy management centers to manage use of smart charging and V2G technologies for load balancing.

Activity 1.1B.3: Conducting of relevant research and analysis in preparation for designing of legislation related to use of EVs or retired EV batteries to sell power back to the grid. Research may include but not be limited to review of domestic and international policies and regulations in this area. Design of policies that enable EVs (via V2G) or distributed power sources related to EVs (e.g. retired EV battery systems or RE micro-grids developed to charge EVs) to sell power back to the grid at an attractive price. Market access (e.g. grid access) and pricing mechanisms for EVs (or distributed power sources related to EVs) developed under this activity will be tested in the Shanghai and Yancheng demos of this project. The V2G pricing mechanism will take into consideration technical and economic analysis of V2G conducted under Activity 3.5B.1.

Activity 1.1B.4: Conducting of relevant research and analysis related to V2G incentive policies. Design and recommendation of policies to incentivize V2G, including policies specific to both large fleets and individual vehicle owners. Technical and economic analysis on V2G will be undertaken to inform design of recommended policy in this activity, as well as to inform the pricing scheme and grid access mechanisms developed under Activity 1.1B.3. For individual vehicle owners, policies will include a third-party mechanism to lower the transaction costs associated with potentially millions of individual household EVs in the future each supplying small amounts of electricity to the grid via V2G. Incentive policies designed in this activity will be in addition to and distinct from the attractive pricing methodology designed under Activity 1.1B.3. That is, rather than being based on attractive pricing, these policies will adopt other types of incentive measures, such as tax breaks and subsidy-based rebates.

Activity 1.1B.5: Conducting of one-on-one meetings with individual government decision-makers to encourage their consideration of proposed policies via the following process: (i) present suggested policies from Activities 1.1B.1, 1.1B.2, 1.1B.3, and 1.1B.4 to regulate and promote EVs as a means of balancing electric power generation and load, (ii) receive feedback for revisions, and (iii) build consensus on policy recommendations. These one-on-one meetings with decision-makers will be integrated with those of Activity 1.1C.4 and Activity 1.1D.3 when appropriate.

<u>Output 1.1C</u>: Proposed national-level policies to regulate and incentivize systems for the charging of EVs with RE, including those integrating either RE micro-grids or grid-based large-scale RE installations.

Activity 1.1C.1: Analysis, design, and local-level testing in project demo cities of regulations to manage RE-based micro-grids that are established for the purpose of charging EVs. The regulations will cover protocols for the submission for approval of RE micro-grid based EV charging systems, specifications for their construction, and procedures for their inspection. Following local level testing, national level regulations will be designed.

Activity 1.1C.2: Analysis, design, and local-level testing in project demo cities of incentive policies for RE-based micro-grids that are established for the purpose of charging EVs. Following local level testing, national level incentive policies will be designed.

Activity 1.1C.3: Analysis, design, and local-level testing in project demo cities of incentive policies for grid-based smart charging of EVs that achieves reduction of peak power demand specifically related to large-scale grid-connected RE installations. This will include, in particular, incentive policies for smart charging of EVs that makes use of RE power in certain locations and at certain times that previously was (or otherwise would in the future be) in excess of demand. Following local level testing, national level incentive policies will be designed.

Activity 1.1C.4: Conducting of one-on-one meetings with individual government decision-makers to encourage their consideration of proposed policies via the following process: (i) present policies designed in Activities 1.1C.1, 1.1C.2, and 1.1C.3 to regulate and incentivize systems for the charging of EVs with RE, including those integrating either RE micro-grids or large-scale grid-based RE installations, (ii) receive feedback for revisions, and (iii) build consensus on final drafts. These one-on-one meetings with decision-makers will be integrated with those of Activity 1.1B.5 and Activity 1.1D.3 when appropriate.

<u>Output 1.1D</u>: Proposed national-level policy instruments to regulate and incentivize use of retired EV batteries, which may play a key role in large-scale EV-RE integration.

Activity 1.1D.1: Conducting of research and analysis related to guidelines for secondary use of retired EV batteries. Design of guidelines for secondary use of retired EV batteries. Proposed guidelines will be based on technical and economic analysis of secondary use of retired EV batteries and will draw on, but not be limited to, technical guidelines for retired EV battery refurbishment and maintenance developed under Activity 3.5C.3.

Activity 1.1D.2: Conducting of relevant research and analysis related to incentive policies for use of retired EV batteries. Design of incentive policies for use of retired EV batteries.

Activity 1.1D.3: Conducting of one-on-one meetings with individual government decision-makers to encourage their consideration of proposed policies via the following process: (i) present the guidelines and incentive policy designed in Activities 1.1D.1 and 1.1D.2, respectively, to guide and incentivize the use of retired EV batteries as a basis for future scale-up of RE-EV integration, (ii) receive feedback for revision, and (iii) build consensus on final drafts. These one-on-one meetings with decision-makers will be integrated with those of Activity 1.1B.5 and Activity 1.1C.4 when appropriate.

Output 1.2: Issuance of technical standards and specifications facilitating EV-RE integration and scale up, including those for smart charging systems, vehicle to grid (V2G) systems, mobile charging systems, and use of retired EV batteries.

Activity 1.2.1: Conducting of an international workshop on international standards and specifications related to EV-RE integration. Participants will include relevant foreign manufacturers and international organizations that establish and/or implement such standards and specifications.

Activity 1.2.2: Research and design of standards and specifications for energy management centers (for large-scale EV-RE integration via load management), including standards and specifications for communication protocols among the grid, the charger, and the EV.

Activity 1.2.3: Research and design of standards and specifications for smart charging systems, including technical and safety aspects.

Activity 1.2.4: Research and design of technical standards and specifications for V2G systems. The international practices in these areas will be synthesized to benefit this activity.

Activity 1.2.5: Research and design of standards for uses of retired EV batteries, including: (i) standards for categorizing retired EV batteries; (ii) standards for safety, measurement, and testing of retired EV batteries; and (iii) standards to determine when EV batteries should be retired from EV use. This work may build on data collected and analysis conducted as a part of the retired EV battery work of Output 3.5.

Activity 1.2.6: Research and design of standards for mobile charging systems, including technical specifications, safety requirements, and defining features of mobile charging station vehicles.

Activity 1.2.7: Research and design of safety and technical standards, especially with regard to the fire protection system, for distributed RE systems that serve as charging systems for EVs.

Activity 1.2.8: Conducting of: (i) one-on-one meetings with individual decision-makers and (ii) a seminar to present standards and specifications, seek input, and build consensus and industry acceptance of the draft standard designs resulting from Activity 1.2.2, Activity 1.2.3, Activity 1.2.4, and Activity 1.2.5, Activity 1.2.6, and Activity 1.2.7. The seminar will be distinct from and precede the meetings held to publicize standards to industry via Output 4.1C, once the standards have been adopted.

Output 1.3: Recommendations presented to transport sector authorities for incorporation of incentives for EV charging with RE in transport sector national carbon trading policies, including carbon trading rules for EVs powered by RE, to promote greater adoption of RE in the grids supplying electricity to EVs.

Activity 1.3.1: Review and assessment of international experience and plans for carbon trading based on carbon dioxide emission reduction achieved via EV use, particularly that achieved via charging of EVs with RE.

Activity 1.3.2: Within the framework of the national carbon emission trading system, design of rules for carbon dioxide emission reduction credits achieved via charging EVs with RE in China, thus promoting the charging of EVs with RE.

Activity 1.3.3: Conducting of one-on-one meetings with government decision makers on the proposed national carbon trading rules for EVs charged with RE, as designed via Activity 1.3.2. The meetings will aim to: (i) present the proposed system, (ii) gather feedback for revision, and (iii) build consensus on finalized version.

Output 1.4: City-level RE-EV integration and scale up plans, including replication plans for the adoption of best models demonstrated in Shanghai and Yancheng.

Activity 1.4.1: Preparation of comprehensive scale-up plans for EV-RE integration for each of Shanghai and Yancheng. Plans will go beyond the scale of the project demos to encompass additional locations in each city and include five-year, ten-year, and 15-year targets. Scale-up plans will consider results of monitoring and evaluation of project demos under Output 3.5. Plans to include: (i) distributed RE micro-grids either to charge EVs directly or to provide a significantly larger share of RE to the grid (than previously provided) for grid-based integration of RE with EV charging; (ii) the building of smart charging infrastructure (including both an increased number and density of smart charging stations and the establishment of energy management centers to ensure EVs promote peak shaving and valley filling with regard to the electric load); (iii) scale up of EV fleets in synchronization with plans for scale up of grid-connected large-scale RE installations (and RE micro-grids dedicated to EV charging, as mentioned previously); (iv) use of retired EV batteries in facilitating EV-RE integration; and (v) local EV-RE policy to stimulate progress in each of the foregoing areas.

Activity 1.4.2: Organization and carrying out of city-level discussions on, revisions of, and eventual consensus building on the city-level EV-RE scale-up plans for each of Yancheng and Shanghai, as drafted under Activity 1.4.1.

Activity 1.4.3: Design of city-level EV-RE integration plans for cities other than Yancheng and Shanghai that replicate the project demos. Like the Shanghai and Yancheng EV-RE plans, these plans will be much broader than the demos alone, including city wide five-year, ten-year and 15-year targets and local level policy plans. The city-level plans will be tailored to the specific situations of the selected replication cities. Identification of replication cities and initial ideas for design of their replication plans will be developed during the training of local-level officials in Output 2.1. This activity (Activity 1.4.3) will then assist in elaborating the initial ideas and plans prepared at the training events.

Activity 1.4.4: Organization and carrying out of city-level discussions of, revisions of, and eventual consensus building on the city-level EV-RE plans for cities other than Yancheng and Shanghai.

<u>Output 1.5:</u> Proposed institutional plan to establish responsibilities of and coordination among various government organizations for EV-RE integration.

Activity 1.5.1: Based on consultations with central government entities responsible for transport, autos, and electric power, preparation of a draft institutional plan that will clarify the responsibilities of each relevant government agency in the development and promotion of EV-RE integration. The plan will also consider where the responsibility for leading EV-RE integration lies at the highest levels of government. It will also recommend coordination among relevant agencies and proposed mechanisms, such as the establishment and periodic meetings of a cross-institution government working group on EV-RE integration.

Activity 1.5.2: Promotion of institutional plan for EV-RE integration to relevant government decision makers and consensus building on plan. Once the plan is drafted via Activity 1.5.1, one-on-one meetings will be held with individual government decision makers to secure their feedback and build consensus on the plan.

Component 2: Government Institutional Capacity Building: Component 2 will focus on increasing the awareness, knowledge base, and capacity of national and local level Chinese government officials in areas related to EV-RE integration. It will also aim to gather their feedback and gain consensus as a group on various policy instruments designed under Component 1. Component 2 will include a training program for 100 city level policy makers, that covers policy instruments developed under Component 1 and guides these policy makers in preparing city level EV-RE integration plans that replicate the project demos. In addition, a series of three workshops for national-level policy makers and other stakeholders conducted under Component 2 will aim to gather feedback and achieve group consensus on the following items designed under Component 1: (1) the draft national EV-RE integration roadmap (first workshop), (2) the draft policies and standards related to EV-RE integration (second and third workshops), (3) and the draft rules for allocating carbon credits for EVs using RE (fourth workshop). Component 2 will also promote learning from international experience and international exchange regarding EV-RE integration. It will do this through a study on international developments in EV-RE integration and through two international forums on EV-RE integration. Finally, under Component 2, briefing materials and an online-information base will be prepared with the aim of raising policy makers' understanding of EV-RE integration and related issues. A strategic plan to disseminate these materials to policy makers will be designed and implemented.

Outcome 2: Increased institutional capabilities and awareness of policymakers at national and local levels on the use of integrated EV - SG (Smart Grid) - RE systems.

Output 2.1: Training program for 100 city-level policy makers on EV-RE integration policies and demonstration experience.

Activity 2.1.1: Preparation of training materials on city-level EV-RE integration, encompassing: (i) findings of evaluation of demo results (Output 3.5); (ii) findings on international practices and experiences (Output 2.3); (iii) the national roadmap, policy/regulations, carbon trading with EV-RE systems, and standards results of the project's policy component (Outcome 1); and (iv) guidance for preparing city level EV-RE integration plans. This activity will also include preparation of a test to assess training session attendees' mastery of presented materials.

Activity 2.1.2: Carrying out of training sessions using training materials developed in Activity 2.1.1 to train 100 city-level policy makers and policy influencers in EV-RE integration and its scale up. Trainees will be mainly city-level officials and practitioners who will potentially play a role in EV-RE integration planning and implementation in their own cities. During the training, trainees will prepare initial ideas for: (i) replication in their cities of the project's demos and (ii) broader EV-RE integration plans. These preliminary ideas for demo replication and city-level EV-RE integration plans will be taken through the full design and approval stages via Activity 1.4.3 and Activity 1.4.4. Finally, this activity will also include administration of the test designed in Activity 2.1.1 at the end of training session to determine whether trainees achieve mastery of presented materials.

Output 2.2: Four workshops conducted to validate the EV-RE integration policy and planning framework.

Activity 2.2.1: Conducting of a workshop for policymakers on the national level technical, policy, and implementation roadmap for the integrated development of EVs with RE. The workshop will aim to educate attendees on EV-RE integration, stimulate discussion on the roadmap produced by Activity 1.1A.1, and reach consensus on a revised version. Attendees will be mainly national-level officials, relevant experts, and local officials from the project's two demo cities, Shanghai and Yancheng. Workshop will include an end-of workshop survey to determine level of consensus on revised version of draft roadmap.

Activity 2.2.2: Conducting of two workshops for policy makers ("Part I" and "Part II") to cover the policy framework developed under Outputs 1.1B, 1.1C, and 1.1D and the standards framework developed under Output 1.2. The policy framework includes: (i) policies to regulate and incentivize EVs' potential role in balancing electric power generation and load; (ii) policies to regulate and incentivize the charging of EVs with RE, including power from both RE micro-grids and grid-based large-scale RE installations; and (iii) guidelines and incentive policy for the use of retired EV batteries as a basis for scale-up of RE-EV integration. For each of these three areas, the relevant recommended policies and guidelines will be presented and discussed, feedback sought, and consensus built on final recommended policies and guidelines. The standards framework will include: (i) standards for energy management centers (for large-scale EV-RE integration via load management); (ii) standards for smart charging; (iii) standards for V2G systems; (iv) standards for use of retired EV batteries; (v) standards for mobile charging station vehicles; and (vi) safety and technical standards for distributed RE systems used to charge EVs. For each of these six areas, the relevant draft standards will be presented. Feedback gathered from industry and other technical stakeholders on the draft standards via Activity 1.2.8 will be presented. Finally, consensus will be built on draft standards. Each workshop will include an end-of workshop survey to determine level of consensus achieved on revised versions of policies and standards.

Activity 2.2.3: Conducting of a seminar on the recommended rules within the national transport sector carbon trading framework for carbon dioxide emission reductions achieved via charging EVs with RE, as designed via Activity 1.3.2. The seminar will aim to: (i) present the proposed transport sector carbon trading rules for EVs charged with RE; (ii) gather feedback; and (iii) build consensus on a finalized version. The seminar will include an end-of workshop survey to determine level of consensus on revised version of trading system. Transport sector authorities and experts working on China's carbon trading system will be included among those attending the seminar.

Output 2.3: International forums with participants from central government agencies and EV demonstration cities that disseminate international developments in and plans for EV-RE integration.

Activity 2.3.1: Preparation of a study on international developments and plans in EV-RE integration. The target audience of the study will be Chinese policy makers at the national and local levels.

Activity 2.3.2: Conducting of two international forums on EV-RE integration, one when the project is about half completed (halfway through Year 2 of implementation) and one towards the project's end (end of Year 3 of implementation). Findings from the study on international developments in EV-RE integration (Activity 2.3.1) will be presented. Cities from other countries with EV-RE practices, as well as international experts, will be invited to share their experience. At the same time, results to date from the project demos in Yancheng and Shanghai, based on the most recent reporting of Output 3.5, will also be presented.

Output 2.4: Written materials on EV-RE integration strategically disseminated to policy makers.

Activity 2.4.1: Preparation of succinct briefing materials on key EV-RE integration topics for high-level and mid-level government officials. Briefing materials will be based on technical and economic data and analysis of EV-RE integration from the project demos (as prepared for Output 3.5) and on findings on international work in EV-RE integration as prepared for Output 2.3. The aim will be to produce crystallized high-level briefing materials for the highest levels of government (very short, concise documents) and mid-levels of government (somewhat more detailed versions). Information on the proposed national EV-RE integration roadmap and recommended policies and regulations, standards, and transport sector carbon trading system rules for EVs charged with RE as developed in Outcome 1 may also be included. The main focus of the prepared briefings, however, will be to inform officials of the technical and economic feasibility and benefits of EV-RE integration.

Activity 2.4.2: Development and implementation of strategy for conveying information covered in prepared briefing materials (Activity 2.4.1) in the most impactful way to the highest levels and mid-levels of the Chinese Government. Activity should confirm which and how many officials at mid-level (e.g. division chief in a ministry) and at high level (department director or higher) have reviewed and understand the contents of the briefing materials.

Activity 2.4.3: Preparation of centralized online information base and detailed information notebooks on EV-RE integration for relevant working level officials. The policy briefings of Activity 2.4.1, the international study of Activity 2.3.1, and the detailed reports on various aspects of the demos as prepared for Output 3.5 will be included in the information base. Also included will be the proposed national EV-RE roadmap, policies, and standards designed under Outcome 1. Materials in the information base will be presented in a clear and organized fashion on a publicly accessible website. For policy makers especially interested in detailed information to facilitate their work, key materials will also be printed and organized into notebooks.

Activity 2.4.4: Strategic dissemination of EV-RE integration information base prepared under Activity 2.4.3. Work will be done to ensure that a wide group of relevant policy makers are aware of how to access the online information base and that those with strong interest receive hard copy versions of the EV-RE integration information notebooks.

Component 3: Piloting of Technical Measures and Commercialization Approaches (Project Demos): Component 3 will focus on demonstrating and testing various technical and commercial aspects related to the integration of EVs with RE in the cities of Yancheng and Shanghai. Each city will demonstrate integration of EVs with the power grid via smart charging as key foundational work needed to achieve large-scale EV-RE integration. Each city will also demonstrate integration of EVs with RE in RE micro-grids and include V2G functionality in its micro-grid demonstration. In addition to EVs and RE power systems, the micro-grids will include use of retired EV batteries for storage and a building (or manufacturing facility), which will, in addition to the EVs, serve as a load for the system. Further, each city will demonstrate the establishment of energy management centers to control EV smart charging and V2G, as well as similar processes for retired EV batteries being used as storage. The two cities will also demonstrate conditions and business models that can stimulate the scale-up of China's EV fleet, thus laying the ground work to realize the benefits of EV-RE integration on substantial scale. This will include demonstration of scale-up of a car sharing fleet and bus rental fleet in Shanghai and scale-up and increased concentration of stationary charging stations in Shanghai. Yancheng will demonstrate scale-up of its EV fleet, including a large fleet of trucks used for logistics. In addition, the development of mobile charging station vehicles, which use retired EV batteries, will be demonstrated in Yancheng. The component will, in addition, include monitoring and evaluation of the project demos, covering the following aspects: (1) EV smart charging, (2) RE micro-grid charging of EVs, and (3) use of batteries retired from EVs. Monitoring and evaluation of use of batteries retired from EVs, in addition to basic monitoring, will include testing and data collection on safety aspects; development of technical guidelines for refurbishment, maintenance, and repair of retired EV batteries; and technical and economic analysis of various uses of retired EV batteries. While this component is designed to cover demos in Yancheng and Shanghai only, there is significant enthusiasm for this project in China. Thus, if one or two other cities are ready to join with quality EV-RE demonstration plans and sufficient co-financing by the time of project inception, they may be added. Project proponents are currently in discussions with the City of Tianjin regarding such a possibility.

<u>Outcome 3: Two city-scale projects piloted, demonstrating the integration of EVs and RE, as well as other foundational work needed to achieve large-scale EV-RE integration</u>.

Component 3 Investment Outputs

<u>Output 3.1</u>: Demonstration of integration of EVs with the power grid, needed as basis for EVs eventually to address intermittency issues of large-scale RE power incorporation into the grid.

Activity 3.1.1: Design and planning of smart charging systems for Shanghai and Yancheng, including procurement of needed equipment and software. (Systems will make use of energy management centers developed under Output 3.4.) The purpose of the systems will be to demonstrate the equipment and know-how for EV smart charging and intelligent charging management, so that EVs can play a role in "shaving the peaks and filling the valleys" of the electric grid created by variability of the amount of power supply and demand throughout each day.

Activity 3.1.2: Testing and implementation of smart charging systems in Yancheng with 1,000 smart charging poles and fleet of 1,000 EVs, including 700 trucks, 50 taxis, 10 buses, 100 fleet passenger vehicles, and 140 private or rental passenger vehicles (including those used for daily car rental and hourly car sharing), achieving intelligent charging management. System will make use of the Yancheng Energy Management Center developed under Output 3.4.

Activity 3.1.3: Testing and implementation of smart charging systems in Shanghai with 200 smart charging poles and 50 smart charging stations and fleet of 8,000 hourly car sharing passenger vehicles and 200 pure electric rental buses, achieving intelligent charging management. System will make use of Shanghai Energy Management Center developed under Output 3.4. (Note: The same vehicles will be made use of in Shanghai's micro-grid demo. Involvement in smart charging will depend on whether vehicles park at and are recharged at smart charging stations. In any one day, the number of involved vehicles is likely to be on the order of 200 – the number of smart charging poles.)

<u>Output 3.2</u>: Demonstration of technically and commercially effective RE micro-grids that enable distributed integration of EVs with RE.

<u>Output 3.2A:</u> Demonstration of integration of EVs into RE micro-grids, including demonstration of micro-grids incorporating wind, PV, use of retired EV batteries as storage, EVs, and buildings and a manufacturing facility.

Activity 3.2A.1: Establishment and implementation in Yancheng of two EV-RE micro-grids. The first micro-grid, to be demonstrated at Aoxin Company, will include 500 kW of newly established PV, 80 EVs (20 trucks delivery trucks belonging to Aoxin, 40 sanitation vehicles belonging to Yancheng's development zone, 16 passenger cars belonging to Yancheng's development zone, and 4 passenger cars belonging to Aoxin), and 79 retired EV battery packs[28]. Aoxin's

[28] While it is anticipated that retired batteries will be cheaper than new ones, in the event this is not true, new battery packs shall be purchased

micro-grid will also include a building load, consisting mainly of lighting and HVAC applications. The second micro-grid, to be demonstrated at a Goldwind company facility in the area, will enhance an existing micro-grid with the addition of EVs and retired EV batteries. The existing power sources in the Goldwind micro-grid are a 2 MW large wind turbine and a 10 kW small one, as well as 100 kW of PV. Ten EVs (passenger cars) and 16 retired EV battery packs will be added to the micro-grid. Most of this micro-grid's power will continue to be used by a neighboring manufacturing facility, but its excess power can be used to charge the EVs. The purpose of the two micro-grids will be to demonstrate EV charging by micro-grid RE. The Aoxin Micro-Grid will also demonstrate V2G (see Output 3.2B), while both micro-grids will demonstrate other uses of power, namely serving building and manufacturing energy needs.

Activity 3.2A.2: Establishment and implementation in Shanghai of ten EV-RE micro-grids, including in aggregate: 240 kW PV, up to 8,000 EVs (passenger cars used for car sharing), use of 160 retired EV battery packs[29] for storage, and a building. The purpose of the micro-grids will be to enable EV charging by RE. One of the micro-grids will also demonstrate V2G (see Output 3.2B) and other uses of power, such as serving building energy needs. (Note: While all 8,000 EV passenger cars may use the micro-grids at one time or another, it is estimated that about 90 vehicles in aggregate will charge at the ten micro-grids on any one day.)

<u>Output 3.2B</u>: Demonstration of V2G technologies and pilot commercial systems enabling EVs (or retired EV battery packs) to send power back to the micro-grid at times that it is needed.

Activity 3.2B.1: Determination of specifications for Yancheng and Shanghai V2G demos and procurement of V2G equipment for sending power from EVs to the grid. In addition to inverter connections for vehicles (when needed) and bidirectional charging stations, energy exchange and switching equipment to be utilized in EV-RE-retired EV battery pack micro-grid demos in Yancheng and Shanghai will be identified and purchased.

Activity 3.2B.2: Establishment of a pilot commercial energy trading platform and coordinated control system to facilitate V2G transactions and commands in each of the Yancheng and Shanghai project EV-RE micro-grids. The control system design will take into consideration findings of Activity 3.5B.2 on the impact of V2G on battery life.

Activity 3.2B.3: Using Yancheng and Shanghai micro-grid demos (Output 3.2A), carrying out of micro-grid V2G demonstrations. The V2G demonstrations will use equipment procured in Activity 3.2B.1. Ten vehicles will demonstrate V2G in Yancheng with ten V2G charging poles at the Aoxin Micro-Grid. Five vehicles will demonstrate V2G in Shanghai with five V2G charging poles.

<u>Output 3.3</u>: Demonstration of conditions and business models that can stimulate scale-up of China's EV fleet, thus laying the ground work to realize the benefits of EV-RE integration on substantial scale.

<u>Output 3.3A</u>: Demonstration of greater density of the EV stationary charging network, thus serving as a basis for scale-up of EV-RE integration.

Activity 3.3A.1: Scaling up of Shanghai's EV stationary charging infrastructure from its current pilot scale (4,400 poles) to 16,000 poles. A siting analysis will be conducted to ensure that charging stations and poles are established in locations at which use will be maximized. The analysis will consider existing and projected EV density, as well as driving patterns, range, charging times, and other relevant factors.

<u>Output 3.3B</u>: Demonstration of alternatives to stationary charging stations, in particular mobile charging station vehicles, to deal with emergency needs for charging, thus increasing the feasibility of EV use and thereby supporting the scale-up of EV-RE integration.

Activity 3.3B.1: Assembly, planning of spatial distribution and outreach, and operation of three mobile charging station vehicles, using retired EV battery packs[30], in Yancheng. Planning work will determine the best areas of the city for the

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[29] Comment 28 also applies, regarding the use of retired batteries
[30] Comment 28 also applies, regarding the use of retired batteries

three mobile charging station vehicles to be available in and how to ensure EV drivers are aware of and able to take advantage of the mobile charging opportunity. Mobile charging station vehicles in Yancheng will be available to serve the city's full fleet of EVs, over 1,000 of which will be involved in either the smart charging or micro-grid demos. Planning work will include a siting analysis, conducted to ensure that the mobile charging stations are available in areas at which their use will be maximized. The analysis will consider existing and projected EV density, as well as driving patterns, range, charging times, and other relevant factors. The siting analysis will also be used for the addition of 300 smart charging poles in Yancheng under the project's smart charging initiative. These new poles, in conjunction with the upgrade of Yancheng's existing 700 charging poles, will form a smart charging infrastructure of 1,000 poles.

Output 3.3C: Demonstration of business models to scale-up the number of EVs, thus laying the ground work to realize the benefits of EV-RE integration on substantial scale.

Activity 3.3C.1: Scaling up of Shanghai car sharing business model (using *EVCARD* brand fleet) from current pilot scale of 1,600 vehicles at 1,500 rental/recharging sites in Jiading District to 8,000 vehicles with 4,000 rental/recharging sites citywide.

Activity 3.3C.2: Scaling up of Shanghai electric bus rental fleet (*E-Drive* brand fleet) from 50 buses to 200 buses.

Output 3.4: Demonstration of energy management centers that collect and manage data on dispersed EVs and retired EV battery packs used as storage for the grid, so that the charge and discharge of these devices can be managed.

Activity 3.4.1: Establishment of energy management centers in each of Yancheng and Shanghai to collect data on and send control messages to the EVs involved in the smart charging demos or micro-grid V2G demos. The centers will also collect data on the retired EV battery packs involved in the micro-grid demos. This activity will include the development of software needed for a network management system to carry out the data acquisition, analysis, and control functions. This work will also involve preparation of models to predict how much EV power can be traded and how much demand for EV power comes from the grid side.

Component 3 Technical Assistance Outputs

Output 3.5: Detailed monitoring and evaluation of project demo performance, providing insights to city planners for developing EV-RE demonstration plans for their cities.

Output 3.5A: Detailed monitoring and assessment of project demos of EV integration with the power grid.

Activity 3.5A.1: Data collection, analysis, and reporting on aspects of project demos related to EV integration with the power grid. Based on findings, recommendations for city planners of best models will be prepared for: (i) Smart charging, based on the demos of Output 3.1. Cost-benefit analysis of intelligent charging systems, showing the most cost-effective way to implement them, will be conducted. (ii) Energy management centers, based on the demos of Output 3.4.

Output 3.5B: Detailed monitoring and assessment of project demos of EV-RE micro-grids.

Activity 3.5B.1: Data collection, analysis, and reporting on aspects of the project demos related to EV charging via RE micro-grids. Based on findings, recommendations will be prepared for city planners of best models for various aspects of EV charging via RE micro-grids, including best models for: (i) EV-RE micro-grid design and implementation, based on the demos of Output 3.2A. Cost-benefit analysis of such micro-grids will be conducted and business models to develop and run them profitably will be identified. (ii) V2G implementation in micro-grids, based on the demos of Output 3.2B. Assessments on reliability, costs and benefits (including cost-benefit assessment of V2G and of EVs as electricity storage devices), and suitability of available V2G technologies will be conducted.

Activity 3.5B.2: Assessment of the impact of V2G on battery life, based on experience in project micro-grid demos, and determination of V2G guidelines to reduce this impact.

Output 3.5C: Detailed monitoring and assessment of aspects of project demos related to the use of retired EV batteries, including development of know-how with regard to use of retired EV batteries so that they can be leveraged as tools of EV-RE integration.

Activity 3.5C.1: Research and assessment of cost structure of EV battery repurposing and design of plans for reducing and minimizing repurposing costs. Incorporation of plans for cost reduction into repurposing work carried out under the demos in Activity 3.2A.1 (Yancheng micro-grids with retired EV batteries for storage), Activity 3.2A.2 (Shanghai micro-grids with retired EV batteries for storage), and Activity 3.3B.1 (Yancheng mobile charging vehicles with retired EV batteries for storage).

Activity 3.5C.2: Data collection, analysis, and reporting on aspects of the project demos related to use of retired EV batteries. Based on findings, recommendations for city planners of best models for various aspects of retired EV battery use will be prepared. Analysis will include: (i) Use of retired EV batteries in micro-grids, as demonstrated in Output 3.2A. Cost-benefit analysis of micro-grid based fixed location electricity storage systems using multiple retired EV battery packs will be conducted. (ii) Use of retired EV batteries in mobile charging station vehicles, as demonstrated in Output 3.3B. (iii) Testing and analysis carried out on retired EV battery packs via Activities 3.5C.2, 3.5C.3, and 3.5.4.

Activity 3.5C.3: Monitoring of safety aspects of use of retired EV battery packs during the demos (including micro-grid demonstration of use of retired EV battery packs in Yancheng and Shanghai in Output 3.2A and mobile charging station use of retired EV batteries in Yancheng in Output 3.3B). Preparation of a safety performance database and conducting of assessment.

Activity 3.5C.4: Based on experience gained in micro-grid and mobile charging station vehicle use of retired EV batteries (Output 3.2A, and Output 3.3B), development of technical guidelines for the refurbishment, maintenance, and repair of retired EV batteries for secondary use. Guidelines will include a technical process for battery disassembly and recombination, as needed.

Activity 3.5C.5: Carrying out of a technical and economic evaluation of use of retired EV batteries. This will include a system for evaluating the life of retired EV batteries vis-à-vis different types of secondary use.

Output 3.5D: Detailed monitoring and assessment of aspects of project demos related to scale-up and increased concentration of China’s EV fleet and charging infrastructure.

Activity 3.5D.1: Data collection, analysis, and reporting on aspects of project demos related to scale-up and increased concentration of China’s EV fleet and charging infrastructure, as a basis of future scale-up of RE-EV integration. Based on findings, recommendations will be prepared for city planners of best models for various aspects of EV fleet and charging infrastructure scale-up and concentration. The evaluation will cover all business models and methods tested in the project demos for scale-up and concentration of: (i) Fixed location charging infrastructure, as demonstrated in Output 3.3A. Cost-benefit analysis of charging stations will be conducted; and profitable models for charging infrastructure will be developed. (ii) Mobile charging station vehicles, as demonstrated in Output 3.3B. Cost-benefit analysis of mobile charging station vehicle business models will be conducted. (iii) EV auto and bus fleets, as demonstrated in Output 3.3C. Assessment of commercial viability of car sharing business models will be conducted.

Component 4: Awareness Raising and Dissemination amongst Manufacturers, Suppliers, and Consumers: Component 4 will focus on raising awareness and knowledge of EV-RE integration amongst both industry and consumers. On the industry side, the component will undertake several initiatives to raise awareness and knowledge including: (1) forums for industry on EV-RE business models, technology, and demo results; (2) dissemination of project’s EV-RE information base; (3) meetings for publicizing EV-RE standards developed by the project; (4) operations and maintenance training workshops related to EV-RE integration; and (5) establishment of an EV-RE integration alliance for industry. The project will also promote exchange amongst car sharing companies and other interested parties on car sharing business models and on EV-RE integration in car sharing businesses. Initiatives to raise the awareness and knowledge of consumers about EV-RE integration will focus on: media outreach, including the TV, radio, and print and online news media; outreach to and promotion of EV clubs; and a social media campaign on EV-RE integration. Finally, the project will coordinate establishment of an EV-RE integration demonstration center in Yancheng to raise awareness and knowledge on EV-RE integration among both industry and consumers.

Outcome 4: Increased knowledge and capacity of business and consumer stakeholders,-facilitating awareness, research and development, manufacture, operation, and maintenance with regard to EV-RE integration.

Output 4.1: Dissemination of knowledge amongst industry players (vehicle manufacturers, charging equipment providers, power industry, and other relevant sectors) regarding EV-RE integration.

Output 4.1A: Forums for industry, including both domestic and international players active in the China market in the vehicle, power, and other related sectors, on EV-RE business models, technology, and demonstration results.

Activity 4.1A.1: Planning and conducting of two forums for industry stakeholders on EV-RE business models, technology, and project demo results. Planning will include strategic selection of invitees, who will include both domestic and international players from the vehicle, power, and other related sectors that are active in the China market.

Output 4.1B: Dissemination to industry of project's EV-RE information base.

Activity 4.1B.1: Development and carrying out of strategy to alert relevant organizations from industry about the project's online EV-RE integration information base prepared via Activity 2.4.3. Strategy should target organizations that can play a significant role in promoting EV-RE integration through their products and services. These organizations may include companies from the auto industry, charging station industry, power industry, and other related sectors.

Activity 4.1B.2: Preparation and targeted distribution of printed materials ("information notebooks") for industry on EV-RE integration. While targeted for the industry audience, these materials will draw from reporting on the project demos (Output 2.5), from the policy related items (from Outcome 1, with special emphasis on standards), and from information on international experience with EV-RE integration (Output 2.3). Materials may be similar to those prepared for policy makers in Output 2.4, so that synergies with that work may be leveraged in this activity. Information gathering and analysis will be carried out to determine the most strategic industry organizations and experts in industry to target for distribution of these hard-copy materials.

Output 4.1C: Meetings publicizing EV-RE related technical standards, held for vehicle OEMs, charging equipment suppliers, and other related industrial companies.

Activity 4.1C.1: Preparation and conducting of meetings on EV-RE integration related standards. The meetings will be held to publicize relevant standards to vehicle OEMs, charging equipment suppliers, and other relevant parties. These meetings will be distinct from the seminar held as a part of Activity 1.2.8 to gather industry input on the standards. The meetings of this activity (Activity 4.1C.1) will be held after the aforementioned seminar has been held and after the standards have been adopted by industry in China. This activity will include preparation and administration of a short test to attendees at the end of the meetings to determine their level of mastery of the materials.

Output 4.1D: Technical operation and maintenance workshops related to EV-RE integration aspects held for relevant industrial organizations.

Activity 4.1D.1: Preparation and holding of technical operation and maintenance workshops related to EV-RE integration aspects. Preparation work will include preparing curriculum and identifying attendees whose attendance will provide the greatest positive impact on promotion of EV-RE integration in China. This activity will include preparation and administration of a short test of attendees at the end of the meetings to determine their level of mastery of the materials.

Output 4.1E: Establishment of industry alliance or association subcommittee for promoting and advancing EV-RE integration and liaising with government on EV-RE integration policy.

Activity 4.1E.1: Development of strategy for industry alliance or association subcommittee for promoting and advancing the level of EV-RE integration and liaising with government on EV-RE integration related policy. If entity is formed as association subcommittee, possible associations for consideration include China Society for Automotive Engineers and China Electric Power Association. The strategy should consider which type of organization will have the relevance and impact need to move EV-RE integration efforts forward. The strategy will also detail the specific functions desired for the organization. Lastly, strategy will include plans for sustainability of the organization once the project is over.

Activity 4.1E.2: Setting up and obtaining approval for industrial alliance or association subcommittee focused on EV-RE integration as planned in Activity 4.1E.1.

Output 4.2: Awareness raised among current and future potential car sharing companies of various car sharing business models and integration of EVs with RE in car sharing businesses.

Activity 4.2.1: Planning and execution of an exchange workshop for current and future potential car sharing companies. The workshop will give attendees the opportunity to share ideas on business models for car sharing and to learn about and discuss how to achieve EV-RE integration within a car sharing business.

Output 4.3: Promotion of EV-RE integration to the general public by various methods to raise awareness of and interest in EV-RE integration as a means of realizing the true environmental potential of EVs.

Output 4.3A: Media promotion of EV-RE integration, raising awareness of the public regarding the need to incorporate RE into EV development to realize the environmental potential of EVs and educating the public on various aspects of EV-RE integration.

Activity 4.3A.1: Promotion of EV-RE integration via preparation and screening of a documentary on EV-RE integration. The documentary will emphasize the need for EV-RE integration to realize the environmental benefits of EVs and will introduce viewers to various technologies, business models, and issues regarding EV-RE integration. The documentary will be aired at various auto industry and environmental events. It will also be made available online. Links to the online version will be promoted via the social media campaign of Output 4.3C.

Activity 4.3A.2: Carrying out of print and online news media campaign to publicize developments in and the potential for EV-RE integration. The campaign will aim to result in numerous news articles that will promote awareness of and initiatives in EV-RE integration.

Activity 4.3A.3: Carrying out of radio media campaign targeting interviews to publicize developments in and the potential for EV-RE integration. Campaign will aim to result in sessions on radio shows to promote awareness of and initiatives in EV-RE integration.

Output 4.3B: Promotion of EV-RE integration to consumers via social organizations, increasing consumers' understanding of and attraction to the concept and related opportunities.

Activity 4.3B.1: Design and implementation of initiative to increase social attractiveness of EV user clubs in China and, via such clubs, to promote awareness and understanding of EV-RE integration. This activity will aim to increased social aspects of the EV user clubs so that potential members will be attracted to them not only by the opportunity to share information on EVs, but also by opportunities for business networking and development of new friendships.

Activity 4.3B.2: Design and implementation of initiative to promote the concept of EV-RE integration among women's groups. This activity will first involve the identification of women's groups that are promising avenues for promoting EV-RE integration, along with its environmental and potential health benefits, to women. A range of organizations, such as feminist groups and the All China Women's Federation (ACWF) will be considered. The activity will then involve the setting up and coordination of promotion of EV-RE integration to the members of these groups. This may be achieved by attendance and promotion at the groups' regularly scheduled meetings or by setting up special events for members of these organizations.

Output 4.3C: Outreach on social media platforms and cooperation with social media companies to carry out promotion of EV-RE integration.

Activity 4.3C.1: Design of social media strategy to promote and disseminate information about EV-RE integration. Strategy will consider use of platforms of and/or direct cooperation with popular online auto discussion forums, such as Autohome, and major social media channels, such as WeChat (Tencent). Strategy may include efforts to generate lively and widely read discussions about EVs generally and EV-RE integration in particular.

Activity 4.3C.2: Implementation of social media strategy to promote and disseminate information about EV-RE integration. Implementation will be based on strategy designed as part of Activity 4.3C.1.

Outputs 4.4: An EV-RE integration demonstration center in Yancheng, created to raise awareness on the topic of EV-RE integration amongst consumers, companies using EVs, and industries related to RE or EV.

Activity 4.4.1: Design and planning of content of EV-RE integration demonstration center in Yancheng. Design will take into consideration the center's purpose of raising awareness amongst consumers, companies using EVs, and industries related to RE or EVs. The main focus of the center will be on EV-RE integration, rather than on general EV concepts. With its focus on EV-RE integration, the center will raise awareness of the potential of EV-RE integration to enable a very large proportion of RE in the electric grid and the achievement of very low-carbon transport. Further, the center will provide information on the business models, infrastructure, and technical aspects that enable EV-RE integration.

