



Chinese experience of RET development – mapping of national and regional approaches, laws, programs and investment



Yiyang Shen, Energy consultant for UNDP China

China RE policy and planning



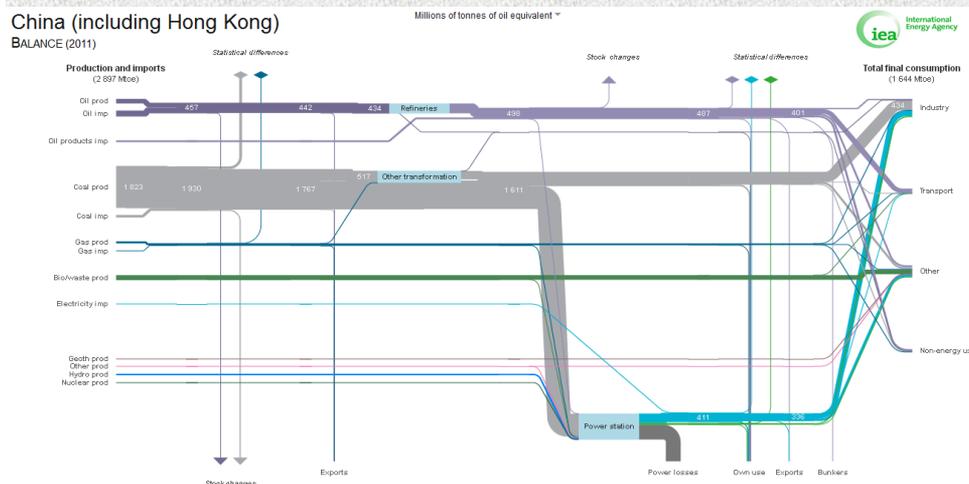
China's new challenges and how energy sector support "new normal"

Chinese government is navigating the structural shift to slower but higher-quality growth, a phase of development referred to as the 'new normal', while facing considerable environmental and resource security challenges.

Globally, the slowdown in China's economy has sent reverberations through commodity markets, pulling the plug on the decade-long commodities 'super cycle'.

China's domestic challenges such as air quality and water scarcity push the country to pursue an environmentally sustainable model of economic development. In 2015 China's leaders set out the key incentives, accountability and mechanisms to deliver the ecological civilization in China's 13th Five-Year Plan. Central elements of this vision, such as building sustainable cities, pursuing environmentally-friendly economic growth and developing the circular economy will have major impacts on China's future resource consumption and import needs.

China Energy Flow



China's 13th 5-year's plan and RE



- By the end of 2020, the nation will form five energy production bases in Shanxi province, Ordos Basin, eastern Inner Mongolia, Southwestern China and the Xinjiang Uygur autonomous region.
- With stricter environmental protection standards, China will lower the coal-fired generation to under 62 percent of the national total by 2020, according to the plan, and of that thermal coal use should be raised to above 60 percent. Average coal consumption at new power plants should be less than 300 grams of standard coal per kilowatt hour (kwh). Average coal consumption at existing furnaces should be brought below 310 grams of standard coal per kwh before 2020.
- The country's total wind power installed capacity will reach 200 million kilowatts by 2020, doubling the 12th Five-Year plan period's level, and solar power will be quintupled to more than 100 million kilowatts compared with the target during the 12th Five-Year plan period.
- Solar poverty alleviation program: 16provinces, 35,000 low income village, 2Million poor people, add 500USD per person
- The action plan comes after the central government approved climate change goals to be met by 2020. Carbon emissions per unit of GDP will be cut by 40 percent to 45 percent by 2020 from the 2005 level.

13th 5-year's plan new focus



- Smart grid / energy internet
- Strengthen Power grid
- New town +RE
- Manufacture +RE
- Agriculture + RE
- Poverty reduction +RE
- Mini-grid +RE
- RE public data platform
- Cost down
- International cooperation
- New RE base

