

Establishing Sustainable Training Facility in Rural Renewable Energy Power Supply in China

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ABSTRACT: In China, it is a historical task and process to promote flourishing of rural economy by firmly developing rural electrification. With regard to rural electrification in China, the sustainable training facility of rural RE power supply is becoming urgent and strategic issue. In the China 11th 5-Year Plan and the State Long and middle-termed development layout, it has been put forward to develop power supply of renewable energy in the rural area and was regarded as the important measures to promote the development of economy and society of the countryside. In next 15 years, solving the problem of power supply to the population with no electricity and improving the renewable energy application level in their daily life is arranged as the key task of renewable energy in China.

In this study, with the establishing of China rural renewable energy power supply sustainable training mechanism, the following has been summarized herein.

1) The necessity and strategic meaning of the establishing of China Rural RE power supply sustainable training mechanism are investigated. 2) The training demand on the involved industries, finance, economy, administrative management, quality supervision and so on, is analyzed. 3) The training needs, for the RE directly associated industries including R & D, system integration, engineering, manufacturing, market and sales, management and service, consultation, productive application and small scale commercialization, are predicted. 4) An implementation plan of the Rural RE power supply sustainable training facilities is presented here. Suggestion for establishing State level training organization of rural renewable energy power supply is advanced as well.

Key words: Renewable energy, rural electrification, sustainable training mechanism

NOMENCLATURE

DRC	- Developing and Reform Commission	O/M	- Operation & Maintenance
NDRC	- National Developing and Reform Commission in China	PV	- Photovoltaic
-		R&D	- Research and Development
		RE	- Renewable energy

1. INTRODUCTION

Rural electrification is the important basis of rural modernization and important constitution of industrial modernization. In China, the rural population is about 0.9 billion. Agriculture, countryside, and farmers are the important three issues concerning the reform and opening in China and the modernization. Either developed or developing countries, development of rural electrification is closely linked with the development of national economy. In China, it is a great and arduous, historical mission to promote agricultural production, flourishing of rural economy and improving of farmers life by firmly promoting rural electrification.

Status of rural electrification in China is summaries as follows,

(1) China rural electricity-consuming level has gained significant improvement.

(2) The rural electrification degree has been improved continually.

(3) Rural electricity grid owns a certain scale.

(4) Progress has been achieved in exploitation of rural power supply.

(5) Tremendous achievements have been made in construction of "Rural electrification Pilot Counties".

(6) Rural electrification level is still very low.

In the grid-connected areas, in 2000, the average annual power consumption per capita at county or below the county level is less than half of total national power consumption, much lower than the citizens in the cities. At the end of 2000, there were 766 townships, 16509 villages, 7.06 million homes and 30 million people inaccessible to power.

In "China 11th 5-Year Pan" and "State Long and middle-termed development layout", it has been stressed to develop power supply of renewable energy in the countryside and taken as the important measure to promote the development of economy and society of the countryside

In the next 15 years, "Supply power to the

population with no power and improving the energy application of the farmers in their daily" is regarded as the important task of renewable energy industry.

During the period of "11th 5-Year Plan" and "12th 5-year Plan", Chinese central government will focus on solving the problem of power supply by renewable energy to the villages and homes with no power in remote areas, the emphasis is on Tibet, Qinghai, Inner Mongolia, Xinjiang, Ningxia, Gansu, Yunnan and other provinces. In 2010, in the areas with less resources of small hydropower, the power supply of farmers and herdsman in remote countryside can be solved by application of off-grid small wind power, home PV and hybrid system.

The total toll of non-electrified population with no illumination energy, all over the world, can be given in quantity of people, with 2.2 billion or 2.13 billion. Report from World Bank (1996) indicated that the population with no power in the world was lower than 2 billion. According to the report (1996) of World Bank, 24% of the urban population in the developing countries and 67% of rural population has no electricity.

The population with no electricity in the developing countries is 1.6 billion; rural electrified rate is 51.1%. People of 1.6 billion with no power in the developing countries occupy 27% of the total population in the world, among them 80% is in the countryside.