Activity 4.4.2: Setting up of EV-RE integration demonstration center in Yancheng, according to design and plans of Activity 4.4.1.

Activity 4.4.3: Development of a strategy for targeting individuals and organizations to visit the EV-RE integration demonstration center in Yancheng, issuing of invitations, and hosting of visits. The strategy will consider the priorities of promoting replication of the project's EV-RE integration demos and city plans; promoting adoption of policies favorable to EV-RE integration; and promoting greater investment by industry in aspects related to EV-RE integration.

Component 5: Monitoring and Evaluation (M&E): Component 5 will focus on refining and then implementing the project's monitoring and evaluation plan. Key constituents of this plan will be: measuring of project indicators, preparing quarterly reports, preparing annual reports, holding of full project team monitoring meetings, and holding of project steering committee meetings. In addition, a mid-term review and a final evaluation of the project will be carried out by outside consultants who have not been involved in project design or implementation. As part of this component, the project will conduct some tailored activities, such as surveys necessary to determine the status of certain project indicators. It will also include activities associated with ensuring that there are no negative environmental or safety impacts associated with the project demos. Finally, once the terminal evaluation is completed, design will be carried out of and consensus reached on a plan for long-term sustainability of project achievements in RE-EV integration and for continuing to build on those results.

Outcome 5: A robust mechanism for M&E in place to ensure the attainment of project outcomes.

Output 5.1: Project monitoring plan refined and executed.

Activity 5.1.1: Refinement of project monitoring plan, including designation of timeline for: (a) measuring indicators, (b) preparing quarterly reports, (c) preparing annual reports, (d) holding full project team monitoring meetings, and (e) holding PSC monitoring meetings. The monitoring plan will consist of three main parts: First, it will include periodic monitoring of project indictors at the objective, outcome, and output levels. Indicators have been initially designed during the project formulation phase. In some cases, measurement of indicators will require special activities (such as surveys) that are included as a part of this component in Output 5.2. In addition to the monitoring of indicators, the project monitoring plan will include as its second part, higher level assessment of results involving the full project team and the project steering committee. The higher level assessment work will consist of periodic consideration as to whether the project is making good progress towards the project objective and each of the project outcomes. This higher level work will consider whether, based on lessons learned or new information gathered, the project will benefit from an adjustment of activities, outputs, and/or indicators. The higher level work will also look at project management and whether there are adjustments that need to be made to better deliver project outputs and outcomes. This higher level effort will in some ways anticipate findings of the mid-term review and, later, terminal evaluation and endeavor to achieve adaptive management. The third aspect of the monitoring plan will consist of quarterly and annual reporting.

Activity 5.1.2: Periodic gathering of data and information to update values of project indicators. Data and information sources will be those indicated as "means of verification" in the Project Results Framework. Some indicators may require separate activities, such as surveys; and these are outlined in the activities for Output 5.2. Every six months, the project should review and update all indicators. (Indicators requiring special surveys may be updated less often.) After indicators are updated, the full project team should discuss the project's progress and indicators. Discussion should address whether adaptive management should be undertaken to adjust indicators and activities in light of new findings as the project progresses.

Activity 5.1.3: Preparation of quarterly reports and annual reports on project progress. Quarterly reports will focus on activities carried out, as well as any progress towards outputs and outcomes achieved, with greater emphasis on outputs. They may also contain relevant news and updates on the status of EV-RE integration in China. Quarterly reports will be prepared every three months for a total of 12 quarterly reports over the life of the project. The annual reports will summarize progress in activities over the full year and assess progress towards outputs and outcomes, with the greater emphasis on outcomes and inclusion of findings from high level monitoring meetings.

Activity 5.1.4: Conducting of periodic monitoring meetings of the full project team and of the project steering committee to discuss whether the project is making good progress towards the project objective and each of the project's outcomes. The team and/or committee will consider whether, based on lessons learned or new information gathered, the project will benefit from an adjustment of activities, outputs, and/or indicators. They will also look at the effectiveness of project management and whether there are adjustments that need to be made to better deliver project outputs and outcomes.

Output 5.2: Data and information collected to measure certain of the project's outcome and output level indicators, as well as indicators for project's Environmental and Social Management Plan (ESMP). While determining the value of many of the outcome and output indicators may require a minimal level of effort and thus be fully handled by the project team member responsible for monitoring, determining the status of certain indicators may require separately budgeted activities, such as surveys. This output will provide for the collection of data and information needed for assessment of such indicators via separately budgeted activities.

Activity 5.2.1: Survey of city level officials involved in project's Component 2 outreach program. Survey should determine how many cities, as a result of project outreach, have developed a strong interest in learning more about and carrying out EV-RE integration work. Finding will be used in determining value of one of the indicators for Outcome 2.

Activity 5.2.2: Survey of companies involved in various aspects of project's Component 4 outreach program. Survey should determine how many companies, as a result of project outreach, have decided to dedicate greater effort to EV-RE integration. Findings will be used in determining the value of one of the indicator's for Outcome 4. Companies surveyed that have received the project's EV-RE information base materials will be asked whether they found those materials useful in developing their business plans. This specific information will be used to evaluate an indicator for Output 4.1B.

Activity 5.2.3: Monitoring of safety of construction and operation of charging poles and EV-RE micro-grids. Preparation of report on compliance in construction with safety regulations and of safety record during project of charging poles and EV-RE micro-grids.

Activity 5.2.4: Setting up of system to track on EV batteries (or battery backs) involved in project, whether within EVs or as stand-alone storage. Implementation of system in the tracking of project batteries and battery packs throughout the project.

Output 5.3: Project mid-term review and terminal evaluation conducted.

Activity 5.3.1: Conducting of project mid-term review (MTR), including: pre-mission preparation, mission, document review and data collection, analysis of findings, MTR report preparation, management review of MTR report, and finalization of MTR report. The MTR should occur roughly half-way through project implementation, which will be 1.5 years after project launch.

Activity 5.3.2: Conducting of project terminal evaluation (TE), including: pre-mission preparation, mission, document review and data collection, analysis of findings, TE report preparation, management review of TE report, and finalization of TE report.

Output 5.4: Recommendations and agreed upon action plan for long term project sustainability as part of follow-up to terminal evaluation.

Activity 5.4.1: Identification of recommendations (from TE report or other sources) for post-project sustainability and follow-up and preparation of action plan.

Activity 5.4.1: Building of consensus on post-project action plan and determination of funding sources and institutional responsibility, as needed.

Changes from the PIF

During the design phase, a detailed analysis of the project structure was made that resulted in making the amendments described in detail in Annex I. The majority of outputs from the PIF were maintained, though some of these were adjusted in scope or orientation. During the PPG phase, many experts and industry players participated in logframe analysis work, which was the basis of refinement of the project outputs. Some new outputs arose from this work and follow-up team work, including one that addresses the need for government institutional coordination on EV-RE integration and one that recognizes the need for leveraging the media in building awareness of the public of EV- RE integration.

Further, the project design team decided that the project outputs should more tightly adhere to the targeted project objective of facilitating the integration of EVs with RE in China. Thus, efforts were made to ensure that each of the project outputs has a clear link to EV-RE integration, rather than some being related to EVs only. There were also some refinements made to the PIF's preliminary project pilot designs. A key modification is that Shanghai has added EV-RE micro-grids, to participate more directly in EV-RE integration. Shanghai also added smart charging in order to develop capacity in this area that could one day be important in integrating more renewable energy into the grid. During the PPG phase, the budget allocation amongst the project outcomes was adjusted.

A.1.4 Incremental/ Additional Cost Reasoning

Incremental GEF financing of USD8.93 million will be combined both with the very large ongoing expenditures occurring in China to promote electric vehicles ("the baseline") and with co-financing specifically allocated for project activities. Co-financing, at 13.1 times the amount of GEF funds, will be USD117 million. Incremental GEF funds, quite small in comparison to overall EV related expenditures in China (which include a range of subsidies, manufacturing efforts, R&D efforts, policy initiatives, etc.), have the opportunity to stimulate a major qualitative change in China's EV charging and even in the grid's adoption of renewable energy. That is, the project's incremental financing can play a critical role in facilitating the launch of China's transition from fossil fuel power based EVs to RE power based EVs. As outlined in this document's review of the baseline and alternative scenarios, it is unlikely without this project that much progress will be made in the short term in EV-RE integration in China. Yet, if successful, this project could stimulate a range of national policies and plans related to EV-RE integration, replication of EV-RE integration pilots, and local level EV-RE integration plans. None of these is likely to occur without the incremental financing provided by the project. Yet, at the same time, the very high level of activity with regard to EVs in the baseline scenario provides a highly attractive and highly leverage-able platform on which to build incrementally with GEF financing.

A.1.5 Global Environmental Benefits

Estimates of the project's anticipated direct GHG emission reductions imply the EV-RE pilots generate substantial direct GHG emission reductions. Emission reductions come through three main avenues: replacement of fossil fuel dominated grid power for charging EVs with RE in RE mini-grids; use of grid-connected wind power in Yancheng that was previously curtailed (not used) instead of fossil fuel dominated grid power (via smart charging of EVs); and scale-up, beyond business-as-usual, in number of EVs replacing ICEVs that is stimulated by the project. Indirect emission reductions (defined as reductions resulting from indirect project impacts, such as replication of the pilots, but not from the pilots themselves) also suggest promising results, using both "bottom up" and "top down" approaches. At the same time, some pilot activities, particularly smart charging in Shanghai, do not in and of themselves generate emission reductions, as the typical mix of fossil fuel dominated grid power is not replaced with RE. Instead, such aspects of the pilots are considered "foundational," laying the groundwork for future EV-RE integration. Detailed methodology and results for GHG emission reductions generated by the project (directly and indirectly) can be found in Annex F. In this section, highlights are summarized.

Exhibit 15 provides highlights of GHG emission reduction estimates for the project. Total direct emission reductions (all due to the project pilots) are 223,852.5 tons CO_2, consisting of 25,628.5 tons CO_2 during the project (between the years 2017 to 2019, inclusive) and 198,224.0 tons CO_2 after the project. Exhibit 15 provides a breakdown of GHG emission reductions during the project by type of measure. Type A indicates replacement of ICEVs with EVs beyond the business-as-usual expectation. Type B indicates replacement of fossil fuel dominated grid charging of EVs with RE mini-grid charging. Type C indicates uptake of previously curtained wind power via smart charging of EVs. Smart charging in Yancheng, which will involve 1,000 EVs daily, provides the largest benefit (Type C) among the three types, with an estimated 14,147.0 tons of CO_2 emission reductions during the project. ICEV replacement with EVs beyond business-as-usual (Type A) provides the second largest benefit, reflecting the large number of vehicles involved. The benefit is 9,896.0 tons of CO_2 emission reductions during the project. The RE mini-grid charging of EVs provides the lowest benefit of the three types, with 1,585.5 tons CO_2 during the project. This lower amount, despite a high amount per EV, reflects the lower number of vehicles involved. The RE mini-grid charged vehicles in the project pilots number approximately 90 per day (with different vehicles charged each day) in Shanghai and a total of roughly 90 (charged daily) in Yancheng, for a total of roughly 180 vehicles. Though the majority of these can be charged by RE, in some cases, RE capacity will not be enough to charge all of them daily. Assumptions in estimating direct emission reductions achieved after the project include a lifetime of 18 years for charging equipment and RE mini-grid equipment.

The indirect GHG emission reduction estimates are 1,119,263 tons CO_2 for the bottom up approach, comprised of 62,181.3 tons during the project and 1,057,082.1 tons after the project, and 5,408,868.8 tons CO_2 for the top down approach. The bottom up approach considers project activities to prepare local-level EV-RE integration plans, which will include specific plans for replications of the project pilots. It is assumed these plans result in replications in the pilot cities of Shanghai and Yancheng at two times the original per city pilot scale and replication in six other cities at the average scale (per city) of the project pilots. Replication is assumed to be initiated in the year 2019.

Exhibit 15: Summary of GHG Emission Reductions for China EV-RE Project

Direct GHG Emission Reductions (tons CO_2)								
During Project					**After Project**		**Total (During and After Project)**	
Yancheng			Shanghai		Yancheng	Shanghai	Yancheng	Shanghai
A*	B†	C‡	A	B				
3,090.6	1,058.9	14,147.0	6,805.4	526.6	146,372	51,852.0	164,668.5	59,184.0
Total for the Two Pilot Cities					Total for the Two Pilot Cities		Total for the Two Pilot Cities	
A		B	C					
9,896.0		1,585.5	14,147.0					
Total								

25,628.5 tons CO_2	198,224.0 tons CO_2	223,852.5 tons CO_2
Notes: EV-RE equipment is assumed to have 18 year lifetime. Most EV-RE equipment is assumed to be installed/ put in place at the beginning of the second year of the project and operates for two years during the project and 16 years after. The exceptions are EVs in Shanghai that are beyond the business as usual case in number. These are assumed to be put in place in tranches: one tranche in 2017, one in 2018, and one in 2019. Lifetime of these EVs post project is adjusted based on when they were put in place.		
Indirect GHG Emission Reductions (tons CO_2) – Bottom-up Approach		
During Project	**After Project**	**Total (During and After Project)**
62,181.3 tons CO_2	1,057,082.1 tons CO_2	1,119,263.4 tons CO_2
Notes: Replication of pilots in 6 other cities on scale similar to the average scale per city of the project pilots is assumed. Further, replication in the two pilot cities (Shanghai and Yancheng) at a scale two times their original scale is assumed. In both cases, replication is assumed to initiate operation in year 3 of project. Further, a total lifetime of replicated installations of 18 years is assumed, so that operation extends 17 years after closure of project.		
Indirect GHG Emission Reductions (tons CO_2) – Top-down Approach		
Total: 5,408,868.8 tons CO_2		
Notes: Estimate based on emission reductions from equipment installed in each of 10 the years following project close. Assumed lifetime of equipment installed each year is 18 years. Annual installation of EV-RE equipment is computed from the base of amount of operational equipment in two project pilots in last two years of project (divided by 2) combined with annual growth. Annual growth rate used is 20 percent. Causality factor of 80% applied to results, as the EV-RE market is a completely new one in China; and the project is thus likely to play a strong role in growth of the market during the ten years following the project.		

*A refers to emission reductions achieved from replacing ICEVs with EVs (beyond the business-as-usual case) that use East China Grid power.
†B refers to emission reductions achieved by replacing East China Grid power with RE micro-grid power, mainly to power EVs.
‡C refers to emission reductions achieved by smart charging that enables the replacement of East China Grid power with large-scale grid connected renewable energy power that previously was wasted.

The top down approach, instead of looking at specific replication opportunities, assumes a market growth rate. Further, the approach is confined to indirect emission reductions achieved via equipment put in place during the ten years directly following project close, 2020 – 2029. Taking the emission reductions achieved via the equipment installed in the two project pilots as the base (and dividing by two to get an annual amount of emission reductions for the equipment installed, noting that this equipment is installed in the last two years of the project), the top down approach assumes the amount of equipment installed or put in place grows by 20 percent annually, beginning in 2020. It further assumes an 18 year lifetime of that equipment to compute total GHG emission reductions. Lastly, an 80 percent causality factor is applied to results, as the EV-RE market is completely new to China; and it is likely the project will have played a strong role in any market growth that occurs in the ten years after the project.

The incremental cost in terms of GEF funds per ton of CO_2 abated may be computed using the total proposed GEF Trust Fund funding of the project, which is USD8,930,000. Exhibit 16 shows the numbers used for the calculations and the resulting incremental cost per ton of CO_2 abated when different types of emission reductions are included

Exhibit 16. Incremental Cost of CO_2 Abatement

Types of Emission Reductions Included	Total Emission Reductions in Category	GEF Incremental Investment (Total GEF Funding of Project)	Incremental Cost per Ton of CO_2 Abated
Direct Emission Reductions Only	223,852.5 tons CO_2	USD8,930,000	USD39.89
Direct and Bottom Up Indirect Emission Reductions Combined	1,343,115.9 tons CO_2	USD8,930,000	USD6.65
Direct and Top Down Indirect Emission Reductions Combined	5,632,721.3 tons CO_2	USD8,930,000	USD1.59

A.1.6 Innovativeness, Sustainability, and Potential for Scale Up

This sub-section covers the key topics of the project's innovativeness, sustainability, and potential for scale up.

Innovation: The project presents a high level of innovation, both in its overall concept and in certain individual aspects. The project is working in a new, emerging field, EV-RE integration, in which China has little prior experience. Yet, given the strengths both of China's EV sector and of its RE sector, as outlined earlier in this document, the pursuit of EV-RE integration in China is quite apt. The project is not only working in the new field of EV-RE integration, but is taking a comprehensive approach to promoting this field, an approach that has yet to be seen anywhere in the world. That is, the project looks not only at demonstration aspects or policy aspects. Instead, in one project, it integrates EV-RE demonstration, policy, public awareness, and capacity building for government officials and industry.

As for certain individual aspects of the project that are innovative, several of these are to be found in the project pilots. The mobile charging station vehicles that will be tested in Yancheng have not been introduced in China before in an urban environment, but may address a strong barrier to EV purchase – concern about being out of power without a place to charge. The mobile charging vehicles will be charged by renewable energy based electricity.

Other innovative areas within the project pilots include: smart charging, V2G, use of retired EV batteries for power storage, and control of EV charging via a central energy management facility. No demonstration of any of these areas on a substantial scale has been carried out to date in China. In Yancheng, smart charging will be carried out on a very substantial scale (1,000 vehicles daily) and has the potential to eventually support the uptake of currently curtailed wind power in Yancheng. Shanghai will have roughly 200 vehicles per day participate in smart charging.

Another innovative aspect of the pilots is that, in the case of Shanghai, the pilots will leverage an EV car sharing business to test and promote EV-RE integration. The car sharing business may achieve higher visibility, given the number of drivers that may be exposed, than an EV-RE integration project involving cars with fixed drivers. Car sharing, which is actually hourly rental of vehicles, is gradually being initiated in a good number of Chinese cities, with an emphasis on electric vehicles. Yet, the EV car sharing business model is still in the early stages. Some believe that scale-up that would allow a greater density of vehicles is needed before such a business will take off. The project pilot in Shanghai will promote this kind of scale-up for an EV car sharing business. And, the project will, in addition, promote EV-RE integration to car sharing businesses elsewhere in the country, as well as to those considering going into the car sharing business.

The project is also innovative in its approach to public awareness. In addition to its media campaign, which is a more standard approach to public awareness, the project will promote EV-RE integration via social media. It will also reach out to EV user clubs to promote EV-RE integration and look at ways to increase the attractiveness of such organizations so that membership increases. And, recognizing that women often are those that care most about the environmental issues impacting health, the project will reach out to a range of women's organizations to promote EV-RE integration. This approach of outreach to women's organizations is a-typical of those hoping to promote technical topics. Lastly, the project is planning, in both its more traditional media campaign and in its social media campaign, to come up with a number of specific strategies or methods of promotion that target women specifically.

Sustainability of results: Project design work has carefully considered sustainability in developing a strategy that will ensure that project results last beyond the lifetime of the project itself. First, as for the pilots, partners have been chosen carefully to ensure they are organizations with a strong vested interest in carrying on the pilots beyond 2019. The Yancheng Government, leading efforts in Yancheng, is strongly committed to developing Yancheng as a center of NEVs and renewable energy. Shanghai International Automobile City (SIAC), leading efforts in Shanghai, also has a strong vested interest in carrying on the pilots beyond 2019. SIAC is a leader in the EV car sharing business and EV monitoring. It has a strong desire to achieve viability of the EV car sharing business via scale-up and to expand its technical know-how into areas such as secondary use of retired EV batteries.

Further, the project gives strong attention to charging infrastructure, with substantial scale up of fixed charging poles and testing of mobile charging station vehicles planned. In doing so, it addresses one of the key roadblocks to EV development (and thus to EV-RE integration), lack of sufficient charging infrastructure.

The project strategy also calls for detailed monitoring and assessment of the project pilots. Monitoring work will uncover any problems that are occurring. Thus, problems can be dealt with during the project, so that the system for the pilots can gradually be improved. One of the most important aspects of the project sustainability strategy is that the project incorporates a heavy level of policy work and capacity building work directly related to EV-RE integration. While the pilots will serve the purpose of "proving the concept," it is the accompanying policies specifically addressing EV-RE integration that will cause this integration to grow and be sustained in China. Further, capacity building will ensure that government officials have a good enough understanding of EV-RE integration to promote it and incorporate it into their local plans. Finally, capacity building for industry will ensure that commercial entities have enough understanding of EV-RE integration to consider pursuing new opportunities in the area.

Scale up potential: The existing environment in China provides a strong basis for potential scale-up of EV-RE integration. And, the project includes leveraging of this scale-up potential in its design. China's strong basis for potential scale up is its large NEV demonstration program, which encompasses 88 cities among the targeted 39 "cities and regions" of the program. The project will leverage this potential both by promoting the development of EV-RE integration related incentive policies at the national level and ensuring that EV-RE integration plans are developed at the local level. As for local level planning, the project includes activities to train local officials in various areas of EV-RE integration, among which is the design of local-level plans. In addition to these training activities, the project also includes specific activities to design EV-RE integration plans for both the two demo cities and a number (at last six) of other cities. These plans will be the basis upon which the earliest expected replication of the project demos is expected to occur. A national roadmap on EV-RE integration, which will include specific five, ten, and 15-year targets, will, in concert with the above measures, work to promote replication and scale up of EV-RE integration.

A.2. Child Project? If this is a child project under a program, describe how the components contribute to the overall program impact.
N/A

A.3. Stakeholders. Identify key stakeholders and elaborate on how the key stakeholders' engagement is incorporated in the preparation and implementation of the project. Do they include civil society organizations (yes √☐ /no☐)? and indigenous peoples (yes ☐ /no√☐)?

Project stakeholders include national-level government organizations (MIIT, MOF, NDRC, NEA, and MOST), project pilot coordinating agencies (Yancheng Municipal Government's Economic and Technological Development Zone Management Agency and Shanghai International Auto City), various city-level governments whose cities are among the 88 included in China's EV demonstration program, technical experts, manufacturing companies (particularly manufacturers of vehicles, manufacturers of charging equipment, and manufacturers of renewable energy equipment), service providers (including car sharing companies, operators of charging stations, and engineering firms that set up RE mini-grids), users or potential users of EVs not already mentioned (such as taxi companies, bus companies, delivery companies, and consumers), the general public, civil society organizations (including engineering societies, industrial associations, EV user organizations, and women's organizations), and the media. Key stakeholders are listed in Exhibit 17, where their engagement in preparation and implementation of the project is also briefly described.

Exhibit 17: Key Stakeholders and Their Engagement in Preparation and Implementation of the Project

Stakeholders	Engagement in Preparation and Implementation of the Project
Ministry of Industry and Information Technologies (MIIT)	As executing agency for the project, MIIT is responsible for overseeing project management, including coordination with partners, procurement, recruitment, administration, and reporting. In particular, MIIT will oversee the work of SAE, which it will entrust with day to day activities of the project. As the Chinese Ministry responsible for industrial development, MIIT will also be closely involved in the project's relevant policy initiatives in EV-RE integration, including the EV-RE integration national roadmap, national level policies, and industry standards. Its staff will take part in capacity building for national-level officials on EV-RE integration. MIIT will also be an important target of project activities aimed at developing a cross-agency coordination mechanism for EV-RE integration in China.
UNIDO	As GEF implementing agency for the project, UNIDO is responsible for the project design and preparation, and carries out supervision, monitoring, and evaluation functions. Based on consultations with the main project partners, UNIDO will also provide specific

	execution support during the main project phase. The national execution modalities will be reflected in the project implementation agreement with MOF and an execution agreement to be concluded with MIIT.
Ministry of Finance (MOF)	As focal point for the GEF in China, MOF has responsibility to oversee the GEF national portfolio. MoF has also passed specific guidance for GEF projects administration, which required all projects to be nationally executed. In addition, in its capacity as a the regulatory agency for financial incentives and subsidies, MOF will be technically involved in review of EV-RE integration incentive policies and the national EV-RE integration roadmap drafted under the project. Relevant staff from MOF will also participate in capacity building in EV-RE integration as carried out under the project for national-level policy makers.
China Society for Automotive Engineers (SAE)	As the organization entrusted by MIIT to handle day-to-day operation of the project, SAE will be involved in ensuring coordination of national counterparts, and carrying out designated project activities. SAE will host the PMO (project management office) that will conduct execution, including recruiting consultants and sub-contractors, keeping track of their progress, elaborating technical and financial progress reports.
National Development and Reform Commission (NDRC)	As the government agency overseeing planning and energy, NDRC will participate in policy and roadmap efforts during project execution, as well as project capacity building workshops for national level officials. NDRC will also be an important target of project activities aimed at developing a cross-agency coordination mechanism for EV-RE integration in China.
National Energy Administration (NEA)	NEA, the agency under NDRC that is specifically responsible for energy, is a key player in the promotion of and design of policy for RE in China. As such, it will participate in policy and roadmap work of the project, as well as capacity building work for national-level officials. NEA will also be an important target of the cross-agency coordination mechanism for EV-RE integration that the project will design.
Ministry of Science and Technology (MOST)	As the national level agency responsible for scientific research and the development of technology, MOST will also be a relevant player for participating in project efforts to design an EV-RE roadmap and will be included as a target of the cross-institution coordinating mechanism that the project will design.
Yancheng Municipal Government Economic and Technological Development Zone Management Agency	Yancheng's Economic and Technological Development Zone Management Agency has played the leading role in designing the project demo in Yancheng during the PPG phase. In this role, the Agency has brought on various partners from industry to implement the project. During execution, the Agency will continue to play a coordinating and management role with regard to the demo. It will also play a central role in setting up the Yancheng EV-RE integration demonstration center as called for under the project's fourth component.
Shanghai International Automobile City (SIAC)	SIAC has played the leading role in designing the project demo in Shanghai during the PPG phase. In this role, it has marshalled its extensive internal resources, including its software company and its EV monitoring center, to be a part of efforts during execution. SIAC will involve its car sharing business in the project demo and scale up the number of vehicles and charging posts available as a part of the demo.
Various city-level governments whose cities are among the 88 included in China's EV demonstration program	Officials from the cities included in China's EV demonstration program will be included during project implementation in the training of local-level government officials. Part of their training will include design of local-level EV-RE integration plans for their cities.
Experts in EVs and RE, including in both technical and policy aspects	Experts on EVs and RE, including in both technical and policy aspects, were involved in project preparation, through both consultations and involvement in the project's logframe analysis (LFA) workshop. Experts will continue to play a role in the project during execution, providing their input on various key aspects of the project, such as EV-RE integration roadmaps, policies, and

	standards, and successful execution and monitoring of the project pilots. They will also be included in project capacity building and international exchange efforts and will be recruited as consultants to carry out various project activities.
Manufacturing companies, including manufacturers of vehicles, manufacturers of charging equipment, and manufacturers of renewable energy equipment	During project execution, manufacturing companies will be involved in both the project pilots and the project's fourth component, which includes capacity building for the industrial sector on standards and other topics related to EV-RE integration. As for the pilots, some manufacturing companies may provide equipment or services. A few companies will be directly involved in the pilots, such as Goldwind (China's top wind turbine manufacturer, which also has a subsidiary that sets up micro-grids) and Aoxin (an EV and fuel cell vehicle manufacturer at whose facilities one of the Yancheng mini-grid pilots will be located).
Service providers, including car sharing companies, operators of charging stations, and engineering firms that set up RE micro-grids	Service providers will be involved in relevant project activities, including capacity building, exchange workshops, and the project pilots. The project will hold a special workshop for car sharing companies (which are now growing in number in China) on the topic of EV-RE integration; and SIAC's car sharing company will be involved in the Shanghai demo. Operators of charging stations (e.g. TELUS) have offered input during project design and will be involved in scale-up of charging infrastructure, as well as in development of specialized smart charging and V2G charging poles, in both Yancheng and Shanghai, via the project pilots. Engineering firms that set up RE micro-grids will be included in project outreach and some will be involved directly in setting up EV-RE micro-grids in Shanghai and Yancheng.
The general public including, but not limited to, potential EV purchasers	The project will endeavor to involve the general public in the awareness raising efforts of the project's fourth component. The media campaign, the social media campaign, and outreach to social organizations will all target raising the general public's awareness of EV-RE integration.
Civil society organizations, including engineering societies, industrial associations, EV user organizations, and women's organizations	Civil society organizations will also be key stakeholders during project execution. Already SAE, an engineering society, has, as indicated above, been the key organization involved in coordinating project design. It will also be the key organization involved in day-to-day project implementation In the project's outreach to social organizations, work will be done to increase the membership of EV user organizations and raise their awareness of EV-RE integration. As for women's groups, the project will also conduct specially designed outreach to such organizations to raise their awareness of EV-RE integration.
The media	During execution, the project will directly involve the media in certain activities under the project's fourth component, targeted to raise awareness of the general public on EV-RE integration. Project outreach will endeavor to raise the media's awareness of EV-RE integration so that they will feature this topic in their articles, radio shows, etc.

A.4. Gender Equality and Women's Empowerment Elaborate on how gender equality and women's empowerment issues are mainstreamed into the project implementation and monitoring, taking into account the differences, needs, roles and priorities of women and men. In addition, 1) did the project conduct a gender analysis during project preparation (yes ☐ /no√☐)?; 2) did the project incorporate a gender responsive project results framework, including sex-disaggregated indicators (yes √☐ /no☐)?; and 3) what is the share of women and men direct beneficiaries (women 35%, men 65%)? [31]

During the project design, measures to promote gender equality and women's empowerment were assessed and considered. Actions will be taken amongst all components of the project, but direct actions will be specifically addressed in those components that are devoted to capacity building and public awareness. The project addresses both the promotion of women's participation in technical and policy fields and the encouragement of participation of women as NEV drivers.

[31] Same as footnote 33 above.

As for women's participation in technical and policy fields, women are equally represented among university graduates in China, making up 52.15 percent of undergraduates in the nation in 2015 (Ministry of Education, China). Yet, Chinese women are underrepresented in science, technology, engineering, and mathematics majors and careers. As an example, a study has found that the ratio of men to women engineering students at Hunan University ranges from 7.5:1 to 9:1; and in some specific engineering disciplines the students are all women.[32] Further, among top management in technology oriented organizations, women are also underrepresented. Given the technical nature of EV-RE integration, an opportunity is presented for the project to be proactive in encouraging women in a technical field. Hence, the project will endeavor to reach a substantially higher proportion of female representation at all capacity building activities than is the norm. Typically, based on experience with SAE sponsored events, representation of women at engineering oriented events in China may be quite low, such as ten to twenty percent. The project targets for the proportion of women participants at capacity building events to be 35 percent for each workshop or meeting held for government officials and 35 percent for each workshop or other event held for industry. These targets will be reflected in indicators for each of the government events as a whole and industry events as a whole, both of which require an overall women attendee proportion of 35 percent.

In terms of public awareness and women, there will be outreach to women's organizations in Component 4. The importance of the project's outreach to women to address the gender gap in the public awareness field is further illustrated by trends in underrepresentation of women in areas related to EVs and to autos generally in China. Data from Shanghai International Automobile City (SIAC) about both registered members of its EVCARD EV hourly car rental business and test drivers of EVs at its Jiading, Shanghai, test driving center reveal a strong gender gap in which women were 24 percent of registered EVCARD users and 19 percent of EV test drivers.[33] Data on gender and drivership generally in China shows that the male-female gap is not specific to EVs, but is instead part of a wider trend of underrepresentation of women among drivers in China. The Ministry of Public Security in China provides information from time to time on gender and drivership. In 2014, the latest year for which data is provided; there were 300 million drivers in China. Of these, 230 million were male, accounting for about 77 percent of the total, and 70.9 million were female, accounting for about 24 percent of the total, the same proportion as for female registered EVCARD users.

China has a number of different types of women's organizations, including the China-wide All China Woman's Federation (ACWF) whose network reaches to practically every corner of China all the way down to the rural level. ACWF is also well-connected politically. The project will identify a range of women's organizations that may be good channels for raising awareness of EV-RE integration. The project will then work to attend meetings of these organizations or set up special events/meetings for them at which the project promotes and explains EV-RE integration and its potential for improving the environment. At these meetings, discussions on women's perspective on EV-RE integration can be held.

Also with regard to public awareness, the project in its media and social media initiatives will include design of special measures to attract women to the cause of EV-RE integration. The project design recognizes that public awareness initiatives for technically oriented issues often do not take women's concerns into consideration. Yet, globally it has been found that women often prioritize areas such as health and the environment to a greater extent than men. Thus, women can be strong promoters of environmental causes, particularly when the link with health issues is clear, and should be considered in the design of promotion campaigns, even when the content is somewhat technical.

Also, the project will take advantage of its role of recruiting consultants to promote gender equality. Consulting roles to be filled by the project will encourage application by women. In the case of equivalently qualified candidates, women

[32] Tang Jun, Master's Thesis, Ideological and Political Education of Engineering Major, Hunan University, 2012.

[33] Based on data provided by Shanghai International Automobile City (SIAC), by the end of 2015, among the 31,761 registered members of the company's EVCARD EV hourly car rental ("car sharing") business, there were 24,210 male drivers, accounting for 76 percent of the total, and only 7,551 female drivers, accounting for 24 percent of the total. Among test drivers taking advantage of the SIAC EV test driving center in Jiading, Shanghai, based on 4,030 test drives for which driver gender was recorded, there were 3,279 male test drivers (81 percent of the total) and 751 female test drivers (19 percent of the total). (Note: There were 68 test drives for which gender of the driver was not recorded.)

may be given preference. Overall, the project will target that 35 percent of its domestic consultant consulting days and 35 percent of its international consultant consulting days will be performed by women. The project will include an indicator to assess achievement of these 35 percent targets.

Finally, efforts will be made to mainstream gender issues by allocating funding to address gender needs that may arise in project execution. A budgetary provision of 10,000 USD will be made available in the three years to address these issues, based on experience from prior projects. These funds may be used to cater for needs of female candidates, such as dedicated space for child care during full day training sessions.

A.5 Risk. Elaborate on indicated risks, including climate change, potential social and environmental risks that might prevent the project objectives from being achieved, and, if possible, the proposed measures that address these risks at the time of project implementation.(table format acceptable):

Exhibit 18 lists the key identified risks that might prevent the project from achieving its targets. It also rates the level of each risk as low (L), medium (M), or high (H). It further offers proposed measures to address the risks at the time of project implementation. The proposed risk mitigation measures are designed into project activities and the project management approach. It is not foreseen that climate change will negatively impact performance of the project, so such a risk is not included among those listed.

Exhibit 18: Project Risks and Measures to Address Them

Risk	Rating	Measures to Address Risk
1. Project progress is much too slow to achieve targets by end of project's three years	M	Project design includes a timeline with chronological targets. Further, project M&E design calls for four levels of monitoring. At the lowest level, there will be a PMO team member responsible for monitoring. In addition to day-to-day monitoring, the team member will prepare quarterly project reports and monitor project indicators, with an update on indicators every six months. At the next level, the full project team will discuss progress on indicators at least twice per year. At the highest level, project progress will be monitored by the Project Steering Committee, which will meet periodically, preferably two times per year. In addition, UNIDO, in its role as GEF Implementing Agency, will monitor the timeliness of project work.
2. Pilots become too simplified and/or too small scale to provide convincing and useful evidence to the central government and potential replication cities regarding the viability of and value of EV-RE integration	L	During the design phase, very detailed pilot descriptions have been prepared for both the Yancheng and Shanghai pilots. These descriptions specify the scale and constituents of each type of demo, whether it is smart charging with the main grid or micro-grid EV charging incorporating a certain number of retired EV battery packs. These detailed pilot descriptions have been prepared based on input directly provided by the pilot coordinating organizations, Yancheng Economic and Technological Development Zone Management Agency and Shanghai International Automobile City. It is expected that the level of this detail in project pilot design will prevent the pilots from becoming too simplified or too small-scale to provide convincing and useful evidence to stakeholders.
3. Repurposing of retired EV batteries is more expensive than anticipated, exceeding the cost of new battery purchase, and thus rendering aspects of the project depending on repurposing poor examples of economic viability.	L	The project has included an activity to assess the costs of battery repurposing and to develop measures to minimize each cost in the battery repurposing cost structure. While it is unlikely that new batteries will provide a more cost effective alternative than repurposed ones, if this is to prove to be the case, new batteries will be purchased in order to maximize the economic viability demonstrated by the project.
4. Cooperation from State Grid and subsidiary grid companies to reduce wind power curtailment in Yancheng based on introduction of smart charging for 1,000 vehicles is not obtained. Further, cooperation from State Grid on energy management center	M	The PPG phase has involved State Grid personnel in project design. During project implementation, State Grid and relevant local gird personnel will be proactively included in various capacity building efforts to build their engagement with and buy-in for EV-RE integration concepts and plans.

exchange of information between the grid, vehicles, and charging poles is not obtained.		
5. EV-RE integration related policy and roadmap recommendations of the project not adopted by policy makers	M	Project design involves a high level of consultation with government stakeholders in the design of the national EV-RE integration roadmap and in the drafting of policies related to such integration. As a part of Component 1, focused one-on-one meetings to discuss proposed policies and the roadmap will be held with relevant government organizations. As a part of Component 2, government officials will be involved in workshops/ large group discussions to revise and build consensus on the same. Finally, the project will frequently make stakeholders aware of the overall importance and urgency of integrating EV with RE. It will make stakeholders aware that if EVs in China are to truly realize their environmental potential and thus make the substantial effort to promote EVs in China to date worthwhile, EV-RE integration is needed.
6. Industry and service sectors do not see potential in EV-RE integration and thus do not get involved in providing the products and services needed	L	In China, businesses have a strong tendency to respond with enthusiasm to those new industries that they see the government promoting with policy. Thus, the project's emphasis on policy and planning initiatives should also serve to stimulate interest from businesses. In addition, the project, in its fourth component, includes specific capacity building related to EV-RE integration for relevant industry and service sectors.
7. Other cities not interested in replicating EV-RE integration pilots	L	The strong efforts that many cities have put into promoting EVs under the central government's EV promotion program is evidence that many cities are likely to similarly pick up EV-RE integration efforts if these are promoted by the central government. In addition, the project's capacity building program for 100 local government officials is likely to raise their enthusiasm as it guides them in developing EV-RE integration plans for their cities.
8. Relevant central government organizations not willing to coordinate with each other on EV-RE integration	L	The project will address the need for inter-ministerial coordination to realize EV-RE integration in China by developing a plan for such institutional coordination. Chinese government organizations have a history of cooperating on other issues by cross-department working groups, so such cooperation should be possible once a mandate for it is developed.
9. Press not interested in covering the topic of EV-RE integration	L	Project design calls for specific activities for outreach to the press. In the past, the Chinese press has been receptive to topics involving new technologies and the auto industry, as well as topics involving the environment.
10. China's EV market stagnates in the future as subsidies and other incentives are reduced, so that EV-RE integration cannot be achieved on a large scale in the nation	L	Increased charging infrastructure for EVs, as promoted by the project, will serve as a counterforce to reduced subsidies. Further, the growth in establishment of EV car sharing businesses in city centers will serve both to increase EV numbers directly and to raise awareness of EVs among consumers. Finally, the Chinese Government carefully monitors the EV market and is adjusting its policy for incentive phase out accordingly, so as not to have an overly negative impact on growth of the EV market.
11. Social/ gender risk: Very few women are involved in the project, so that the project serves to reinforce the gender gap rather than reduce it	L	The project has adopted specific measures to ensure the project is a positive force in reducing the gender gap. These include ensuring that women make up 35 percent of trainees and /or participants at various capacity building events and workshops. They also include outreach to women's groups about EV-RE integration. Project management, in addition, will strive to ensure that 35 percent of the project's domestic and international consultant days, respectively, are performed by women.

A.6. Institutional Arrangement and Coordination.

UNIDO is entrusted by the Government of China and by the GEF with the mandate to implement the project to achieve its objective, its outcomes and outputs and within its budget and time frame as approved in this project document. UNIDO is accountable to the GEF for the funds of this project and will in close consultation with MIIT; implement the project according to the established UNIDO's rules and regulations, the applicable GEF requirements, and the Ministry of Finance "GEF Grant Project Management Approach" Notice No. 45 from 26 June 2007. This means that UNIDO will maintain the oversight on the project implementation, including supervision of the execution of key activities, as well as organize planned evaluations.

Overall responsibility for project execution will lie with the MIIT. The SAE-China, and the City Governments of Yancheng and Shanghai will have specific responsibility at national level for executing activities within the current UNIDO/GEF project.

The relationship between the MIIT, UNIDO and the Ministry of Finance (MoF) in China as the supervisory national body for GEF projects will be outlined in a set of project agreements that shall be concluded once the project approval cycle is completed. This will include an implementation agreement between MoF and UNIDO, an execution agreement between MIIT and UNIDO, and project agreement between SAE-China and UNIDO.