China's on-grid RE development plan



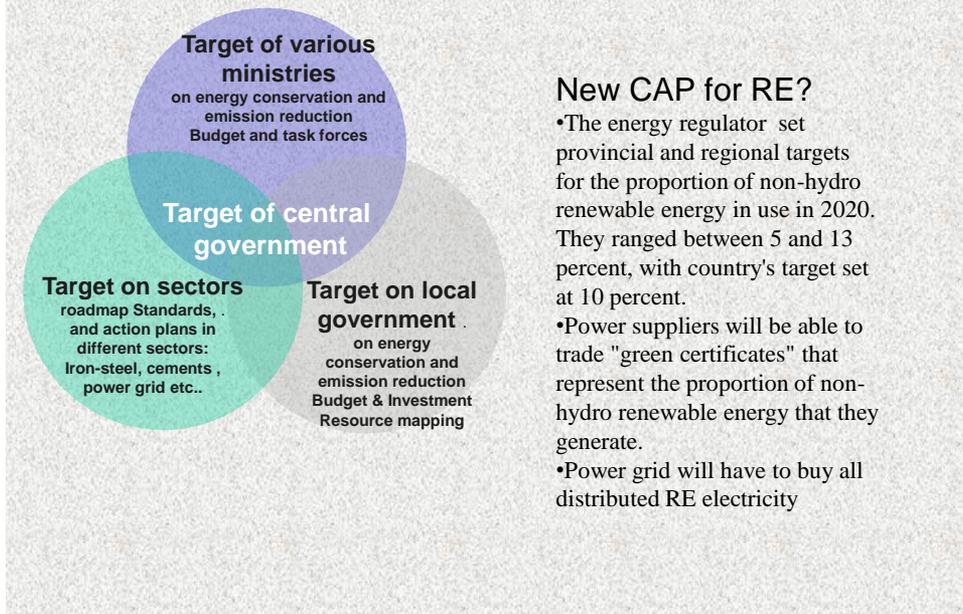
13th 5-year's plan Solar poverty alleviation program



Solar poverty alleviation program: 16 provinces, 35,000 low income village, 2 Million poor people, add 500USD per person in next 5 years. National Energy Administration and State Council Leading Group of Poverty Alleviation and Development cooperate to use solar projects to provide power and income in poor regions.

China will build financing mechanisms in cooperation with local governments, banks and investors, and coordinate the development of distributed generation systems in poor areas. The central government will also allocate necessary subsidies and discounted government loans, while local governments should arrange matching funds and banks provide low-interest loans.

Target distribution



Renewable Energy vs GDP trend in China 2016

The country's current growth path will allow China to soon surpass their carbon emissions targets. Specifically, China broke two new records in 2015, installing a record 32.5 GW of wind in 2015, and a record 18.3 GW of solar in 2015 — both of which were higher than initial estimates.

China's solar and wind energy capacity increased by 74% and 34%, respectively, in 2015, while coal consumption dropped by 3.7%.

IEEFA forecasts that China will install an additional 22 GW of wind, 16GW of new hydro, another 6GW of nuclear, and 18GW of solar (60% utility scale, 40% distributed rooftop solar) in 2016. With electricity demand forecast to grow by 3.0-3.5% in 2016, this 62GW of additional zero carbon electricity capacity will be sufficient to meet total electricity demand growth, such that coal consumption is forecast to fall again in 2016.

Renewable Energy Policy in China

First-level policies: provide general direction and guidance, and include laws ,plans about development of renewable energy and the Chinese government’s standpoint on the global environment.

Second-level policies: specify goals/objectives/roadmaps and sector development plans, and focus on rural electrification, renewable energy-based generation technologies . These policies attempt to standardize the directions, focal points, and objectives of renewable energy development from different viewpoints. Some departments propose concrete policies and regulations. Second-level policies have played a very important role in promoting renewable technologies in China.

Third-level policies: consist of practical and specific incentives and managerial guidelines. These outline specific supporting measures for developing and using renewable energy. These third-level government policies provide crucial support to help develop renewable energy in its early growth stages. Since the mid-1990s, many provinces and autonomous regions of China have adopted policies for developing renewable energy, including subsidies and tax reduction. The central government also issued several effective regulations.

Renewable Energy barriers in China

15 years ago and now:
Key RE barriers and solutions

- Technology
- Business model
- Management scheme
- Human resource
- Finance
- Policy



At \$89.5 billion, China has now become the largest market for renewable energy. As the global manufacturing hub for solar photo voltaic panels (with nearly 75 percent of total PV panel manufacturing), China is now considered to be the fastest growing market for solar energy for the next five years.

How China and Ghana cooperate on these key factors?