With regard to the whole world, it is so important to realize the electrification of 1.6 billion no electricity people, for that the electrification in rural area will remove poverty, laggardness, and promote education. Only grid extension is obviously not enough. It is of great practical significance to solve the problem by renewable energy power in the world. For example, in Africa, more than 90 percent people can not be electrified through grid extension, and in Mexico, only 10 % residents can be supplied power through power grid extension. Even more, in some countries, such as (in Burundi, Rwanda

and Tanzania) the power accessing rate just exceeds more than 1%, 77% of the population in south of Sahara of African areas is with no power and 66% of the population in south of Asia with no power.

2. NECESSITY AND STRATEGIC IMPORTANCE OF ESTABLISHING SUSTAINABLE TRAINING MECHANISMS ON RENEWABLE ENERGY POWER SUPPLY IN THE RURAL AREAS OF CHINA

2.1 Necessity

(1) With increased emphasis and increased investment on renewable energy power programs in rural areas, the policy-makers and associated officials and management division should have systematic studies on the knowledge of renewable energy power and the personnel engaged in financial affairs, tax, industry and commerce, technical supervision of quality, financial and investment related to renewable energy power of rural areas should understand in depths and be familiar with the knowledge of renewable energy power of rural areas. Sustainable training facility enables the forth-mentioned personnel to better evaluate the projects and risks of renewable energy power in rural areas.

(2) The technology and engineering level of renewable energy power in rural areas of China is backward compared with the developed countries. Power station operators are not enough for the of-grid power plants. It is very necessary for the operators to be trained so as to improve the knowledge and promote the technical innovation and dissemination. The sustainable training facilities of renewable energy power supply could improve the sale quality in dealers and merchants and stimulate the market sales as well.

(3) The beneficial areas of renewable energy power in the forthcoming rural areas are usually the areas with backward economy situation, poor communication, education and sanitation situation. The masses are not

well educated and need to be systematically trained on renewable energy power in the countryside.

(4) The normal schools education in the subject of renewable energy power and educational background are weak and teaching resources are even-distributed and unbalanced. The establishment of training facility will be beneficial to school and vocational education and supplement to each other.

(5) Compared with the developed countries (such as United States, Germany, and Japan), the scientific content in power management and service in China are lower leveled, and service is not good. Technical and vocational training and dissemination of knowledge are neglected often. Some employees are not qualified and this hinders the orderly development of power management and service in the countryside.

(6) In China power sector, education and training facility of hydropower (including small and micro scale hydropower) has been formed, however the training facilities of off-grid PV power and wind power have not been established fully. Therefore it is necessary to establish off-grid PV power and wind power in the countryside before 2010.

2.2 Strategic importance

(1) It is helpful to promote the application of new energy and renewable energy. At present, the importance of renewable energy has not been understood and recognized by whole society. Therefore the training of renewable energy power supply will help people to have the sense of renewable energy power of the rural areas better and promote the development of renewable energy.

(2) With more applications of renewable energy power in agricultural production and daily life. The dissemination, training and education of renewable energy have become imperative under the current situation. Otherwise it cannot meet the demand of production, cultural life and social development and cannot meet the demand of the development of new energy and

renewable energy.

(3) In order to reach the goals of sustainable development, renewable energy has played greater roles and the ratio of new and renewable energy in the total energy consumption is increasing annually. The sustainable training becomes especially important and indispensable.

(4) The sustainable training facility of renewable energy of the countryside shall be oriented to the rural areas. The sustainable training will provide necessary conditions and approach for dissemination of the knowledge and skills improvement for the staffs of renewable energy in the countryside.

(5) The establishments of sustainable training facility of renewable energy in the countryside not only promotes the development of economy of renewable energy, but promote the spiritual and material civilization in the rural areas and make contributions to harmonious society.

3. ANALYSIS ON RURAL RENEWABLE ENERGY POWER SUPPLY TRAINEES AND TRAINING FACILITIES

3.1 Analysis on the demand of personnel and facilities for training

The demand on the qualified personnel in 2005 was as follows,

(1) Administrative management from the Ministries of the Central Government: 14,800.

(2) R&D, design, system and engineering construction: 1,200

(3) Sale, management and service: 14,200

(4) Economy, finance and investment: 3,700

(5) Quality control, productive application and small-scaled commercial application: 27,200

The total qualified employment in 2005 is needed nearly 61,000, the one third shall have the qualified certificate and other 2/3 shall be the RE knowledge dissemination.