Coordination among Government agencies and the implementing agency will be achieved through a Project Steering Committee (PSC) which will be chaired by MIIT and UNIDO. The PSC will provide necessary guidance and oversight on the project's execution and will invite members and experts for specific meetings, as needed. The PSC meetings will be held once every year.

The PSC is expected to deal with the coordination of various aspects of project activities, including all execution, and its planning. The PSC will function not only to coordinate the project execution, but will also act as a discussion forum for proposed activities, policies and initiatives. The proposed members of the PSC are

- Ministry of Industries and Information Technology of China as executing agency
- Ministry of Science and Technology
- National Development and Reform Commission
- National Energy Administration
- Ministry of Finance, as the GEF Operational Focal Point
- UNIDO as implementing agency

The PSC will be responsible for:

- Coordinating and managing the overall project activities at a macro level.
- Facilitating coordination of project activities across institutions.
- Reviewing project activities and their adherence to the work plan set forth in the project document, in line with the GEF regulations on major and minor amendments.
- Reviewing and commenting on each year's proposed work plan and budget.
- The PSC will be responsible to request and review financial and progress reports.
- Taking decisions on the issues brought to its notice by UNIDO and other cooperating institutions and advice regarding efficient and timely execution of the project.
- Initiating remedial action to remove impediments in the progress of project activities that were not envisaged earlier.

UNIDO's role in the PSC is to provide supervision and technical support. The UNIDO Project Manager (PM) will facilitate the work of the Project Management Office (PMO) in co-ordination and networking with other related initiatives and institutions in the country. UNIDO will fulfill this responsibility by appointing a Project Manager and mobilizing services of its other technical, administrative and financial branches at UNIDO Headquarters and at the UNIDO Regional Office in Beijing. In the context of technical cooperation, UNIDO's support of the execution function will provide the project with knowledge transfer, technical expertise and experiences gained in other countries, and a global platform for China to showcase its innovation to other countries.

The PMO or a relevant government financial institution will maintain an accounting and financial transaction reporting mechanism for the project, and report to the Ministry of Finance and to the PSC. The UNIDO Beijing Office will assist with this area of work. The MIIT will provide UNIDO with certified periodic financial statements, and with an annual audit of the financial statements relating to the status of UNIDO (including GEF) funds according to the procedures set out in the UNIDO Operational Guidelines for national execution. These audits will be conducted by the legally recognized auditor of the Government, according to the Chinese auditing procedures, or by a commercial auditor engaged by the Government.

It is expected that each set of activities to be implemented in the targeted country will be governed by the provisions of the Standard Basic Cooperation Agreement concluded between the Government of China and UNIDO, which was signed on 29 June 1979 and entered into force on 24 June 1985.

Project execution
A set of execution agreements will be subscribe between UNIDO, MIIT and the designated execution agencies at local level during the inception phase.

The roles and responsibilities of the stakeholders involved in the project are depicted in the following figure:

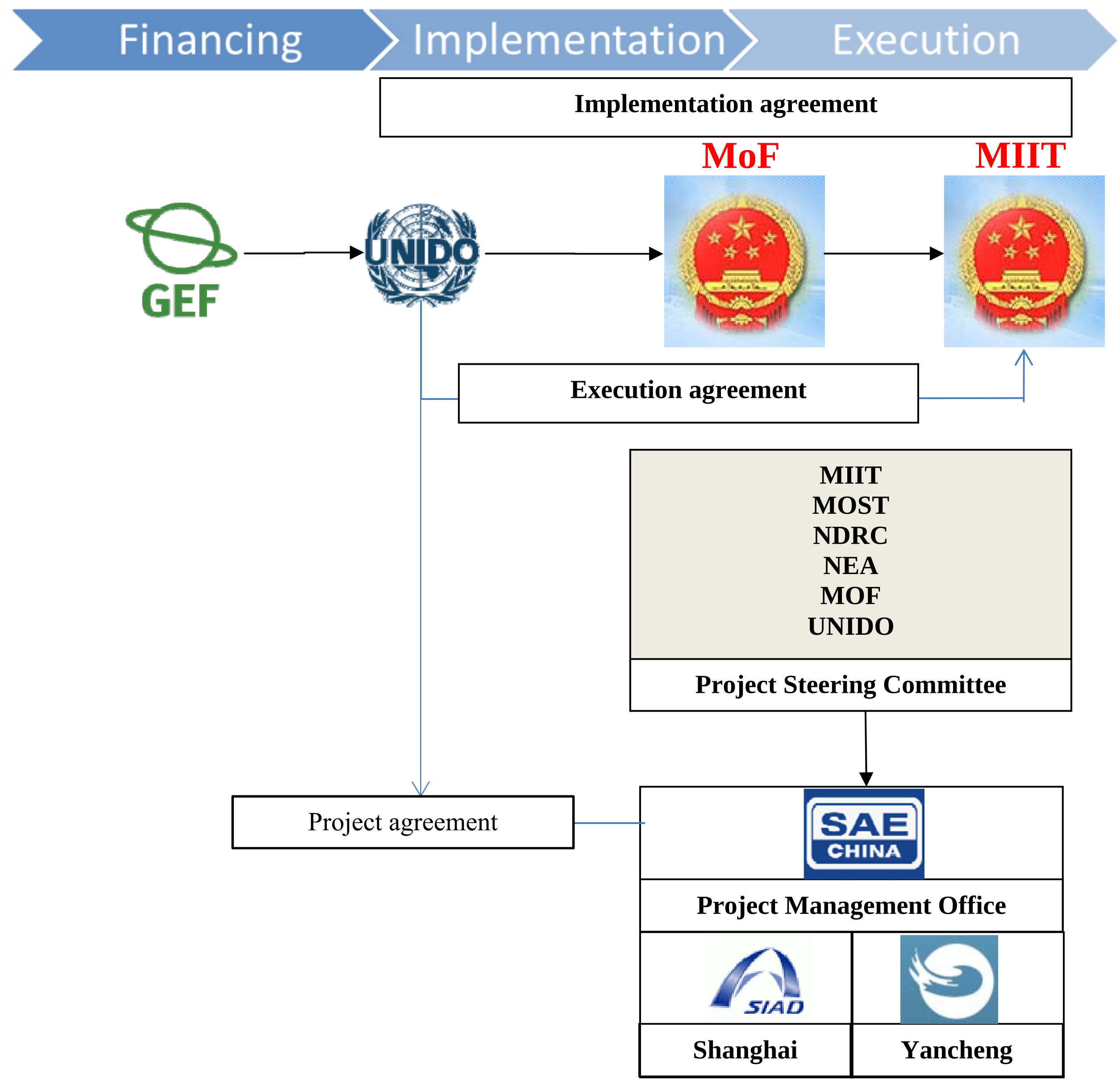

Figure 18. Stakeholder map for project coordination

Project management

The Project Management Office (PMO) will be the project secretariat and will coordinate the execution of each project component. The PMO shall be established during the inception phase and will be located at SAE-China. The PMO will be responsible for the day-to-day management and monitoring of project activities as agreed through the annual project work plan.
The PMO will be located at SAE-China offices in Beijing. During the whole execution period of the project, the UNIDO will provide the PMO with the necessary technical and monitoring support while the PMO will be responsible for the management of the project and coordination with the project stakeholders. In addition, the cities of Yancheng and Shanghai will set up their own project management structure, to undertake the project pilots.
The PMO will comprise of

- (1) the National Project Manager, dedicating 20% of time (co-financed)
- (2) the Deputy National Project Manager, dedicating 30% of time (co-financed)
- (3) the Project Management Office Director, dedicating 50% of time (co-financed)
- (4) the Director of Project Activities and Reporting, full time
- (5) the coordinator of Project Activities and Reporting, full time

The Job Descriptions for PMO staff are included in Technical annex 6.
The PMO will report to the PSC and will be responsible for:

- Coordinating the management and execution activities of the project as set out in the project document, in the execution agreement and yearly work plans.
- Providing assistance to the SPC to ensure that project activities conform to the agreed project document.
- Coordinating with the other Yancheng and Shanghai PMOs involved in the project execution.
- Coordinating and supervising the work carried out by consultants/contractors (international & national) who will be involved in the project.
- Providing guidance to the PSC for the execution and adhering to the planned milestones and to ensure that project activities conform to the agreed project document.
- Organizing tripartite review meetings as per PSC procedures.
- Preparing Annual Project Reports (APR) for submission to UNIDO and GEF Secretariat.
- Preparing technical progress reports.
- Chairing the PMO monthly meetings.
- Preparing the annual work plan and budget of the project and its timely submission Submitting regular progress reports to the MIIT and UNIDO.

UNIDO will support the execution by providing the PMO with the necessary technical and monitoring support, which includes ensuring that the PMO acquires the ability in the day-to-day operation, the access to internal procurement and recruitment platforms. These abilities will enable the Executing Agency to comply with the term of Project Execution Agreements to be concluded. The respective budget allocation for these activities will be presented in the Execution Agreement.

<u>Additional Information not elaborated at PIF Stage:</u>

A.7 *Benefits*. Describe the socioeconomic benefits to be delivered by the project at the national and local levels. How do these benefits translate in supporting the achievement of global environment benefits (GEF Trust Fund) or adaptation benefits (LDCF/SCCF)?

The project's promotion of the new field of EV-RE integration in China is expected to have multiple socioeconomic benefits at the national and local levels. These benefits will serve to reinforce interest in EV-RE integration, leading to its scale-up, which, in turn, will increase the global benefit of GHG emission reductions achieved.

Local air quality is a chief national and local-level benefit that will be achieved via the promotion of EV-RE integration. While EVs charged by the grid have air quality benefits at the very local level (e.g. within the city center), they shift emissions with negative health impacts from the tailpipe of vehicles to power plants. EV-RE integration, in contrast, completely eliminates local air pollution emissions with negative heath impacts (e.g. particulates and nitrous oxides) and negative environmental impacts (sulfur oxides, which lead to acid rain). Given the serious environmental and environmental health challenges that China faces, these local-level air quality benefits and their scale-up can play an important role in improving the quality of life for the Chinese people.

Energy security is another key potential national-level benefit of the project's promotion of EV-RE integration. As indicated, China, as of 2013, had net petroleum imports accounting for about 56 percent of its total petroleum consumption. Forecasts suggest that proportion will rise to 75 percent by 2035 in the business-as-usual scenario. Such high levels of petroleum imports present geopolitical risks, as well as make the nation's economy sensitive to fluctuations in global oil prices. Given that the road transport sector is responsible for the majority of petroleum consumption in China, growth in EVs generally, and EV-RE integration in particular that, reduces China's dependence on petroleum can play an important role in increasing energy security. EVs that use grid power allow replacement of petroleum with resources that are more abundant in China, particularly coal. EV-RE integration takes the local provision of energy resources to the highest level as all renewable energy resources (with perhaps the exception of biomass in some cases) are local by definition (e.g. wind, sunlight, etc.).

The development of EV-RE integration in China, as a new industry, has the potential to create substantial new economic opportunities. EV-RE integration will create demand for now types of products, such as charging poles with smart charging and/or V2G capabilities. It will also create demand for engineers with skills in setting up EV-RE micro-grids and providing other services related to EV-RE integration. Scale up will further promote the already growing economic opportunities in China in the areas of electric vehicles and renewable energy, respectively.

Finally, the project's promotion of car sharing, as a means of achieving EV-RE integration, may yield certain side benefits. Car sharing (hourly rental) can reduce the need for car ownership in the city. The resulting reduction in total number of vehicles can reduce urban congestion, particularly with regard to parking spaces.

A.8 *Knowledge Management.* Elaborate on the knowledge management approach for the project, including, if any, plans for the project to learn from other relevant projects and initiatives (e.g. participate in trainings, conferences, stakeholder exchanges, virtual networks, project twinning) and plans for the project to assess and document in a user-friendly form (e.g. lessons learned briefs, engaging websites, guidebooks based on experience) and share these experiences and expertise (e.g. participate in community of practices, organize seminars, trainings and conferences) with relevant stakeholders.

The project is quite knowledge intensive and has incorporated knowledge management into a number of its activities. First, given that EV-RE integration is a relatively new field in the world, the project will draw as much as possible on learnings from international experience. The project includes an activity for the compilation and analysis of case studies of international demonstrations related to EV-RE integration. It also calls for the holding of international forums on EV-RE integration at which Chinese participants can learn about international cases and exchange with international participants. The project will proactively seek international cooperation and involvement in various activities to leverage the experience of other nations. In particular, V2G and V2X/ "smart city" experience and experience with secondary use of EV batteries in Japan will be leveraged. Persons from companies, think tanks, and government from Japan and other nations will be involved in the project through conferences, case studies, consulting assignments, exchange on the project demos, and other types of coordination. Preliminary exchange on the specifics of such cooperation has already been held with Toyota and Mitsubishi Research Institute. Further discussions will be held with these and other organizations, such as relevant departments of Japan's Ministry of Economy, Trade, and Industry (METI), during project implementation.

Project activities, in addition, include detailed monitoring of and information gathering on the project demos, so that findings can be documented, assessed, and shared with various stakeholders. For each demo city, this documentation will cover the smart EV charging demonstration and the EV-RE micro-grid demonstrations. It will also feature relevant aspects of these demos, such as use of retired EV batteries in EV-RE micro-grids, scale up of vehicles and fixed location charging infrastructure, and use of mobile charging station vehicles.

For government officials, the project will prepare two levels of documentation on EV-RE integration, some of which will also be integrated into materials for the industrial and service sectors. For high-level officials, the project will prepare succinct policy briefs to ensure these officials understand the importance, key concepts, and key findings with regard to EV-RE integration. For other officials that may require more detailed information, the project will prepare detailed briefing books, that cover policy, plans, and standards designed by the project, as well as detailed information on the project demos. The project will similarly prepare detailed briefing information targeted towards the needs of relevant industry and service sector stakeholders.

In addition, the project will prepare a website for knowledge sharing on EV-RE integration. The website will include many of the materials prepared by the project, similar to those included in the hard copy detailed briefing materials mentioned above. The website will be designed so that different areas of work of the project are accessed through different webpages reachable by the site. Such areas include: international experience in EV-RE integration (webpage to include links to the international case studies and analysis thereof prepared by the project); EV-RE integration related policy (webpage to include links to drafts prepared by the project of the national-level EV-RE integration roadmap, local level roadmaps, policies relevant to EV-RE integration, standards for EV-RE integration, and proposed carbon trading rules for EVs powered by RE); project demo data, information, and assessment (webpage links arranged by type of demo or aspect of demo); and materials for raising public awareness about EV-RE integration (webpage to include links to project EV-RE integration documentary and articles published in the press).

The project will also disseminate the knowledge it generates on EV-RE integration via various capacity building events, workshops, meetings, and promotion. In addition to the international forums mentioned above, there will be a capacity building program for 100 city level officials. There will also be events for government officials at which draft policies, roadmaps, and standards related to EV-RE integration will be introduced and discussed. Further there will be capacity building for industry via events on EV-RE integration standards and other topics. In addition, the project will seek to share knowledge on EV-RE integration with the general public via a documentary and via newspaper, online news, and radio broadcast outreach.

The project, in its knowledge management, will leverage results gained through the CICETE, SAE, and UNIDO project "Vehicle Technologies in China." That project, whose implementation period has overlapped with the PPG period of this project and will overlap with the first year of full implementation of this project, includes in-depth work on the current situation and future path of EVs in China. This information can be used as a basis for the project's planning with regard to EV-RE integration, particularly the national-level roadmap.

Lastly, efforts will be made to share the knowledge gained in this China EV-RE integration project with other countries. Given the newness of the field of EV-RE integration and the innovative, first-of-its-kind nature of the project, it is believed dissemination of results to other countries will make an important contribution to the global community. As one key avenue of dissemination, UNIDO, as a member of the Partnership on Sustainable, Low Carbon Transport (SLoCaT), will aim to transfer the lessons learned on policies and technologies to other stakeholders.

B. DESCRIPTION OF THE CONSISTENCY OF THE PROJECT WITH:

B.1 *Consistency with National Priorities.* Describe the consistency of the project with national strategies and plans or reports and assessments under relevant conventions such as NAPAs, NAPs, ASGM NAPs, MIAs, NBSAPs, NCs, TNAs, NCSAs, NIPs, PRSPs, NPFE, BURs, etc.:

The project is highly consistent with China's national priorities as well as its commitments under the United Nations Framework Convention on Climate Change (UNFCCC). Yet, it combines these priorities in a new way via the field of EV-RE integration, thus introducing a new approach for China to achieve its targets and commitments at a level beyond that possible by pursuing EVs and RE in an unintegrated fashion. In terms of China's national priorities, the areas of "new energy vehicles" (with the greatest emphasis on electric vehicles); renewable energy; and power grid modernization are all areas identified by the Government of China for priority development. Further, under the UNFCCC, China is committed to working with the global community to limit greenhouse gas emissions. EV-RE integration, with its high potential for replacing either the petroleum used in ICEVs or the fossil fuel dominated grid power currently used by EVs in China, has high potential for enabling China to limit the growth of and potentially even eventually reduce greenhouse gas emissions from the nation's transport sector.

China prioritizes EVs to reduce dependence on foreign produced petroleum and improve local air quality. China's strong priority on developing the NEV sector is evidenced by the many policy documents issued and the strong subsidies and other preferential policies offered at both the national and local levels. As for China's NEV promotion program, it was launched in 2009 with the *Ten Cities, 1,000 NEVs Program*. Evidence of continued prioritization of the NEV demo program (and thus, of NEVs) is shown through the good number of more recent relevant policy documents issued, such as the September 2013 issued *Notice on Further Promotional Work for New Energy Vehicles*. With this notice, China expanded its NEV demo program to encompass 39 designated cities and regions (or a total of 88 cities). Further evidence of China's strong and continued policy prioritization of NEVs can be found in Annex T3 as well as in the summary on China's NEV policy presented earlier in this document.

China's strong priority on increasing utilization of RE is reflected in ambitious targets and preferential policies that have led China to be a leader in annual installation and total installed RE power generation capacity. As mentioned earlier in this document, as of 2015, China ranked first in the world in total installed RE power capacity whether including or excluding hydropower. China's *Renewable Energy Law*, passed in 2005 and amended in 2009, has been a driving force behind China's great growth in RE power production, particularly through implementing regulations calling for feed-in tariffs and/or concession and bidding programs for RE power development. Showing yet a further step-up in China's push for RE power are the *Guiding Opinions on Establishing Renewable Energy Portfolio Standards*, issued by the National Energy Administration (NEA) in early 2016. This document indicates a requirement that each province meet targets of between two and 13 percent for share of non-hydro RE power (mainly wind, PV, and biomass) in total generation used. For the nation as a whole, the NEA targets nine percent share for non-hydro renewables in China's power mix of consumed electricity by 2020. It targets 15 percent share for all non-fossil fuel power sources in China's power mix by 2020 and 20 percent share by 2030. As for specific RE technologies, in its 13th Five Year Plan (2016 - 2020), China targets 250 GW of installed wind capacity by 2020 (as compared to 145 GW at the end of 2015), 160 GW of installed PV capacity by 2020 (as compared to 43 GW at the end of 2015), and 340 GW of installed hydro capacity (as compared to 321 GW at the end of 2015).

China's prioritization of power grid modernization is clear from targets and substantial funds allocated to grid modernization. China targets a "strong and smart grid," which is a grid able to transmit large amounts of electricity reliably over long distances, as well as one that is able to work interactively with loads by sharing information with users for their decision making and by allowing for users to send power back to the grid at times when it is available and needed. According to State Grid, China will spend around 820 billion yuan (USD128 billion) between 2016 and 2030 on smart grid and related infrastructure. According to some, China represents the largest market for smart grid equipment in the world.

China also puts a lot of emphasis on climate change mitigation, a key potential benefit of EV-RE integration and motivation of this project. As an example of this emphasis, China has recently developed a framework for carbon trading. Further, in its *Intended Nationally Determined Contribution* (INDC) prepared as a part of its climate change policy process in June 2015, China indicates that integrating low-carbon development concepts to control emissions in the transport and building sectors are important means of mitigating climate change.

C. DESCRIBE THE BUDGETED M&E PLAN:

The project's fifth component is dedicated to monitoring and evaluation (M&E); and there is a budgeted M&E plan, most of which is associated with that component. M&E will be conducted at several levels. At the most basic level, a project management office team member will be responsible for tracking project indicators and preparing quarterly reports and initial drafts of annual project reports. At the level of project team members, site visits to the demo cities will also be carried out to monitor progress of the demos. (MIIT and UNIDO may also participate in these site visits.)

At the next level, the full project team will meet periodically and at least once per quarter to discuss project progress, indicators, and problems encountered in project management. The Project Steering Committee will, in turn, meet at least once every six months to monitor and evaluate project progress, taking actions as necessary. In addition to the foregoing measures, the project will commission a mid-term review after about 1.5 years of implementation and a

terminal evaluation after about three years of implementation, as the project is nearing its close. These evaluations will be carried out by parties who have not previously been involved with the project. The project's M&E plan and indicators will be finalized at the time of inception. Exhibit 19 summarizes M&E activities, budget, and time frame.

Exhibit 19: M&E Work Plan and Budget

Type of M&E activity	**Responsible Parties**	**Budget USD**		
		timeframe	GEF*	UNIDO and project partners
Inception Workshop (IW) and inception report	UNIDO Project Manager (PM); Project Management Office (PMO)	Within first two months of project start up	20,000	20,000
M&E design and tools to collect and record data (performance indicators) including survey to confirm baseline including gender specific indicators	UNIDO Project Manager (PM); Project Management Office (PMO) and M&E specialists and gender specialists	Within first two months of project start up and mid of project	20,000***	30,000
Regular monitoring and analysis of performance indicators (policy technical, environmental, and social incl. gender)	UNIDO Project Manager (PM); Project Management Office (PMO), M&E specialists as required	Regularly to feed into project management and Annual Project Review	25,000***	250,000
Annual Progress (APRs) and Project Implementation Reports (PIRs)	Project Management Office (PMO) to prepare prior to the annual project review	Annually	-	30,000
	PM UNIDO to validate and finalize to submit to GEF	Annually	-	-
Annual Project Review to assess project progress and performance (including GEF Tracking Tool specific indicators)	Project Management Office (PMO), PM UNIDO HQ and Project Steering Committee to review the project performance and make corrective decision	Annually prior to the finalization of APR/PIR and to the definition of annual work plans	15,000	20,000
Project Executive Committee	PMO, PM UNIDO HQ	Yearly	- *	-
Mid-term Evaluation including survey to measure progress against baseline	PMO, external consultants, UNIDO PM, UNIDO Evaluation Office (ECA) in advising on TOR and selection of evaluators, Steering Committee and M&E specialists as required	Mid project	50,000***	50,000
Environmental and socio-economic impact assessments of infrastructure projects in Shanghai and Yancheng	UNIDO Project Manager (PM); Project Management Office (PMO) and M&E specialists		100,000	-
Project terminal report	UNIDO Project Manager (PM); Project Management Office (PMO)	One month before end of project implementation	-	50,000
Final Project Evaluation	UNIDO Evaluation Office (ECA), Project Management Office (PMO), PM UNIDO HQ and Project Steering Committee, independent external	Within 6 months of project completion	90,000***	50,000

	evaluators			
Lessons learned	PMO, external consultants, UNIDO PM	By the end of project implementation; annual as part of PIR		
Visits to field sites	PM	Annually	0*	
	UNIDO HQ		-	
	Representative from the Steering Committee			
TOTAL indicative cost ** Excludes project team staff time and UNIDO staff* *** The costs are covered under Project Management Costs* **** to be executed by UNIDO*			**320,000**	**500,000**

Project monitoring and evaluation (M&E) are conducted in accordance with established UNIDO and GEF procedures. The M&E activities are defined by project component 5 and the concrete activities for M&E that are specified and budgeted in the M&E plan. Monitoring will be based on indicators defined in the strategic results framework (which details the means of verification), and the annual work plans. M&E will make use of the GEF Tracking Tool, which will be submitted to the GEF Secretariat three times during the duration of the project: at CEO Endorsement, at mid-term review, and at project closure.

UNIDO as the Implementing Agency will involve the GEF Operational Focal Point and project stakeholders at all stages of the project monitoring and evaluation activities in order to ensure the use of the evaluation results for further planning and implementation.

According to the Monitoring and Evaluation policy of the GEF and UNIDO, follow-up studies like Country portfolio evaluations and thematic evaluations can be initiated and conducted. All project partners and contractors are obliged to (i) make available studies, provide reports or other documentation related to the project and (ii) facilitate interviews with staff involved in the project activities.

PART III: CERTIFICATION BY GEF PARTNER AGENCY(IES)

GEF Agency(ies) Certification

This request has been prepared in accordance with GEF policies[34] and procedures and meets the GEF criteria for CEO endorsement under GEF-6.

Agency Coordinator, Agency Name	Signature	Date (mm/dd/yyyy)	Project Contact Person	Telephone	Email Address
Mr. Philippe R. Scholtès, Managing Director, Programme Development and Technical Cooperation - PTC, UNIDO GEF Focal Point		04/11/2017	Ms. Bettina Schreck, Industrial Development Officer, PTC/ENE/IEE, UNID	+43 (1) 26026 3032	b.schreck @unido.org

[34] GEF policies encompass all managed trust funds, namely: GEFTF, LDCF, and SCCF

ANNEX A: PROJECT RESULTS FRAMEWORK

Project Strategy	KPI/ Indicator	Baseline	Target at End of Project	Sources of Verification	Assumptions
Project Objective: Facilitation and scale-up of the integrated development of electric vehicles (EVs) with renewable energy (RE) in China	Direct GHG emissions reduced from integration of EVs with RE and from scale-up of EV use beyond business as usual, based on the project demos (tons CO_2)	0	25,629	Demo monitoring reports	Sustained and solid support for the project from local partners in Yancheng and Shanghai
	Indirect GHG emissions reduced from integration of EVs with RE and from scale-up of EV use beyond business as usual, based on replication of the project demos (tons CO_2)	0	62,181	Records of replication cities and original demo cities; energy management centers in replication cities and original demo cities	Strong political support in replication cities and original demo cities for integration of EVs with RE
	Amount of RE used to charge EVs in China via micro-grids and smart charging (both direct via project demos and indirect via replication of demos) (MWh)	0	69,465[35]	Records of replication cities and original demo cities; energy management centers in replication cities and original demo cities	Strong political support in replication cities and original demo cities for integration of EVs with RE
Outcome 1: Drafted and recommended policies, technical standards, and guidelines that provide regulatory and planning elements, leading to the higher adoption of EV-RE integration schemes by city governments, vehicle manufacturers, and consumers, thus resulting in GHG emission reductions	Number of incentive policies or amendments related to EV-RE integration approved or under current active review with high potential for approval at the ministerial level for entry into the policy pipeline. Such incentive policies may include those for: (a) smart charging, (b) V2G, (c) distributed RE for EV charging, (d) grid-based uptake of RE by EVs, and (e) secondary batteries	0	3	Documentation of ministerial level approval of policies or amendments for entry into the policy pipeline	MIIT and/or NDRC receptive to idea of promoting EV-RE integration Sufficient government funding exists to justify pursuit of incentive policies related to EV-RE integration
	Number of different types of standards adopted to facilitate EV-RE integration and scale-up (types to be selected from the following: energy management center standards, technical standards for V2G connection, standards for secondary use of retired EV batteries, technical and safety standards for smart charging systems, standards for mobile charging systems, and	0	6	Listing of standards issued by China's vehicle industry and by China's renewable energy industry	China's vehicle industry and RE industry have strong enough commitment to EV-RE integration to achieve issuance of multiple standards during the three-year lifetime of project

[35] Demo charging of EVs with REs during project includes power provided to EVs by: (1) Yancheng's Aoxin MicroGridMicro-Grid (1,200,000 kWh), (2) Yancheng's Goldwind Micro-Grid (138,700 kWh), (3) Yancheng's smart charging (assuming the full shift in demand can be supplied by wind power previously in excess, 17,885 MWh), and (4) Shanghai's 10 micro-grids (624,000 kWh). Total for demos during project is: 19,847.0 MWh. Estimated replication in year three of project assumes replication in six new cities (of a scale similar to demo scale in one city) and double original scale replication in the two demo cities. So, this is ten times replication of one city for one year, or five times one demo city over two years and thus 2.5 times the results of our two demo cities over last two years of project: 2.5 x 19,847 MWh = 49,617.5 MWh. And, in total, charging of EVs with RE achieved during the project is 69,464.5 MWh = 19,847.0 MWh (demos) + 49,617.5 MWh (replication).

	standards for distributed RE systems for charging EVs)				
	Number of cities that have officially adopted local EV-RE integration and scale up plans	0	6	Proceedings of city government meetings on EV-RE integration plans in various cities	City governments have fiscal resources to make them confident in ability to adopt EV-RE integration plans
Output 1.1A: National level roadmap to facilitate effective EV-RE integration and scale up that achieves consensus among stakeholders	Number of key ministries providing input to *National Roadmap on EV-RE Integration*	0	3	Project meeting minutes from one-on-one meetings with relevant officials on the proposed *National Roadmap*	Key ministries interested enough in EV-RE integration to take time to offer thoughtful input to draft version of *National Roadmap on EV-RE Integration*
Output 1.1B: Suggested policies and framework that promote balancing of grid load with power generated via utilization of EVs, thus providing a foundation for scale up of EV-RE integration	Number of different key topics covered by proposed policies or amendments submitted to government related to EVs' role in balancing power load with power supply (key topics for which coverage is to be assessed include: smart charging guidelines and incentives, energy management center set-up, V2G power sales to grid, and V2G incentives)	0	4	Project records on official submissions of proposed policies to government	Authorities with relevant purview amenable to receiving policy recommendations in the relatively new area of using EVs to balance grid load with power generated
Output 1.1C: Proposed national-level policies to regulate and incentivize systems for the charging of EVs with RE, including those integrating either RE micro-grids or grid-based large-scale RE installations	Number of different key topics covered by proposed policies submitted to government related to EVs being charged with RE (key topics for which coverage is to be assessed include: guidelines for distributed EV-RE charging systems, incentives for distributed EV-RE charging systems, and incentives for grid-based EV smart charging using RE that would otherwise be curtailed)	0	3	Project records on official submissions of proposed policies to government	Authorities with relevant purview amenable to receiving policy recommendations in the relatively new area of charging EVs with RE
Output 1.1D: Proposed national-level policy instruments to regulate and incentivize use of retired EV batteries, which may play a key role in large-scale EV-RE integration	Number of different key topics covered by proposed policies submitted to government related to use of secondary use of retired EV batteries (key topics for which coverage is to be assessed include: guidelines for use of retired EV batteries and incentives for use of retired batteries)	0	2	Project records on official submissions of proposed policies to government	Authorities whose purview includes regulation and incentives for retired EV batteries amendable to receiving policy recommendations
Output 1.2: Issuance of technical standards and specifications facilitating EV-RE integration and scale up, including those for smart charging systems, vehicle to grid (V2G) systems, mobile charging systems, and use of retired EV batteries	Number of different types of standards proposed by expert standards formulation committees to facilitate EV-RE integration and scale-up (types to be selected from the following: energy management center standards, technical standards for V2G connection, standards for secondary use of retired EV batteries, technical and safety standards for smart charging systems, standards for mobile charging systems, and standards for distributed RE systems for charging EVs)	0	6	Listing of standards issued by China's vehicle industry and by China's renewable energy industry	China's vehicle industry and RE industry have strong enough commitment to EV-RE integration to achieve issuance of multiple standards during the three-year lifetime of project
Output 1.3: Recommendations presented to transport sector	Status of proposal to incorporate charging of EVs with RE into national carbon trading	0	1	Project records on submissions of	Authorities responsible for national carbon trading system amendable to

authorities for incorporation of incentives for EV charging with RE in transport sector national carbon trading policies, including carbon trading rules for EVs powered by RE, to promote greater adoption of RE in the grids supplying electricity to EVs	systems (1= submitted to government, 0=not yet submitted to government)			proposed policies to government	receiving submissions on recommendations for amendments to system
Output 1.4: City-level EV-RE integration and scale up plans, including replication plans for the adoption of best models demonstrated in Shanghai and Yancheng	Number of cities with draft local EV-RE integration and scale up plans	0	6	Proceedings of city government meetings on EV-RE integration plans in various cities	City governments have fiscal resources to make them confident in ability to adopt EV-RE integration plans
Output 1.5: Proposed institutional plan to establish responsibilities of and coordination among various government organizations for EV-RE integration	Number of different ministries reviewing institutional plan	0	3	Project reporting on meetings regarding institutional plan	Government officials willing to meet regarding institutional plan and review materials
Outcome 2: Increased institutional capabilities and awareness of policymakers at national and local levels on the use of integrated EV - SG (Smart Grid) - RE systems	Total number of policymakers reached by project's capacity building and awareness work regarding EV-RE integration	0	100	Attendee lists of all workshops, training programs, and group meetings held under Outcome 2	National and local level government officials receptive enough to idea of EV-RE integration to attend events and be open to one-on-one meetings on the topic
	Total number of cities whose policymakers are reached by project's capacity building and awareness work regarding EV-RE integration	0	30	Attendee lists of all workshops and training programs held under Outcome 2	City level officials receptive enough to idea of EV-RE integration to attend project training program or other relevant events
	Number of cities that indicate they have a strong interest in learning more about and carrying out EV-RE integration work as a result of project outreach	0	10	Survey of cities reached under Component 2 as conducted under Activity 5.2.1	Priorities of their cities make city level officials receptive enough to EV-RE integration concept to want to invest more time in learning more
Output 2.1: Training program for 100 city-level policy makers on EV-RE integration policies and demonstration experience	Number of government officials attending EV-RE integration training program that pass test on mastery of materials given at end of program	0	80	Results of test prepared under Activity 2.1.1 and administered under Activity 2.1.2	Government officials attending training program have enough background to master program content
	Proportion of women among training program attendees	Not applicable	35%	Training program attendee list	Government organizations become onboard with working to achieve higher proportion of women attendees than is typical
Output 2.2: Four workshops conducted to validate the EV-RE integration policy and planning framework	Number of workshops at which strong consensus is achieved for proposed policy, standards, trading system, or roadmap	0	4	Four surveys conducted as part of Activities 2.2.1, 2.2.2, and 2.2.3	Attendees of workshops have strong enough policy backgrounds to provide useful input on proposed policy instruments

	Proportion of women among attendees of all four policy and planning workshops	Not applicable	35%	Workshop attendee list	Government organizations become onboard with working to achieve higher proportion of women attendees than is typical
Output 2.3: International forums with participants from central government agencies and EV demonstration cities that disseminate international developments in and plans for EV-RE integration	Number of country case studies included in report on international developments in EV-RE integration Number of distinct Chinese government officials attending one or both of the two forums on international developments in EV-RE integration Proportion of women among all attendees of the international forums	0 0 Not applicable	5 30 35%	Project study on international developments and plans in EV-RE integration Attendee list of project's two international forums	International developments in EV-RE integration are advanced enough to warrant in-depth case studies National and local-level government officials develop enough interest in EV-RE integration topic to attend the international forums Attending organizations become onboard with working to achieve higher proportion of women attendees than is typical
Output 2.4: Written materials on EV-RE integration strategically disseminated to policy makers	Number of government officials that are confirmed to have reviewed briefing materials Number of categories of items included in online information base (possible categories include: policy briefings, international study, demo reports, roadmaps, policies/ regulations, standards)	0 0	30 6	Project team follow up with government officials (or their team members) that received hard copy briefing materials from project Project's online information base	Government officials become interested in the topic of EV-RE integration once presented with materials and background explanation
Outcome 3: Two city-scale projects piloted, demonstrating the integration of EVs and RE, as well as other foundational work needed to achieve large-scale EV-RE integration	Amount of renewable energy uptake by EVs in project demo micro-grids (kWh)	0	2,101 MWh = 2y x (600/y @Aoxin + 138.7/y @Goldwind + 312/y @SIAC)	Project monitoring report on RE micro-grid demos	Capacity strong enough so that RE micro-grid demos are up and running and supplying RE to EVs at scale by end of year 1 of project implementation
	Amount of energy shifted by smart charging of project demos to reduce peaks and valleys of grid demand (kWh)	0	20,075 MWh = 17,885 Yancheng + 2,190 Shanghai (for two year period)	Project monitoring report on smart charging aspect of demos	Capacity strong enough so that smart charging aspect of demos is up and running at scale by end of year 1 of project implementation
	Amount of energy stored and returned annually to micro-grids by retired EV battery banks	0	819,936 KWh = 2y x (166,090/y @Aoxin + 33,638/y @Goldwind + 210,240/y @SIAC)	Project monitoring report on micro-grids (stationary retired EV battery banks aspect)	Capacity strong enough so that RE micro-grid demos are up and running with retired EV battery banks fully operations by end of year 1 of project implementation
Output 3.1: Demonstration of integration of EVs with the power grid, needed as basis for EVs eventually to address intermittency issues of large-scale RE power incorporation into the grid	Number of (a1) smart charging devices and (b) electric vehicles successfully participating in smart charging system in Yancheng, including: (b1) trucks, (b2) taxis, (b3) buses, (b4) fleet sedans, and (b5) private or rental sedans Number of (a2) smart charging devices and (b)	(a1) 0 (b1) 0 (b2) 0 (b3) 0 (b4) 0 (b5) 0 (a2) 0	(a1) 1,000 (b1) 700 (b2) 50 (b3) 10 (b4) 100 (b5) 140 (a2) 200	Project monitoring report on Yancheng's smart charging demo Project monitoring	Capacity strong enough so that smart charging demo successfully implemented in Yancheng Capacity strong enough so that

	electric vehicles successfully participating on a daily basis in smart charging system in Shanghai, including: (b6) hourly car sharing sedans	(b6) 0	(b6) 200 (daily average)	report on demo of smart charging in Shanghai	smart charging demo successfully implemented in Shanghai
<u>Output 3.2A</u>: Demonstration of integration of EVs into RE micro-grids, including demonstration of micro-grids incorporating wind, PV, use of retired EV batteries as storage, EVs, and buildings and a manufacturing facility	Number of EVs powered mainly by RE micro-grid demos in Yancheng Number of EVs powered mainly by RE micro-grid demo in Shanghai	0 0	87 (Aoxin Micro Grid: 77 = 57 trucks + 20 sedans, there will be 3 additional trucks, but RE power is just about enough for the 77 rather than 80 vehicles; Goldwind Micro-Grid: 10 sedans) 90	Project monitoring report on Yancheng's micro-grids Project monitoring report on Shanghai's micro-grids	Capacity strong enough so that RE micro-grid demos are up and running during project and charging the targeted number of vehicles
<u>Output 3.2B</u>: Demonstration of V2G technologies and pilot commercial systems enabling EVs (or retired EV battery packs) to send power back to the micro-grid at times that it is needed	Number of electric vehicles successfully participating in demonstration of micro-grid connected V2G system in Yancheng Amount of energy sent to the grid via V2G of Yancheng micro-grid (kWh) Number of electric vehicles successfully participating in demonstration of micro-grid connected V2G system in Shanghai Amount of energy sent to the grid via V2G of Shanghai micro-grid (kWh)	0 0 0 0	10 48,180 kWh (assumes V2G demo operational for two years) 5 22,886 kWh (assumes V2G demo operational for two years)	Project monitoring report on Yancheng's Aoxin Micro-Grid (V2G aspect) Project monitoring report on Shanghai's micro-grids (V2G aspect)	Capacity strong enough so that V2G demo in Yancheng is up and successfully running by end of first year of project implementation Capacity strong enough so that V2G demo in Shanghai is up and successfully running by end of first year of project implementation
<u>Output 3.3A</u>: Demonstration of greater density of the EV stationary charging network, thus serving as a basis for scale-up of EV-RE integration	Number of stationary EV charging poles of EVCARD business in Shanghai	4,000	16,000	Project monitoring report on scale-up aspects of project demos	Full targeted co-financing realized in Shanghai and applied to scale-up of EVCARD business as planned
<u>Output 3.3B</u>: Demonstration of alternatives to stationary charging stations, in particular mobile charging station vehicles, to deal with emergency needs for charging, thus increasing the feasibility of EV use and thereby supporting the scale-up of EV-RE integration	Mobile charging stations circulating on daily basis in Yancheng Total number of retired EV battery packs used on mobile charging stations on daily basis in Yancheng	0 0	3 36	Project monitoring report on mobile charging station vehicle	Viable model for mobile charging station vehicle developed
<u>Output 3.3C</u>: Demonstration of business models to scale-up the number of EVs, thus laying the ground work to realize the benefits of EV-RE integration on	Number of hourly car rental ("car sharing") passenger vehicles in Shanghai's EVCARD fleet Number of pure electric buses in E-drive's	1,600 50	8,000 200	Project monitoring report on scale-up aspects of project demos	Full targeted co-financing realized in Shanghai and applied to scale-up of EVCARD and E-drive business as planned

substantial scale	rental fleet				
Output 3.4: Demonstration of energy management centers that collect and manage data on dispersed EVs and retired EV battery packs used as storage for the grid, so that the charge and discharge of these devices can be managed	Number of vehicles receiving commands from Yancheng's energy management center on an ongoing basis that control their charging times (and discharging times, if relevant) including: (b1) trucks, (b2) taxis, (b3) buses, (b4) fleet sedans, and (b5) private or rental sedans (*Note: Likely to be similar to Yancheng indicator values for outcome 3.1A, except that 10 V2G vehicles are added*) Number of vehicles receiving commands from Shanghai's energy management center on an ongoing basis that control their charging times (and discharging times, if relevant), including: (b6) hourly car sharing sedans	(b1) 0 (b2) 0 (b3) 0 (b4) 0 (b5) 0 (b6) 0	(b1) 700 (b2) 50 (b3) 10 (b4) 110 (b5) 140 (b6) 205	Records and data from Yancheng Energy Management Center Records and data from Shanghai Energy Management Center	Co-financed scale-up of vehicles in Yancheng achieved, with all 1,000 vehicles incorporated into smart charging system Successful implementation of smart charging system and V2G in Shanghai
Output 3.5A: Detailed monitoring and assessment of project demos of EV integration with the power grid	Number of areas in which EV integration with power grid demo data and information on experience is collected, assessed, and reported with recommendations. (Areas to be covered include: (1) smart charging and (2) energy management centers) Number of smart charging poles in Yancheng for which data is collected and assessed for 2 years Number of smart charging poles in Shanghai for which data is collected and assessed for 2 years	0 0 0	2 1,000 200	Project reports assessing EV integration with power grid demo results Yancheng Energy Management Center data reports Shanghai Energy Management Center data reports	Capacity of personnel involved in analysis work high enough to generate useful and analytic insights based on data and information collected from the project EV power grid integration demos Energy Management Centers achieve high quality data collection, enabling analysis work
Output 3.5B: Detailed monitoring and assessment of project demos of RE-EV micro-grids	Number of areas in which EV-RE micro-grid demo data and information on demo experience is collected, assessed, and reported with recommendations. (Areas to be covered include: (1) EV-RE micro-grid generally and (2) V2G in RE micro-grid) Number of regular micro-grid charging poles and number of V2G charging poles in Yancheng for which data is collected and assessed for 2 years (number of regular poles, number of V2G poles) Number of regular micro-grid charging poles and number of V2G charging poles in Shanghai for which data is collected and assessed for 2 years (number of regular poles, number of V2G poles)	0 regular: 0 V2G: 0 regular: 0 V2G: 0	2 regular: 80 V2G: 10 regular: 85 V2G: 5	Project reports assessing micro-grid demo results Yancheng Energy Management Center data reports Shanghai Energy Management Center data reports	Capacity of personnel involved in analysis work high enough to generate useful and analytic insights based on data and information collected from the project EV-RE micro-grid demos Energy Management Centers achieve high quality data collection, enabling analysis work
Output 3.5C: Detailed monitoring and assessment of	Number of areas in which retired EV battery demo data and information on demo	0	3	Project reports assessing demo	Capacity of personnel involved in analysis work high enough to

aspects of project demos related to the use of retired EV batteries, including development of know-how with regard to use of retired EV batteries so that they can be leveraged as tools of EV-RE integration	experience is collected, assessed, and reported with recommendations. (Areas to be covered include: (1) retired EV battery packs in RE micro-grid, (2) retired EV battery packs in mobile charging station vehicles, and (3) other testing of retired EV batteries) Number of retired EV battery packs utilized in the project demos for which data is included in the safety database and associated assessment Number of key technical topics covered in retired EV battery guidelines (possible key topics include: maintenance, repair, and refurbishment). Number of key battery chemistries covered in technical and economic evaluation of use of retired EV batteries	 0 0 0	 291 3 3	results related to retired EV batteries Yancheng Energy Management Center data reports Shanghai Energy Management Center data reports Project developed retired EV battery performance database Project developed guidelines for use of retired EV batteries Project report on technical and economic evaluation of retired EV battery use	generate useful and analytic insights based on data and information collected from the project demos' use of retired EV batteries Project demo aspects involving retired EV battery packs successfully provide data accessed via project-established energy management centers Technical capacity exists to develop strong technical guidelines on use of retired EV batteries Initial findings of technical work imply merit in covering at least three battery chemistries in technical and economic evaluation
Output 3.5D: Detailed monitoring and assessment of aspects of project demos related to scale-up and increased concentration of China's EV fleet and charging infrastructure	Number of areas of scale-up and increased concentration in which demo data and information on demo experience is collected, assessed including business feasibility assessment, and reported with recommendations. (Areas and to be covered include: (1) mobile charging station vehicles generally (Yancheng), (2) increased density of network of stationary charging poles (Shanghai), (3) car sharing EV scale up (Shanghai), and (4) EV rental bus scale up (Shanghai)) Number of mobile charging stations for which general operational data is collected and assessed for 2 years	0 0	4 3	Project reports assessing demo results Accounting profit-loss statements of entities operating mobile charging stations vehicles, fixed location charging poles, and car sharing and bus rental business	Capacity of personnel involved in analysis work high enough to generate useful and analytic insights based on data and information collected from project demos aspects related to scale up and increased concentration of vehicles and charging infrastructure Involved entities are willing to share profit and loss data on relevant charging, car sharing, and bus rental initiatives.
Outcome 4: Increased knowledge and capacity of business and consumer stakeholders, facilitating awareness, research and development, manufacture, operation, and maintenance with regard to EV-RE integration	Estimated number of consumers/ the public reached by all forms of project outreach on EV-RE integration	0	8 million	Project collected data on viewership of documentary and radio program audiences, as well as estimates of readership of EV-RE articles in the press and viewers of social media campaign	Consumers attracted to view / listen to programs on RE-EV and to read articles on this topic in the press and on social media