Capacity building: Investment in Skill Development

- Until the recent emergence of labor shortages, China's manufacturing sector has benefited from a growing pool of young workers trained for production jobs in government-run vocational schools. At the start of the reforms in 1980, only 19 percent of senior high school graduates came out of vocational schools. By 2001, however, driven by a policy to emulate Germany's dual-track training system, the proportion of senior high school students graduating from vocational schools was much larger: 45 percent or about 6-7 million vocationally trained graduates each year. This policy ensured that 90-100 percent of the young workers joining China's factories would be well-trained.

China' s Gov RE fund to support RE

- To address the solvency of the renewable energy fund, in August 2012, the NDRC doubled the electricity surcharge on industrial customers to 0.015 yuan / kWh (0.25 US¢ / kWh), keeping the residential and agriculture surcharge at 0.008 yuan / kWh (0.13 US¢ / kWh) (Chinese announcement). With a little over three-quarters of electricity going to industry, this will increase substantially the contributions to the fund. At the same time, solar FITs were scaled back slightly by instituting a regional three-tier system akin to that developed for wind: sunny but remote areas in the north and northwest offer 0.90-0.95 yuan / kWh (15-15.5 US¢ / kWh) while eastern and southern provinces close to load centers but with lower quality resources offer 1 yuan / kWh (16 US¢ / kWh).
- Additionally, distributed solar electricity consumed on-site (which could be anything from rooftops to factories with panels) receive a 0.42 yuan / kWh (6.9 US¢ / kWh) subsidy. Excess electricity sold back on the grid, where grid connections and policy are in place, will be at the prevailing coal tariff, ranging from 0.3-0.5 yuan / kWh (5-8 US¢ / kWh).

What areas Chinese public and private sectors paying attention



Renewables work together with rural sectors

- Per ha Agri product: 5,711 USD
35,982RMB (2,400RMB/mu)
- Per ha solar income: 95,190 USD
- 599700RMB(40,000 RMB/mu)



China's off-grid RE development



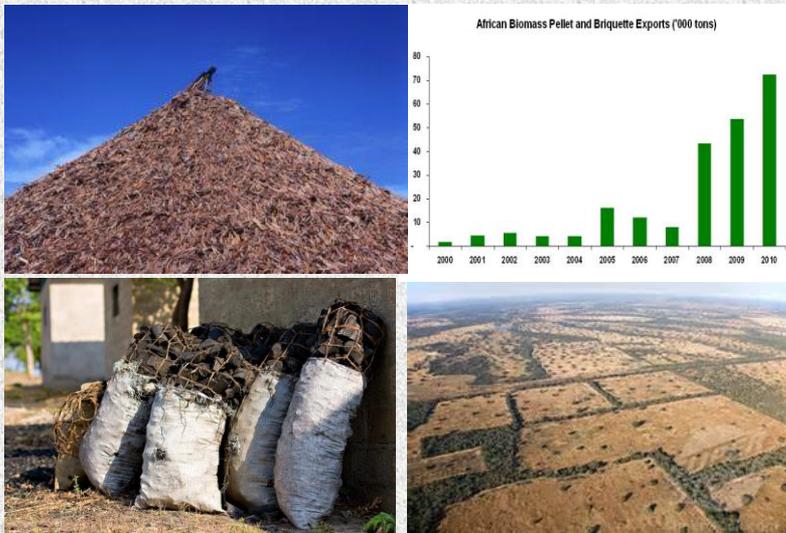
RE work with development: Building integrated PV: new urbanization focus