In 2008-2020 the trainee can be predicted according to production value, see table 1.

Table 1 Prediction of the demand of trainee in 2008-2020

	2008	2009	2010	2015	2020
*Total production value, $\times 10^8$ RMB	45.03	59.42	77.58	372.5	569.5
Number of employee, $\times 10^4$	1.74	2.3	3.02	14.72	22.57
Number of people, need be trained, $\times 10^4$	0.7	0.8	1.0	9.1	8.6

*: Refer to the total off-grid PV and wind power, including manufacturing, building, service and power generation etc.

3.2 Analysis of the basic facilities for RE sustainable training

As analyzing the need of the basic facilities for RE sustainable training, the followings will be considered, 1) Geographical location; 2) Training requirement of subject, number of trainee, levels of knowledge and so on; 3) The existent professional school and University. From the statistic of the existent professional schools and Universities, the existent training recourse can meet the need of basic facilities for RE sustainable training. It is necessary to supplement the testing equipments of off-grid PV and wind turbine to the training organization selected.

3.3 Status of training of rural renewable energy power supply in China

In the past, the training of power supply by renewable energy in rural areas only aims at training the personnel, such as those in manufacturing, engineering construction and plant operators, and never with the personnel training of policy management, economy and finance related to power and supply by renewable energy in rural areas. Schools of all grades and all levels (including universities and technical secondary schools and vocational school) have not offered the subjects of power and supply of renewable energy. Few organizations are training

professional personnel in power and supply of renewable energy and a few of them are training people of high grade, such as Master and Doctor Degree. For the implementation of state, local government and special projects aided by the international organizations, some training courses have been held, however a few for such kind sources of training is offered.

Compared with the specialties in conventional coal-fired and hydro power system, power transforming and transmitting and high voltage of higher education and vocational schools, there are very few organizations holding off-grid PV system, off-grid wind power study and few schools offer the subjects of new energy and renewable energy. The Universities with the subjects of new energy and renewable energy only train graduates of higher education, such as Master Degree and Doctor Degree. The subject of new energy and renewable energy for under graduates is basically as null and no emphasis is put on it in majority of Universities.

In summing up, the training of power supply of renewable energy of rural areas in China is not systematized and is not in regular basis.

4. PLAN FOR IMPLEMENTATION

4.1 Training targets setting

Targets in the long term

1) To make the education of RE knowledge be included into national normal education system.

2) In the future, the scope of the RE training will be extended to following items: PV (off-grid, on grid, BIPV), solar thermal utilization and power generation (solar heating water, heat supply and air conditioning); Pico hydropower, wind power (on/off grid), geothermal power generation and utilization, bio-energy etc.

3) Make the resources of RE vocational training and education more optimized and broad-distributed;

4) Build a long-term and effective mechanism, so as to promote rural RE power supply to develop speedily, steadily, orderly, and harmoniously.

Targets in the near future

1) Guideline of establishing sustainable training facility in the countryside should be fixed.

2) Make the vocation of RE be included into the national vocational category system.

3) Probe the problems addressing with the sustainable training of renewable energy in the countryside.

4) Establish the sustainable training facility of renewable energy, set down the total plan, training subjects and the scale of teachers and trainees

5) Setting sub-tasks for implementing the training of renewable energy power in the countryside as follows,

(1) Organizing the training and guiding centre.

(2) Making implementation of plan and rules for training.

(3) Compiling the teaching materials.

(4) Making the implementation plan for school education

(5) Compiling and making the scientific popularization and dissemination material via mass media.

(6) Evaluation and examination of training at phase.

4.2 Measures for establishing long-termed training facility

The requirements for sustainable training mechanism of rural areas are the followings,

1) The training of RE in the countryside should be combined closely with the vocational training and personnel management of Ministry of Personnel and Ministry of Labor of Society Security;

2) In order to make the training system sustainable, there should be the feasible training plan, strict certificate system, qualified teachers, good training materials, perfect facilities and strict supervision, checking and quality evaluation. Otherwise it

will end halfway and the effects cannot be realized. The training should be systematized and on regular base. The new employees should all be trained.