	Estimated total number of companies reached by all forms of project outreach on EV-RE integration	0	60	Attendee information of project meetings and workshops; listing of membership of EV-RE Alliance; listing of companies receiving project briefing materials	Companies find EV-RE integration, once explained to them, to be an attractive area worth further study
	Number of companies deciding to dedicate greater effort to the EV-RE area as a result of project outreach	0	15	Project survey conducted under Activity 5.2.2	Companies find EV-RE integration fits with their strategy for the future
Output 4.1A: Forums for industry, including both domestic and international players active in the China market in the vehicle, power, and other related sectors, on EV-RE business models, technology, and demonstration results	Number of distinct industrial companies related to EVs, power, or RE attending at least one of project's forums Proportion of attendees at forums for industry that are women	0 Not applicable	30 35%	Attendee lists from project's forums for industry	Players active in the China market and the vehicle, power, and other related sectors find that forum attendance fits with their business objectives Attending organizations become onboard with idea to increase proportion of women attendees
Output 4.1B: Dissemination to industry of project's EV-RE information base	Number of industrial organizations that receive project's EV-RE information base materials and find them useful in their business plans	0	10	Survey carried out under Activity 5.2.2	EV-RE integration is found by businesses to fit with their strategies and plans
Output 4.1C: Meetings publicizing EV-RE related technical standards, held for vehicle OEMs, charging equipment suppliers, and other related industrial companies	Number of persons attending meetings that do well enough on end of meeting test to confirm acceptable grasp of materials presented Proportion of attendees at standards meetings that are women	0 Not applicable	60 35%	Results of test designed and carried out under Activity 4.1C.1 Attendee lists from standards meetings	Attendees have enough basic knowledge to be able to grasp concepts presented at standards meetings Attending organizations become onboard with idea to increase proportion of women attendees
Output 4.1D: Technical operation and maintenance workshops related to EV-RE integration aspects held for relevant industrial organizations	Number of persons attending meetings that do well enough on end of meeting test to confirm acceptable grasp of materials presented. Proportion of women attendees at O&M workshops	0 Not applicable	50 35%	Results of test designed and carried out under Activity 4.1D.1 Attendee lists from O&M workshops	Attendees have enough basic knowledge to be able to grasp concepts presented at O&M workshops Attending organizations become onboard with idea to increase proportion of women attendees
Output 4.1E: Establishment of industry alliance or association subcommittee for promoting and advancing EV-RE integration and liaising with government on EV-RE integration policy	Number of distinct companies that join the industry alliance set up by the project to advance EV-RE integration	0	12	Membership roster of industry alliance set up under project	Potential member companies find EV-RE integration topic pertinent to their long-term strategy
Output 4.2: Awareness raised among current and future potential car sharing companies of various car sharing business	Number of existing car sharing business entities participating in project exchange workshop	0	15	Project records on attendees at car sharing exchange workshop	Car sharing businesses attracted to opportunity to learn more about EV-RE integration and share their experience to date in the car sharing

models and integration of EVs with RE in car sharing businesses	Number of entities interested in newly entering the car sharing business participating in project exchange workshop	0	15		business Companies not yet involved in car sharing find that EV car sharing business to be an attractive opportunity worth exploring
Output 4.3A: Media promotion of EV-RE integration, raising awareness of the public regarding the need to incorporate RE into EV development to realize the environmental potential of EVs and educating the public on various aspects of EV-RE integration	Number of viewers of documentary film on EV-RE integration Number of news articles (print media or online news) in Chinese press on EV-RE integration Number of radio listeners exposed to EV-RE integration via project's radio campaign Number of special strategies or measures adopted in media EV-RE integration outreach that specifically target the interests and concerns of women	0 0 0 0	50,000 30 1 million 3	Data on events at which documentary is aired Data on hits of website link to documentary File of news articles collected by project team Data on Chinese radio audience size Project reports	Event organizers, print and online journalists, and radio stations are convinced of attractiveness and/or meaningfulness of covering the story of EV-RE integration
Output 4.3B: Promotion of EV-RE integration to consumers via social organizations, increasing consumers' understanding of and attraction to the concept and related opportunities	Increase in membership of EV clubs targeted by project (number of new members) Number of persons exposed to EV-RE integration concepts via EV social clubs Number of women's organizations and number of women reached by project's special outreach to women's organizations to promote EV-RE to them	0 0 0 organizations 0 women	200 (=100 in Yancheng and 100 in Shanghai) 500 8 organizations 400 women	Project records of membership growth of pre-existing EV clubs Project records of attendance at EV-RE integration discussion meetings held by EV clubs Project records of attendance at EV-RE integration events for women's organizations	Measures taken to improve attractiveness of clubs attract more consumers to join EV club members interested in potential of EVs to address problems related to energy and the environment Women's organizations receptive to idea of EV-RE integration being explained and promoted at their events or at special events for their organization
Output 4.3C: Outreach on social media platforms and cooperation with social media companies to carry out promotion of EV-RE integration	Number of social media platforms on which the project's social media outreach campaign generates ongoing discussion regarding EV-RE integration Number of special strategies or measures adopted in social media EV-RE integration outreach that specifically target the interests and concerns of women	0 0	3 2	Project records on results of Activity 4.3C.2	Users of social media platforms receptive to well-designed outreach campaign on EV-RE integration
Output 4.4: An EV-RE	Number of Chinese government officials that	0	200	Records of Yancheng	Government officials respond

integration demonstration center in Yancheng, created to raise awareness on the topic of EV-RE integration amongst consumers, companies using EVs, and industries related to RE or EV	have visited EV-RE integration demonstration center in Yancheng Total number of persons that have visited EV-RE integration demonstration center in Yancheng	 0	 2,000	EV-RE Integration Demonstration Center	positively to invitations to visit the Demonstration Center Other experts and the general public are attracted by the opportunity to visit the demonstration center
Environmental and Social Management Plan (ESMP) indicators not included elsewhere	Proportion of international consultant person days performed by women	Not applicable	35%	Project contracts	Qualified women candidates apply for project opportunities
	Proportion of domestic consultant person days performed by women	Not applicable	35%	Project contracts	Qualified women candidates apply for project opportunities
	Proportion of new or upgraded charging poles in project demos that are monitored for safety in construction and operation.	Not applicable	100%	Report prepared as a part of Activity 5.2.3.	Personnel with electrical safety expertise available to participate in project.
	Number of incidents of noncompliance with safety standards in construction or number of safety incidents with regard to project's charging poles or EV-RE mini-grids	Not applicable	0	Report prepared as a part of Activity 5.2.3.	Personnel with electrical safety expertise available to participate in project.
	Number of battery packs or batteries that are part of project that are not disposed of properly	Not applicable	0	Battery tracking system prepared as part of Activity 5.2.4.	Recycling capacity exists for those batteries that are no longer useful for secondary use or for those which secondary use market is not large enough to absorb.

ANNEX B: RESPONSES TO PROJECT REVIEWS (from GEF Secretariat and GEF Agencies, and Responses to Comments from Council at work program inclusion and the Convention Secretariat and STAP at PIF).

Part I. Responses to GEF Secretariat Comments

1. General comment: Please organize the section of components 1-5 (page 12-14) in the order of outputs 1.1-5.3 as listed in table B's Project Outputs column.

Response made at PIF stage: The description of components in section 1 has been modified to reflect the order in table B (pages 12 to 15), including new descriptions for Output 1.4 and Output 4.3.

Additional response at ProDoc submission stage: The listing of outputs in Table B in Part I of the ProDoc fully correspond to the order of the outputs given in the text description of the components and outcomes given in Section A.1.3 of Part II of the ProDoc.

2. Component 1 – comment 1: Please briefly describe the status of guideline and standards development for new energy vehicles in China. According to MIIT, Chinese standards on AC charging are almost comparable to international standards, but the standards on DC charging are still lagging behind, particularly related to charging interface physical structure, charge control pilot circuit and communication controllers. The project should promote adoption of international standards as much as possible to help promote replicability and leadership in this fast-changing field. Private sector partners, such as EV, battery, and charging technology companies, should be actively engaged in the standards development process

Response made at PIF stage: Section 1.3 (pages 12-13) has been edited to reflect the comments made by the reviewer, as follows: "Status of development of NEVs national standards and guidelines: To facilitate the deployment of NEVs, the government has actively improved the standards system. Since SAE has been delegated the standards function by the MIIT, they have been consulted on the current status for the NEVs technologies addressed in the project, which are as follows: (1) charging infrastructure: 15 national standard and 10 industry standards have been published (industry standards are lower in the hierarchy and can be recommended to the MIIT by industry for mandatory adoption. (2) AC and DC charging: standards are being updated and will be published soon. Regarding best practice guidelines, the government has released NEV and RE development guidelines separately. The proposed project will focus on the development of guidelines and industry standards for RE integration with electric vehicles. SAE acknowledges that private sector enterprises are actively engaged in the standards development process; and this will be the case for the proposed project."

Additional response at ProDoc submission stage: The full project design emphasizes that standards work will specifically address areas related to the integration of EVs and RE, which is quite new in China. The ProDoc further clarifies that the specific standards work to be undertaken under the project will be for: (1) energy management centers (for large-scale EV-RE integration via load management), including standards and specifications for communication protocols among the grid, the charger, and the EV; (2) smart charging systems, including technical and safety aspects; (3) V2G systems; (4) use of retired EV batteries (including standards for categorizing retired EV batteries, standards for safety, measuring and testing of retired EV batteries, and standards to determine when EV batteries should be retired from EV use); (5) mobile charging station systems; (6) safety and technical standards, especially with regard to fire protection system, for distributed RE systems that serve as charging systems for EVs.

3. Component 1 – comment 2: Regarding the "Joint Standard Research Committee," please explain who will join MIIT in leading the Committee, and if it will overlap with the functions of the "Electric Vehicle National Engineering Lab," jointly established by MIIT and Ministry of Science and Technology in 2010. If not, please briefly describe your strategy of leveraging synergies with the Lab.

Response made at PIF stage: Section 1.3 (pages 12-13) has been edited to reflect the comments made by the reviewer, as follows: Role of the Government Bodies in the Standards Process: Industry specific standards in China are categorized in the following hierarchy, listed from the highest level in the hierarchy to the lowest: (1) National Standard TB, mandatory, to satisfy industry specific needs; (2) industry standards, voluntary; (3) local standards, voluntary; (5) group standards, voluntary; and (5) company standards, voluntary. In the case of the automotive sector, the responsible agencies are as follows: (1) National standards and industry standards are established by the National Technical Committee of Auto Standardization (NTCAS). National standards are approved by Standardization Administration of the People's Republic of China (SAC), an independent government agency under the State Administration of Quality Supervision, Inspection, and Quarantine (AQSIQ). (2) Industry standards are approved by MIIT. (3) Local standards are developed by local governments. (4) Group standard are usually developed by industrial organizations (like SAE-China), with more flexible requirements and a simpler approval process. In the project design phase, the project the will engage experts from the NTCAS and MIIT to ensure alignment and support from both agencies as well as the EV Lab.

Additional response at ProDoc submission stage: Project activities related to standards development will include one-on-one meetings with individual decision-makers and a seminar to present standards, seek input, and build consensus and government/ industry acceptance of draft standard designs prepared by the project.

4. Component 1 – comment 3: Regarding the incentive mechanisms study, please justify the needs for GEF investment. There are already many reports related to incentive mechanisms, both internationally and domestically. In the case of China, the World Bank published a report, "The China New Energy Vehicles Program: Challenges and Opportunities in 2011." Boston Consulting Group recently also published a report on how China can better incentivize the deployment of EVs. Without improved justification, the resources for the study should be re-allocated to another activity within the project. For example, studying various cost-effective business models for rapid scale up of EVs in China.

Response made at PIF stage: Section 1.3 (pages 12-13) has been edited to reflect the comments made by the reviewer, as follows: Scope of the output 1.3: The PIF only provides one sentence very briefly describing the scope of study to be undertaken in output 1.3. While it is noted that the work would center on incentives for NEVs, the scope of the study is different. The project team recognizes that there is abundant literature evaluating the effectiveness of EV subsidies and government policy in China. The design team has also analyzed more recent literature and found that studies indicate that EVs adoption would be counterproductive for GHG mitigation if powered by electricity that is mainly coal fired. Neither the academic nor intergovernmental studies reviewed make the linkage between the need to incentivize higher supply of renewable energy to power electric vehicles, nor policies to integrate NEVs and RE in China.

Since China has selected carbon trading schemes as a policy mechanism for emission reductions, the objective of this study is evaluating the use of carbon trading / carbon crediting as policy tool to reduce GHG emission from NEVs via development of EV-RE integration. In other words, the study seeks to incentivize GHG mitigation though clean energy technology integration. Business models will be investigated as they operate on the ground (e.g. car sharing in Shanghai) and not theoretically like in the previous studies (real world applications).

Additional response at ProDoc submission stage: The ProDoc clarifies that the full focus of the project is on EV-RE integration or foundational work required for such integration. Thus, any analysis and policy design work related to incentives is specifically tied to promotion of EV-RE integration, something that previous incentive studies and previous incentive policies did not do. Areas targeted for the development of incentive policies (or policies that give users market access to sell power back to the grid are): (1) smart charging; (2) energy management centers; (3) V2G; (4) use of retired EV batteries; and (5) development of RE micro-grids for charging EVs. As for Output 1.3, the output referenced in the original query, that output is focused on developing recommendations for transport sector authorities to incorporate incentives for EV charging with RE in transport sector national carbon trading policies. This, too, is something that does not exist in China at present.

5. Component 2 – comment 1: Please briefly describe your strategy of identifying these 100 policymakers. Will they be mainly from different ministries or from 88 pilot cities?

Response made at PIF stage: Section 1.3 (page 13) has been edited to reflect the comments made by the reviewer, as follows: Selection of policymakers: Project proponents have revised the criteria for selection of policymakers for involvement in project capacity building. Policymakers will include both national level government policymakers from relevant ministries, including MIIT, Ministry of Science and Technology (MOST), National Development and Reform Commission (NDRC), and city and provincial level government policymakers. For the cities, the selection criteria will include: (1) cities that have significant RE resources to consider for integration with EVs; and (2) cities that have in place or are testing car sharing schemes.

Additional response at ProDoc submission stage: Output 2.1 indicates a training program for 100 city-level policy makers on EV-RE integration policies and demonstration experience. Thus, while national level officials will also be involved, the emphasis of this output is to involve city-level policy makers that have good potential to develop EV-RE integration plans for their own cities. Thus, the cities from which these officials will come will likely be among China's 88 pilot EV cities (since such cities have an emphasis on promoting EVs) and be those that also have good potential for EV-RE integration.

<u>6. Component 2 – comment 2</u>: In addition to the Clean Energy Ministerial and US-China EV bilateral cooperation, the proposed project can further raise its visibility at the Urban Electric Mobility Initiative (UEMI), announced at the NY Climate Summit last year. UEMI will have a big announcement at COP21 in Paris, and this should be a showcase opportunity for the project. Further, the EU Mobility Week every year also features EV development in developing countries. Please include these coordination elements in the project.

Response made at PIF stage: Section 1.3 (page 13) has been edited to reflect the comments made by the reviewer, as follows: Project visibility: UNIDO is part of the working group established under UEMI and has contacted the UN Habitat coordination group to explore collaboration. Also, through the UN liaison office in Brussels, actions will be sought to consider showcasing the project in initiatives under the EU Mobility Week during the project execution (for example, at the Frankfurt Auto Show). These relationships will be further developed during the project design phase.

Additional response at ProDoc submission stage: As mentioned in Part II Section A.8 of the ProDoc, efforts will be made to share the knowledge gained in this China EV-RE integration project with other countries. Given the newness of the field of EV-RE integration and the innovative, first-of-its-kind nature of the project, it is believed dissemination of results to other countries will make an important contribution to the global community. As one key avenue of dissemination, UNIDO, as a member of the Partnership on Sustainable, Low Carbon Transport (SLoCaT), will aim to transfer the lessons learned on policies and technologies to other stakeholders.

<u>7. Component 3 – comment 1</u>: Please confirm that the demonstration includes 1,000 charging devices and 1,000 EVs.

Response made at PIF stage: Section 1.3 (page 14) has been edited to reflect the comments made by the reviewer, as follows: Demonstration in Yancheng - charging infrastructure: Figures have been verified with the counterparts from the Yancheng Economic and Technological Development Zone. The charging infrastructure to be built in Yancheng in 2016 is 20 smart charging poles. The poles will have two "smart" characteristics. The first is that they will be able to control the time that charging takes place in order to maximize the use of renewable energy generated power or off-peak electricity. The second is that the charging data will be sent to the energy management center after collection, so that it can be assessed and compared. Yancheng in 2016 will also construct one power storage station using retired EV batteries along with renewable energy. In 2017 and 2018 Yancheng will install 500 intelligent charging poles. During those years, it will also develop ten mobile charging stations. These changes have been reflected in Table B, output 3.1

Additional response at ProDoc submission stage: Annex E of this ProDoc provides the final detailed design of the project demos. In Yancheng, there will be 1,000 EVs involved in the smart charging demos, including 700 e-trucks, 20 e-buses, and 290 electric passenger cars. The 1,000 EVs will represent an increase of 770 vehicles over the current fleet in Yancheng of 230 vehicles. The demo will also realize 1,000 smart charging poles, as compared to none at present. Of the smart charging poles, 700 will be upgrades of current, "non-smart" poles and 300 will be new poles. These poles will be dispersed among 50 new smart charging stations. In addition to the fleet of 1,000 EVs involved in smart charging, Yancheng will have some additional EVs involved in EV-RE micro-grids. At its Aoxin PV micro-grid, it will have 80 vehicles (60 trucks and 20 passenger cars). The Aoxin micro-grid will also include 80 smart charging poles, of which ten will have V2G capabilities to accommodate ten of the sedans that also have V2G capabilities. Finally, the Aoxin micro-grid will have three mobile charging station vehicles. At its Goldwind wind-PV micro-grid, Yancheng will have ten passenger car EVs and ten charging poles.

In Shanghai, by end of project, SIAC will have 8,200 EVs involved in it demonstration, including 8,000 passenger car hourly rental vehicles and 200 rental e-buses. This will be an increase from 1,650 EVs at present (1,600 car sharing vehicles and 50 rental e-buses). SIAC will scale up the number of its charging poles from 4,400 to 16,000 by the end of the project. At present, Shanghai has neither smart charging poles nor smart charging stations. As a part of the project, it will establish 200 smart charging poles spread across 50 smart charging stations. While all 8,000 passenger car EVs will in theory be candidates for smart charging, in practice this status will depend on where they park each day. Given the number of smart charging poles, on average, it is estimated that about 200 EVs per day will be involved in smart charging in Shanghai. Shanghai will also establish ten EV-RE micro-grids using PV power. It is estimate that there will be about nine charging poles at each of the micro-grids. While all 8,000 passenger car EVs will in theory be candidates to charge at the EV-RE micro-grids, in practice this status will depend on where they park. Given the planned available slots at the micro-grids, it is estimated that about 90 EVs per day will charge at these micro-grids.

8. Component 3 – comment 2: The description of outputs 3.1-3.4 on page 13-14 is not consistent with table B. For example, table B list "dedicated micro-grid of 450KW of wind generation" but there is no description of this output in Component 3. Again, please organize the description in the order of output 3.1-.3.4.

Response made at PIF stage: Section 1.3 (page 14) has been edited to reflect the comments made by the reviewer, as follows: Demonstration in Yancheng - micro grid: The installation of a dedicated micro-grid has been verified with the counterparts from the Yancheng Economic and Technological Development Zone. They explained that they could either construct a new micro-grid or make use of those already-built -- small wind or photo-voltaic power generation facilities that are not connected to the main power grid. The final plan will be further investigated in the detailed design phase; hence no edits are made at this stage.

Additional response at ProDoc submission stage: Annex E of this ProDoc provides the final detailed design of the project demos. Yancheng will have two EV-RE integration demonstration micro-grids. One will be a newly constructed PV micro-grid located at Aoxin Company. It will involve 500 kW of PV panels, 80 EVs, and retired secondary EV batteries for storage. The other EV-RE integration demonstration micro-grid in Yancheng will be that of Goldwind. This is a pre-existing micro-grid, including one large wind turbine of 2 MW, one small turbine of 10 kW and 100 kW of solar PV panels. Prior to the project, the micro-grid supplied power to a neighboring factory at a price better than the grid price. The micro-grid will continue to supply the factory during the project, but ten electric vehicles, as well as some retired EV battery packs, will be added to the micro-grid to demonstrate EV-RE integration. In Shanghai, ten PV EV-RE micro-grids will be set up, each able to accommodate the charging of about nine vehicles, for a total of 90 vehicles, and each including retired EV battery packs. Each Shanghai EV-RE micro-grid station will have 24 kW of solar power for a total of 240 kW.

9. Component 3 – comment 3: Given the substantial difference between the peak and off-peak loads (40-45%) in Shanghai, will the project consider demonstrating Vehicle to Grid (V2G) technology in Shanghai as well?

Response made at PIF stage: Section 1.3 (page 14) has been edited to reflect the comments made by the reviewer, as follows: Demonstration in Shanghai – V2G integration: This matter has been verified with the counterparts form the Shanghai Automobile City and they would like to pursue V2G technology integration. This action has been planned for the timeframe beyond 2019. Hence, during the design phase it will be further discussed whether it shall be a project activity, hence no edits are made at this stage.

Additional response at ProDoc submission stage: Annex E of this ProDoc provides the final detailed design of the project pilots. Shanghai will have 200 smart charging poles and thus be able to accommodate about 200 vehicles daily in smart charging to begin to address the great gap between peak and off-peak loads in Shanghai. Shanghai will also carry out limited testing of V2G with five V2G poles in one of its EV-RE micro-grids.

10. Component 3 – comment 4: Existing charging locations in Jiading are mostly uncovered. When it rains, the charging experience can be bad. Therefore, improving existing charging facility's user-friendliness is important. In your scaling up strategy, please take this factor into consideration.

Response made at PIF stage: Section 1.3 (page 14) has been edited to reflect the comments made by the reviewer, as follows: Demonstration in Shanghai – charging locations: This matter has been verified with the counterparts form the Shanghai Automobile City. They recognize that the user friendliness dimension is a key aspect of the design of the EV system. Thus, it will be reflected in the project document.

11. Component 4 – comment 1: In your awareness raising strategy, please consider educating on the environmental and economic benefits of V2G and enhancing the product market.

Response made at PIF stage: Section 1.3 (pages 14-15) has been edited to reflect the comments made by the reviewer, as follows: Awareness raising strategy scope: The recommendation made is now reflected in the PIF.

Additional response at ProDoc submission stage: In the ProDoc, clarification has been made that the focus of awareness raising will be EV-RE integration rather than EVs generally. As such, awareness raising will educate people on various aspects related to EV-RE integration that are demonstrated in the project, such as V2G and smart charging.

12. Component 4 – comment 2: Is the NEV-RE demonstration center a permanent establishment that goes beyond the life expectancy of this project? Does GEF grant also cover the cost of personnel? It would be more appropriate for co-financing to cover personnel costs.

Response made at PIF stage: Section 1.3 (pages 14-15) has been edited to reflect the comments made by the reviewer, as follows: NEV-RE Center in Yancheng: This matter was verified with the counterparts from the Yancheng Economic and Technological Development Zone, who plan to operate the NEV-RE Center as a permanent establishment and will cover personnel costs. This aspect will be reflected when budgeting during detailed design.

13. Component 4 – comment 3: There should be more emphasis on working with private sector partners to develop sustainable business models for EVs.

Response made at PIF stage: Section 1.3 (pages 14-15) has been edited to reflect the comments made by the reviewer, as follows: Private sector partners: The mechanisms to involve the private sector include: (1) Business models to be designed in cooperation with the private sector. (1) Relationship between SAE and members of the private sector. Private sector enterprises are now reflected in the stakeholders table.

Additional response at ProDoc submission stage: The first and second outputs of Component 4 have a focus on industry and the private sector. The ProDoc emphasizes that the focus of this project is not EVs generally, but instead EV-RE integration. As such, cooperation with industry/ the private sector focuses on EV-RE aspects, but encourages industry/ the private sector to get involved in these aspects. As for business models in particular, Output 4.2 focuses on raising awareness among current and future potential car sharing companies of various car sharing business models and integration of EVs with RE in car sharing businesses.

Part II. Responses to GEF Council Member Comments

1. Germany – comment 1: As stated by the STAP, some key issues regarding battery replacement costs, the recycling of battery materials, and reduced voltage output with age would need further consideration in the project.

Response made at PIF stage: The comment from STAP has already been considered. In parallel to the PPG development phase, UNIDO and SAE are undertaking a research project, funded by the China International Centre for Economic and Technical Exchange (CICETE) to investigate commercialization pathways for NEVs by developing a detailed analysis of various NEV technologies and their market. Please refer to baseline scenario description in the PIF, page 12. Also the project document for the additional project is available and attached
Within the scope of that study, the battery life cycle analysis is taken into consideration.

Additional response at ProDoc submission stage: As reflected in the ProDoc, the fully designed project has considerable emphasis on secondary use of retired EV batteries, thus, in part, addressing battery recycling issues. The project's standards work addresses standards related to secondary use of EV batteries. Further the EV-RE micro-grid demos will include retired EV batteries as micro-grid storage devices.

<u>2. Germany – comment 2</u>: The project would benefit from exchanging lessons learned and experiences already made in Japan and the US which already have demonstration projects in place on how to integrate renewables to NEV.

Response made at PIF stage: In the study mentioned in the prior comment, study tours to both the US and Japan are planned. In addition, for the PIF development, engagement with international initiatives has been initiated, including the Urban Electric Mobility Initiative (UEMI) and the Electric Vehicles Initiative (EVI) of the Clean Energy Ministerial (CEM).

Additional response at ProDoc submission stage: PPG work reviewed international developments related to EV-RE integration. Further, the project as designed calls for preparation of detailed case studies of experience with EV-RE integration, as well as the holding in China of international forums on EV-RE integration. Between the case studies and the international forums, it is expected project stakeholders will fully benefit from international experience to date in the field of EV-RE integration.

<u>3. Germany – comment 3</u>: It remains unclear, whether the project only includes electric vehicles or also vehicles running on hydrogen and biofuels. The term New Energy vehicles may be misleading in this context.

Response made at PIF stage: The term "New Energy Vehicles" (NEVs) is featured in the Chinese national legislation; hence the choice of title has been selected to maintain consistency with national programs. The issue was brought up again for the consideration of the national counterparts to decide whether a different title could be given. The national counterpart would rather maintain the title as the definition of New Energy Vehicles in China includes Battery Electric Vehicles (BEV), Plug-in Electric Vehicles (PHEV), and Fuel Cell Vehicles (FCV). The counterparts highlighted that the PIF clearly states that the project will mainly focus on BEVs and PHEVs.

Additional response at ProDoc submission stage: As explained above, the term "NEV" is commonly used in China. Despite its broad scope, because most NEVs to date are BEVs or PHEVs, the term usually refers to such vehicles. Yet, on further discussion, national counterparts have suggested that use of the term "EV" can be appropriate in the English translation in many cases. Thus, to avoid confusion, "EV" is often used in the English version when the scope is clearly limited to EVs.

<u>4. Germany – comment 4</u>: Given the large potential of co-benefits associated with the integration of renewables in NEVs, the project proposal would benefit from outlining the anticipated benefits from reduced air pollution.

Response made at PIF stage: The comment is taken into consideration and will be explored during the detailed design phase, with the use of available the urban vehicle emission calculation tools. During the PIF elaboration phase, the project manager has engaged GIZ Beijing team to discuss their expertise in the urban mobility field, including their model for emission estimation.

Additional response at ProDoc submission stage: Air quality issues are discussed in the ProDoc in the project justification's section A.1.1.

5. Germany – comment 5: Given the high rate of co-financing (117 millions), Germany would seek some clarification of the added value of the envisaged GEF project financing, which only accounts for 8 Million.

Response made at PIF stage: The incremental cost aspect of the project is centered on key dimensions which would not happen in an accelerated manner in the absence of the GEF intervention: (1) The standardization of systems required for the EV adoption (Component 1). (2) The analysis and proposal of policies to promote higher adoption of renewables for supplying power to EVs (Component 1). (3) Adoption of innovative business models as opposed to the experience of conventional public fleets applied in the first 25 pilot cities. (4) The articulation of stakeholders, and promotion of best policies and practices in the pilot cities.

All of these dimensions and the cost effectiveness of the programme will be fully addressed during the design phase.

Additional response at ProDoc submission stage: Incremental cost reasoning is provided in Part II Section A.1.4 of the ProDoc. Although the co-financing is quite substantial, without the project, this co-financing would not be channeled to have a focus on EV-RE integration, but instead would have focused on EVs generally. That is to say, incremental GEF funds, quite small in comparison to overall EV related expenditures in China (which include a range of subsidies, manufacturing efforts, R&D efforts, policy initiatives, etc.), have the opportunity to stimulate a major qualitative change in China's EV charging and even in the grid's adoption of renewable energy. The project's incremental financing can play a critical role in facilitating the launch of China's transition from fossil fuel power based EVs to RE power based EVs. As outlined in this document's review of the baseline and alternative scenarios, it is unlikely without this project that much progress will be made in the short term in EV-RE integration in China. Yet, if successful, this project could stimulate a range of national policies and plans related to EV-RE integration, replication of EV-RE integration demos, and local level EV-RE integration plans. None of these is likely to occur without the incremental financing provided by the project. Yet, at the same time, the very high level of activity with regard to EVs in the baseline provides a highly attractive and highly leverage-able platform on which to build incrementally with GEF financing.

6. Japan – comment 1: Japan acknowledges the importance of the project and would like to have detailed information of it. We sincerely request the Secretariat to provide us the draft final project for consultation

Response made at PIF stage: Japan's comment is taken into consideration and UNIDO is willing to facilitate any additional information or consultations with the Council Members

Additional response at ProDoc submission stage: PPG work benefited from reviewing the experience of Japan with smart communities. For full project implementation, the project looks forward, in its case studies and international forums, to learn more from Japan about its experience in integrating EVs with RE.

7. Japan – comment 2: Why does the project focus on the richest areas of China? Why doesn't it conduct its demos in less prosperous, less developed regions of China?

Response in June 2016: The selection of the cities for the pilot demonstrations is based on the following criteria:

- Technical and natural resources: Yancheng has high availability of wind and solar power, and renewable power generation provides 11% of total electricity supply. Shanghai has been a quick adopter of policies and technologies to promote EV and distributed RE, and can be an enabler for quick uptake;
- Ability to cofinance the demonstration: the technologies which will demonstrate in these two cities are cutting edge and not commercial available. To realize this, Shanghai and Yancheng will provide large amount of cofinancing for execution; and
- Government selection: The EV demonstration program (88 pilot cities) in China is mainly located developed areas in the central and eastern China, which include Yancheng and Shanghai.

Response at ProDoc submission stage: On the one hand, some of the less developed regions of China, such as Northwest China, have substantial wind power curtailment and thus present attractions in terms of location, as smart charging of EVs might reduce curtailment. Further, there is a desire to bring more economic development to the less developed regions of China; and EV-RE integration might play this type of role. At the same time, the pattern of EV development in China has been one that is driven by China's largest cities, with Shanghai in the lead. Because these cities can commit considerable resources and have other drivers for the adoption of EVs (such as local policies that make it easier to purchase an EV than an ICEV), the environment is very positive for the development of EV-RE integration. In contrast, Northwest China has had little development of EVs. Yancheng was chosen both for its interest in EVs and also for its substantial wind power. While Yancheng is located in the relatively prosperous province of Jiangsu, it is located in northern Jiangsu, which is not considered as prosperous as the area of southern Jiangsu, which borders Shanghai. Further, Shanghai and Yancheng were chosen as demo cities for their strong level of committed co-financing. Less prosperous areas of China would not be able to commit this level of co-financing. Overall, the regional approach suggested by the project strategy is to demonstrate EV-RE integration in the areas that are more proactive EV-wise and that are generally more prosperous, so that progress made can later bring along the less prosperous areas, particularly those with wind power curtailment that might find more immediate benefits from EV-RE integration than some other locales.

Part III. Responses to STAP Comments

STAP Comment 1: [Note: The title is "New Energy Vehicles" but only electric vehicles are included and not those running on hydrogen or biofuel fuels.]

Response at ProDoc submission stage: This point has impacted decisions of how to communicate the project more clearly to international counterparts. The term "New Energy Vehicle" (NEV) is used in China to refer to PHEVs (plug-in hybrid electric vehicles), BEVs (battery electric vehicles/ pure electric vehicles) and FCVs (fuel cell vehicles, which may run on hydrogen). It does not include vehicles that run on biofuels, which are part of the category referred to as "Alternative Energy Vehicles" in China.

Despite the broad scope of the term "NEV," because most NEVs in China to date are BEVs or PHEVs, the term usually refers to such vehicles. Yet, on further discussion, national counterparts have suggested that use of the term "EV" can be appropriate in the English translation in many cases. Thus, to avoid confusion, "EV" is often used in the English version of the ProDoc when the scope is clearly limited to EVs. And, it is now used instead of "NEVs" in key places, such as the project title and the project objective.

STAP Comment 2: Standards and guidelines are sought for electric vehicles and integrating recharging schemes into the grid, with the aim for cities to adopt them following two pilot demonstrations. Trucks, buses, taxis will be included as well as private cars. Why electric scooters and pedal-assist electric bicycles are also not included is not clear since many exist in China and are growing rapidly worldwide. EVs featured prominently within China's INDC.

Response at ProDoc submission stage: This is an important point that was carefully considered at the full project design stage. In the end, however, the project design team and project proponents decided the project should maintain its focus on the larger EVs: trucks, buses, taxis, and other passenger cars. This is the area in which the greatest potential impact on greenhouse gas emissions and local air quality can be achieved by replacing ICEVs with EVs powered by RE. Further, while China has a substantial bicycle and scooter market, as living standards continue to rise, the real growth story in recent decades in China's transport market has been the growth in China's automobile market, which is now the largest in the world.

STAP Comment 3: Capacity building on smart-grid systems (based on renewable energy (RE)) will be undertaken for key stakeholders. In addition, the outcomes will be disseminated to the manufacturers of EVs and recharging systems.

Response at ProDoc submission stage: These suggestions are now well-reflected in project design. In Component 2, there is extensive capacity building for government officials. In Component 4, there is extensive capacity building for manufacturers. Both include all aspects of EV-RE integration covered in the project, including smart grid aspects, such as smart-charging, V2G, and energy management centers. Results of the project demos will also be disseminated through these capacity building programs.