Biogas: Large Scale and Household



RE with Forestry

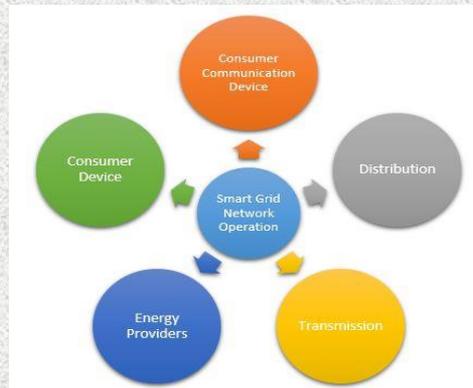


Biomass: Large scale and household



Smart grid and energy-internet development

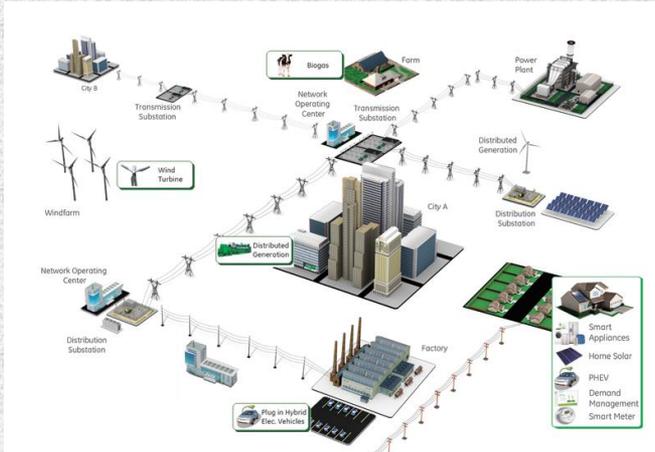
- Smart grid technology would help its network to integrate the thermal and renewable energy supplies. This would make for a safe, stable and efficient grid that could transmit renewable energy power. China's focus on renewable energy makes smart grid development a top priority since the renewable energy that it generates cannot be utilized in large scale without smooth grid transmission that comes from using smart grids.



China aims to deliver generated power from developable hydropower sources located in the mountainous southwestern region, as well as wind and solar resources concentrated in the northwest. This indicates a centralized approach of generating and distributing power which needs an efficient transmission and distribution system. Moreover, individuals, households, small business and large enterprises have now caught on to the need and possibility of generating power from renewable sources

Smart grid and energy-internet development

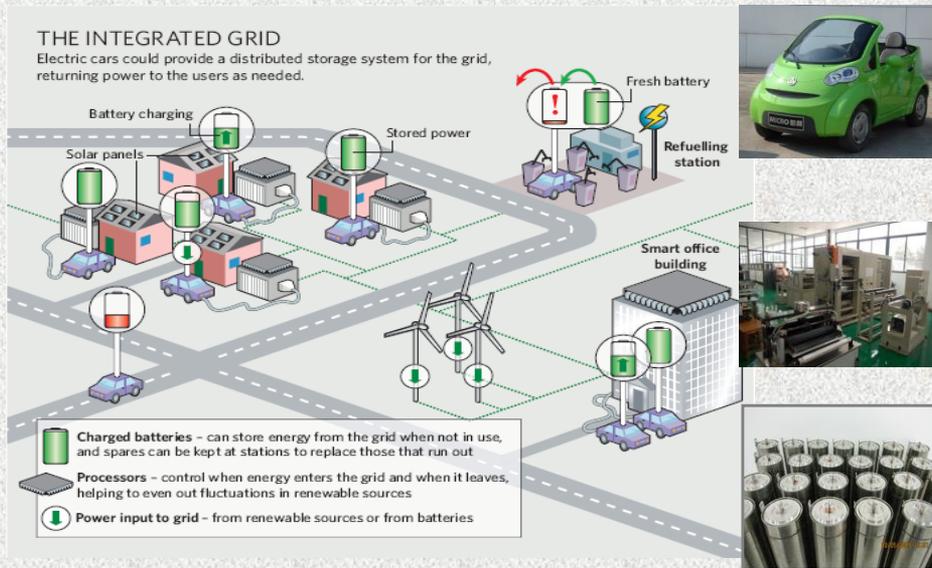
- During the NPC and CPPCC, Premier Li Keqiang stated in the government work report that we should formulate Internet+ campaign plans, boost the integration between mobile internet, cloud computing, big data, IoT, etc. and modern manufacturing, to propel the healthy development of industrial internet and internet finance.



Energy storage: connecting solar + EV

THE INTEGRATED GRID

Electric cars could provide a distributed storage system for the grid, returning power to the users as needed.



Technology and Key Barriers to Deploying Energy Storage

- Bulk to distributed spectrum
- Pumped Hydro
- Compressed Air
- Rechargeable Batteries (such as lead acid, sodium sulfur, lithium ion, flow)
- Thermal (end use and solar)
- Hydrogen
- Flywheels
- Ultracapacitors
- Superconducting Magnetic Energy Storage
- Technology Maturity
- Regulations & Utility Processes
- Revenue opportunities
- High Capital Costs
- Lack of Awareness of Energy Storage Benefits

How to RE finance works for 2016-2020 new normal



Mission of Green Finance in China

- Financial sector development provides the engine for growth.
- Inclusive growth is one of the keys to poverty reduction.
- Focus on Financial Institutions
- Developing stable financial institutions and markets
- Extending capital and financial services to SMEs and the agricultural sector
- In the PRC, traditionally, local municipal governments used to be responsible for the provision, financing and management of municipal infrastructure services. However, because of limited capacity of public finance and ever increasing demand to meet urbanization, more and more sectors are open to invite private sector participation.

China low-carbon investment

- New funds invested into clean energy gained 16% in 2014 to reach \$310 billion. The record is still \$318 billion, set in 2011, but there was a significant upward trend last year. Overall, the world added about 100 gigawatts of solar- and wind-power capacity in 2014.
- China aims to get 15 percent of total energy demand from low-carbon sources by 2020 and cut its carbon intensity by 17 percent from 2011 to 2015 and by 40-45 percent by 2020 versus 2005 levels.
- China is setting up domestic carbon markets and reduce fossil fuel subsidies.
- These goals will require total investment of up to \$333 billion by 2015 and \$413 billion by 2020
- Both public and private finance will be needed to plug the finance gap but private sector finance will have a larger role to play particularly after 2015.
- The Chinese government should consider preferential tax rates for cleaner fuels, market mechanisms to promote energy efficiency and make it easier for green bonds to be issued.
- New environmental law set historic strict penalty for "dirty-production"

Smart grid and energy-internet investment

Power Grid Company received support, but still slow

- China has emerged as the largest smart grid market in the world in recent years, given that the country is in the transition process of rebuilding its grid network to meet its power sector requirement and plans.
- China invested \$4.3 billion on smart grid in 2013, far outpacing U.S. spending of \$3.6 billion in the same period. China is putting policies in place to bring smart meters to 95 percent of households by 2017.



Rural and off-grid barrier in African RE: financial gap and business model

Commercial Banks

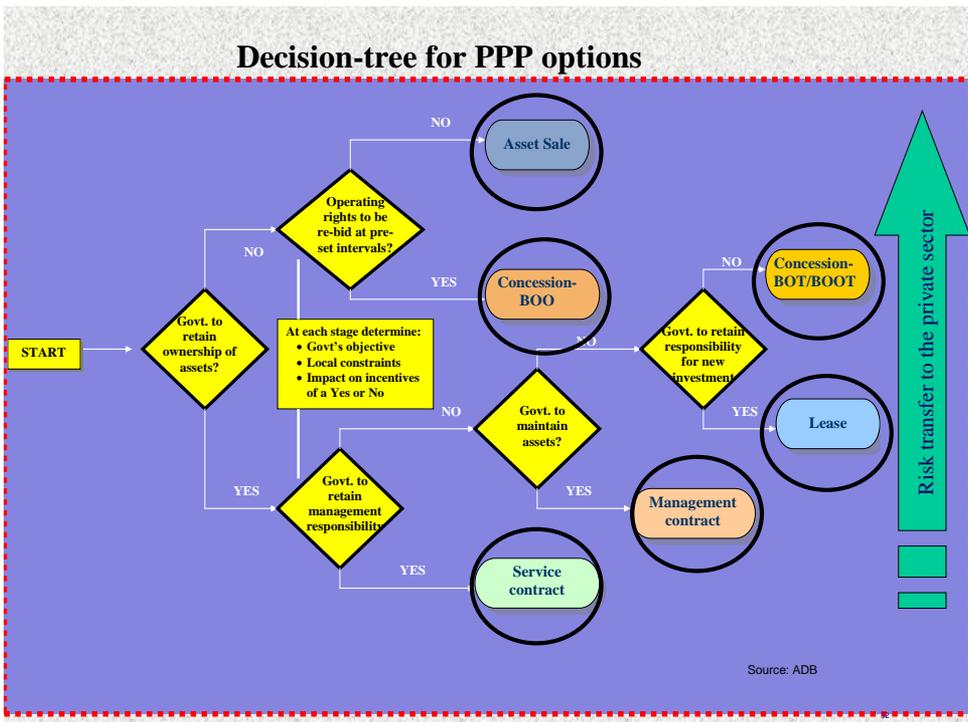
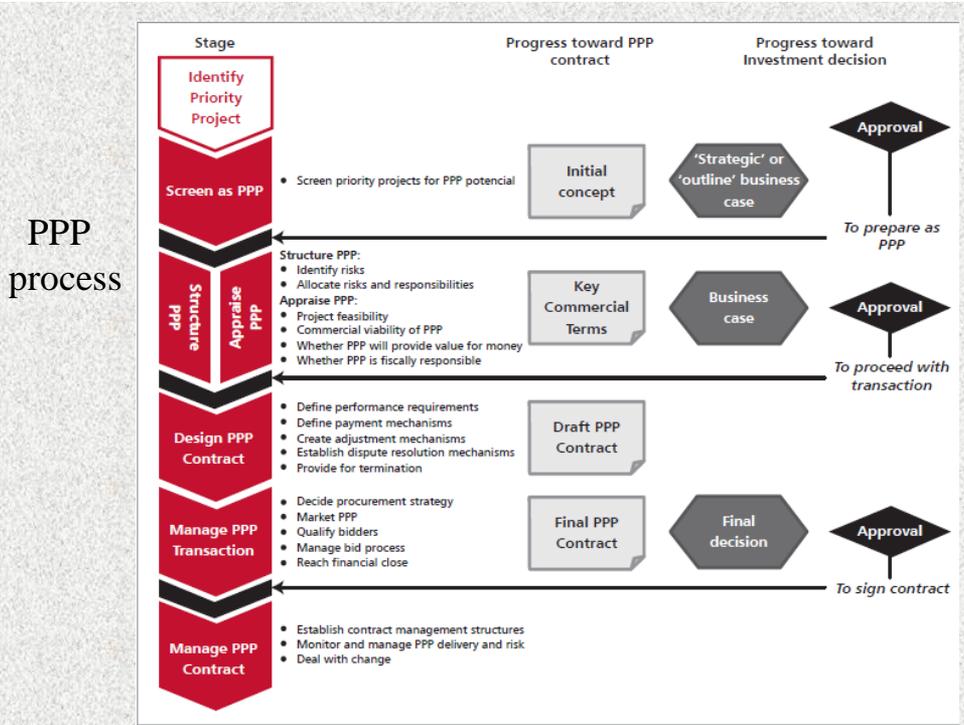
- Large commercial banks
- Joint stock commercial banks
- Rural commercial banks
- Foreign banks