STAP Comment 4: The project is linked with policies to increase the share of low-carbon electricity sources in the grid. Little GHG emission reduction, if any, occurs if displacing gasoline or diesel vehicle fuels with electricity systems with a high carbon emission factor (at around 600-900 kg CO_2 /kWh generated). (This point is made in section 1.1). For example, one life cycle analysis showed an EV automobile in China emits as much CO_2/km traveled as a large gasoline vehicle consuming 9l/100km (http://shrinkthatfootprint.com/electric-caremissions). This is verified by the Tsinghua University analysis (page 13) so is understood by the project proponents and the goal of full "integration" of EVs with RE systems. Annex B clearly outlines the data assumptions. For example it shows:

- a diesel bus running 200km a day emits 5.68 t CO_2 /yr;
- the same bus using power from a coal-fired power grid emits 6.99 t CO_2/yr;
- the same bus using power from a 50% RE / 50% coal grid emits 3.50 t CO_2/yr

Response at ProDoc submission stage: The project design recognizes the important link of the project objective with increasing the share of low-carbon electricity sources in the grid. As such, the project emphasizes that it will “set the stage” for higher adoption of renewable energy into the grid by preparing the ground work, such as through smart charging and V2G demonstration. In Yancheng, the smart charging demonstration can show how previously curtailed wind power can be used and therefore result in greenhouse gas emission reductions. The project also emphasizes demonstration of EVs in RE mini-grids as a means to immediately achieve greenhouse gas emission reductions. Lastly, although as the STAP has pointed out, diesel buses have lower GHG emissions than electric buses in China, it turns out that passenger vehicles and other smaller vehicles, when powered by electricity from East China Grid, have lower GHG emission reductions than ICEVs. Thus, overall, while scale-up in EV numbers is a supporting aspect rather than the main focus of the project, scale-up of such smaller vehicles does bring some emissions reductions, more than cancelling out the negative impact of the grid-powered buses (which are far fewer than the sedans and delivery or sanitation trucks).

STAP Comment 5: Yancheng City may have a higher share of renewables (11%) in its electricity mix than other cities on the grid, but this is still insufficient to make EVs a true low-carbon transport option.

Response at ProDoc submission stage: This is an important point that was considered in project design. As the project cannot hope all at once to achieve a majority share of RE in Yancheng’s grid, the role of the project will be to set the stage for higher and higher shares of RE in Yancheng’s, and also China’s, grid over time. The smart charging demo, in particular, by enabling previously curtailed wind power in Yancheng to come online, can demonstrate strong GHG emission reductions results and encourage greater adoption of RE in the main grid in the future.

STAP Comment 6: In Shanghai, there is potential for EVs to be integrated and benefit from off-peak power and solar PV, as well as provide the benefits from vehicle battery storage becoming part of a smart-grid development. However, replacing 200 diesel buses with 200 electric buses gives negligible reduction in total GHG emissions per year. Surprisingly, what are not addressed in any detail in the PIF are project co-benefits such as the health benefits from reduced local air pollution and lower associated costs.

Response at ProDoc submission stage: The final project design calls for smart charging of EVs in Shanghai with off-peak power and for EV-RE mini-grids powered by PV and using retired EV batteries as storage. The revised justification of the project now addresses the health benefits from reduced local air pollution.

STAP Comment 7: Annex B shows a diesel bus in Yancheng at 30l/100km produces 5.68 t CO2 /yr whereas a diesel bus in Shanghai for some unknown reason has a lower fuel consumption at 25l/100km so produces relatively less 4.73 t CO2/yr. Assumptions made are not clear and could be explained in the project document

Response at ProDoc submission stage: The GHG emission reduction calculations have been completely revised in the full project design. Now the same diesel bus parameters are used for both Yancheng and Shanghai. Fuel consumption for both is estimated at 30 liters per 100 km of travel. This fuel consumption figure is based on a test program by SAE (Society for Automotive Engineers) China that was carried out in 2013 and 2014 for trucks and buses. The emissions factor used in the case of both cities for diesel buses is 2.63kg CO_2 per liter.

STAP Comment 8: Project proponents are advised to use new GEF GHG accounting guidelines and report emissions accordingly (https://www.thegef.org/gef/node/11187). The numbers given in the proposal for post-project direct emissions as it seems are direct project emissions. Indirect or consequential emission calculations have to be verified.

Response at ProDoc submission stage: The GHG emission reduction calculations for the full project design have been completely revised. Methodology is based on *Manual for Calculating Greenhouse Gas Benefits of Global Environment Facility Transportation Projects*. As that document defines “direct post-project emissions” as those related to financial mechanisms set up by the project and as the project does not set up any such financial mechanisms, direct post-project emissions are no longer included as part of the project’s GHG emission reduction calculations. As for indirect emission reductions, the project bases its “bottom up” approach on replications targeted by the project and its “top down” approach on a market share estimation methodology.

STAP Comment 9: Promotion of EV and associated systems does not go in isolation from the overall transport development infrastructure. There are several ongoing GEF and non-GEF projects targeting development of sustainable low-carbon transport in China. Project proponents are advised to connect/mainstream project-specific activities into the larger transport development frameworks. Experience of SLoCaT partnership and closer links with this initiative could benefit project sustainability and wider dissemination of lessons learned.

Response at ProDoc submission stage: The project’s integration with the promotion of urban car sharing in China gives it a strong link to efforts to create more sustainable transport systems in China. Further, as one key avenue of dissemination, UNIDO, as a member of the Partnership on Sustainable, Low Carbon Transport (SLoCaT), will aim to transfer the lessons learned on policies and technologies to other stakeholders.

STAP Comment 10: Barriers to deployment of EVs are the initial relatively high purchase cost of EVs, lack of public recharging facilities. Linking the purchase of EVs with carbon markets and investment in grid renewables is a novel approach. Deploying grid renewables in parallel with EVs and smart-grid designs is a commendable approach. Missing perhaps is the option for off-grid direct recharging of EVs by small-scale independent RE systems such as solar PV panels installed on a vehicle garage roof.

Response at ProDoc submission stage: The project now incorporates extensive demonstration of EV-RE micro-grids in both Yancheng and Shanghai. While these micro-grids may ultimately be grid connected, they will operate as grid-independent off-grid systems at times when exchange with the grid is not required.

STAP Comment 11: Concerns over battery replacement costs, lowering of voltage output with age and hence reduced vehicle range, and recycling of battery materials at end-of-life, are issues that need attention in the project interventions.

Response at ProDoc submission stage: The project now gives extensive attention to such issues through its strong planned efforts in the field of secondary use of retired EV battery packs. Value-add use of retired EV battery packs reduces the net economic costs of replacing EV batteries. The project will give much attention to assessment of and approach to be taken in utilizing retired EV battery packs.

STAP Comment 12: Many other countries are undertaking similar studies. It would be ideal if an international standard could be applied worldwide for EV recharging, so it may be wise to investigate what other work is being done. The IEA's Electric Vehicles Initiative, which China has co-chaired with the US, is a useful place to start http://www.iea.org/topics/transport/subtopics/electricvehiclesinitiative/ . Project proponents are advised to consider links with these and other initiatives to assure that lessons learned in this project are disseminated widely.

Response at ProDoc submission stage: The project will make strong efforts both to leverage international experience to date in EV-RE integration and to disseminate results widely, worldwide. The project design calls for international case studies on EV-RE integration as well as international forums to share experience. Given the newness of the field of EV-RE integration and the innovative, first-of-its-kind nature of the project, it is believed dissemination of results to other countries will make an important contribution to the global community. As one key avenue of dissemination, UNIDO, as a member of the Partnership on Sustainable, Low Carbon Transport (SLoCaT), will aim to transfer the lessons learned on policies and technologies to other stakeholders.

ANNEX C: STATUS OF IMPLEMENTATION OF PROJECT PREPARATION ACTIVITIES AND THE USE OF FUNDS[36]

A. Provide detailed funding amount of the PPG activities financing status in the table below:

PPG Grant Approved at PIF: $200,000			
Project Preparation Activities Implemented	***GEF/LDCF/SCCF Amount ($)***		
	Budgeted Amount	***Amount Spent as of Feb 28, 2017***	***Amount Committed***
1. Studies, surveys, and drafting of background sections of CEO EF	27,000	25,000	2,000
2. Detailed design of the project components and activities	32,000	29,800	2,200
3. Stakeholder and partner coordination	118,000	116,500	1,500
4. Revision and improvement of CEO EF	10,000	7,844	2,156
5. Finalization of CEO EF	4,000	2,400	1,600
6. Contingencies	9,000	5,325	3,675
Total	200,000	186,869	13,131

[36] If at CEO Endorsement, the PPG activities have not been completed and there is a balance of unspent fund, Agencies can continue to undertake the activities up to one year of project start. No later than one year from start of project implementation, Agencies should report this table to the GEF Secretariat on the completion of PPG activities and the amount spent for the activities. Agencies should also report closing of PPG to Trustee in its Quarterly Report.

ANNEX D: CALENDAR OF EXPECTED REFLOWS (if non-grant instrument is used)

Provide a calendar of expected reflows to the GEF/LDCF/SCCF Trust Funds or to your Agency (and/or revolving fund that will be set up)

N/A

ANNEX E. DETAILED PILOT PROJECTS DESCRIPTIONS

CHINA EV-RE INTEGRATION PROJECT

The Project has two main types of demonstrations to promote the development of EV-RE integration in China: (1) integration of EVs with the power grid as a foundation for future scale-up of EV-RE integration, allowing greater incorporation of intermittent RE into the grid and (2) EV-RE micro-grids. In addition, co-financing will support (3) scale-up and increased concentration of charging infrastructure and EVs that will be integrated into the demos and can also serve as a foundation for future scale-up of EV-RE integration.

Demonstration cities: The piloting will be carried out in the cities of Yancheng in Jiangsu Province and Shanghai. Yancheng is known for its rich wind resources, which continue to be extensively developed via the construction of wind farms on land. The city also has plans in the pipeline for the development of offshore wind farms. At present, an estimated ten percent of Yancheng's wind power capacity is not being used due to excess supply and time of day issues in the availability of wind power. The city also has fairly strong solar resources. The Yancheng Municipal Government is putting strong effort into the development of "*new energy vehicles*"[37] (NEVs), and is developing an "NEV Park" for relevant manufacturing companies within its Yancheng Economic and Technological Development Zone.

Shanghai is known in China for being a leader in the auto industry, leads the country in its electric vehicle fleet, and has the most comprehensive system in the country for tracking EV activity. In addition, Shanghai has fairly strong solar resources. Shanghai has strong daily variation in electric power load, with a very large gap within each 24-hour period between peak and minimum power consumption. Further, prices for peak and off-peak electricity in China are already differentiated. This makes it a good candidate for eventual large-scale use of smart charging, in which EVs charge at times of day when demand from other loads is low and excess power supply is high.

Content of Annex E: This annex provides details on the project demos in each of Shanghai and Yancheng. Each city's demos include both of the two main types of demos: (1) integration of EVs with the power grid as a foundation for future scale-up of EV-RE integration and (2) EV-RE micro-grids. Both also include (3) co-financed scale-up and increased concentration of EV fleets and charging infrastructure that are integrated with the demos. In the case of Shanghai, the scale-up of charging infrastructure is of fixed location charging poles. In the case of Yancheng, an innovative demonstration of mobile charging station vehicles will be carried out. The mobile charging station vehicles will make use of retired EV battery packs to supply power to EVs in need of charging. The motivation behind and basics of the main demo types are briefly described below. Then, details on the full demo plans for each of Shanghai and Yancheng are presented.

Objective of Pilot Type 1 – integration of EVs with the power grid - in promoting EV-RE integration: The first type of demonstration is integration of EVs with the power grid, via smart charging. "Smart charging" essentially means that the vehicles will intelligently draw power from the grid at times when it is advantageous to do so. This will generally be when excess power is available and load from other end uses is low. EV integration with the power grid is a needed basis for EVs eventually to address the intermittency issues associated with the power grid taking on large proportions of RE. And, the power grid taking on large proportions of RE, in turn, is an important means of ensuring EVs achieve a very low carbon status. If EVs can smart charge (charging at the best times, when there is an excess of power available) and send power back to the grid (when there is a shortage of power), when they eventually exist in very large numbers, they will be able to play a distributed storage role in which they smooth out the "peaks and valleys" resulting from the intermittency of a power grid that has a large share of RE power. While the project's pilots of EV integration with the power grid will not include V2G (in which vehicles can send power back to the grid), the smart charging demo may serve as the foundation for this type of future bidirectional "peak and valley" grid smoothing with EVs.

[37] Term that in China refers to hybrid, electric, and fuel cell vehicles as a group.

Objective of Pilot Type 2 – EV-RE micro-grids - in promoting EV-RE integration: Given the vast scale of the power grid and low proportion of RE in it, in the short term, RE micro-grids present the best means of realizing immediate integration of EVs with RE. That is, RE micro-grids is one of the most immediate opportunities to ensure that EVs involved are charged with RE power rather than fossil fuel based power. In addition, RE micro-grids represent one of the two main paths for the future of EV-RE integration. Many experts suggest that the "renewable energy future" will be based on a combination of (a) large-scale RE power installations connected to a large-scale power grid with a large proportion of renewable power and (b) numerous distributed small-scale RE power sources either off-grid or on-grid. On-grid small-scale RE power sources, in turn, may serve locations that at times need to draw additional power from the grid and at times send their excess RE power to the grid.

The project's micro-grid based EV-RE integration demos, then, will demonstrate the direct charging of EVs with RE power. The micro-grids will have as their RE power wind power and/or PV generated power. The RE power will be arranged in micro-grids (small, local electric grids with multiple load and power generating components). These micro-grids will include: one or two sources of RE power, EVs (when not being driven), retired EV battery packs (as an additional source of storage), and other loads besides EVs, such as buildings or manufacturing facilities. Because V2G and battery-to-grid capabilities will also be incorporated into these demos, there will be essentially three types of power sources in these micro-grids: the RE power (wind and/or PV), the retired EV battery packs, and the small subset of the EVs that are involved in V2G. The loads in turn will also be of three types: other loads (such as buildings or manufacturing facilities), the EVs (when they are drawing power from the micro-grid), and the retired EV battery packs (when they are drawing power from the micro-grid). V2G capabilities of a subset of the EVs on a micro-grid level will enable those EVs to serve both as load and power source, depending on needs, to the micro-grid. Use of V2G in the micro-grids, as well as simulation of trading platforms to serve the micro-grids, will provide useful and technically relevant experience that may be applied to integration of EVs with the main power grid in the future.

Some clarification with regard to use of "retired EV batteries" may be useful: The "retired EV batteries" to be used in the project's RE-EV micro-grids will be disassembled into constituent battery packs and used in that form in the micro-grids. Thus, descriptions of the micro-grids will indicate how many battery packs will be included. Yet, size of each battery pack (in kWh) will depend on the brand/vehicle from which the retired EV battery came. Further, it should be noted that the term "EV battery" is sometimes used loosely to refer to the full battery system of an EV, but may also be used to refer to constituents at various levels of that system. At the lowest constituent level of an EV battery, a number of "battery cells" make up a "battery module." Then, a number of "battery modules" make up a "battery pack." Finally, a number of "battery packs," along with other components, make up the "battery system." Each EV sedan has one battery system installed. Roewe E50 EVs, which will be the source of "retired EV batteries" for the Shanghai micro-grids, each have a battery system with a capacity of 18 kWh. Each system, in turn, consists of four battery packs, three with a capacity of 5 kWh each and one with a capacity of 3 kWh each. As another example, the BYD E6 EV has a battery system with a capacity of 63 kWh. The system consists of ten battery packs of 6.3 kWh each.

Role of co-financed scale-up and increased concentration of charging network and EVs in promoting EV-RE integration: The project's co-financed scale-up and increased concentration of charging networks and EVs, in addition to facilitating other aspects of the demos, are meant to lay the groundwork needed for scale-up of China's EV fleet. This scale-up, in turn, is needed to enable EV-RE integration to eventually play a significant role both in addressing the intermittency issues of RE and in reducing carbon dioxide emissions from road transport. Once scaled up, China's EV fleet, combined with achievements from this project, will be able to realize the intended benefits of EV-RE integration. The project's co-financed scale-up of charging infrastructure and EVs will address major barriers to EV market scale-up, namely lack of fixed charging infrastructure and other charging alternatives, lack of sufficient density and numbers of EVs to demonstrate to the public their feasibility on substantial scale, and lack of commercially attractive business models to enable scale-up. Both city demos will involve scale-up in the number of EVs. In the case of Shanghai, this scale-up will be part of the expansion of a car-sharing business, thus demonstrating the potential positive impact of this business model on scale-up of the industry. For charging infrastructure in Shanghai, scale up will be via substantial increase in the number of charging poles associated with the car-sharing business. In the case of Yancheng, mobile charging station vehicles, which can drive to EV users in need of a charge, will be demonstrated.

1. Yancheng EV-RE Integration Demos

The Yancheng EV-RE integration demos will include demonstration of: (1) integration of EVs with the power grid and (2) two EV-RE micro-grids. (3) Scale-up in the number of vehicles (supported by co-financing) and introduction of mobile charging station vehicles will be integrated with and support the foregoing two demo types and illustrate the kind of scale-up and increased concentration of EVs and charging infrastructure needed to realize EV-RE integration on a large scale.

1a. Yancheng Integration of EVs with Power Grid Demo

The *Yancheng Integration of EVs with Power Grid Demo* will plan, design, and demonstrate a grid-connected smart charging system (in which EVs charge at times there is excess power available from the grid) for Yancheng. As part of this, Yancheng will demonstrate its Energy Management Center. The Center will manage the smart charging via automatic control systems located on its servers that send commands to vehicles as to when to charge. (The Energy Management Center will also be used to control the RE micro-grid demos.)

The equipment for smart charging will consist of EV charging poles upgraded with software to enable smart charging. The system will be implemented and tested using 1,000 smart charging poles spread amongst at least 50 charging stations located in and around Yancheng's NEV Park and surrounding counties. The test fleet for the smart charging demo will consist of 1,000 EVs, including 700 special purpose (delivery or sanitation) vehicles, 50 taxis, 10 buses, 100 fleet sedans, and 140 private or rental passenger sedans (including those used for daily car rental and those used for hourly car sharing rental). This fleet of 1,000 vehicles will represent a scale up from an original fleet of 230 vehicles. Exhibit 1 summarizes the number of vehicles and smart charging poles (and stations) that will be involved in the Yancheng smart charging demo. It also shows the amount of scale-up in the Yancheng EV fleet, something that will be carried out by co-financing. Prior to the demo, there were no smart charging poles in Yancheng. The smart charging will necessarily take place at charging poles that have been upgraded or custom built anew with smart charging software that can communicate with the project's Yancheng Energy Management Center. That is, the smart charging cannot take place at other places at which the EVs may recharge. The Energy Management Center, described later in this annex, will control the timing of the smart charging via calculations taking place on its servers and via communications with the upgraded or newly built charging poles.

Exhibit 1: Number of EVs and Smart Charging Poles and Stations for Yancheng Demo

Number and Type of EVs			
Type of EV	**electric special purpose (delivery or sanitation) vehicle**	**e-bus**	**e-passenger car**
Current number	200	10	20
Increase in number for demo	500	0	270
Total for smart charging demo	**700**	**10**	**290**

Number of Smart Charging Poles, Stations, and EVs			
Item	**Smart charging poles**	**Smart charging stations**	**EVs**
Current number	0	0	230
Increase in number for demo	1,000 (700 upgrades of non-smart poles; 300 new poles)	50	770
Total for smart charging demo	**1,000**	**50**	**1,000**

Yancheng is known for its wind resources. It has a significant installed capacity of grid-connected wind power at present and plans in the pipeline for extensive grid-connected capacity additions, including offshore wind farms. Yet, at present, about ten percent of Yancheng wind power is in excess and thus goes to waste. That is, local wind farms are asked by State Grid to disconnect about ten percent of capacity from the grid. Given the strong demand of the Huadong (East China) Grid, of which Yancheng is a part, for electricity, the wind power excess is not as great as is being seen in some other parts of the country, especially in Northwest China. At the same time, the Yancheng excess provides an opportunity via smart charging for this currently wasted wind energy to be used to charge electric vehicles. The demo design will include a method of bringing excess wind power online at times EVs are available for smart charging. The EVs in essence, then, will charge the most when the wind is blowing. The smart charging will occur when there are peaks in Yancheng's local power production. In this way, Yancheng can prepare to adopt more and more EVs to absorb more and more local capacity of grid connected wind, such as is being planned via new wind farms. Further, the smart charging will provide an additional benefit in that wind power generated will be used closer to the source of its generation, thus reducing line losses of transmitting the wind power long distances.

Exhibits 2 and 3 below present expected scale and impact of the smart charging aspect of the demo of integration of EVs with the power grid in Yancheng. Exhibit 2 shows the maximum load that may be shifted, assuming all vehicles participate concurrently, as about 6.6 MW. Electrical energy consumption that may be shifted by smart charging daily will be about 24.5 MWh. Annual shifting via smart charging is estimated at up to 17.9 GWh. Exhibit 3 shows vehicle miles travelled and liters of gasoline avoided by EVs involved in Yancheng's smart grid demo. Yet, it should be noted that in calculating direct GHG emission reductions for the project (see Annex F), only those EVs that would not have been purchased in the absence of the project can be considered to achieve the full emission reduction in going from gasoline or diesel to wind power. For those EVs that would exist in the baseline case, estimates of GHG emission reductions achieved by smart charging with previously curtailed wind power will be based on charging emissions associated with the typical East China Grid based charging mix. In both cases, however, the benefit of moving to RE based charging of EVs is substantial.

Exhibit 2. Grid-Connected Smart Charging in Yancheng – Power Consumption

Vehicle Type	Number of vehicles	Smart charging load per vehicle	Sum of smart charge load for all vehicles in category	Smart charging per day per vehicle	Total smart charging per day summed for all vehicles in category	Total smart charging for all vehicles in category for duration of demo (e.g. 2 years)
Special purpose**	700	7 kW	4,900 kW	25 kWh	17,500 kWh	12,775 MWh
Taxi	50	7 kW*	350 kW	38 kWh	1,900 kWh	1,387 MWh
Bus	10	60 kW	600 kW	150 kWh	1,500 kWh	1,095 MWh
Fleet sedan	100	3.3 kW	330 kW	15 kWh	1,500 kWh	1,095 MWh
Rental or car sharing sedan	140	3.3 kW	462 kW	15 kWh	2,100 kWh	1,533 MWh
Total	1,000	---	6,642 kW	---	24,500 kWh	17,885 MWh

*Note: Taxis will have a larger average load than other sedans, as fast charging will be most likely be used in the case of taxis.
**Special purpose vehicles include small delivery vehicles and sanitation vehicles.

Exhibit 3. Grid-Connected Smart Charging in Yancheng – Vehicle Miles Travelled on Power Provided by Smart Charging

Vehicle Type	Number of vehicles	km per day per vehicle	km per vehicle for duration of demo (e.g. 2 years)	Total aggregate km per day for all vehicles in group	Total km for all vehicles in category for duration of demo (e.g. 2 years)	Total liters gasoline consumption avoided for duration of demo* (e.g. 2 years)
Special purpose**	700	125 km	91,250 km	87,500 km	63,875,000 km	7,665,000 L
Taxi	50	200 km	146,000 km	10,000 km	7,300,000 km	730,000 L
Bus	10	150 km	109,500 km	1,500 km	1,095,000 km	438,000 L
Fleet sedan	100	90 km	65,700 km	9000 km	6,570,000 km	657,000 L
Rental or car sharing sedan	140	90 km	65,700 km	12,600 km	9,198,000 km	919,800 L
Total	1,000	---	---	---	----	10,409,800 L

*Note: Fuel consumption per hundred kilometers is: 12 L for special purpose vehicles, 40 L for buses, and 10 L for all types of sedans.
**Special purpose vehicles include small delivery vehicles and sanitation vehicles.

GHG emission reduction for *Yancheng Integration of EVs with Power Grid Demo*: *Yancheng Integration of EVs with Power Grid Demo* will result in GHG emissions reductions in that smart charging enables use of previously wasted wind power as a replacement to largely fossil-fuel based grid power (or in some cases, for EV purchases stimulated by the project, as a replacement to gasoline or diesel). Some reductions may also be achieved by reduction in power line losses, achieved via the use of wind power close to its source, rather than transmission and distribution of the wind power to further away places. In addition, this work will pave the way for greater uptake of renewable power by the grid and thus large potential GHG emission reductions (and, relatedly, low carbon electric transport) in the future. As mentioned, the co-financed scale-up of EVs (i.e. new EVs) used in this demo that are purchased instead of internal combustion engine vehicles (ICEVs) and that would not have been purchased in the absence of the project will result in realization of additional GHG emissions reductions. For ease of calculation, GHG emission reductions for this demo are calculated in two steps: One step calculates the benefit achieved by EVs powered by the standard power mix in the East China Grid replacing ICEVs via the co-financed scale-up. This is applied only to those EVs that would not have been purchased without the stimulation of the project. The second step will look at GHG emission reduction benefits realized by smart charging with curtained wind power as compared to using grid powered EVs in a business-as-usual fashion. GHG emission reductions are assessed in greater detail in Annex F.

1b. Yancheng Micro-Grid-based EV-RE Integration Demos

Two EV-RE micro-grids will be set up as demos under the project in Yancheng, both located at the facilities of companies. The two micro-grids will demonstrate technically and commercially effective grid-connected micro-grids enabling the distributed integration of EVs with RE. The Aoxin Micro-Grid will use PV power, incorporating both EVs and retired EV battery packs. The Goldwind Micro-grid will include both wind and PV power and also incorporate both EVs and retired EV battery packs. A client's manufacturing facility is also included in the Goldwind Micro-Grid. While connected to the main power grid, both micro-grids will be designed to operate as off-grid/partitioned systems in terms of the RE generated. That is, all RE generated will be utilized by the various loads connected to the micro-grid, including EVs, retired EV battery packs, and buildings or manufacturing facilities. Yet, in some cases, power will also need to be drawn from the main power grid to satisfy the full load.

1b-1. Aoxin Solar PV-EV Micro-Grid

The Aoxin Micro-grid will be a newly set up micro-grid at the alternative vehicle manufacturer Aoxin, which has facilities in Yancheng's Economic and Technological Development Zone. Aoxin is a manufacturer of both electric vehicles and fuel cell vehicles.

Exhibit 4 summarizes the constituents of Aoxin's micro-grid, which are also described in the following text: Aoxin's micro-grid will be powered by 500 kW of PV via 5,000 m^2 of PV panels. Annual power to be generated by the panels is estimated at 600 MWh or about 1.63 MWh per day. Aoxin's micro-grid will involve a total of 80 vehicles. Of these 80 vehicles, 20 will be passenger cars, 20 will be delivery vehicles, and 40 will be sanitation vehicles. Of the 20 passenger cars, 16 will belong to the Government of Yancheng's development zone. Of these, four will be designated for V2G demonstration. There will also be four passenger cars belonging to Aoxin Company, all of which will be designated for V2G demonstration. The 20 delivery trucks will belong to Aoxin's logistics company. The 40 sanitation vehicles will belong to the Government of Yancheng's development zone. The micro-grid demo will further include 80 smart charging poles, of which ten will be V2G poles to accommodate the ten passenger cars to be used for V2G. Energy exchange and switching equipment will be identified and procured for the V2G aspect of the demo. Further, the EVs to be used in V2G may need to be fitted with equipment enabling discharging to achieve V2G, since most EVs sold today have only one-way charging capability. The Yancheng Energy Management Center will be used to control charging of EVs and retired EV battery packs in the micro-grid, as well as discharging of the battery packs and of the ten EVs that are part of the demo's V2G aspect.

The Aoxin micro-grid will include two sets retired EV battery packs. The battery packs will be obtained via disassembly of the original EV battery systems, each system having consisted of multiple battery packs. One set, containing 79 battery packs, will serve as a stationary storage bank for the micro-grid. The other, containing three sets of 12 battery packs (36 battery packs in total), will serve as the source of recharged batteries to be used in Yancheng's three mobile charging station vehicles (i.e. 12 battery packs per vehicle) to be deployed under the project. The source of the retired EV battery packs for both sets will be battery systems retired from Aoxin Company's electric delivery trucks.

The Aoxin micro-grid will incorporate a building into its load. The building at present has a maximum load of 30 kW and a minimum load of 5 kW. The main use of electricity in the building is lighting and HVAC. The average electricity usage of the building is less than 10,000 kWh per month or less than 120 MWh per year. Yet, because the demand for power of the EVs is expected to use most of the PV power (either directly or after being stored in the battery packs), it is likely the building will continue to receive most of its power from the main grid, unless the mini-grid PV installation is later expanded. Based on calculations provided in Exhibit 4, it can be seen that the micro-grid annual PV power generation of an estimated 600 MWh per year will be approximately the amount of power needed to charge 70 of the EVs (the 20 delivery trucks, the 40 sanitation vehicles, and the ten passenger cars not a part of the V2G aspect of the demo).

Total annual electric energy consumption of all 80 vehicles in the Aoxin Micro-Grid and the mobile charging station vehicle's retired EV battery packs combined is estimated at 741,096 kWh, about 24 percent more than the electricity estimated to be provided by the micro-grid's PV panels annually. Considering just the 70 vehicles not involved in V2G, the total annual demand is estimated 602,250 kWh per year, close to the 600,000 kWh per year estimated to be provided by the PV in the micro-grid. Thus, it is concluded that the micro-grid can provide the majority of power needed by the involved EVs, but not all, and is unlikely to have much excess power available for the building. Top priority for charging with RE from the micro-grid or retired battery packs that have been charged with RE will be given to any EVs that are connected at the time to the micro-grid. Second priority for charging with RE will be given to retired battery packs in the micro-grid. Last priority for RE power supply will be given to the building. Yet, in order to maximize charging of EVs by PV energy, some additional consideration of battery bank size and charging times may be needed. At present, with a capacity of 505.6 kWh (or, assuming 90 percent of capacity used, 455 kWh available), the stationary battery bank has less than a third of the total capacity needed to charge the 70 non-V2G EVs, which have an estimated daily demand of 1,650 kWh, were these to need to undergo full charging at night with battery power.

Exhibit 4. Constituents of Aoxin's Micro-Grid in Yancheng

RE Power in Yancheng's Aoxin Micro-Grid
• 500 kW PV (5000 m^2 of PV panels) • Annual RE power generated: 500 kW * 1,200 h = 600,000 kWh (assumes PV panels work for equivalent of 1,200 hours per year at maximum power output)
EVs and charging poles in Yancheng's Aoxin Micro-Grid
• Type and number of EVs: 80 EVs total including 20 passenger cars (16 belonging to Yancheng's development zone and 4 belonging to Aoxin), 20 delivery trucks belonging to Aoxin's logistics company, and 40 sanitation vehicles belonging to the Yancheng's development zone • Smart charging poles: 80 • V2G passenger cars and charging poles: 10 V2G vehicles (among total of 80 vehicles, including 6 of the Yancheng development zone and 4 of Aoxin Company) and 10 V2G charging/discharging poles (among total of 80 smart charging poles)
Stationary Retired EV Battery Bank of Yancheng's Aoxin Micro-Grid
• Number of stationary, retired EV battery packs: 79 • Capacity of each battery pack: 6.4 kWh; Total battery pack capacity: 505.6 kWh • Source of retired EV battery packs: battery systems retired from Aoxin Company's electric trucks
Retired EV Battery Packs Associated with Yancheng's 3 Mobile Charging Station Vehicles and Recharged in Aoxin Micro-Grid
• Number of retired EV battery packs to be used in the 3 mobile charging station vehicles and recharged at Aoxin: 36 (or 12 battery packs per mobile charging station vehicle) • Capacity of each battery pack: 6.4 kWh; Total battery bank capacity: 76.8 kWh per vehicle or 230.4 kWh in total for all three vehicles • Source of retired EV battery packs: battery systems retired from Aoxin Company's electric trucks • Source of mobile charging station vehicles: These will be vehicles newly designed by the project to accommodate 12 retired EV battery packs each and to be configured such that charging can easily be provided to multiple EVs that park close to the mobile charging station vehicle. • Charging source: The retired EV battery packs to be used in the mobile charging station vehicle will be charged at night using stored charge from the Aoxin Micro-Grid's stationary retired EV battery bank if available, or, otherwise grid power.
Building Load of Yancheng's Aoxin Micro-Grid
• Maximum load: 30 kWh • Minimum load: 5 kWh • Power mainly used for the lighting and air conditioning system of the building. • Variation in load by time of day: 24 kW (80% of the maximum) for the work period (8:00~18:00), and 5kW (minimum) for other, non-work times. • Pre-micro-grid monthly grid power consumption and electricity bill: consumption less than 10,000 kWh per month, bill less than 10,000 RMB
Total Energy Demand for EVs and Mobile Charging Station Vehicles and Prioritization of Charging
• Total Energy Demand for EVs and Mobile Charging: 741,096 kWh per year (method: [60 delivery trucks or sanitation vehicles*25kWh/truck + 20 sedans*15 kWh/sedan + 3 mobile charging station vehicles *76.8 kWh/charging vehicle]*365 days/year = 741,096 kWh per year • Total demand of the 70 non-V2G vehicles: 602,250 kWh per year (method: [60 delivery trucks or sanitation vehicles*25kWh/truck + 10 sedans*15 kWh/sedan]*365 days/year = 602,250 kWh per year • Prioritization of charging order: (1) EVs will be charged with RE from PV panels or retired battery bank whenever there is one or more EVs connected to micro-grid. (2) Second priority will be charging of retired battery packs with RE when there is no EV charging. (3) When there are neither EVs nor battery packs charging, RE will be used to address the building load.

Exhibit 5 summarizes a number of targets for the Aoxin Micro-Grid and methods used to calculate them. The targeted annual power output of the PV system is 600 MWh of which most is anticipated to be used in charging EVs. If there is excess power at times, it may be used for the building load. Annual V2G transmission (of power from EVs back to the micro-grid) is estimated at 24.090 MWh per year. Electrical energy generated by the PV and stored in the stationary battery bank and supplied later back to the micro-grid to power the EVs (or possibly the building or mobile charging station vehicle's battery packs) is estimated at 166 MWh annually, or about 28 percent of the amount supplied by the PV system. The amount of electrical power from the grid (or possibly, at times, the micro-grid) used to charge the mobile charging station vehicles' battery packs (which in turn will be used to charge vehicles circulating around town) is estimated at 75.7 MWh annually.

Exhibit 5: Targets for Yancheng's Aoxin Micro-Grid

Targets for Yancheng Aoxin Micro-Grid
• Expected annual RE power generated: 500kW * 1,200h= 600,000 kWh (method of calculation: 500kW PV, assumes PV panels work for an equivalent of 1,200 hour per year at maximum power output) • Expected annual combination of RE power and grid power used to charge EVs and mobile charging station battery packs: 741,096 kWh per year (method of calculation: see last section of Exhibit 4; amount is 124% of the gross generation of micro-grid, some of which may be delivered via RE power stored in the stationary battery packs; thus, some grid power will be needed to make up the deficit) • Expected annual power used for building load, mostly grid powered unless PV installation is expanded: 113,150 kWh (method of calculation: 24 kW average day load * 10 hr + 5 kW average after work load * 14 hr) *365 days/ year = 113,150 kWh • Expected annual V2G of vehicles as used by either building load or other load: 24,090 kWh (method: set V2G output power as 3.3 kW, the same as input power; 10 vehicles in total; 2 hours work time during high load period of the grid; then the electrical energy provided by V2G and used by building and others is = 10 vehicles * 3.3kW * 2h/day *365 days = 24,090 kWh/ year) • Expected annual retired EV battery pack powered electrical energy stored and then provided to micro-grid by stationary retired EV battery bank: 166,090 kWh (method: 505.6 kWh total capacity * 90% capacity utilized * 365 days = 166,090 kWh per year; method assumes one full charge and discharge per 24 hour period) • Expected annual electrical energy drawn (either from grid or from stationery battery packs) by retired EV battery packs used in mobile charging vehicles and potentially provided to EVs circulating in the city: 75,686 kWh (method: 6.4 kWh per battery pack * 90% * 12 battery packs/vehicle *3 vehicles * 365 days = 75,686 kWh per year)

Exhibit 6 gives estimated investment and expected returns for Yancheng's Aoxin Micro-Grid. Total investment for the PV generating system is estimated at about 5 million RMB (or 749,457 USD). The energy storage system (consisting mainly of 115 retired EV battery packs) is estimated to have a cost of 6 million RMB (or 901,000 USD). Thus, the total cost of the system (not including EV purchase costs) is about 11 million RMB (or 1.65 million USD). Based on a total cost of power in the area of 1.6 RMB per kWh and the estimated 600,000 kWh to be provided per year, value creation is estimated at 960,000 RMB per year (or about 144,000 USD per year). At this rate, the payback period of the system is estimated to be 11.5 years. If benefits from charging at valleys and selling at peaks for V2G and for the mobile charging station vehicles is include, the payback period is reduced to 10.7 years. The stationary batteries might also be used to generate this kind of valley-peak charge-sell benefit, but for now those batteries are assumed to provide power when the sun is not shining to mainly the EVs and possibly other loads in the micro-grid system.

Exhibit 6: Investment and Expected Returns for Yancheng's Aoxin Micro-Grid

Investment	PV generating: 5 million RMB (749,457 USD)
	Energy storage system: 6 million RMB (901,000 USD)
	Total investment: 11 million RMB (1.65 million USD)
Value creation per year (PV only)	Electricity charging: 600,000 kWh @1.6 RMB per kWh
	Total annual "profit" (value created): 960,000 RMB (144,000 USD)
Payback period	11.5 years (PV system only); 10.7 years (if V2G and mobile charging systems benefits of buying at valley and selling at peak are included)

Methodology
Investment: PV power generation system investment includes: solar panels, inverters, micro-grid system, monitoring system, etc. According to the current market, 1 watt needs 10 RMB investment including all these things. So, 500 kW PV need 5 million RMB investment. The energy storage system (79 retired battery packs for the stationary system and 36 retired EV battery packs for the mobile charging station vehicles, a total of 115 retired EV battery packs) needs 6 million RMB (or about 52,000 RMB or 7,800 USD per battery). Thus, the total investment for the PV system and retired EV battery packs is about 11 million RMB (or 1.65 million USD).
Profits (value generation):
PV system: The PV system is capable of generating 600,000 kWh electricity. In this area of Jiangsu Province, the standard price of electricity (including service charge) is 1.6 RMB/kWh, which implies total annual value generated of 600,000kWh * 1.6 RMB/kWh = 960,000 RMB/year (USD144,000/year)
V2G system and mobile charging system: The value creation from V2G and the mobile charging system, when power is purchased at valley prices and sold at peak prices, is computed as follows: 24,090kWh (V2G) + 75,686 kWh (mobile charging vehicles) = 99,776kWh; The peak and valley price difference =1.0RMB-0.3RMB=0.7RMB; the net value of providing power back to the grid at off-peak is = 99,776 x 0.7 = 69,843 RMB
Payback: Thus, if the system operates at full load, the shortest recovery period is: 11 million/ (960,000 RMB/year + 69,843 RMB/year) = 10.7 years if both PV benefits and peak-valley benefits are considered

1b-2. Goldwind Wind and Solar PV EV Micro-Grid

Yancheng's Goldwind EV-RE Micro-Grid will be achieved by additions to an existing micro-grid developed and operated by a subsidiary of Goldwind, a leading wind turbine manufacturer in China. The Goldwind subsidiary is specializing in developing and operating micro-grids. The existing micro-grid already incorporates wind power and PV power. It supplies power to a neighboring manufacturing facility at a price lower than that facility pays for power from the main grid. Thus, the customer benefits and Goldwind also makes a profit on the arrangement, earning its original investment back over time.

Exhibit 7 summarizes the planned constituents of the project's EV-RE Yancheng Goldwind Micro-Grid. The RE power will continue to be the original micro-grid's existing combination of wind and solar, with wind providing the majority share. The wind power is provided by one large wind turbine of 2 MW capacity and one small turbine of 10 kW. The PV installation is 100 kW. All of these constituents that are part of the existing system providing power to the neighboring manufacturing facility will have already been in operation a good while once the project's EV-RE integration functionality is added. To achieve micro-grid integration of EV-RE, six passenger cars belonging to Goldwind and four sanitation trucks belong to Dafeng District will be added to the system, and ten charging poles. The Goldwind Micro-Grid will incorporate a set of 16 retired EV battery packs sourced from the company Aoxin's electric trucks. With a capacity of 6.4 kWh per battery pack, the total retired EV battery bank capacity will be 102.4 kWh.

Goldwind's existing Micro-Grid is already serving a maximum load of 7,500 kW from the neighboring manufacturing facility. The manufacturing facility's load tends to vary from 6,000 kW during work hours (8:00 – 16:00) to 5 kW during non-work hours. The manufacturing facility uses about 92 percent of the micro-grid's annual supply of RE of 4,150 MWh, which in turn represents about 18.7 percent of the manufacturing facility's total electricity consumption. Prior to the micro-grid, the manufacturing facility had a consumption of less than 1,850 MWh per month and an electricity bill less than 1,850,000 RMB per month.

The micro-grid also serves a much smaller load from Goldwind's building at the site, where the main end uses are lighting, HVAC, and technical operation of the micro-grid. The building's maximum load is 35 kW and its minimum load is 3 kW. Overall, the building's load tends to vary from an average of 28 kW during work hours (8:00 – 16:00) to 3 kW during non-work hours.

Exhibit 7. Constituents of Goldwind's Micro-Grid in Yancheng

RE Power in Yancheng's Goldwind Micro-Grid
• Wind: 1 large turbine of 2MW, 1 small turbine of 10kW • Solar: 100 kW PV
EVs and charging poles in Yancheng's Goldwind Micro-Grid
• Type and number of EVs: 6 passenger cars belonging to Goldwind, 4 sanitation trucks belonging to Dafeng District • Charging poles: 10
Stationary Retired EV Battery Packs of Yancheng's Goldwind Micro-Grid
• Number of stationary retired EV battery packs:16 • Capacity of each battery pack: 6.4 kWh; Total battery bank capacity: 102.4 kWh • Source of retired batteries: Retired battery systems from the company Aoxin's electric trucks
Manufacturing Facility and Building Load of Yancheng's Goldwind Micro-Grid
• Share of energy going to other applications: about 92% of power produced is supplied to neighboring manufacturing facility of China South Railway, mainly used in production activities, while 2% supplies Goldwind's building at the site, covering lighting, HVAC, and operational end uses • Maximum load of manufacturing facility: 7,500 kW • Minimum load of manufacturing facility: 5 kW • Variation in load of manufacturing facility by time of day: 6,000 kW (80% of maximum) for working hours (8:00 – 16:00) and 5 kW (minimum) at other times. • Maximum load of building: 35 kW • Minimum load of building: 3 kW • Variation in load of building by time of day: load is typically 28 kW (80% of the maximum) during work hours (8:00~18:00), and 3kW (minimum) for the other time period.

Exhibit 8 summarizes a number of targets for the Goldwind EV-RE Micro-Grid and methods used to calculate them. The targeted (and currently achieved) annual power output of the combined wind and PV system is 4,150 MWh, with the majority (4,000 MWh) coming from the 2 MW wind turbine. Of the total annual targeted power output, only a small portion, about 1.68 percent, or 69,350 kWh per year, is targeted to be used to charge the ten EVs or retired EV battery packs that will later charge the EVs. The bulk of the power (92 percent) will continue to be used to power the neighboring manufacturing facility and about 2.83 percent will continue to be used to power Goldwind's building on the site. The annual amount of power to be stored by the battery bank and provided back to the micro-grid (to power the EVs or other loads) will be 33,636 kWh, which is roughly half of the annual charging demand of the ten EVs as a set.

Exhibit 8: Targets for Yancheng's Goldwind Micro-Grid

Targets for Yancheng's Goldwind Micro-Grid
• Expected (and current) annual RE power generated: 4,130,000 kWh (method of calculation: 2 MW turbine works for the equivalent of 2,000 hours per year at maximum power output, generating about 4,000,000 kWh; 100 kW turbine works for equivalent of 300 hours per year at maximum power output, generating about 30,000 kWh; 100 kW PV panel works for equivalent of 1,200 hours per year of maximum power output, generating about 120,000kWh; total power output is 4,150,000 kWh per year) • Expected annual RE power used to charge EVs: 69,350 kWh (method of calculation: (15kWh * 6 sedans + 25kWh * 4 trucks) * 365 days = 69,350kWh, accounting for 1.68 percent of the total generation) • Expected annual retired EV battery pack power stored by the battery packs and later provided back to the micro-grid: 33,638 kWh (method: annual retired EV battery pack power capacity of energy storage station is 102.4 kWh * 90% * 365 days = 33,638 kWh, assuming the battery packs are both charged and discharged once per 24 hour period) • Expected annual RE power used Goldwind building load: 117,530 kWh = (28kW*10h + 3kW*14h)*365days, accounting for 2.85% of the total generation • Expected annual RE power used for neighboring manufacturing load = 3,799,600 kWh (method of calculation: 92% of gross generation is used for manufacturing facility, so, 0.94 x 4,130,000 = 3,799,600 kWh • Total of annual Goldwind building and manufacturing facility estimated use of RE power = 3,917,130 kWh, accounting for about 95% of RE power generation

Exhibit 9: Investment and Expected Returns for Yancheng's Goldwind Micro-Grid Incremental Investment to Accommodate EV Charging with RE

Original investment in micro-grid	Equipment: 20 million RMB (about 3 million USD)
	Construction: 3.05 million RMB (about 458,000 USD)
	Installation: 1.4 million RMB (about 210,000 USD)
	Other: 2.55 million RMB (about 383,000 USD)
	Total original investment (pre-EV-RE project): 27 million RMB (about USD4 million)
Incremental investment in micro-grid to accommodate EVs	Ten charging poles added: 130,000 RMB (USD19,500); Method: 10 poles x 13,000 RMB per pole
	Sixteen retired EV battery packs and rest of battery system: 133,120 RMB (19,900 USD); Method: 102.4 kWh*1,300 RMB/kWh
	Total incremental cost: 263,120 RMB (USD39,400)
Value-add ("profit") per year from incremental EV related investment	110,960 RMB (about USD16,600) = 69,350 kWh RE used per year to charge EVs * 1.6 RMB per kWh
Recovery period for incremental EV related investment	2.4 years = 263,120 RMB/110,960 RMB (Note: The recovery period is quite short, as the demo takes advantage of excess RE previously installed; the investment cost of the RE is not included in project costs, only that of the charging poles and retired EV battery bank are included in incremental investment costs for the add-on to the much larger RE system.)

Methodology

<u>Gross investment before EV-RE integration project:</u> 27 million RMB is sum of original equipment, construction, and installation of the micro-grid. However, given that the micro-grid has developed a profitable business before incorporating EV-RE integration, to calculate value-add/profits for this project we look only at incremental investment and resulting incremental profits/ value add as outlined below.

<u>Incremental investment for EV-RE integration project</u>: 263,120 RMB is sum of the cost of the ten charging poles, the sixteen retired EV battery packs, and other expenses

<u>Profits of incremental EV-RE integration project</u>: Annual profit estimate of 110,960 RMB per year based on 69,350 kWh per year used to charge EVs * 1.6 RMB per kWh as total cost per KWh of power in the area = 110,960 RMB per year (about USD16,600 per year)

<u>Payback of incremental EV-RE integration project</u>: 2.4 years = Total incremental cost of 263,120 RMB/ 110,960 RMB per year

The costs of the 16 retired EV battery packs, and total of 263,120 RMB (USD39,400). Based on the assumption that EV charging by micro-grid RE avoids costs of RMB1.6 yuan per kWh, annual benefit associated with the 69,350 kWh used to charge the ten EVs each year is estimated at 110,960 RMB (about USD16,600). The recovery period of the incremental investment is then estimated to be just 2.4 years. The recovery period is quite short as the pilot takes advantage of excess RE previously installed. The investment cost of the RE is not included in project costs. Only the investment in the charging poles and the retired EV battery bank are included in incremental investment costs for the add-on to the much larger RE system

Exhibit 9 gives the original investment, the new incremental investment, and the expected additional value creation for the EV-RE integration aspects of Yancheng's Goldwind Micro-Grid. The original total investment in the micro-grid, at about 27 million RMB, or USD4 million, is quite large. Yet, given that the micro-grid was developed with other purposes and was profitable before institution of the EV-RE integration elements, the main calculations here look at incremental investment for EV-RE integration aspects only. Those incremental investments include costs of the ten charging poles that will be added, as well as

1b-3: GHG Emission Reduction of Yancheng Micro-Grid Pilots

For vehicles included in the micro-grid demos that were already operating in Yancheng prior to the demos, the Yancheng Micro-Grid-based EV-RE Integration Demo will result in GHG emission reduction equivalent to the fossil fuel based power replaced by the new RE power generated in the micro-grid. As the EVs would exist regardless of the demo, the calculation of the emission reduction is not based on replacement of gasoline with RE power in transport, but of grid-based fossil-fuel power replaced with micro-grid RE power. In the case of the Aoxin Micro-Grid demo, RE power may be used by either the EVs or the building or the batteries to be used in the mobile recharging station vehicles, but the GHG reduction benefits will be calculated in the same way as the benefit of replacing typical fossil-fuel based grid power with RE. For the Goldwind Demo, because the RE micro-grid was in existence before the project, only that RE powering EVs or retired EV battery packs will be considered for emission reduction calculations. The RE powering the manufacturing facility or Goldwind's own facility will not be considered in calculating the project's GHG emission reductions. In cases where an EV in one of the two micro-grid demos is a newly purchased vehicle that is purchased instead of an ICEV due to stimulation by the project, the result is the even larger emissions reduction of going from an ICEV to an RE powered EV. Yet, as with such vehicles in the smart charging demo, the GHG emission reduction calculations will be carried out in a two-step process: The first step estimates the benefits in going from an ICEV to EV with standard fossil-fuel based grid power for any new vehicles that are deemed to have been stimulated by the project, rather than a part of business-as-usual expansion of Yancheng's EV fleet. The second step estimates the benefits in going from fossil-fuel based grid power to RE.

1c. Yancheng Energy Management Center

The Yancheng Energy Management Center will be set up to collect and manage the data on the dispersed EVs and charging poles involved in both Yancheng's smart charging demo (1,000 EVs and 1,000 smart charging poles) and its two RE micro-grid demos (80 EVs and 80 charging poles for the first micro-grid demo and 10 EVs and 10 charging poles for the second one). The heart of the Center will be a number of servers that will provide the data collection, analysis, and control functions needed. The Center will also include a number of desk top computers as well as large screens on the wall that will enable staff to have a better view of the system and verify that all is operating properly.

On the basis of a previous monitoring center platform in Yancheng's NEV Industry Park, the project will upgrade the hardware and software as needed to establish the Yancheng Energy Management Center. The capabilities of the Center will include GPRS remote network control and the collection, transmission, alarm (as needed), analysis, and calculation of data from the EVs, smart charging poles, main grid, wind and/or solar power charging in the micro-grids, fixed location energy storage stations using retired EV battery packs in the micro-grids, mobile charging station vehicles, V2G charging poles in one of the micro-grids, and standard AC charging poles throughout the city. Specific remote network control functions of the Center will include the management of EVs' smart charging and V2G charging and discharging, control of wind power installations and PV power installations, and management of retired EV battery pack charging and discharging. The functions will also include calculation of fees for electricity used and issuance of information on power usage.

During the demos, in addition to control functions, the Center will conduct analysis of relevant data collected. As such, the Center will provide insights on how V2G affects EV battery system life and the strategy for dispatching electricity and estimating the stability, economic efficiency, and the applicability of V2G. These insights, in turn, will serve as a basis for the scale-up of methods used in the demos.

2. Shanghai EV-RE Integration Demo

The Shanghai EV-RE integration pilot will include demonstration of: (1) integration of EVs with the power grid via smart charging and (2) ten separate EV-RE micro-grids. In contrast to the Yancheng demo, where the three pilots (the power integration pilot of smart charging and the two EV-RE micro-grid pilots) will be operated with separate sets of vehicles, in Shanghai, grid-integrated smart charging and the ten EV-RE micro-grids will be demonstrated with the same set of vehicles. The pilot will be implemented by Shanghai International Auto City (SIAC), which has a car sharing business (for hourly sedan rental) that exclusively uses EVs and an e-bus rental business. The car sharing business, called EVCARD, has multiple sites for hourly auto rental, EV charging, and return of autos. A number of these sites, through the demo, will become smart charging sites at which EVs will be charged with grid power at optimal times of day. And, ten select charging stations, including one right by the headquarters of SIAC, will be EV-RE micro-grid sites at which EVs will be charged with RE. The various aspects of the Shanghai demo, then, will be fully integrated in that the same car may be used for grid-integrated smart charging one day and micro-grid RE charging at one of ten micro-grid sites the next; and co-financed scale-up will serve both purposes (smart charging with the main grid and micro-grid EV-RE integration). For ease of explanation, however, the text below separates the description of the Shanghai demo into the following subsections: (1) co-financed scale-up of vehicles and charging piles; (2) smart charging sites; (3) the ten EV-RE micro-grids, including EVs, solar PV installation, and retired EV battery pack banks, with demonstration of both regular RE charging and bidirectional charging (i.e. V2G); and (4) the Shanghai Energy Management Center.

2a. Shanghai Co-financed Scale-up of EVs and Charging Poles

Shanghai International Automobile City (SIAC), as part of its co-financing for this project, will pursue scale-up of its EV car sharing fleet (branded EVCARD) and charging pole network throughout the city of Shanghai. It will also scale up its e-bus rental fleet (branded EDRIVE). While SIAC already has a significant car sharing fleet through its EVCARD hourly car rental business, it is believed that scale up will enable it to achieve a concentration of vehicles and charging stations that will be more attractive to consumers, and thus launch the business into a profitable and sustainable mode. SIAC realizes that, for the car sharing business to be profitable, a much greater density is needed. Once density and popularity of the car sharing model is increased, they believe the daily revenues per vehicle will rise to a level at which the business is profitable. Ultimately, though it may be several years in coming, they aim for a density of rental/charging stations that will enable customers to walk just 300 to 500 m each time they wish to rent a car share vehicle. This basic type of scale-up of vehicles and charging stations, in turn, as has been discussed elsewhere, is an important foundational aspect for realizing the large-scale integration of EVs with RE.

Exhibit 10 shows the current number of vehicles (as of end of August, 2016), car sharing and charging stations, charging poles, and parking spaces associated with SIAC's EVCARD car sharing business and EDRIVE e-bus rental business, as well as the targeted co-financed scale up during the project demo. Total number of SIAC electric vehicles (including cars and buses) will almost quintuple (becoming five times the end of August, 2016 value) during the project, going from 1,600 at end the end of August, 2016, to 8,200 by end of project (end of 2019). The total number of charging poles will more than triple, going from 4,400 poles at the end of August, 2016, to 16,000 at end of project (end of 2019). Exhibit 11 shows more specifically the planned pace of scale up on an annual basis for both the vehicles and charging poles during the duration of the three-year project.

Exhibit 10. SIAC Scale-up Targets for Car Sharing and Bus Rental Businesses in Shanghai

Items		Now†	Additions during the project	Total at end of project
Vehicles	Hourly car sharing passenger cars (Roewe E50, Chery EQ, BMW Zinoro 1E)	1,600	6,400	8,000
	E-bus (daily rental)	50	150	200
	Total electric vehicles	1,650	6,550	8,200
Infrastructure	Sharing stations (sites with multiple spaces; also called "charging stations")	1,500	2,500	4,000
	Charging poles (charging stations have multiple parking spaces and a charging pole for each parking space)	4,400	11,600	16,000
	Energy production and storage stations*	0	10	10

*Energy production and storage stations contain PV panels and retired EV battery packs that will serve as the EV-RE micro-grids presented in a later sub-section.

†As of end of August, 2016. This date will be used as the baseline date for the project. Although the project is targeted to officially launch in January 2017, additions after August, 2016, will be a part of the co-financed project scale-up effort.

Exhibit 11. SIAC's Plan for Annual Scale-up of EVs and Charging Poles in Shanghai during Project

		Now (Aug. 31, 2016)	To add in 2017†	To add in 2018	To add in 2019	Total at end of project
Vehicles	**Passenger cars**	1,600	4,400	1,000	1,000	8,000
	E-buses	50	100	25	25	200
	Total EVs	1,650	4,500	1,025	1,025	8,200
Charging poles		4,400	8,600	2,000	1,000	16,000
Charging stations		1,500	1,750	500	250	4,000

†This will include additions between September 2016 and end of 2017, as co-financed scale-up associated with the project is considered to officially launch in September 2016, a few months before anticipated official start of project in January 2017.

Exhibit 12 shows vehicle miles travelled and gasoline consumption avoided for the electric cars and buses that are a part of the Shanghai demo. Because the number of vehicles increases each year, calculations are made on an annual basis and summed. The total amount of gasoline or diesel avoided with these vehicles between 2017 and 2019 is estimated at over 70 million liters. In order to determine GHG emission reductions for the project due to scale up of EVs, calculations will be different than those in Exhibit 12. The GHG emission reduction calculations will only consider those vehicles that are a part of the scale-up, as the original 1,620 EVs would exist without the project. Further, the emission reduction calculations only consider the increment of new vehicles that it is believed would not have been put in service in the business-as-usual case (the case without the project). Due to the project, SIAC sees the opportunity to enhance the financial viability of its business model through getting into the "energy business" and thus is encouraged to expand the number of vehicles beyond what they would have in the business-as-usual case. There are two key points about how the project introduces increased financial viability to SIAC, thus encouraging greater scale-up: (1) First, they will be able to make use of batteries retired from EVs, thus increasing the value to them of EVs purchased. (2) Second, these retired batteries can be used to store power provided from the grid at "valley times" (where pricing is 0.45 RMB per kWh) and sell it at "peak times" (where pricing is 1.0 RMB per kWh). As for the GHG calculations, once the number of vehicle additions beyond business-as-usual is estimated and the calculations for their GHG emission reduction benefits (in going from gasoline or diesel fuel to East China power grid mix) are done, separate calculations will estimate GHG emission reduction benefits from use of micro-grid based RE instead of grid-based power in charging EVs for the number of EVs that can be accommodated by the ten Shanghai micro-grids.

Exhibit 12. Vehicle Miles Travelled and Gasoline Consumption avoided by Shanghai ECARD Sedan and EDRIVE E-Bus Fleet

Vehicle Type	Number of vehicles	km per day per vehicle*	km per vehicle for the year†	Total km per day for all vehicles in group combined†	Total km for all vehicles in group for the year	Total gasoline or diesel consumption avoided for the year (liters)‡
E-cars in 2017	6,000	90	31,207	513,000	187,240,000	18,724,000
E-buses in 2017	150	96	33,288	13,680	4,993,200	1,497,960
Total 2017	**6,150**	**---**	**---**	**---**	**--**	**20,221,960**
E-cars 2018	7,000	90	31,207	598,500	218,450,000	21,845,000
E-buses 2018	175	96	33,288	15,960	5,825,400	1,747,620
Total 2018	**7,175**	**----**	**---**	**---**	**---**	**23,592,620**
E-cars 2019	8,000	90	31,207	684,000	249,660,000	24,966,000
E-buses 2019	200	96	33,288	18,240	6,657,600	1,997,280
Total 2019	**8,200**	**---**	**---**	**--**	**--**	**26,963,280**
Total 2017-2019	**----**	**---**	**--**	**--**	**--**	**70,777,860**

*km per day per vehicle are based on experience to date with ECARD hourly passenger EV car rental and EDRIVE e-bus rental, respectively.
†95% uptime is assuming in calculating km per year and also in calculating total km per day for all vehicles in group combined
‡In calculating gasoline consumption avoided the following is assumed: Fuel consumption per 100 kilometers of bus travel is 30 L of diesel. Fuel consumption per 100 kilometers of passenger vehicle travel is 10 L of gasoline.

2b. Shanghai Smart Charging and Integration of EVs with Main Power Grid

Smart charging in Shanghai will enable the charging of electric vehicles when the load in the rest of the Shanghai grid is low. SIAC will establish 200 smart charging poles (among its 16,000 charging poles targeted by end of project) spread across 50 smart charging stations (among its 4,000 charging stations targeted by end of project). Thus, it can be seen that smart charging poles will make up only 1.25 percent of SIAC's charging poles and be available at only 1.25 percent of SIAC's charging stations. The specific vehicles involved in smart charging will vary from day to day depending on which vehicles end up getting returned and parked at charging stations with smart charging capabilities. Exhibit 13 summarizes the smart charging infrastructure to be set up by end of project, emphasizing that, at present, there is no smart charging infrastructure for EVs in Shanghai. Establishment of smart charging poles will require either upgrades of existing poles or installation of completely new poles.

Exhibit 13. Establishment of Smart Charging Infrastructure in Shanghai

Time	Smart charging poles	Smart charging stations	Vehicle number
Now	0	0	1,600
By end of demo	200	50	8,000*

*Note: While all 8,000 of EVCARD's passenger car electric vehicles will be involved in the smart charging demo, it is highly unlikely they will all do so on a daily basis. Involvement will depend on whether a particular vehicle is returned to a site with smart charging poles. Given the 200 smart charging poles and assuming approximately one smart charging opportunity per day per pole, up to an estimated 200 vehicles per day could be involved in the smart charging aspect of the Shanghai demo.

Exhibit 14 provides an estimate of the scale of smart charging that may be achieved via the Shanghai demo. As there will be 200 smart charging poles and demand for smart charging will not occur throughout the day, but only at times when the grid has reduced demand, an assumption of 200 vehicles involved per day in smart charging is made. Assuming a load of 3.3 kW per vehicle, this can generate a combined load of 660 kW, if all vehicles were to charge simultaneously. Assuming the average smart charge per vehicle per day is 15 kWh, the daily load shift potential of the 200 cars as a group is 3,000 kWh. Based on the same assumptions, the annual load shifting potential over two years of implementation is estimated at 2,190 MWh.

Exhibit 14. Potential Scale of Smart Charging in Shanghai demo

Vehicle Type	Number of vehicles	charging load per vehicle (kW)	Sum of charge load for all vehicles in category (kW)	charging per day per vehicle (kWh)	Total smart charging per day for all vehicles combined (kWh)	Total smart charging for all vehicles during two year period (MWh)
EV: sedan	200	3.3 kW	660 kW	15 kWh	3,000 kWh	2,190 MWh

Shanghai has very substantial time of day variations in power load, with the lowest off-peak load levels being 40 to 45 percent less than maximum peak levels. The grid offers price benefits to those that use power off-peak, with an off-peak price of 0.45 yuan per kWh, compared to 1.0 yuan per kWh for peak power. Shanghai also has strong potential solar resources that may eventually be utilized via grid-connected distributed PV systems. Thus, for both reasons (high variation and potentially high levels of grid-connected distributed PV in the future), the ability to reduce load variations with smart charging by EVs in Shanghai could be very helpful. Thus, the pilot may lay the groundwork and build the capacity to enact larger scale load modulation with smart charging in Shanghai in the future. The pilot design will focus on using smart charging to charge vehicles when Shanghai's load is at its lowest. After demonstration, as more EVs are on the road in Shanghai, greater load modulation can be achieved with the methods learned. Also, as more PV is added to the local grid, smart charging may also play a role in reducing power supply peaks associated with the PV.

2c. Shanghai EV-RE Micro-Grids

The ten Shanghai EV-RE micro-grids will be set up by SIAC at various locations, including one near the company's headquarters in Jiading, Shanghai, an area of the city known for its concentration of auto industry facilities. Although they will be connected to the main power grid, the micro-grids will be designed to operate as off-grid/partitioned systems in terms of the RE generated. That is, all RE generated will be utilized by the various loads connected to the micro-grid, including EVs, retired EV battery packs, and, in the case of one micro-grid, the SIAC headquarters building. In the case of the micro-grid with the headquarters building, power will also need to be drawn from the main power grid to satisfy the full load of the building.

Constituents and other details of the Shanghai EV-RE micro-grids are given in Exhibit 15 below. The micro-grids in total will have 240 kW of PV, distributed among ten 24 kW stations. The maximum number of EVs involved will be 8,000, which represents the company's full fleet of hourly car rental sedans by the end of the project. Yet, large portions of this fleet on any one day will be parked and recharged in other parts of the city, away from the mini-grid at the main headquarters of SIAC and its other nine micro-grids. So, daily participation in the micro-grids is likely to be substantially less than 8,000 EV passenger and is estimated to be around 90 vehicles at a time spread across the planned ten charging stations (each with about nine charging poles) associated with ten micro-grids, respectively. One of the micro-grids will include demonstration of V2G for five vehicles, which will be accommodated by five of the charging poles being V2G charging poles. The Shanghai EV-RE micro-grids will have a substantial stationary storage bank consisting in total of 160 retired EV battery packs divided among the ten stations (e.g. sixteen battery packs per station). The battery packs will be derived from disassembled retired Roewe E50 EV battery systems. Each EV has a battery system, which contains multiple battery packs. The capacity of each battery pack to be used will be 4 kWh (assuming it is 80 percent of original capacity of 5 kWh), yielding a total capacity of 640 kWh, or 64 kWh per micro-grid. In addition to charging EVs and its retired EV battery bank, the micro-grid co-located with the SIAC headquarters building will provide power to the building. The building has a maximum load of 140 kW, which typically ranges from 112 kW during work hours to 5 kW during non-work hours.

Exhibit 15. Constituents of SIAC's 10 Micro-Grids in Shanghai

RE Power in Shanghai Micro-Grids
• Total capacity: 240 kW PV (= 24 kW per PV station * 10 stations)
EVs and charging stations at the Shanghai Micro-Grids
• Maximum number of EVs involved: 8,000 passenger cars (Note: Number involved on a daily basis will be far fewer. Many of the full EV fleet will be parked and recharging at other sites throughout the city, rather than at the micro-grids.) • Likely number of EVs charging at micro-grids each day: Approximately 90 EVs associated with the 10 charging stations of micro-grids (one charging station at each micro-grid). Each mini-grid charging station will have about 9 charging poles. • Source of EVs: Car sharing (hourly rental) sedans belonging to Shanghai International Auto City • EV sedan models and their battery system capacity: ROEWE E50, Chery EQ, and BMW1E, with battery system capacities of 18 kWh, 22.3 kWh, and 24 kWh, respectively. • V2G: 5 vehicles and 5 V2G charging poles (among the 9 poles at the headquarters mini-grid)
Retired EV Battery Packs in Shanghai Micro-Grids used as Stationary Storage Banks
• Number of retired EV battery packs: 160 distributed across 10 stations with 16 battery packs each • Type of retired EV battery packs: Roewe E50 battery systems will be disassembled so that the constituent battery packs can be used. Original capacity of E50 battery packs to be used is 5 kWh each. Capacity after retirement is 4 kWh. Target for use during operation is 90% of capacity. • Capacity of each battery pack of retired battery systems: 4 kWh; Total battery bank capacity: 640 kWh or 64 kWh per station • Source of retired EV battery packs: battery systems retired from Shanghai International Automobile City hourly rental car sharing fleet
Building Load of Shanghai Micro-Grid
• Building: Shanghai International Auto City Office Building, located in Jiading, Shanghai, will be linked to one of the 20 EV-RE micro-grids • Maximum load: 140 kW • Minimum load: 5 kW • Variation in load by time of day: 112 kW (80% of the maximum) for the work period (8:00~18:00), and 5kW (minimum) for other time periods. • Pre-micro-grid monthly grid power consumption and electricity bill of building: less than 30,000 kWh per month with corresponding bill less than 30,000 RMB (USD4,500)

Exhibit 16 shows targets for the ten Shanghai micro-grids as a group, as well as methods of computation of these. The estimated annual RE power generation from the micro-grids' PV panels as a group is 332,880 kWh. It is estimated that EVs will consume 93.7 percent of the RE power. This estimate assumes about 90 EVs charging 10 kWh per day at one of the ten micro-grid stations. The other 6.3 percent of the RE power, or 20,971 kWh annually, may be used to power the building at one of the micro-grids or other loads at the micro-grids. Annual V2G power provided to the respective micro-grid by the two designated V2G vehicles is estimated to be 11,443 kWh per year. For the retired EV battery packs, it is estimated that the amount of RE power provided via storage in batteries will be 210,240 kWh per year. This estimate assumes one full charge and one discharge at 90 percent per day of the retired EV battery packs.

Exhibit 17 shows the investment and expected returns for Shanghai's EV-RE micro-grids. Estimates are first made on a single micro-grid basis and then computed for the total of ten micro-grid stations (each comprised of PV, retired battery bank, and charging posts) to be developed. The cost of one such station is estimated at 600,000 RMB (about USD90,000); and the cost of all ten such stations is estimated at 6 million RMB (about USD900,000). An estimate of the value of power generated by each station is based on the assumptions of the equivalent of 1,387 hours per year with maximum output of the PV panels and a value of 1.6 RMB per kWh, the current cost of power (including service fee) in Shanghai. The total value generated per station is 53,260 RMB per year; and the total value of electricity generated by all ten stations combined is 532,608 RMB per year (about USD80,000). The payback period is the total investment divided by the total annual value generated and is about 11.3 years.

Exhibit 16: Targets for Shanghai's Ten Micro-Grids

Targets for Shanghai Micro-Grids
• Expected annual RE power generated: 332,880 kWh (method of calculation: 24 kW x 1,387 h x 10 stations. The average generation power of each station is 24 kW; and the average equivalent sunshine duration per year assuming maximum output is 1,387 h.) • Expected annual RE power used to charge EVs: 312,000 kWh (accounting for about 93.7% of the RE generation; method: 10 kWh/day charging for each vehicle x 90 vehicles x 365 days/year x 95% up time = 312,075 kWh. Currently, there are 1,500 EVCARD brand car sharing stations across Shanghai and this is targeted to rise to 4,000 by end of project. The micro-grid will incorporate ten such car sharing stations and it is assumed the average number of cars parked at each station per day and available to charge will be 9 cars, resulting in a total of 90 cars per day. It is assumed that these vehicles have 95% uptime. And, it is assumed average charging demand per vehicle is 10 kWh per day. • Expected annual RE power used for building load and/or other loads: 20,971 kWh (accounting for the remaining roughly 6.3% of the RE generation) • Expected annual V2G of vehicles as used by building load/other load: 11,443 kWh (method of calculation: 3.3 kW/h * 2 h/day *V2G utilized *5 vehicles*365 work days/year*95% uptime). BYD e6 is the vehicle used. It is assumed that each vehicle can provide 3.3 kW per hour and 6.6 kWh over 2 hours per day. There are five vehicles involved in V2G. It is assumed V2G is utilized at peak 365 days per year, aside from 5 percent downtime of vehicles.) • Expected annual retired EV battery power provided to micro-grid: 210,240 kWh (method: 57.6kWh/station*10 stations * 365 days/year=210,240 kWh. The frequency of charging and discharging is once a day. Each station has 16 battery packs with capacity of 4 kWh each, or 64 kWh total, assumed to charge and then discharge 90%, or 57.6 kWh, one time per day.)

Exhibit 17: Investment and Expected Returns for Shanghai's 20 Micro-Grids

Investment	Preparation of storage system, including battery testing and assembly of battery packs for system: 160,000 RMB per micro-grid
	PV panels: 140,000 RMB per micro-grid
	Vehicle shed (for covering the cars and placement of the PV panels) and other infrastructure: 60,000 RMB per micro-grid
	Micro-grid system power distribution cabinet, controller, and other hardware: 200,000 RMB per micro-grid
	Communication and monitoring system: 40,000 RMB per micro-grid
	Total investment per micro-grid: 600,000 RMB (USD90,000)
	Total investment for all 20 stations: 6 million RMB (USD900,000)
Value generated per year	Power generated per micro-grid per year: 33,288 kWh
	Value of electricity generated per micro-grid per year: 53,260 RMB
	Power generated by all 10 micro-grids per year: 332,880 kWh
	Value of electricity generated by 10 stations per year: 532,608 RMB (USD80,000)
Payback period	11.3 years

Methodology

Investment: Total investment is computed based on investment per micro-grid. Investment for each micro-grid consists of PV panels, retired EV battery pack storage and their configuration, sheds for the vehicles on which PV panels are placed, power distribution cabinet and controller, and communication and monitoring system. Total investment per micro-grid is 600,000 RMB; and the total for 10 stations comes to 6 million RMB (about USD900,000).

Value of power generated: Power generated is based on equivalent of 1,387 hours per year with maximum output with each of the 10 stations having installed capacity of 24 kW. Price of power (including service charge) is 1.6 RMB/kWh in Shanghai. Total value of power generated by all 10 stations per year is estimated at 532,608 RMB (USD80,000) = 332,880 kWh x 1.6 RMB/kWh

Payback period: Payback period is computed by dividing total investment of 6 million RMB by total value of power generated annually of 532,608 RMB/ year. Result is 11.3 years.

2d. Shanghai Energy Management Center

The Shanghai demo will include demonstration of the Shanghai Energy Management Center that will collect and manage the data on the dispersed EVs, EV smart charging poles, EV V2G charging poles, and the retired EV battery pack banks being used as storage for the micro-grids. The Shanghai Energy Management Center will enable management of the charge and discharge of the battery packs and EVs.

The Center will be housed in an existing facility of Shanghai International Automobile City that monitors the city's passenger car EVs and shows their status on a large screen. While the existing facility currently monitors passenger EVs and their charging activities, it does not have capabilities in sending control messages to the vehicles. To upgrade the facility to have capabilities in controlling smart charging and V2G, four servers will be purchased to serve as the heart of the Center. Their automated software will model power demand and power availability from distributed EVs and retired EV battery packs and send control messages to vehicles and retired EV battery packs to realize smart charging, V2G, and provision of retired EV battery pack power to the micro-grid. Five desktop computers will be purchased for the Shanghai Energy Management Center as well as two large screens to be placed on the wall, all of which will be dedicated to enabling staff to view developments and actions of the automated system and verify that all is operating properly.

2e. GHG Emission Reductions for Shanghai Demo

As with the Yancheng demos, calculation of GHG emission reductions for the Shanghai demo may be carried out in two steps. The first step will consider scale-up in the number of electric vehicles. Given EVCARD's expansion plans, many new EVs will be purchased in the business-as-usual case. Yet, the total number is less than in the alternative scenario, as greater scale-up than originally planned is now targeted under the project. As explained, this greater than business-as-usual scale up is stimulated by the recognition by SIAC, via the project, that they will be able to generate greater profits by entering the "energy business." They will utilize retired EV batteries as storage and thus be able to profit from storing power purchased from the grid off-peak and selling it back on-peak. For the number of EVs that will be purchased due to the influence of the project, a benefit in GHG emission reductions attributable to the project is achieved in replacing ICEVs with EVs. The benefit is computed based on the difference between GHG emissions associated with gasoline or diesel fueled vehicles and GHG emissions associated with EVs charged with electricity from East China Grid's fossil fuel based power mix. Then, as the second step in calculating GHG emission reductions for the Shanghai demo, the benefit of RE powered EVs as compared to EVs powered with East China Grid's typical fossil fuel based mix can be computed. In the case of Shanghai, smart charging with the main power grid will not immediately provide any GHG emission reduction benefits, as it will just be shifting load from one time of day fossil fuel based power mix to the same mix at another time of day. Yet, the project's development of a foundation and capacity in smart charging could lead to substantial GHG emission reductions in the future, as smart charging is coordinated with greater and greater amounts of large scale renewable energy integrated into the main grid.

ANNEX F. GHG EMISSIONS REDUCTIONS

This annex provides the methodology for calculating and the estimation of GHG emission reductions expected to result from the MIIT-UNIDO-GEF China EV-RE Integration Project. The annex classifies project GHG emission reductions into a number of areas and sub-areas, as follows:

1. Direct GHG emission reductions: Direct GHG emission reductions are emission reductions resulting directly from investments of the project (both GEF financing and co-financing) and associated with results indicated in the Project Results Framework (PRF). These reductions are computed as those that occur beyond the business-as-usual baseline estimates. In the case of this project, the main contributors to direct GHG emission reductions are:

- In Yancheng: (1) Scale up in the number of EVs beyond business as usual expectations, achieving beyond baseline replacement of ICEVs (internal combustion engine vehicles) with EVs powered by East China Grid. (2) Replacement of use of East China Grid Power in EVs, buildings, or mobile charging station vehicles with use of the RE power of the project's two Yancheng micro-grids. (3) Replacement of use of standard East China Grid Power in EVs with use of previously discarded grid-connected large-scale wind power in Yancheng via smart charging.
- In Shanghai: (1) Scale up in the number of EVs beyond business as usual expectations, achieving beyond baseline replacement of ICEVs with EVs powered by East China Grid. (2) Replacement of use of standard East China Grid Power in EVs or buildings with use of the RE power of the project's ten Shanghai micro-grids.

Our methodology separates (a) GHG emission reduction benefits from replacement of ICEVs with EVs (beyond business as usual) using East China Grid power from (b) GHG emission reduction benefits of replacement of typical East China Grid charging of EVs with RE. This result in a two-step process adopted both to simply calculations and to show the relative impacts of these two types of measures.

To facilitate assessment for the Project Results Framework (PRF), which has end of project targets, each of the following types of direct emission reduction estimates will be made for each of Yancheng and Shanghai:

1a. Direct GHG emission reductions during three-year lifetime of project (used as an indicator in the project logframe)
1b. Direct GHG emission reductions achieved after project close by ongoing use for the rest of its lifetime of equipment put in use during project
1c. Total direct emission reductions during three-year lifetime of project and after project close achieved by use of equipment put in use during project for the equipment's full lifetime (sum of two items above)

2. Indirect GHG Emission Reductions: Indirect emission reductions are those resulting from impacts of the project that occur outside of the Project Results Framework. The most obvious indirect emission reductions are those that result from replication planned during the project, but not directly implemented by the project. While the China EV-RE Integration Project includes in its results replication plans for EV-RE integration investments for other cities, its activities do not include implementation of such replication. Thus, such replication will be included in indirect emission reductions. Two methodologies are used in calculation of indirect emission reductions: (a) the bottom up approach and (b) the top down approach. The bottom up approach is the more conservative, lower estimate of indirect emission reductions. The estimate is based on a specific estimate of replication magnitude that it is believe the project can stimulate. The top down approach is the more optimistic of the two indirect GHG emission reduction estimates. It is "top down" in that it estimates potential indirect emission reductions based on market share or market growth aspects. In the case of this project, estimates of annual growth rates for EV-RE integration are used to generate the top down estimate of indirect GHG emission reductions.

For the bottom up approach to indirect emission reductions, the following are computed:

2a-i: Bottom up indirect GHG emission reductions during project: Indirect emission reductions achieved during project lifetime via replication of project pilots (used as an indicator in the project logframe)

2a-ii: Bottom up indirect GHG emission reductions after project close: Indirect emission reductions achieved after project close via replication of project demos, with replication having been either initiated during or after project, but having been stimulated by replication planning during the project.
2a-iii: Total bottom up indirect GHG emission reductions: Sum of the two items above

For the top down approach to estimating indirect reduction emissions, the following is computed:

2b-i: Top down indirect GHG emission reductions for equipment installed or put into place during the ten years following project close: Indirect emissions reductions calculated based on estimated market growth of project model (RE-EV integration) in each of the ten years following project and computed for the lifetime of all relevant equipment installed or put in place during each of those ten years. The result is multiplied by a "causality factor" estimating the proportion of RE-EV market segment attributable to the project.

1. Direct Emission Reductions of Yancheng Demo

In this section, the GHG emission reductions of the Yancheng Demo that occur as a direct result of activities included in the project framework are estimated. For ease of calculations, estimates are divided into three parts. The first part, representing GHG emission reductions in replacing ICEVs with EVs beyond the business-as-usual case, considers only those EVs that would not have been purchased had there been no project. The second part represents GHG emission reductions achieved by replacing grid-based power (mainly used for EVs, but some used for buildings) with RE power via the project's two EV-RE micro-grids in Yancheng. The third part represents GHG emission reductions achieved via the smart charging aspect of the Yancheng Demo. For this part, it is assumed smart charging enables use of large-scale wind power that had previously being going to waste. Thus, the standard East China Grid mix is replaced with RE for the amount of smart charging achieved.

Part 1: Yancheng GHG emission reductions due to purchase of EVs that would not have been purchased in absence of project: This subsection computes Yancheng emission reductions due to the purchase of EVs that would not have been purchased in the absence of the project. As background, Exhibit 1 provides information on Yancheng's EV fleet size prior to the project, the number of EVs expected to be added to the Yancheng fleet in the business as usual case, the number of EVs that will be added due to the influence of the project, and the total number of EVs that will participate in the Yancheng demo.

Exhibit 1: Breakdown of EVs to be used in Yancheng Demo, including EVs that would not have been purchased in Business as Usual Scenario

Type of EV	Number of EVs in Yancheng Fleet prior to Project	Number of Additional EVs Purchased in Business as Usual Scenario	Number of Additional EVs Purchased due to Project only	Total EVs to be used in Yancheng Demo
Truck	200	100	400	700
Taxi	0	0	50	50
Bus	10	0	0	10
Fleet sedan	20	10	70	100
Rental or car sharing sedan	0	0	140	140
Total	**230**	**110**	**660**	**1,000**

To calculate the GHG emissions reductions achieved during the project by putting more EVs on the road than in the business as usual case, the fourth column of Exhibit 1, "Number of additional EVs purchased due to the project only" is utilized. Taking this column, the baseline CO_2 emissions during the project had the vehicles in this mix been ICEVs, as shown in Exhibit 2, are computed. Then, the CO_2 emissions reductions achieved in the alternative scenario when EVs use East China Grid power to replace ICEVs for this mix, as shown in Exhibit 3, are calculated. Then, to compute GHG emissions reductions achieved during the project, emissions in the alternative scenario are subtracted from those in the baseline scenario, as shown in Exhibit 4. The differences, as shown in the right-most column of Exhibit 4, are the first of three components of our overall emission reductions for the Yancheng demos. While the project duration is three years, for Exhibits 2, 3, and 4, it is assumed that it takes one year to get the demos up and running, so that the vehicles whose GHG emissions are assessed run for two years during the project. As shown in Exhibit 4, the total direct emissions reduction in Yancheng during the last two years of the project due to the replacement of ICEVs that would not have been replaced without the project with EVs is estimated at 3,090.6 t CO_2.