Small and Medium Size Financial Institutions

- Urban credit cooperatives
- Rural credit cooperatives
- Rural cooperative banks

New-type Rural Financial Institutions

- Village or township banks
- Lending companies
- Rural mutual cooperatives



What lessons to learn in a south-south manner



Renewable Energy Commercialization in Ghana : What key lessons should Ghana take from the China targets

- 1) increased number of successful commercial renewable energy applications; ii) expanded market for renewable energy applications;
- 2) enhanced capacity to design, implement and monitor renewable energy projects; (institution and private sectors)
- 3) availability and accessibility of financing to existing and new renewable energy projects;
- 4) strengthened legal and regulatory structures in the energy and environmental sectors; and,
- 5) increased awareness and knowledge on renewable energy and renewable energy technologies among key stakeholders.

- RE for local development.
- RE for agriculture and industrial development
- RE for poverty reduction

Renewable Energy Planning in Ghana and SSA : What key lessons should take from the China experience

- 1) Combine RE planning with economic planning (industry, transportation , agriculture etc.)
- 2) Combine RE planning with power grid development planning
- 3) Combine Ghana RE planning with neighbor countries RE planning and power grid development planning
- 4) Start from the most important targets and easiest targets rather than spread the budget on all areas
- 5) Public fund focus SDG, private investment focus on commercial application
- 6) Long term subsidy
- 7) Do resource mapping in early stage for all sectors, cover demands and RE sources
- 8) Pilot and demonstration project: without public budget or business model for replication will be a fail

Principles for technology transfer

- **Balancing Public and Private Interest**
- Form partnerships that serve the public interest and government's energy goals. Demonstrate appropriate stewardship of publicly funded assets, yielding national benefits. Provide value to the commercial partner as most technology transfer happen through business cases. Sometimes exchange market for technology with JV approach, in case enabling environment ready.
- **Focusing on Outcomes**
- Demonstration not only on technology but also on business model, policy improvement and financial model. Develop mutually beneficial collaborations through processes, which are timely, flexible, efficient, and compliant with requirements. Align actions with real business outcomes and demonstration.
- **Creating Transparency**
- Make goals, processes, business model and the availability of intellectual assets transparent. Keep partners informed of decisions and the status of actions as agreements are developed.
- **Seeking Continuous and sustainable Improvement**
- Measure, monitor, and seek feedback about processes and outcomes. Use this information to improve processes and practices.