Exhibit 2: Baseline CO_2 Emissions during Project of ICEVs in Yancheng that would not have been replaced by EVs in Baseline Scenario

Type of Internal Combustion Vehicle	Number	Fuel type	Typical fuel consumption (L/ 100 km)	km per day per vehicle	Fuel use per year* (all vehicles) (L)	Emission factor for fuel (kg CO_2/L)	Emissions for 2 years (all vehicles) (t CO_2)
Truck	400	gasoline	9	125	1,560,375	2.3	7,177.7
Taxi	50	Gasoline	10	200	346,750	2.3	1,595.1
Bus	0	Diesel	30	150	0	2.63	0
Fleet sedan	70	Gasoline	10	90	218,453	2.3	1,004.9
Rental or car sharing sedan	140	Gasoline	10	90	436,905	2.3	2,009.8
Total	**660**	----	----	---	---	---	**11,787.4**

*Assumes 95% uptime on average for all vehicle types.

Exhibit 3: CO_2 Emissions during Project of EVs in Yancheng that Replace ICEVs only in the Alternative Scenario

Type of EV	Number	Energy use of vehicle (kWh/ 100 km)*	km per day per vehicle	Direct electricity use per year (all vehicles)† (MWh/y)	Typical distribution losses for uncoordinated charging (%)	Total electricity use per year (all vehicles) (MWh/y)	Emission factor of East China Grid‡ (t CO_2 / MWh)	Emissions for 2 years (t CO_2)
Truck	400	18	125	3,120.8	2.4%	3,197.5	0.791	5,058.4
Taxi	50	22.4	200	7,76.7	2.4%	795.8	0.791	1,259.0
Bus	0	120	150	0	2.4%	0	0.791	0.0
Fleet sedan	70	22.4	90	489.3	2.4%	501.4	0.791	793.2
Rental or car sharing sedan	140	22.4	90	978.7	2.4%	1,002.7	0.791	1,586.3
Total	**660**	---	---	**5,365.5**	**2.4%**	**5,497.4**	**0.791**	**8,696.9**

* Data from fuel consumption test program by SAE China in 2013-14 for trucks and buses.
Typical consumption for cars is obtained for the EV (Nissan Leaf) and PHEV (GM Chevrolet Volt) as reported by US DOE of 0.36 kWh/mile (22.4kWh/100km) at http://www.afdc.energy.gov/vehicles/electric_emissions_sources.html accessed in August 2016.
†Assumes 95% uptime.
‡The emission factors of the East China Grid are combined as 75% of the Operating Margin + 25% Built Margin as indicated by the UNFCCC guidelines for grid emissions.

Exhibit 4: Direct CO_2 Emission Reductions during Project in Yancheng due to Additional EVs that are purchased due to the Project only

Type of vehicle	Number of vehicles in category	Baseline - ICEV case: Emissions of all vehicles over 2 years (t CO_2)	Alternative - EV case: Emissions of all vehicles over 2 years (t CO_2)	Emission reduction over 2 years for all vehicles (t CO_2)
Truck	400	7,177.7	5,058.4	2,119.3
Taxi	50	1,595.1	1,259.0	336.1
Bus	0	0	0	0
Fleet sedan	70	1,004.9	793.2	211.7
Rental or car sharing sedan	140	2,009.8	1,586.3	423.5
Total	660	11,787.4	8,696.9	**3,090.6**

Part 2: Yancheng GHG emission reductions due to replacing standard East China Grid based power with RE from Yancheng's pilot EV-RE micro-grids: To estimate direct GHG emission reductions by replacing East China Grid power with EV-RE micro-grids in Yancheng, we first estimate the total RE from these micro-grids that is *newly* used in Yancheng in place of what would have been East China Grid based power. This *newly* used micro-grid RE power is mainly to be used by EVs, though in the case of the Aoxin micro-grid, a minority portion of the total power generated might be used by a building. Estimates of total East China Grid power replaced by RE for each of the two Yancheng micro-grids are based largely on the reasoning presented in Annex E, which describes the project pilots, and summarized in Exhibit 5 below. Exhibit 6 summarizes key data used to estimate emissions reductions achieved via the micro-grids in the alternative scenario. The exhibit also calculates the CO_2 emissions that would have been created by the East China Grid based power replaced, thus providing an estimate of emission reductions achieved via the RE micro-grids of 1,058.9 tons of CO_2 over two years.

Exhibit 5: Yancheng East China Grid (mainly fossil fuel) based Power Newly Replaced with RE Micro-Grid Power in the Alternative Scenario

Aoxin Micro-Grid Replacement of East China Grid Power with RE, Mainly for EVs

- Expected annual micro-grid RE power generated: 500kW * 1,200h= 600,000 kWh (method of calculation: 500kW PV to be installed. PV panels are assumed to work for the equivalent of 1,200 hours per year at maximum power output.)
- Expected annual total power demand of the 80 EVs associated with the Aoxin micro-grid and the three mobile charging station vehicles: 741,096 kWh. Thus, as this demand is higher than the total RE power generated. It is expected most RE power will go towards these two purpose. Yet, some may at times, be used to power the building in the load. As the replacement of grid power with RE power is being compared, the end use does not need to be considered in the calculations.
- Expected East China Grid power replaced over two years: 1,200,000 kWh (=2*600,000 kWh)

Goldwind Micro-Grid Portion *Newly* Replacing East China Grid Power with RE, Mainly for EVs

- Goldwind Micro-Grid existed prior to the project. Of total estimated 4,130,000 kWh generated annually, about 92% is sold to the neighboring manufacturing facility for use in production. Some of the remaining excess is used to power Goldwind's facility at the micro-grid site.
- As the micro-grid presently has some excess RE power, the amount of *newly* replaced East China Grid power with micro-grid RE will be that portion of RE used by the EVs. Expected annual RE power used to charge EVs in the Goldwind micro-grid is estimated at: 69,350 kWh (method of calculation: (15kWh * 6 sedans + 25kWh * 4 trucks) * 365 days = 69,350kWh, accounting for 1.68 percent of the total generation)
- Expected East China Grid power newly replaced by RE charging of EVs over two years: 138,700 kWh = (2*69,350 kWh)

Exhibit 6: Key Data for Estimating and Estimates of Yancheng Direct GHG Emission Reductions via Pilot Micro-Grid RE Replacement of East China Grid Power in Alternative Scenario (Mostly Used for EVs)

Micro-grid	Amount of East China Grid Power Replaced over 2 years	Emission factor of East China Grid (t CO_2 / MWh)	Emission Reduction over 2 years for micro-grid RE replacement of East China grid power (t CO_2)
Aoxin Micro-Grid	1,200 MWh	0.791	949.2
Goldwind Micro-Grid	138.7 MWh	0.791	109.7
Total	**1,338.7 MWh**	**0.791**	**1,058.9**

Part 3: Yancheng direct GHG emission reductions due to replacing standard East China Grid based power used to power EVs with previously discarded large-scale wind power via smart charging: Exhibit 7 below provides estimates of the total shift in power consumption potentially achievable via smart charging in Yancheng. If this shift is achieved as desired, it could enable the use of currently wasted wind power in Yancheng at the time of day (or night) that the wind blows. The magnitude of smart charging is significant as Yancheng plans to install 1,000 smart charging poles to match an equal number of vehicles. The total shift over two years is estimated to be 17,885 MWh. Exhibit 8 estimates total direct GHG emission reductions that may be achieved by this shift, assuming the shift enables use of previously discarded wind power. The total estimated reduction is 14,147 tons CO_2.

Exhibit 7. Grid-Connected Smart Charging in Yancheng – Power Consumption

Vehicle Type	Number of vehicles	Smart charging load per vehicle	Sum of smart charge load for all vehicles in category	Smart charging per day per vehicle	Total smart charging per day summed for all vehicles in category	Total smart charging for all vehicles in category for duration of demo (e.g. 2 years)
Truck	700	7 kW	4,900 kW	25 kWh	17,500 kWh	12,775 MWh
Taxi	50	7 kW*	350 kW	38 kWh	1,900 kWh	1,387 MWh
Bus	10	60 kW	600 kW	150 kWh	1,500 kWh	1,095 MWh
Fleet sedan	100	3.3 kW	330 kW	15 kWh	1,500 kWh	1,095 MWh
Rental or car sharing sedan	140	3.3 kW	462 kW	15 kWh	2,100 kWh	1,533 MWh
Total	**1,000**	**---**	**6,642 kW**	**---**	**24,500 kWh**	**17,885 MWh**

*Note: Taxis will have a larger average load than other sedans, as fast charging will is likely to be used in the case of taxis, but not other sedans.

Exhibit 8: Estimate of Direct CO_2 Emission Reductions Achieved in Yancheng via Smart Charging Shift of EV Load to Use Currently Wasted Large Scale Wind Power

Demo	Total electric energy drawn from grid that is shifted to optimal time over two years via smart charging of EVs	Emission factor of East China Grid (t CO_2 / MWh)	Emission Reduction over 2 years for RE replacement of grid power (t CO_2)
Yancheng Smart Charging Pilot(1,000 smart charging poles and 1,000 vehicles)	17,885 MWh	0.791 to CO_2/ MWh	14,147.0 t CO_2

Combining of the three sources of direct GHG emission reductions in Yancheng during project: Combining (1) direct emissions reductions achieved via replacement of ICEVs as compared to the business-as-usual case with East

China Grid powered EVs; (2) emission reductions due to replacement of East China Grid based power with micro-grid RE (mainly for EV charging); and (3) direct emission reductions due to use of previously wasted large-scale wind power for EV charging via smart charging over the project's last two years results in the following CO_2 emission reductions:

Direct emission reductions achieved via Yancheng Demo during project = **18,296.5 tons CO_2** = 3,090.6 tons (ICEV replacement) + 1,058.9 tons (RE micro-grid) + 14,147.0 tons (smart charging)

Direct emission reductions in Yancheng achieved after project and total direct emission reductions (during and after project): As a rough estimate, it is assumes that the EVs, PV panels, smart charging infrastructure, etc. in the Yancheng demo have a lifetime of about 18 years. (EVs may require battery replacement during this period, but it is assumed, given the value of the EVs, that project partners carry out such replacement in a timely fashion.) Thus, it is assumed these various types of equipment, if operated for two years during the lifetime of the project, will have an additional life beyond the project of 16 years. Thus:

Direct emission reductions achieved in Yancheng demo after project = 8 x emission reductions achieved during project = 8 x 18,296.5 tons CO_2 = **146,372 tons CO_2**

Total direct emission reductions achieved via Yancheng demos (both during and after project) = 18,296.5 tons CO_2 (during project) + 146,372 tons CO_2 (after project) = **164,668.5 tons CO_2**

2. Direct GHG Emission Reductions of Shanghai Demo

In this section, estimate are made of the GHG emission reductions of the Shanghai Demo that occur as a direct result of activities included in the project framework. For ease of calculation, estimates are divided into two parts. The first part, representing direct emission reductions in replacing ICEVs with EVs beyond the business as usual case, considers only those EVs that would not have been purchased had there been no project. The second part represents direct emission reductions achieved by replacing East China Grid based power (mainly used for EVs, but some used for a building) with RE power via the project's 10 EV-RE micro-grids in Shanghai.

Part 1: Shanghai GHG emission reductions due to purchase of EVs that would not have been purchased in absence of project: This subsection computes Shanghai International Auto City (SIAC) GHG emission reductions due to the purchase of EVs that would not have been purchased in the absence of the project. As background, Exhibit 9 provides information on the SIAC EV fleet size prior to the project, the number of EVs of each type expected to be added to the Shanghai fleet in the business-as-usual case, the number of EVs of each type that will be added due to the influence of the project, and the total number of EVs to participate in the Shanghai demo. Because SIAC has a plan for gradually introducing its newly purchased EVs over the years 2017, 2018, and 2019, a column is allocated for each year. In that column, the first number is the total number of vehicles of each type to be added that year. The second number (which is also the first number in parenthesis) indicates the number of vehicles that would be added in the business-as-usual case. The third number (which is also the second number in parenthesis) indicates the number of vehicles added due to the influence of the project.

To calculate the emissions reductions achieved during the project in Shanghai by putting more SIAC EVs on the road than in the business-as-usual case, the number of vehicles added under the influence of the project each year of each type are taken from Exhibit 9 and comparison of the GHG emissions in the baseline case (ICEVs used) to those in the alternative scenario (EVs used) is carried out. As the first step in this comparison, the number of vehicles added each year and of each type that become EVs only in the alternative scenario are incorporated into the second column of each of Exhibit 10 and Exhibit 11. Exhibit 10 then shows calculations for CO_2 emissions for this group in the ICEV case; and Exhibit 11 shows calculations for CO_2 emissions in the case of EVs powered by the East China grid. The gaps between the CO_2 emissions calculated in the ICEV case and the EV case are computed in Exhibit 12. Results show that, over the three years of phasing in a subset of EVs that are purchased only in the alternative scenario, total direct CO_2 emission reductions achieved are 6,805.4 tons. The methodology used for the Shanghai case, in which EVs are phased in with three tranches (in the first, second, and third years of the project, respectively), is somewhat different than that used for Yancheng, in which the targeted new EVs are anticipated to be put into service as a group at the beginning of the second year of the project.

Exhibit 9: Breakdown of EVs to be Used in Shanghai Demo, including Current Fleet and Annual Additions, Broken down into Business-as-Usual Expected Additions and Additions due to Influence of Project*

		Now (end of Aug. 2016)	Total to add in 2017† (BAU, influence of project)	Total to add in 2018 (BAU, influence of project)	Total to add in 2019 (BAU, influence of project)	Total at end of project
Vehicles	**Passenger cars**	1,600	4,400 (1,000, 3,400)	1,000 (500, 500)	1,000 (500,500)	8,000
	E-buses	50	100 (0,100)	25 (0, 25)	25 (0,25)	200
	Total EVs	1,620	4,500 (1,000, 3,500)	1,025 (500, 525)	1,025 (500,525)	8,200

*First number in each parenthesis is the number of vehicles added beyond business-as-usual due to the stimulation of the project. The second number in each parenthesis is the number of vehicles added in the business-as-usual scenario.
†Will include vehicles added between Sept. 2016 and end of 2017, as those added at the end of 2016 will be co-financed and added in preparation for the project.

Exhibit 10: Baseline CO_2 Emissions during Project of ICEVs in Shanghai that would not have been replaced by EVs in Baseline Scenario

Vehicle Type	Number of vehicles added due to influence of the project	Typical fuel consumption (L/ 100 km) / fuel type	km per day per vehicle*	Fuel use per year (all vehicles in group) (L) †	Emission factor for fuel (kg CO_2/L)	Emissions for 3 years (2017 vehicles); for 2 years (2018 vehicles); for 1 year (2019 vehicles) (t CO_2)
cars in 2017	1,000	10/ gas.	90	3,120,750	2.3	21,533.2
buses in 2017	0	30/ diesel	96	0	2.63	0
Total 2017	**1,000**	---	---	---	---	**21,533.2**
cars 2018	500	10/ gasoline	90	1,560,375	2.3	7,177.7
buses 2018	0	30 / diesel	96	0	2.63	0
Total 2018	**500**	----	----	---	---	**7,177.7**
cars 2019	500	10/ gasoline	90	1,560,375	2.3	3,588.9
buses 2019	0	30/ diesel	96	0	2.63	0
Total 2019	**500**	---	---	---	---	**3,588.9**
Total 2017-2019	**2,000**	---	--	---	---	**32,299.8**

*km per day per vehicle is based on SIAC's experience to date with e-car hourly rental and e-bus rental, respectively.
†95% uptime is assumed in calculating km per year.

Exhibit 11: East China Grid Based CO_2 Emissions during Project of EVs in Shanghai that Replace ICEVs only in the Alternative Scenario

Type of EV	Number	Energy use of vehicle (kWh/ 100 km)*	km per day per vehicle	Direct electricity use for all vehicles per year† (MWh/y)	Typical distribution losses for uncoordinated charging (%)	Total electricity use per year (all vehicles in category) (MWh/y)	Emission factor of East China Grid‡ (t CO_2 / MWh)	Emissions for 3 years (2017), 2 years (2018), 1 year (2019) (t CO_2)
e-cars 2017	1,000	22.4	90	6,990.5	2.4%	7,162.4	0.791	16,996.4
e-buses 2017	0	120	96	0	2.4%	0	0.791	0.0
Total 2017	**1,000**	---	---	---	2.4%	---	0.791	**16,996.4**
e-cars 2018	500	22.4	90	3,495.2	2.4%	3,581.1	0.791	5,665.3
e-buses 2018	0	120	96	0	2.4%	0	0.791	0
Total 2018	**500**	---	----	---	2.4%	---	0.791	**5,665.3**
e-cars 2019	500	22.4	90	3,495.2	2.4%	3,581.1	0.791	2,832.7
e-buses 2019	0	120	96	0	2.4%	0	0.791	0
Total 2019	**500**	----	---	---	2.4%	---	0.791	**2,832.7**
Total 2017-2019	**2,000**	---	--	---	2.4%	---	0.791	**25,494.4**

* Data from fuel consumption test program by SAE China in 2013-14 for trucks and buses.
Typical consumption for cars is obtained for the EV (Nissan Leaf) and PHEV (GM Chevrolet Volt) as reported by US DOE of 0.36 kWh/mile (22.4kWh/100km) at http://www.afdc.energy.gov/vehicles/electric_emissions_sources.html accessed in August 2016.
†Assumes 95% uptime.
‡The emission factors of the East China Grid are combined as 75% of the Operating Margin + 25% Built Margin as indicated by the UNFCCC guidelines for grid emissions.

Exhibit 12: Direct CO_2 Emission Reductions in Shanghai during Project due to Additional EVs that are purchased due to the Project only

Type of vehicle	Number of vehicles in category	Baseline - ICEV case: Emissions of all vehicles over 3, 2 or 1 years (t CO_2)	Alternative - EV case: Emissions of all vehicles over 3, 2 or 1 years (t CO_2)	Emission reduction over 3, 2, or 1 years for all vehicles (t CO_2)
e-cars 2017	1,000	21,533.2	16,996.4	4,536.80
e-buses 2017	0	0	0.0	0.00

Total 2017	**1,000**	**21,533.2**	**16,996.4**	4,536.80
e-cars 2018	500	7,177.7	5,665.3	1,512.40
e-buses 2018	0	0	0	0.00
Total 2018	**500**	**7,177.7**	**5,665.3**	1,512.40
e-cars 2019	500	3,588.9	2,832.7	756.20
e-buses 2019	0	0	0	0.00
Total 2019	**500**	**3,588.9**	**2,832.7**	756.20
Total 2017-2019	**2,000**	**32,299.8**	**25,494.4**	6,805.40

Part 2: Shanghai direct GHG emission reductions achieved by replacing standard East China Grid power with RE in EV-RE micro-grids: To estimate direct GHG emission reductions achieved by replacing East China Grid power (used mostly to charge EVs) with micro-grid RE power in Shanghai, first, estimates are made of the total RE from the ten micro-grids that will be newly used in Shanghai. This power is mainly used by EVs or batteries that will eventually recharge EVs, though one of the ten micro-grids will also provide RE power to the SIAC office building if/ when it has excess power. Estimates of total East China Grid power replaced by RE for each micro-grid are based largely on reasoning presented in Annex E, which describes the project demos. Relevant points are summarized in Exhibit 13 below. Then, Exhibit 14 summarizes key data used to estimate GHG emissions reductions achieved in the alternative scenario where the RE mini-grids are set up. It calculates the CO_2 emissions that would have been created by the East China Grid based power, thus providing an estimate of emission reductions achieved via the RE micro-grids of 526.6 tons of CO_2 over two years. The time period of two years is used based on the assumption that it takes the first year of the three-year project to get the RE micro-grids up and running.

Exhibit 13: Shanghai East China Grid based Power Newly Replaced with Micro-Grid based RE in the Alternative Scenario

Shanghai Replacement of East China Grid Power with RE in 20 Micro-Grids, Mainly Used for EVs
• Expected annual RE power generated by the 10 planned Shanghai EV-RE micro-grids: 332,880 kWh (method of calculation: 24 kW per micro-grid x 1,387 h/year x 10 micro-grids. The average generation power of each micro-grid is 24 kW; and the average equivalent sunshine duration per year assuming maximum output is 1,387 h.) • Expected annual RE power used to charge EVs: 312,000 kWh (accounting for about 93.7% of the RE generation, method: about 10 kWh per day per vehicle * 90 vehicles charging at RE charging stations per day * 95% uptime of vehicles * 365 days/ year = 312,075 kWh per year) • Expected annual RE power used for SIAC building or other loads: 20,971 kWh (accounting for the remaining roughly 6.3% of the RE generation) • Expected East China Grid power replaced over two years: 665,760 kWh (=2 y x 332,880 kWh/y)

Exhibit 14: Key Data for and Estimates of Shanghai Emission Reductions Achieved via Micro-Grid RE Replacement of East China Grid Power in Alternative Scenario (Mostly used for EVs)

Micro-grid	Amount of East China Grid Power Replaced over 2 years	Emission factor of East China Grid (t CO_2 / MWh)	Emission Reduction over 2 years for RE replacement of grid power (t CO_2)
10 SIAC EV-RE micro-grids	665.8 MWh	0.791	526.6

Combining the two sources of direct GHG emission reductions in Shanghai during project: Combining: (1) emissions reductions achieved via replacement of ICEVs as compared to the business-as-usual case, phased in over the three years of the project; and (2) emission reductions due to replacement of East China Grid based power with micro-grid RE (mainly for EV charging) over the last two years of the project yields:

Direct GHG emission reductions achieved via Shanghai Pilot during project = **7,332 tons CO_2** = 6,805.4 tons + 526.6 tons

Direct GHG emission reductions in Shanghai achieved after project and total direct emission reductions (during and after project): As a rough estimate, it is assumed the EVs and PV panels each have a lifetime of about 18 years. (This assumes project partners replace EV batteries during this lifetime as needed.) As the EVs purchased beyond the business as usual case are put into service over three years in annual tranches, the calculations will be slightly different for each tranche. Referring back to Exhibit 12:

- For the 2017 tranche of vehicles, the annual benefit of using EVs instead of ICEVs is 4,536.8÷3 or 1,512.3 tons CO_2 per year.
- For the 2018 tranche of vehicles, the annual benefit of using EVs instead of ICEVs is 1,512.4÷2 or 756.2 tons of CO_2 per year.
- For the 2019 tranche of vehicles, the benefit of using EVs instead of ICEVs is 756.2 tons of CO_2 per year.
- Thus, assuming each tranche lasts 18 years, the total CO_2 emission reductions associated with beyond business as usual EVs replacing ICEVs, during and after the project, is (1,512.3+756.2+756.2)*18 = 54,444.6
- And, the portion of CO_2 emission reductions after the project due to beyond business-as-usual replacement of ICEVs with EVs is: 54,444.6 – 6,805.4 = 47,639.2 tons CO_2.

Thus, considering both (1) ICEV replacement with EVs beyond business as usual and (2) replacement of East China Grid power with RE power from Shanghai's 10 EV-RE micro-grids yields the following:

Direct emission reductions achieved in Shanghai demo after project = 47,639.2 tons CO_2 + 8 x emission reductions achieved during project via RE = 47,639.2 tons CO_2 + 8 x 526.6 tons CO_2 = **51,852.0 tons CO_2**

Total direct emission reductions achieved via Shanghai demos (both during and after project) = 54,444.6 + (9x526.6) = **59,184.0 tons CO_2**

3. Total Direct GHG Emission Reductions (Yancheng + Shanghai)

Referring to the above results for the Yancheng and Shanghai demos, total direct emission reductions for the project are:

Total direct emission reductions during project = 18,296.5 (Yancheng) + 7,332.0 (Shanghai) = **25,628.5 tons CO_2**.

Total direct emission reductions after project = 146,372.0 (Yancheng) + 51,852.0 (Shanghai) = **198,224.0 tons CO_2**

Total direct emission reductions (both during and after project) = 164,668.5 (Yancheng) + 59,184.0 (Shanghai) = **223,852.5 tons CO_2**

4. Indirect GHG Emission Reductions of Project

Bottom up Indirect GHG Emission Reductions Estimate

As mentioned, the bottom up emission reductions estimate is the more conservative estimate of emission reductions not tied directly to the project. For this conservative estimate, it is assumed that the project, which has demos in two cities, achieves replication in six other cities at similar scale and also achieves replication in each of the original two cities at double original scale (thus realizing a tripling of original scale in the demo cities). It is further assumed that the replication vehicles, related RE micro-grids, and other aspects of replication are put in place in year three of the project and have a similar lifetime of 18 years as estimated in the case of the demos. As Shanghai and Yancheng have different direct emission reductions, the annual average per city is taken and then multiplied by ten times to get the result in the first year of replication, which will be the last year of the project. The ten times figure includes the six new cities and replications double the size of the original demos in each of the two demo cities. Related calculations are given below.

Indirect GHG emission reductions (bottom up) during project: Total direct emission reductions for the two cities (over 18 years) are 223,852.5 tons CO_2, which are an average of 111,926.3 tons per city and an average of 6,218.1 tons per city per year. As such, assuming ten times replication of the per city average annual emission reductions (or five times replication of the two city pilots' annual reductions in aggregate), and all taking place in the last year of the project, indirect GHG emission reductions (bottom up) are **62,181.3 tons** during the project.

Indirect GHG emission reductions (bottom up) after project: If it assumed that the replications complete only one year of operation during the last year of the project and have an 18 year lifetime, then the indirect emission reductions after the project will be 17 times those before completion, or 853,740 tons CO_2. Thus, indirect emission reductions (bottom up) after project completion are estimated at **1,057,082.1 tons** CO_2.

Total indirect GHG emission reductions (bottom up): Total indirect emissions reductions (including both during and after the project) are the sum of the foregoing two items, 62,181.3 + 1,057,082.1. Thus, total indirect emission reductions (bottom up approach) are **1,119,263.4 tons** CO_2.

Top down Indirect GHG Emission Reductions Estimate

The top down approach to the indirect emissions reductions estimate adopts a market scale approach to estimating total GHG reductions due to the indirect impacts of the project in stimulating EV-RE integration. The top down approach is defined such that all relevant equipment for EV-RE integration installed in the ten years following the project is considered. And, estimates will cover the lifetime GHG emission reductions for that equipment once installed. Lastly, since part of the market scale of EV-RE integration achieved may be due to factors other than the project, a "causality factor" is used to indicate the proportion of the market in which causation may be attributed to the project. As EV-RE integration is essentially an untapped market in China and as the project will be working at a high level to influence government policy, as well as at the local level to demonstrate actual implementation of smart charging and RE micro-grids, a high level of causality (80 percent) is applied.

To simplify calculations, a market growth approach building from the baseline level of the project pilots will be adopted. Given the newness of EV-RE integration in China, the scale-up from a virtually non-existent market, and high expected government support for initiatives once successful demonstration is achieved, a substantial market growth rate of 20 percent annually is assumed. That is, it is assumed that, following the project's close, the installation of new EV-RE equipment in the first year (and thus related GHG emission reductions) is 120 percent the annual average for the last two years of the project. In the second year after project close, the installation scale is assumed to be 120 percent of the first year after project close, and so on. In addition, it is assumed the equipment has a lifetime of 18 years and provides GHG emission reductions for this full period. The installation of new EV-RE equipment includes EV-RE micro-grids (that achieve emission reductions via replacement of standard grid power with RE), smart charging (that allows in certain cities excess, previously wasted RE to be utilized, thus replacing standard grid power with RE), and adoption of EVs to an extent greater than would be achieved otherwise (thus replacing ICEVs and use of liquid fossil fuels with grid based power). For the last category (adoption of EVs), to simply calculations, estimates start from a base not of the whole EV market, but of that small portion assumed in the demos to be adopted expressly because of the EV-RE integration initiatives.
Clearly, if the base of the whole EV market were to be used, the calculations would need to make use of a much lower causality factor, as China's EV market is already substantial in scale at the time of start of this project.

Exhibit 15 shows the annual increase in market size for installation of EV-RE related equipment during the ten years directly following the project, as well as the multiplicative factor that can be used on the average annual scale in the last two years of the demos to get the respective post-project year's market scale. For the first year, the factor is 120 percent. For simplification, this factor is multiplied by the average annual GHG emission reductions achieved in the last two years of the project to get the annual GHG emissions reduction due to newly installed equipment in year one after project close, and so on. One technical note is that, because the methodology for Shanghai includes some benefits achieved in the first year of the project rather than only the last two years, some adjustment is needed. Benefits from the first year are subtracted based on the result of dividing the benefits from the beyond business as usual 2017 tranche of EVs (see Exhibit 12) by three. That is:

Average annual direct GHG emission reduction benefits in the last two years of the project = [Total direct GHG emission reduction benefits during the project – benefits achieved during the first year of the project in Shanghai] ÷ 2 = [25,628.5 tons CO_2 – (4,536.8 tons CO_2)/3] ÷ 2 years = 12,058.1 tons CO_2/ year.

Exhibit 15: Assumptions and Calculations for Top-Down Approach to Indirect GHG Emission Reductions of Project

Year	Increase in amount of EV-RE equipment installed as compared to previous year	Multiplicative factor for scale-up of market as compared to annual average of project demo's installed EV-RE equipment during last two years of project	One year of GHG emission reductions for EV-RE equipment installed in the year in tons of CO_2/ year (base is 12,058.1 tons)	GHG emission reductions for full lifetime of EV-RE equipment installed in year in tons of CO_2 (18 year lifetime assumed)
2020	20%*	1.20	14,469.7	260,454.6
2021	20%	$(1.20)^2 = 1.440$	17,363.7	312,546.6
2022	20%	$(1.20)^3 = 1.728$	20,836.4	375,055.2
2023	20%	$(1.20)^4 = 2.074$	25,003.7	450,066.6
2024	20%	$(1.20)^5 = 2.488$	30,004.4	540,079.2
2025	20%	$(1.20)^6 = 2.986$	36,005.3	648,095.4
2026	20%	$(1.20)^7 = 3.583$	43,206.4	777,715.2
2027	20%	$(1.20)^8 = 4.300$	51,848.6	933,274.8
2028	20%	$(1.20)^9 = 5.160$	62,217.1	1,119,908
2029	20%	$(1.20)^{10} = 6.192$	74,660.6	1,343,891
Total	---	---	----	**6,761,086**

Thus, the total of the top-down indirect emission reductions are computed as:

Total top-down indirect GHG emission reductions = causality factor x total from Exhibit 15 = 0.80 x 6,761,086 tons CO_2 = **5,408,868.8 tons CO_2**

5. Summary of GHG Emission Reductions Computed for China EV-RE Project

Exhibit 16 summarizes the key results of the foregoing analysis, including direct emission reductions both during and after the project for the two demo cities, and including results for the bottom-up calculation of indirect emission benefits and the top-down calculation of the same.

Exhibit 16: Summary of GHG Emission Reductions for China EV-RE Project

<table>
<tr><th colspan="9">Direct GHG Emission Reductions (tons CO_2)</th></tr>
<tr><th colspan="5">During Project</th><th colspan="2">After Project</th><th colspan="2">Total (During and After Project)</th></tr>
<tr><td colspan="3">Yancheng</td><td colspan="2">Shanghai</td><td rowspan="2">Yancheng</td><td rowspan="2">Shanghai</td><td rowspan="2">Yancheng</td><td rowspan="2">Shanghai</td></tr>
<tr><td>A*</td><td>B†</td><td>C‡</td><td>A</td><td>B</td></tr>
<tr><td>3,090.6</td><td>1,058.9</td><td>14,147.0</td><td>6,805.4</td><td>526.6</td><td>146,372</td><td>51,852.0</td><td>164,668.5</td><td>59,184.0</td></tr>
<tr><td colspan="5">Total for the Two Demo Cities</td><td colspan="2" rowspan="5">Total for the Two Demo Cities</td><td colspan="2" rowspan="5">Total for the Two Demo Cities</td></tr>
<tr><td colspan="2">A</td><td>B</td><td colspan="2">C</td></tr>
<tr><td colspan="2">9,896.0</td><td>1,585.5</td><td colspan="2">14,147.0</td></tr>
<tr><td colspan="5">Total</td></tr>
<tr></tr>
<tr><td colspan="5">25,628.5 tons CO_2</td><td colspan="2">198,224.0 tons CO_2</td><td colspan="2">223,852.5 tons CO_2</td></tr>
<tr><td colspan="9">Notes: EV-RE equipment is assumed to have 18 year lifetime. Most EV-RE equipment is assumed to be installed/ put in place at the beginning of the second year of the project and operate for two years during the project and 16 years after. The exception are EVs in Shanghai that are beyond the business as usual case in number. These are assumed to be put in place in tranches: one tranche in 2017, one in 2018, and one in 2019. Lifetime of these EVs post project is adjusted based on when they were put in place.</td></tr>
<tr><th colspan="9">Indirect GHG Emission Reductions (tons CO_2) – Bottom-up Approach</th></tr>
<tr><th colspan="5">During Project</th><th colspan="2">After Project</th><th colspan="2">Total (During and After Project)</th></tr>
<tr><td colspan="5">62,181.3 tons CO_2</td><td colspan="2">1,057,082.1 tons CO_2</td><td colspan="2">1,119,263.4 tons CO_2</td></tr>
<tr><td colspan="9">Notes: Replication of demos in 6 other cities on scale similar to the average scale per city of the project demos is assumed. Further, replication in the two demo cities (Shanghai and Yancheng) at a scale two times their original scale is assumed. In both cases, replication is assumed to initiate operation in year 3 of project. Further, a total lifetime of replicated installations of 18 years is assumed, so that operation extends 17 years after closure of project.</td></tr>
<tr><th colspan="9">Indirect GHG Emission Reductions (tons CO_2) – Top-down Approach</th></tr>
<tr><td colspan="9">Total: 5,408,868.8 tons CO_2</td></tr>
<tr><td colspan="9">Notes: Estimate based on emission reductions from equipment installed in each of 10 the years following project close. Assumed lifetime of equipment installed each year is 18 years. Annual installation of EV-RE equipment is computed from the base of amount of operational equipment in two project demos in last two years of project (divided by 2) combined with annual growth. Annual growth rate used is 20 percent. Causality factor of 80% applied to results, as the EV-RE market is a completely new one in China; and the project is thus likely to play a strong role in growth of the market during the ten years following the project.</td></tr>
</table>

*A refers to emission reductions achieved from replacing ICEVs with EVs (beyond the business-as-usual case) that use East China Grid power.

†B refers to emission reductions achieved by replacing East China Grid power with RE micro-grid power, mainly to power EVs.

‡C refers to emission reductions achieved by smart charging that enables the replacement of East China Grid power with large-scale grid connected renewable energy power that previously was wasted.