RE solution for industry and production use



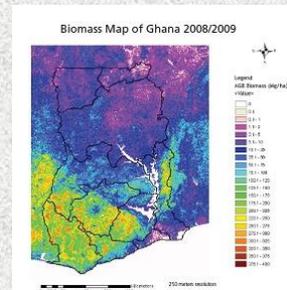
Renewable Energy Planning and Resource Mapping: energy resources + energy demands

Public funds:

With all the advantages electrification offers in health care, education, business operations, communications, and agriculture, if the subcontinent were to become fully electrified, it could support a cycle of investment and job growth. SSA's underdeveloped electricity grid offers huge potential for distributed solutions to meet the needs of the area's farmers and residential populations who compose 60% of the total population and 70% of those in poverty.

Private sector investments:

Currently power shortage and high cost become barrier of the value chain cover SMCs, industries, and agriculture product processing. Once the process starts, micro-grid communities could soon connect to production activities, sprouting where conditions are right and spurring regional and national development.



Resource Mapping experience from China

RE Resource mapping for various technologies

Optimal technology choosing based on proper business model

- Technology no need to be most advance
- Business and management model
- Problem identification and demand investigation
- Combine planning from various sector

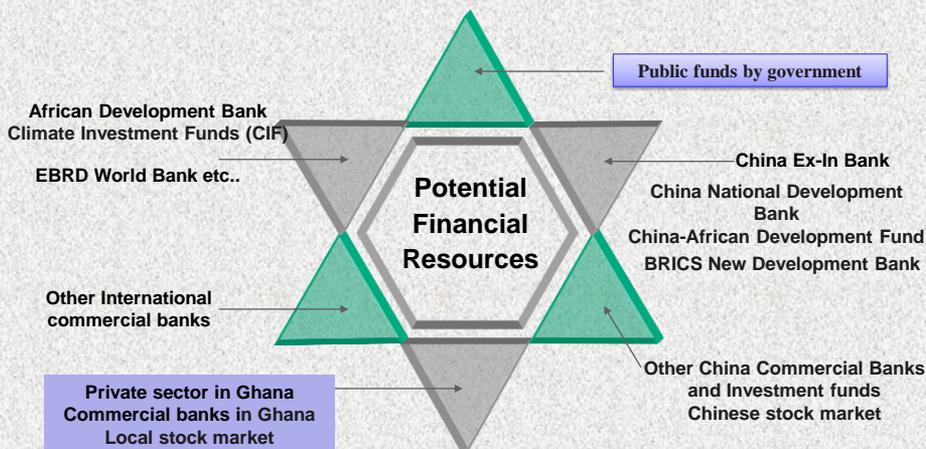


One of Principal constraints to renewable energy development in C

- *Uncertainty of available resources.*
- *Inadequate credible data on available renewable resources at prospective sites impedes potential investors from selecting such sites.*
- *resource monitoring programs are expected to provide the necessary information to eliminate this uncertainty.*

In the next 25 years, nearly one billion people will gain access to electricity in SSA, but, because of forecasted population growth, the number of people who have no access to electricity will only drop from the 600 million now to about 530 million.

Opportunities for financing



How to demonstrate RE under limit budget



NDRC/UNDP/GEF Support for China's National Rural Electrification Programs 2004 Community Power Project Development



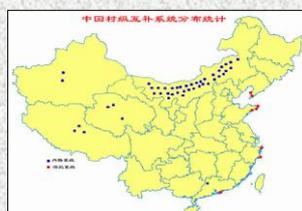
Assessment of needs and perspectives of Chinese rural RE technology in China (2001)

Resource mapping: What technology and where to demonstrate:
Identify number of un-electrified villages and Individual households in each province