ANNEX G: PROJECT BUDGET

	Budget	Budget Phasing		
Annual budget planning (figures in USD)	GEF	Year 1	Year 2	Year 3
Component 1: Policies and Programs				
1.1. National-level policy instruments for the integration of electric vehicles (EVs) with RE are recommended to government agencies for their consideration	686,820	228,940	228,940	228,940
1.2. Technical standards and specifications facilitating EV-RE integration and scale up, including those for smart charging systems, vehicle to grid (V2G) systems, mobile charging systems, and use of retired EV batteries are issued	396,760	132,253	132,253	132,253
1.3. Analysis of carbon policies to promote a higher adoption of renewable energy (RE) in the grids supplying electricity to power NEVs; to be proposed to Government agencies for adoption	150,800	50,267	50,267	50,267
1.4. City-level RE-EV integration and scale up plans, including replication plans for the adoption of best models demonstrated in Shanghai and Yancheng are proposed to city governments	159,980	53,327	53,327	53,327
1.5: an institutional plan establishing responsibilities of and coordination among various government organizations for EV-RE integration is proposed	80,640	26,880	26,880	26,880
Subtotal Component 1	1,475,000	491,667	491,667	491,667
Component 2: Institutional Capacity Building				
2.1. Training programmes for 100 city-level policy makers on EV-RE integration policies and demonstration experience are given	182000	60,667	60,667	60,667
2.2. Four workshops to validate the EV-RE integration policy and planning framework are conducted	166800	55,600	55,600	55,600
2.3. Two international forums between national and regional government agencies are organize to disseminate international developments in EV-RE integration	185800	61,933	61,933	61,933
2.4. Dissemination materials on EV-RE integration are strategically distributed to policymakers	345400	115,133	115,133	115,133
Subtotal Component 2	880,000	293,333	293,333	293,333
Component 3: Piloting of Technical Measures and Commercialization Approaches				
3.1. The demonstration of integration of EVs with the power grid, needed as basis for EVs eventually to address intermittency issues of large-scale RE power incorporation into the grid	1,241,800	413,933	413,933	413,933
3.2. Demonstration of technically and commercially effective RE micro-grids that enable distributed integration of EVs with RE	1,195,900	398,633	398,633	398,633

Annual budget planning (figures in USD)	GEF	Year 1	Year 2	Year 3
3.3: Demonstration of conditions and business models that can stimulate scale-up of China's EV fleet, thus laying the ground work to realize the benefits of EV-RE integration on substantial scale	207,700	69,233	69,233	69,233
3.4: Demonstration of energy management centers that collect and manage data on dispersed EVs and retired EV battery packs used as storage for the grid, so that the charge and discharge of these devices can be managed	722,300	240,767	240,767	240,767
3.5. Detailed monitoring and evaluation of project demo performance, providing insights to city planners for developing EV-RE demonstration plans for their cities	1,462,300	487,433	487,433	487,433
Subtotal Component 3	4,830,000	1,609,999	1,609,999	1,609,999
Component 4: Awareness Raising and Dissemination amongst Manufacturers, Suppliers and Consumers				
4.1. Dissemination of knowledge amongst industry players (vehicle manufacturers, charging equipment providers, power industry, and other relevant sectors) regarding EV-RE integration	617,600	205,867	205,867	205,867
4.2. Awareness raised among current and future potential car sharing companies of various car sharing business models and integration of EVs with RE in car sharing businesses	-	-	-	-
4.3. Promotion of EV-RE integration to the general public by various methods to raise awareness of and interest in EV-RE integration as a means of realizing the true environmental potential of EVs	362,400	120,800	120,800	120,800
4.4. A EV-RE integration demonstration center in Yancheng, is created to raise awareness on the topic of EV-RE integration amongst consumers, companies using EVs, and industries related to RE or EV	20,000	6,667	6,667	6,667
Subtotal Component 4	1,000,000	333,334	333,334	333,334
Component 5: Monitoring and Evaluation (M&E)				
5.1. A project monitoring plan is designed and executed	170,000	56,667	56,667	56,667
5.2. Project mid-term review and terminal evaluation conducted	150,000		50,000	100,000
5.3. Recommendations are determined for long term project sustainability as part of follow-up to actions		-	-	-
Subtotal Component 5	320,000	56,667	106,667	156,667
TOTAL	8,505,000	2,785,010	2,835,010	2,885,010

ANNEX H: WORK PLAN

		Year 1												Year 2												Year 3											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Project Component 1 - Policies and Programs																																					
Project component1 - Policies and Programs	**1.1 Policy instruments**																																				
	1.1A National level roadmap																																				
	1. Research on national level roadmap																																				
	2. One-on-one meetings on the draft roadmap																																				
	3. Submission of the finalized national level roadmap to ministries																																				
	1.1B Policies for balancing the gird load via EVs																																				
	1. Policies, guidelines, and incentives regarding smart charging																																				
	2. Research on the incentives and regulations of energy management centers																																				
	3. Research on electricity price regulation and policy design																																				
	4. Research on incentives of V2G																																				
	5. Government meetings on activities 1.1B.1~1.1B.4																																				

	（1.1C.4&1.1D.3 ）																																				
	1.1C Policies for charging with RE																																				
	1. Design of regulations to manage micro-grids																																				
	2. Design of incentive policies for micro-grids																																				
	3. Design of incentive policies for smart charging																																				
	4. Government meetings on activities 1.1C.1~1.1C.3 （1.1B.5&1.1D3）																																				
	1.1D Policies on retired EV batteries for secondary use																																				
	1. Research on the guidelines of retired EV batteries for secondary use																																				
	2. Research on the incentives of retired EV batteries for secondary use																																				
	3. Government meetings on activities 1.1D.1~1.1D.2 (1.1B.5&1.1C.4）																																				
	1.2 Technical standards and specifications																																				
	1. International workshop on international standards and																																				

	specifications																																				
	2. Research and design of standards and specifications for energy management centers (communication and price)																																				
	3. Research and design of standards and specifications for smart charging systems																																				
	4. Research and design of technical standards and specifications for V2G systems																																				
	5. Research and design of standards for uses of retired EV batteries																																				
	6. Research and design of standards for mobile charging systems																																				
	7. Research and design of safety and technical standards																																				
	8. Meetings on the standards and specifications above																																				
	1.3 National carbon trading policies																																				
	1. Review and assessment of																																				

	international experience and plans																																				
	2. Design of rules for carbon dioxide emission reduction credits (for EV-RE)																																				
	3. Meetings on activity 1.3.2																																				
	1.4 City-level RE-EV integration and scale up plans																																				
	1. Design of EV-RE plans for Shanghai and Yancheng																																				
	2. Discussion and modification of EV-RE plans for Shanghai and Yancheng																																				
	3. Design of EV-RE plans for other cities (including but not limited to demo replication) replication plans for other cities																																				
	4. Discussion and modification of the EV-RE plans for other cities																																				
	1.5 Plan for government coordination																																				
	1. Clarification of the responsibilities of each relevant government agency																																				
	2. Holding of cross-institutional government meetings																																				

Project Component 2 - Institutional Capacity Building																																					
Project Component 2 - Institutional Capacity Building	**2.1 Training program for city-level policy makers**																																				
	1. Preparation of training materials													■	■	■	■	■	■	■	■	■	■	■	■												
	2. Training sessions																			■	■	■	■	■	■	■	■	■	■	■	■						
	2.2 Workshops for policy framework and standards framework																																				
	1. Workshop for the roadmap																			■	■	■	■	■	■												
	2. Workshops to cover the policy framework developed under Outputs 1.1B, 1.1C, and 1.1D and the standards framework developed under Output 1.2													■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	3. Seminar on the carbon trading framework developed under activity 1.3.2																			■	■	■	■	■	■												
	2.3 Two international forums																																				
	1. Study on international EV-RE development and plans	■	■	■	■	■	■	■	■	■	■	■	■																								
	2. Two international forums													■	■	■	■	■	■							■	■	■	■	■	■						
	2.4 Distribution of materials to policy makers																																				
	1. Preparation of briefing materials	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	2. Development and implementation of strategy	■	■	■	■	■	■																														

	3. Preparation of online information base and notebooks																																				
	4. Strategic dissemination of materials prepared under Activity 2.4.3																																				
Project Component 3 - Piloting of Technical Measures and Commercialization Approaches																																					
Project component3 - Piloting of Technical Measures and Commercialization Approaches	**3.1 Demos of interaction of EVs with the power grid**																																				
	1. Design of smart charging system for Shanghai and Yancheng																																				
	2. Testing and implementation of smart charging systems in Yancheng																																				
	3. Testing and implementation of smart charging systems in Shanghai																																				
	3.2 Demos of micro-grids																																				
	3.2A Demos of integration of EVs into RE micro-grids																																				
	1. Micro-grid demo in Yancheng																																				
	2. Micro-grid demo in Shanghai																																				
	3.2B Demos of V2G technologies and pilot commercial systems																																				
	1. Determining the devices of V2G demos in Shanghai and Yancheng																																				
	2. Carrying out V2G trading and control system in Shanghai and																																				

	Yancheng
	3. Carrying out V2G demos with micro-grid in Shanghai and Yancheng
	3.3 Business model demos
	3.3A Demonstration of greater density of the EV stationary charging network
	1. Scale up of stationary charging infrastructure in Shanghai
	3.3B Demos of mobile charging station vehicles
	1. Preparation of plan for mobile charging station vehicles with retired EV batteries
	3.3C Demos of business models
	1. Demo of hourly car sharing business model in Shanghai
	2. Demo of E-bus rental business in Shanghai
	3.4 ICT Energy management centers
	1. Building of ICT Energy management centers in Shanghai and Yancheng
	3.5 Monitoring and evaluation of project demo performance
	3.5A monitoring and assessment of project demos of EV integration with the power grid
	1. Data collection, analysis, and reporting on project

	demos related to EV integration with the power grid																																				
	3.5B Monitoring and assessment of project demos of EV-RE micro-grids																																				
	1. Data collection, analysis, and reporting on project demos related to EV charging via RE micro-grids																																				
	2. Assessment of the impact of V2G on battery life																																				
	3.5C Monitoring and assessment of project demos related to the use of retired EV batteries																																				
	1. Research and assessment of cost structure of EV battery repurposing and design of plans for reducing and minimizing repurposing costs. Incorporation of plans for cost reduction into repurposing work carried out under the demos in Activity 3.2A.1 (Yancheng micro-grids with retired EV batteries for storage), Activity 3.2A.2 (Shanghai micro-grids with retired EV batteries for storage), and																																				

	Activity 3.3B.1 (Yancheng mobile charging vehicles with retired EV batteries for storage).																																				
	2. Data collection, analysis, and reporting on project demos related to use of retired EV batteries.																																				
	3. Building and assessment with a database on retired EV batteries																																				
	4. Preparing of guidelines for retired EV battery refurbishment and maintenance																																				
	5. Technical and economic evaluation of retired EV batteries																																				
	3.5D Monitoring and assessment of scale-up of EV fleet and charging infrastructure																																				
	1. Data collection, analysis, and reporting on project demos related to the scale up of fleet and infrastructure																																				
Project Component 4 - Awareness Raising and Dissemination																																					
- Awareness Raising and	**4.1 Dissemination of knowledge amongst industry players**																																				
	4.1A Forums for industry																																				
	1. Two forums on models,																																				

	technology, and project demo results																																				
	4.1B Dissemination to industry of project's EV-RE information base																																				
	1. Development of a dissemination strategy and establishment of a website																																				
	2. Preparation and targeted distribution of printed materials																																				
	4.1C Meetings publicizing EV-RE related technical standards																																				
	1. Holding of meetings publicizing EV-RE related technical standards																																				
	4.1D Technical operation and maintenance workshops																																				
	1. Holding of technical operation and maintenance workshops																																				
	4.1E Establishment of industry alliance or association subcommittee																																				
	1. Development of strategy for industry alliance or association subcommittee																																				
	2. Setting up and obtaining approval for industry alliance or association subcommittee																																				
	4.2 Awareness raising of car sharing scheme																																				

	1. Workshops on car sharing																																				
	4.3 Increased promotion of EV-RE to consumers																																				
	4.3A Media																																				
	1. Preparation and broadcasting of documentary																																				
	2. Print and online news media outreach																																				
	3. Radio outreach																																				
	4.3B Social organization																																				
	1. Increasing of social attractiveness of EV user clubs in China																																				
	2. Disseminating with other social clubs and organizations																																				
	4.3C Social media platform																																				
	1. Develop a promotion strategy via social media																																				
	2. Implementing of social media strategy from Activity 4.3C.1																																				
	4.4 An EV-RE integration demonstration center in Yancheng																																				
	1. Design and planning of content of the center																																				
	2. Setting up of the center																																				
	3. Development of																																				

	a strategy to attract visitors to the center
Project Component 5 - Monitoring and Evaluation (M&E)	
Project component5 - Monitoring and Evaluation (M&E)	**5.1 Project monitoring plan refined and executed**
	1. Determining the timetable for the full monitoring plan
	2. Data gathering and indicator value updating
	3. Preparation of quarterly reports and annual reports
	4. Periodic monitoring meetings
	5.2 Data and information collected
	1. Survey of city level officials involved in Component 2 outreach program
	2. Survey of companies involved in Component 4 outreach program
	3. Monitoring of safety of construction and operation of charging poles and EV-RE mini-grids

	4. Tracking of EV batteries (or battery backs) involved in project																																				
	5.3 Project mid-term review and terminal evaluation																																				
	1. Project mid-term review (MTR)																																				
	2. Project terminal evaluation (TE)																																				
	5.4 plan for long term project sustainability																																				
	1. Identification of recommendations for sustainability																																				
	2. Consensus on post-project action plan																																				

ANNEX I. CHANGES FROM THE PIF

This annex presents and explains changes in the project framework from that originally proposed in the PIF. As indicated in Section A.1.3 of Part II, strong efforts were made throughout the project design process to honor, to the extent possible, the original design of the PIF. The original PIF objective, components, and outcomes were maintained, aside from minor improvements in wording at times. The project title, which in the PIF submission did not include the term “renewable energy,” has been adjusted to include this term and thus better communicate the focus of the project. During PPG work, allotment of budget among the project outcomes was adjusted some. A detailed activity-wise budget was prepared, estimating costs for each and every activity, to come up with overall outcome budgets. During the PIF phase, this approach was not taken, and instead outcome budget allocations were merely based on rough estimates.

The majority of outputs from the PIF were also maintained, though some of these were adjusted in scope or orientation. During the PPG phase, many experts and industry players participated in logframe analysis work, which was the basis of refinement of the project outputs. Some new outputs arose from this work and follow-up team work, including one that addresses the need for government institutional coordination on EV-RE integration and one that recognizes the need for leveraging the media in building awareness of the public of EV- RE integration. Further, the project design team decided that the project outputs should more tightly adhere to the targeted project objective of facilitating the integration of EVs with RE in China. Thus, efforts were made to ensure that each of the project outputs have a clear link to EV-RE integration, rather than some being related to EVs only. There were also some refinements made to the PIF’s preliminary project demo designs. In particular, Shanghai has added EV-RE mini-grids, to participate more directly in EV-RE integration. Shanghai also added smart charging in order to develop capacity in this area that could one day be important in integrating more renewable energy into the grid.

The six exhibits in this annex give, on an item by item basis, a comparison of the ProDoc and PIF versions of the project framework. In each, the left column shows items as finalized in this ProDoc, while the middle column shows the original PIF version. The right column notes and explains any changes that have been made since the PIF was submitted. Exhibit 1 covers the title, objective, and outcomes, including outcome budget allocations. Exhibits 2 through 6 cover the outputs for each of the project outcomes, respectively.

Exhibit 1: Comparison of ProDoc Framework to PIF – Title, Objective, and Outcomes

ProDoc version	PIF version	Changes and explanation
Title: Integration of Electric Vehicles with Renewable Energy in China	Title: Integrated adoption of New Energy Vehicles in China	Revised title better communicates the focus of the project, which is EV-RE integration, eliminating earlier confusion about the scope of the project among some readers.
Objective: Facilitation and scale-up of the integrated development of electric vehicles (EVs) with renewable energy (RE) in China	Objective: Facilitate and scale up the integrated development of New Energy Vehicles (NEVs) and Renewable Energy (RE) in China.	Minor adjustments in wording only.
Outcome 1: Drafted and recommended policies, technical standards, and guidelines that provide regulatory and planning elements, leading to the higher adoption of EV-RE integration schemes by city governments, vehicle manufacturers, and consumers, thus resulting in GHG emission reductions GEF allocation: USD1.5 million	Outcome 1: Technical standards and guidelines are drafted to provide regulatory elements, leading to higher adoption of NEV schemes by city Governments, vehicle manufacturers and consumers GEF allocation: USD1 million	Minor adjustments in wording and clarification that the focus of all policy work is to promote EV-RE integration. Budget allocation has increased substantially. During the LFA workshop, experts identified much policy related content needed to effectively promote EV-RE integration. At the same time, they found capacity/awareness building for the public and industry (Outcome 4) may have less content than anticipated, as capacity and awareness building work for EVs, RE, and air quality issues have already been extensive in China. Thus, the more limited scope of building capacity and awareness in the specific area of EV-RE integration will require less effort/ funds than previously targeted.
Outcome 2: Increased institutional capabilities and awareness of policymakers at national and local levels on the use of integrated EV - SG (Smart Grid) - RE systems GEF allocation: USD880,000	Outcome 2: The institutional capacities and public awareness of policymakers at national stakeholder on the use of integrated EV-SG(Smart Grid)-RE systems GEF allocation: USD880,000	Minor adjustments in wording and inclusion of "local level" policymakers, who may have inadvertently been omitted at the PIF stage. No change in allocation
Outcome 3: Two city-scale projects piloted, demonstrating the integration of EVs and RE, as well as other foundational work needed to achieve large-scale EV-RE integration	Outcome 3: Two city scale projects are piloted to demonstrate the technology integration (Yancheng) and innovative business models for the promotion of EV	Minor adjustments in wording and clarification that focus are EV-RE integration. As Shanghai will now demonstrate EV-RE integration as well, separate roles for Yancheng and Shanghai are no longer specified.

GEF allocation: USD5,030,500	fleets (Shanghai) GEF allocation: USD4.65 million	 There has been significant overall increase in the allocation for this component, so as to accommodate increased content of the project pilots and associated activities. Both the Shanghai and Yancheng pilots will be more extensive than originally indicated in the PIF. While in the PIF, Shanghai was to focus on car sharing and scale-up, in the full project design it will also carry out smart charging and EV-RE mini-grid demos. As a part of the latter, it will demonstrate retired EV batteries and V2G. Yancheng has increased the number of smart charging posts to be included in its smart charging demo (from 520 in the PIF to 1,000 ProDoc) and will demonstrate two EV-RE mini-grids instead of one. As for activities, monitoring and reporting on the demos, which were not previously included in this component, have been added. In addition to increase in the overall budget for the component, there has been a shift of funds to the investment portion (which has increased) from the TA portion (which has decreased). Originally, the TA portion of the component was made up solely of energy management center work in Shanghai and Yancheng. In the full project design, this work has been fully shifted into the investment portion of the component, thus explaining the shift of budget. Remaining in the TA portion is the monitoring and reporting on the demos, which has been newly added to the component.
Outcome 4: Increased knowledge and capacity of business and consumer stakeholders, facilitating awareness, research and development, manufacture, operation, and maintenance with regard to EV-RE integration GEF allocation: USD1.0 million	Outcome 4: Increased capacities of stakeholders, including awareness, research and development, manufacture, operation, and maintenance GEF allocation: USD1.5 million	Minor adjustments in wording. Clarification of type of stakeholders targeted. Clarification that focuses is EV-RE integration. Allocation reduced. (See explanation for increase in allocation for Outcome 1 above, as the amount of reduction for Outcome 4 has basically been shifted to Outcome 1.)
Outcome 5: A robust mechanism for M&E in place to ensure the attainment of project outcomes	Outcome 5: A robust mechanism for the M&E is put in place to ensure the attainment of project outcomes	Minor adjustment in wording.

GEF allocation: USD114,500	GEF allocation: USD475,000	Exhibit 18 of the ProDoc shows the budget line breakdown for this M&E component. During project design, it was found the main activities falling under M&E (e.g. finalization of M&E plan, inception workshop, measuring of certain project indicators that require surveys or other special activities, mid-term review, terminal evaluation, and follow up plan to terminal evaluation) did not have as high of an aggregate budget as expected. Further, some of these activities (such as preparation of annual reports) will be taken care of under the project management allocation, while others (such as measuring of certain project indicators that require special activities to do so) will be handled by co-financing.

Exhibit 2: Comparison of ProDoc Framework to PIF – Outputs of Outcome 1

Outcome 1: Drafted and recommended policies, technical standards, and guidelines that provide regulatory and planning elements, leading to the higher adoption of EV-RE integration schemes by city governments, vehicle manufacturers, and consumers, thus resulting in GHG emission reductions		
ProDoc version output	**PIF version output**	**Changes and explanation**
Output 1.1: Recommended national-level policy instruments for the integration of electric vehicles (EVs) with RE available to government agencies for their consideration Output 1.1A: National level roadmap to facilitate effective EV-RE integration and scale up that attains consensus among stakeholders Output 1.1B: Suggested policies and framework that promote balancing of grid load with power generated via utilization of EVs, thus providing a foundation for scale up of EV-RE integration Output 1.1C: Proposed national-level policies to regulate and incentivize systems for the charging of EVs with RE, including those integrating either RE micro-grids or grid-based large-scale RE installations	Output 1.1: National Guidelines for the integration of Electric Vehicles (EVs) in the electricity grid are made available to Government agencies for adoption	Adjustments in wording: The term “policy instruments” replaces “national guidelines” to indicate the broader range of policy items identified during the LFA workshop as needed to promote EV-RE integration. Further, it is specified in the adjusted wording that these policy instruments are to address integration of EV with RE, which is the focus of the project. Lastly, given the extensive scope of policy instruments needed, the output is further subdivided into four sub-outputs, one for each of: (1) national-level roadmap on EV-RE integration, (2) policies for balancing grid load with power generation, (3) policies for EV charging with RE, and (4) policies for use of retired EV batteries.

Output 1.1D: Proposed national-level policy instruments to regulate and incentivize use of retired EV batteries, which may play a key role in large-scale EV-RE integration		
Output 1.2: Issuance of technical standards and specifications facilitating EV-RE integration and scale up, including those for smart charging systems, vehicle to grid (V2G) systems, mobile charging systems, and use of retired EV batteries	Output 1.2: Technical standards issued for the integration of EVs in the electricity grid, including those for smart charging systems, vehicles to grid (V2G) connections, mobile charging systems, and secondary uses of EV batteries	Minor adjustments in wording. Clarification that focuses of standards is EV-RE integration.
Output 1.3: Recommendations presented to transport sector authorities for incorporation of incentives for EV charging with RE in transport sector national carbon trading policies, including carbon trading rules for EVs powered by RE, to promote greater adoption of RE in the grids supplying electricity to EVs	Output 1.3: Analysis of domestic and international carbon policies to promote a higher adoption of renewable energy (RE) in the grids supplying electricity to power NEVs; to be proposed to Government agencies for adoption	Adjustments in wording to clarify that the precise nature of this output is, in the end, to provide recommendations for incorporation of incentives for EV charging with RE into transport sector national carbon trading policies.
See Output 3.5	Output 1.4: Monitoring and evaluation of policy performance, through life cycle assessments of the city level pilots; evaluating the technological options social, economic and environmental dimensions	This PIF output has been moved to the demo outcome (Outcome 3) in the ProDoc, as it involves detailed monitoring of the demos. The basic idea of the output has been maintained in the ProDoc. Yet, given the importance of the output, four sub-outputs have been added to clarify the content of the monitoring and evaluation of the demos.
Output 1.4: City-level RE-EV integration and scale up plans, including replication plans for the adoption of best models demonstrated in Shanghai and Yancheng	Output 1.5: Replication plan for the adoption of the proposed policies, allowing other pilot cities to rapidly adopt them	Adjustment in wording to clarify that the city-level replication plans include replication of the project demos and will focus on EV-RE integration.
Output 1.5: Proposed institutional plan to establish responsibilities of and coordination among various government organizations for EV-RE integration	---	New output based on input of experts at the LFA workshop. As EV-RE integration cuts across sectors, the experts see it as critical to the success of EV-RE promotion that various government organizations work together.

Exhibit 3: Comparison of ProDoc Framework to PIF – Outputs of Outcome 2

Outcome 2: Increased institutional capabilities and awareness of policymakers at national and local levels on the use of integrated EV - SG (Smart Grid) - RE systems		
ProDoc version output	**PIF version output**	**Changes and explanation**

Output 2.1: Training program for 100 city-level policy makers on EV-RE integration policies and demonstration experience	Output 2.1: A training programme for 100 policy makers on low carbon technology integration and promotion policies in other countries	Adjustment in wording to clarify the focus on EV-RE integration
Output 2.2: Four workshops conducted to validate the EV-RE integration policy and planning framework	Output 2.2: Four workshops conducted to validate the regulatory framework	Adjustment in wording to clarify the focus on EV-RE integration
Output 2.3: International forums with participants from central government agencies and EV demonstration cities that disseminate international developments in and plans for EV-RE integration	Output 2.3: International forums organized to promote best practices learned in Yancheng and Shanghai with participants from Central Government agencies and EV demonstration cities	Adjustment in wording to clarify the focus on EV-RE integration and that the international forums will disseminate international experience in this area
Output 2.4: Written materials on EV-RE integration strategically disseminated to policy makers	---	New output based on input of experts at the LFA workshop that written materials can be very effective in pushing forward this new area of EV-RE integration. Chinese policy makers desire information and respond well to appropriate written materials. For high level persons, succinct briefing materials are needed. For working level persons, detailed materials that they can "study up on" are appreciated.

Exhibit 4: Comparison of ProDoc Framework to PIF – Outputs of Outcome 3

Outcome 3: Two city-scale projects piloted, demonstrating the integration of EVs and RE, as well as other foundational work needed to achieve large-scale EV-RE integration		
ProDoc version output	**PIF version output**	**Changes and explanation**
Output 3.1: Demonstration of integration of EVs with the power grid, needed as basis for EVs eventually to address intermittency issues of large-scale RE power incorporation into the grid	Output 3.1: Yancheng pilot infrastructure developed: 520 smart charging devices for EVs; 1 static energy storage systems to utilize secondary uses of EV batteries; 10 mobile charging sites; and a dedicated mini grid of 450 KW of wind generation; and vehicle to grid (V2G) system Output 3.2: Yancheng fleet of 1,000 EVs used to test mobile and smart	The outputs for Outcome 3 have been reorganized by content rather than by city. One reason for this is that not only Yancheng, but now also Shanghai, will have demos focusing on smart charging and EV-RE micro-grids. For the ProDoc outputs, the first (3.1) focuses on smart charging; the second (3.2) focuses on EV-RE micro-grids; and the third (3.3) focuses on scale-up (of EVs and charging infrastructure) and business models that will facilitate scale up of EV-RE integration. The new Output 3.1 corresponds roughly with the smart charging aspect of the old Output 3.1 and old Output 3.2,

	charging systems, consisting of 700 trucks, 50 taxis, 10 buses, 100 fleet passenger vehicles and 140 private passenger vehicles (including car rental and car sharing)	except that it will include demos in both Yancheng and Shanghai.
Output 3.2: Demonstration of technically and commercially effective RE micro-grids that enable distributed integration of EVs with RE Output 3.2A: Demonstration of integration of EVs into RE micro-grids, including demonstration of micro-grids incorporating wind, PV, use of retired EV batteries as storage, EVs, and buildings and a manufacturing facility Output 3.2B: Demonstration of V2G technologies and pilot commercial systems enabling EVs (or retired EV battery packs) to send power back to the micro-grid at times that it is needed	*See PIF Output 3.1*	As per the explanation in the above cell, outputs for Outcome 3 have been reorganized by content. The ProDoc Output 3.2 covers EV-RE micro-grids. It is divided into sub-outputs that cover each of the micro-grids generally and V2G in particular. It thus covers those aspects of the PIF Output 3.1. Yet, in the case of the ProDoc, such demos will occur in both Yancheng and Shanghai instead of in Yancheng alone (as indicated in the PIF).
Output 3.3: Demonstration of conditions and business models that can stimulate scale-up of China's EV fleet, thus laying the ground work to realize the benefits of EV-RE integration on substantial scale Output 3.3A: Demonstration of greater density of the EV stationary charging network, thus serving as a basis for scale-up of EV-RE integration Output 3.3B: Demonstration of alternatives to stationary charging stations, in particular mobile charging station vehicles, to deal with emergency needs for charging, thus increasing the feasibility of EV use and thereby supporting the scale-up of EV-RE integration Output 3.3C: Demonstration of business models to scale-up the number of EVs, thus laying the ground	Output 3.3: Scale up of Shanghai infrastructure from current pilot to 2,500 charging piles and 1,500 dedicated EV parking spaces Output 3.4: Shanghai business models for car sharing system expanded from the current pilot of 800 vehicles in 72 sites in Jiading district to scale up its operations to 2,000 vehicles in 500 sites (EVCARD fleet) in all Shanghai; and to develop the 200 pure electric buses service (e-drive fleet) *See also mobile charging station aspect of Output 3.1 and Output 3.2.*	The ProDoc Output 3.3, with its three sub-outputs, cuts across the areas indicated in the PIF's Output 3.3 and Output 3.4, as well as parts of Output 3.1 and Output 3.2. The Output 3.3 sub-outputs cover each of (1) increase in density of stationary charging network, (2) demonstration of mobile charging vehicles, and (3) demonstration of car sharing business models to scale up the number of EVs. ProDoc Output 3.3A, covering fixed charging network scale-up, corresponds to PIF Output 3.3 (for Shanghai). ProDoc Output 3.3B corresponds to mobile charging station vehicle aspects of PIF Output 3.1 and PIF Output 3.2. ProDoc Output 3.3C corresponds to PIF Output 3.4.

work to realize the benefits of EV-RE integration on substantial scale		
Output 3.4: Demonstration of energy management centers that collect and manage data on dispersed EVs and retired EV battery packs used as storage for the grid, so that the charge and discharge of these devices can be managed	Output 3.5: Yancheng control infrastructure developed, consisting of ICT energy management center to collect data on storage systems Output 3.6: Shanghai technology validation: a demonstration network system based on the EV battery storage (secondary use) and a charging infrastructure information platform, which monitors infrastructure use and booking service	The ProDoc Output 3.4 encompasses PIF Output 3.5 (energy management center for Yancheng) and PIF Output 3.6 (energy management center for Shanghai). While these two PIF outputs were originally worded differently, consultation with national project experts has confirmed the two PIF outputs were both intended to refer to the same type of energy management center. Because these centers will require some hardware, Output 3.4 of the ProDoc is included under the investment portion of Outcome 3, rather than the TA portion, where PIF Output 3.5 and PIF Output 3.6 were located.
Output 3.5: Detailed monitoring and evaluation of project demo performance, providing insights to city planners for developing EV-RE demonstration plans for their cities Output 3.5A: Detailed monitoring and assessment of project demos of EV integration with the power grid Output 3.5B: Detailed monitoring and assessment of project demos of EV-RE micro-grids Output 3.5C: Detailed monitoring and assessment of aspects of project demos related to the use of retired EV batteries, including development of know-how with regard to use of retired EV batteries so that they can be leveraged as tools of EV-RE integration	*See PIF Output 1.4*	As explained under PIF Output 1.4 in Exhibit 2 above, the ProDoc output for monitoring and evaluation of the demos (Output 3.5) has been moved to Outcome 3, which is the demo outcome. The ProDoc output is divided into three sub-outputs to specify key areas for monitoring and assessment of the demos: EV integration with the power grid, EV-RE micro-grids, and secondary use of EV batteries.

Exhibit 5: Comparison of ProDoc Framework to PIF – Outputs of Outcome 4

Outcome 4: Increased knowledge and capacity of business and consumer stakeholders, facilitating awareness, research and development, manufacture, operation, and maintenance with regard to EV-RE integration		
ProDoc version output	**PIF version output**	**Changes and explanation**

Output 4.1: Dissemination of knowledge amongst industry players (vehicle manufacturers, charging equipment providers, power industry, and other relevant sectors) regarding EV-RE integration Output 4.1A: Forums for industry, including both domestic and international players active in the China market in the vehicle, power, and other related sectors, on EV-RE business models, technology, and demonstration results Output 4.1B: Dissemination to industry of project's EV-RE information base Output 4.1C: Meetings publicizing EV-RE related technical standards, held for vehicle OEMs, charging equipment suppliers, and other related industrial companies Output 4.1D: Technical operation and maintenance workshops related to EV-RE integration aspects held for relevant industrial organizations Output 4.1E: Establishment of industry alliance or association subcommittee for promoting and advancing EV-RE integration and liaising with government on EV-RE integration policy	Output 4.1: Dissemination of technical standards amongst 15 vehicle manufacturers and charging equipment producers	The ProDoc Output 4.1 is an expanded version of the PIF's Output 4.1. The PIF's Output 4.1 focuses on knowledge/capacity of industry players, but covers only dissemination of technical standards. Output 4.1 also focuses on knowledge/capacity of industry players, but has five sub-outputs. The third of these (ProDoc Output 4.1C) corresponds to the PIF Output 4.1's focus on technical standards. The other ProDoc sub-outputs cover the following areas related to knowledge/ capacity of industry players: (1) Forums on EV-RE integration for industry (Output 4.1A), (2) dissemination of project EV-RE integration information base to industry (Output 4.1B), (3) technical O&M workshops related to EV-RE integration (Output 4.1D), and (4) establishment of industry alliance on EV-RE integration (Output 4.1E).
Output 4.2: Awareness raised among current and future potential car sharing companies of various car sharing business models and integration of EVs with RE in car sharing businesses	Output 4.2: Awareness raising of the car sharing scheme amongst other pilot cities promoting NEVs	Adjustment of wording and specification of target organizations. Clarification that awareness raising will cover EV-RE integration.
Output 4.3: Promotion of EV-RE integration to the general public by various methods to raise awareness of and interest in EV-RE integration as a means of realizing the true environmental potential of EVs	Output 4.3: Promotion of social platforms such as Shanghai user and enterprise owner clubs in Yancheng and other pilot cities promoting NEVs	The ProDoc Output 4.3 is an expanded version of the PIF's Output 4.3. The PIF's Output 4.3 focuses on knowledge/capacity of the general public, but covers only promotion of EV user social platforms. The ProDoc Output 4.3 also focuses on knowledge/capacity of the general public, but has three sub-outputs. The second of these (Output 4.3B)

Output 4.3A: Media promotion of EV-RE integration, raising awareness of the public regarding the need to incorporate RE into EV development to realize the environmental potential of EVs and educating the public on various aspects of EV-RE integration Output 4.3B: Promotion of EV-RE integration to consumers via social organizations, increasing consumers' understanding of and attraction to the concept and related opportunities Output 4.3C: Outreach on social media platforms and cooperation with social media companies to carry out promotion of EV-RE integration		focuses on social organizations, as did the PIF's Output 4.3. Yet, the new Output 4.3B emphasizes the focus will be promotion of EV-RE integration via the EV user social organizations. The other sub-outputs of the ProDoc Output 4.3 include: (1) media promotion of EV-RE integration to the general public (Output 4.3A) and (2) outreach on social media platforms to promote EV-RE integration (Output 4.3C).
Output 4.4: An EV-RE integration demonstration center in Yancheng, created to raise awareness on the topic of EV-RE integration amongst consumers, companies using EVs, and industries related to RE or EV	Output 4.4: A RE-EV demonstration center in Yancheng created to raise awareness amongst 2,000 prospective users of NEV	Adjustment of wording only. The target of 2,000 users is eliminated from the output wording, though numerical targets are included in the project indicators.

Exhibit 6: Comparison of ProDoc Framework to PIF – Outputs of Outcome 5

Outcome 5: A robust mechanism for M&E in place to ensure the attainment of project outcomes		
ProDoc version output	**PIF version output**	**Changes and explanation**
Output 5.1: Project monitoring plan refined and executed	Output 5.1: Project monitoring plan designed and executed	Minor adjustment to wording
Output 5.2: Data and information collected to measure certain of the project's outcome and output level indicators, as well as indicators for project's Environmental and Social Management Plan (ESMP)	---	This output was added to accommodate the measurement of any indicators that will require special activities. Most indicators will not require such special activities, but a few will require special surveys, etc., to determine indicator value.
Output 5.3: Project mid-term review and terminal evaluation conducted	Output 5.2: Mid-term review and terminal project evaluations conducted	Minor adjustment to wording
Output 5.4: Recommendations and agreed upon action plan for long term project sustainability as part of follow-up to terminal evaluation	Output 5.3: Recommendations determined for long term project sustainability, as part of the terminal evaluation follow-up actions	Minor adjustment to wording

ANNEX J. GLOSSARY – ACRONYMS AND DEFINITIONS

AC: Alternating Current – an electric current in which the flow of charge periodically reverses direction
ACWF: All-China Women's Federation – a women's organization in China whose network is extensive and reaches all the way down to the rural level.
Alternative scenario: For a UNIDO-GEF project, the future scenario in which the project has been implemented (as compared to the baseline scenario, in which it is not implemented).
AQSIQ: State Administration of Quality Supervision, Inspection, and Quarantine – government agency in China responsible for quality
AV: audio visual – one type of line item expense in the project budget
Baseline project – For a UNIDO-GEF project, the baseline project consists of the various projects that will be carried out at the same time as the GEF project and contribute to its objective.
Baseline scenario - For a UNIDO-GEF project, the future scenario in which the project has not been implemented (as compared to the alternative scenario in which it is implemented).
Baseline situation - For a UNIDO-GEF project, the relevant situation at start of project.
Battery pack – a constituent of an EV battery system. EV batteries contain multiple battery packs.
BEV: battery electric vehicle
Bottom up indirect (or consequential) emission reductions: This is a GHG emission reduction estimation approach based on the equipment considered to be a replication of the project pilots and installed within the ten years following project close. Typically, a replication factor of the project pilots, such as three times, is assigned. The equipment is not directly financed by the project, but its installation is considered to be due fully to the influence of the project. GHG emissions reductions, in this approach, are calculated based on the lifetime of the replication equipment installed.
BTU: British thermal unit - a measure of energy
BYD: Build Your Dreams – Chinese EV manufacturer
CAGR: compound annual growth rate
CCM: Climate Change Mitigation- the GEF focal area of the proposed project
CICETE: China International Center for Economic and Technical Exchanges – a center under China's Ministry of Commerce that manages international development projects
Co-financing – for a GEF project, co-financing refers to project financing from parties other than the GEF
CO_2: carbon dioxide
Component – for a UNIDO-GEF project, a component refers to one of the main topical areas of the project. The proposed project has five components.
DC – an electric current in which the flow of electrons is unidirectional
Direct emission reductions: This a GHG emission reduction estimation approach that considers emission reductions from equipment purchased directly by GEF funds or co-financing of the project. In the case of the proposed project, direct emission reductions are those due to the project pilots. The direct emission reductions are computed based on the lifetime of the involved equipment.
E-Drive - electric bus rental business of SIAC
Emission factor: a parameter used in calculating GHG emissions which indicates amount of CO_2 emitted per unit fuel or unit energy
ESMP- environmental and social management plan
EU Mobility Week – annual event with strong EV component and including attention to EV development in developing countries. Will be a venue for international knowledge sharing of project results.
EV: electric vehicle
EVCARD – electric car sharing business of SIAC
EVI: Electric Vehicles Initiative of the Clean Energy Ministerial (CEM) – considered being a good avenue for international knowledge sharing of project results.
EV-RE integration - means of achieving higher use of renewable energy to power EVs; integration may also one day allow higher levels of RE adoption by the grid if large numbers of EVs can be utilized to reduce intermittency challenges associated with renewable energy.
FCV: fuel cell vehicle

Feed-in tariff - set payment level (per unit energy) for renewable energy based electricity provided by a local generator to the grid
GEF: Global Environment Facility
GEFTF - GEF Trust Fund – the source of funds proposed for this project
GHG: greenhouse gas
GHG ERs: greenhouse gas emission reductions
GW: gigawatt – a billion watts or 1,000 megawatts
HVAC: heating, ventilation, and air conditioning
ICE: internal combustion engine
ICEV: internal combustion engine vehicle
Incremental cost of CO_2 abatement: estimate of the cost to the GEF of the project per ton of CO_2 abated
INDC: intended nationally determined contributions – is the UNFCCC term for reduction in GHGs that countries signing the UNFCCC were asked to publish in the lead up to the 2015 UN Climate Change Conference
IRENA: International Renewable Energy Agency – an intergovernmental organization that supports countries in their transition to a sustainable energy future. IRENA is a platform for international cooperation and knowledge management in the renewable energy area.
km: kilometer
KPI: key performance indicator – For the project, this refers to the project indicators in the Project Results Framework (PRF)
kW: kilowatt, a measure of power equal to 1,000 watts
kWh: kilowatt hour, a measure of electrical energy consumed
l: liter
LFA workshop: logical framework analysis workshop – This is a type of workshop often conducted in the preparation of GEF workshops. Its purpose is to determine the problems inhibiting the achievement of the project objective and outcomes and to design the targeted results (outcomes and outputs) of the project, as well as, if possible, activities to achieve them.
M&E: monitoring and evaluation
Micro-Grid - A small electric grid that can operate independently of the main power grid. The micro-grid may be either off-grid or connected to the main grid. The micro-grid will have both its own power source(s) and its own loads.
MIIT: Ministry of Industry and Information Technology (China)
MOF: Ministry of Finance (China)
MOST: Ministry of Science and Technology (MOST)
MTR: Mid-Term Review – an evaluation of project progress required of full-size GEF projects that occurs half-way through the project's duration
MW: Megawatt – a measure of power equal to 1,000 kW
MWh: Megawatt hour – a measure of electrical energy consumed equal to 1,000 kWh
NDRC: National Development and Reform Commission (China)
NEA: National Energy Agency (China)
NEVs: New Energy Vehicles – a term used in China to refer to pure electric vehicles, hybrid electric vehicles, and fuel cell vehicles as a group
NTCAS: National Technical Committee of Auto Standardization (China) – technical committee for auto standards, which is under SAC
OEM: original equipment manufacturer – in the case of this project, refers to vehicle manufacturers
PHEV: plug-in hybrid electric vehicle
PIF: Project Identification Form – the concept stage proposal submitted for GEF projects. The PIF of the proposed project has been approved. The next stage is for the full project design to be prepared and submitted to the GEF in the form of a project document and Endorsement Request, as represented by this document.
PIR: Project Implementation Report – report on project implementation progress required annually of GEF projects
PM2.5 – particles with a diameter of 2.5 micrometers or less; considered key constituents of air pollution in terms of having negative health impacts
PMC: project management costs –usually refers to cost of the PMO
PMO: project management office – will be responsible for day-to-day management of the proposed project

PPG: project preparation grant – used for the full design of GEF projects
project activities – In a UNIDO-GEF project, the project activities are carried out to achieve project outputs, which, in turn, contribute to the achievement of project outcomes.
project objective - for UNIDO-GEF project, the overall aim of the proposed project, which the proposed project and other projects together will contribute to
project outcomes - for UNIDO-GEF project, key results targeted by the project. Outcomes can generally not be guaranteed by the project as they depend on outside circumstances. The project, however, can take strategic approaches to maximize potential for achievement. The project outcomes together contribute to the project objective.
project outputs – for UNIDO-GEF project, results targeted by the project. A group of outputs together contribute to achievement of a project outcome. Outputs are generally results that are within the full ability of the project alone to achieve, without depending on outside factors.
Project Results Framework (PRF) – a part of the ProDoc that includes indicators monitoring project progress. In addition to the indicators, it contains end of project targets for each indicator.
ProDoc: project document – this document, in which the proposed project is described
PSC: Project Steering Committee – a high-level committee that will be set up to provide guidance to the project
PV: photovoltaic – a technology that converts light to electricity
quadrillion – one thousand trillion (10^{15})
R&D: research and development
RE: renewable energy
retired EV battery – an EV battery that is no longer suitable for use in an EV. Once no longer suitable to the EV, the battery may be used for other purposes outside of the EV.
RMB: renminbi – China's currency; also called the "yuan."
SAC: Standardization Administration of the People's Republic of China – responsible for approving national standards in China. It is an independent government agency under the State Administration of Quality Supervision, Inspection, and Quarantine (AQSIQ).
SAE: China Society for Automotive Engineers – a key policy advisory and auto industry think tank in China
SG: smart grid – an electricity supply grid that uses digital communications technology that allows reaction to usage at the local scale
SIAC: Shanghai International Automobile City – key partner for the proposed project responsible for implementing the project's Shanghai demo
SLoCaT: Partnership on Sustainable, Low Carbon Transport – UNIDO is a member of SLoCaT, which will be one of the key avenues of international dissemination of project results.
smart charging – the intelligent charging of EVs such that the times at which the charging occurs is selected based on the combined needs/ benefits of the power grid and the user. In particular, if there is a time of day during which the grid has an excess supply of power (and perhaps as a result of which such power may be cheaper for the user), the vehicle may be intelligently charged at that time. Smart charging on a large scale may have the benefit of smoothing out peaks and valleys in power supply. The leading countries in the development of the technology of smart charging include: the US and Japan. Examples are the US DOE - California Energy Commission and Los Angeles Department of Water and Power demonstration project with 67 vehicles, micro-grid, and renewable energy; and the smart charging and vehicle to home technologies developed by both Toyota and Nissan in Japan, which allow for consideration of time-of-day rates for electricity, vehicle owners' usage plans, and, for V2H, needs of the home.
STAP: Scientific and Technical Advisory Panel – a panel serving the GEF to assess the scientific and technical content of proposed projects. Proponents of proposed projects must provide responses to STAP comments at the time of ProDoc submission, such as may be found in this document.
t: ton – metric ton
TE: terminal evaluation – an end of project evaluation required of GEF projects
Top-down indirect (or consequential) emission reductions: This is a GHG emission reduction estimation approach that considers the market of equipment installed in the ten years following project close. The equipment is not directly financed by the project, but its installation is considered to be due partly to the influence of the project. GHG emissions reductions, in this approach, are calculated for the various cohorts of equipment installed in the ten years over their full lifetimes.

UEMI: Urban Electric Mobility Initiative – announced at the NY Climate Summit in 2014, UEMI is considered a good avenue for international dissemination of this project's results.
UNIDO: United Nations Industrial Development Organization – the GEF implementing agency for the proposed project.
UNFCCC: United Nations Framework Convention on Climate Change
V2G: vehicle-to-grid – a system in which electric vehicles can send excess power stored in their batteries to a power grid.
WeChat - China's most popular social networking site
Yancheng – located in Jiangsu Province, one of the project's two pilot cities. (The other pilot city is Shanghai.) Yancheng is known for its wind power resources.

ANNEX K. LIST OF ANNEXES

Technical Annexes (*provided as separate electronic document*)