No.	Province	Total villages	Un-electrified villages	%	Total farmer households	Un-electrified households	%
1	Tibet	7,306	5,254	71.91%	367,000	289,300	78.83%
2	Qinghai	4,054	774	19.09%	671,000	101,000	15.05%
3	IM	13,993	2,360	16.87%	3,477,000	249,590	7.18%
4	Guizhou	25,847	3,377	13.07%	7,087,000	1,294,000	18.26%
5	Hainan	2,633	253	9.61%	999,000	160,300	16.05%
6	Ningxia	15,616	1,306	8.36%	810,000	64,000	7.90%
7	Xinjiang	8,934	563	6.30%	1,872,600	316,200	16.89%
8	Gansu	17,803	1,045	5.87%	4,403,000	488,700	11.10%
9	Guangxi	14,816	700	4.72%	8,779,000	388,600	4.43%
10	Yunnan	13,423	528	3.93%	8,064,000	1,003,800	12.45%
11	Hubei	32,662	1,050	3.21%	9,864,000	121,500	1.23%
12	Sichuan	55,042	1,499	2.72%	19,589,000	648,300	3.31%
13	Fujian	14,970	350	2.34%	6,302,000	33,000	0.52%
14	Henan	48,436	700	1.45%	19,121,000	577,000	3.02%
15	Shaanxi	31,969	344	1.08%	6,860,000	289,100	4.21%
16	Hunan	49,849	518	1.04%	14,417,000	279,500	1.94%
17	Shanxi	32,365	259	0.80%	6,122,000	112,000	1.83%
18	Hebei	50,027	400	0.80%	14,016,000	13,800	0.10%
19	Chongqing	20,647	163	0.79%	7,098,000	191,900	2.70%
20	Jiangxi	20,677	50	0.24%	7,206,000	287,000	3.98%
21	Anhui	30,558	50	0.16%	12,565,000	80,500	0.64%
22	Heilongjiang	14,387	13	0.09%	4,377,000	9,100	0.21%
23	Liaoning	16,310	4	0.02%	6,638,000	4,800	0.07%
24	Guangdong	22,945	-	0.00%	13,198,000	50,800	0.38%
25	Jilin	-	-	-	-	-	-
26	Shandong	0	0	0	0	0	0
27	Jiangsu	0	0	0	0	0	0
28	Zhejiang	0	0	0	0	0	0
29	Beijing	0	0	0	0	0	0
30	Tianjin	0	0	0	0	0	0
31	Shanghai	0	0	0	0	0	0
Total			21,560	3.81%		7,053,790	3.84%

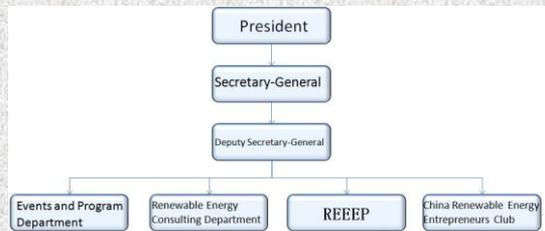
Demonstration strategy on rural RE (example)

- As a momentum, UNDP-China RE project significantly hasten the development of rural RE
- Fully support rural RE in all aspects:
 - Technology dissemination
 - Business and management model study
 - Data collection and analysis
 - Problem identification
 - Training
- Created a considerable number of professions in RE sector



UNDP and Chinese government jointly set-up a RE association (platform) in China

- CREIA promotes the adoption of advanced technologies among renewable energy enterprises in China and actively develops capacity for the rapid industrialization of the Chinese renewable energy sector. CREIA serves as a bridge between regulatory authorities, research institutes, and industry professionals, in order to provide a forum to discuss renewable energy development at the national level and subsequently advise the Government of China on strategic policy formulation.
- CREIA acts as a window to bring together national and international project developers and investors. It promotes technology transfer and raises awareness of renewable energy investment opportunities through an online Investment Opportunity Facility and regional networking and training activities. CREIA provides a network for its members from the Chinese renewable energy business community without access to communication within their sub-sectors, and provides a platform to voice their concerns collectively.



RE project development guidelines 2004

Knowledge products

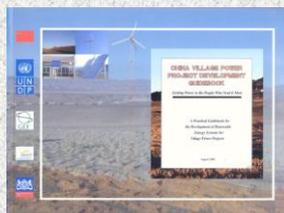


Table of Contents

- Chapter 1 Getting power to the people who want it most
- Chapter 2 Village power alternatives: Resource requirements, System features and Status of applications in China
- Chapter 3 Evaluation of cost effectiveness of village power alternatives
- Chapter 4 Project development process – Stakeholders rules, project development methods and financing aspects
- Chapter 5 Ownership and management options
- Chapter 6 Other critical issues
- Chapter 7 Case studies
- Chapter 8 Lesson learnt

Annex I: List of Community REVP systems installed in China to date

Annex II: Practical guidelines for village power project implementation

Annex III: Assumption made for economic and financial calculation

Thanks!

Yiyang Shen (Tony)
0086-136-71063878
tonyshen86@yahoo.com