4.3 Establishment of training organizations

Training organizations setting-up should have close cooperation with the organizations at state levels. In order to make the training more effective, the organizations should deal with the following aspects:

1) Special organization of training: to establish an organization: state training and guiding center of RE. In west China, the sub-center of training will be set up, under the guidance, governing, and supervision of the State training and guiding center of RE. The function of the central training and guiding organization is to guide, manage, and supervise the overall training issues. The provincial training school or center will cooperate with the existing universities, academies or the professional schools. The candidate institutions of training in the local provinces will be selected by bidding method. The trainer for provincial training will be trained in State training and guiding center of RE, the local training parties will be directly dominated by State training and guiding center of RE. All the training organizations are non-profitable, government part-funding organization.

2) System guarantee is to establish rules and byelaws and everything should be done according to the policy and regulation.

4.4 Training plan

The qualification of enrollment: With the certificate of qualified examination or relative valid document.

The training means and methods: to attend the lecture, to practice and investigation. The practice and skill training shall be paid attention on.

With the trainee, according to the initial level, they will be classified into four levels; the sequence from the highest to the lowest is senior, medium, junior and beginner. The requirement for the each level of the trainee

can be set later on.

With the knowledge requirement to teach, it is categorized into the four parts, administrative management, technology, market and sales, and economy and finance. With the above-mentioned knowledge classification, each part is divided into 4 grades, from the highest to the lowest level; the grade sequence is 4th, 3rd, 2nd and 1st grade. The detailed requirement and contents of each grade of the different knowledge categories can be set by the expert team.

Methods for examination: paper testing, writing report or paper, actual operating; the score of exam is classified into five ranks: excellent, good, medium, passed, disqualifications.

Establish the training management information system. The function of training and information management system includes: management of training schools, management of teachers and students, management of study results and certificates, establish the data base of test questions database for application; functions of networks: issuing information and distance education by network.

With the administrative and financial officials in the central and local governments which have been involved with RE, the training will be gradually deployed later. The training of administrative and financial officials will be systemized. The RE certificate systems need to be included into policies of national official employment and annual assessment of working.

4.5 Certificate of training facility

Certificate of training is one of the criteria of evaluation on the training effect for the trainees. The certificate requests the following: (1) **Authoritativeness**; (2) **Coherence**; (3) **Validity**. (4) **Strictness**. (5) Those who have left the occupation more than 3 years can obtain the employment only by being trained again, (6) The certificate system of training in renewable energy power of rural areas should be included in the management of supervision, service and

production.

4.6 Training text book

The requirement for classification and gradation of knowledge,

A. Knowledge of rural RE power is classified into four parts as follows

- (1) Administrative management,
- (2) RE technology and system,
- (3) Market and sales,
- (4) Economy, finance, and investment.

B. Requirement for the each grade knowledge book is summarized as follows,

1st grade training book, with understandability, introduces the knowledge simply and clearly, with the explanations of examples, which is suitable for the majority people to read, who has the educational record of primary school.

2nd grade training book explains the profound knowledge in a simple way with examples, which is suitable for the people to read, who has the educational level of junior middle school and have the experience of working.

3rd grade training book, explains the knowledge systemically and generally, and emphasizes on the application and practice, which is suitable for the people who has the educational level of senior middle school and have the experience of working.

4th grade training book, explains the knowledge, its status and the latest evolution systemically and generally, with certain extent of discussion and researching, which is suitable for the people who has the educational level of high profession school and have the experience of many years working.

Herein, the specialty knowledge of the RE technology and system, only focuses on the off-grid PV power and off-wind power, including the mini-grid of village and the household system.

4.7 Training facilities and conditions

Training Organization should own the following facilities and conditions: complete set of apparatus, good training facilities, first

grade teachers and engineers. The training Organization should possess facilities of teaching economical management, electrical engineering and market sale and experiences in existent schools. It should provide conditions for the trainee to practice, exercise, and do the experiments.

4.8 Supervision and examination of training and quality evaluation

Function of the supervision: to supervise and examine the training process and check the problems that may occur during the training and evaluate the integrated benefits of training on renewable energy of rural areas. Other functions are to track those who have obtained the qualified certificates and have subsequent assessment with the trainees, and to select teachers for training.

Selecting and choosing of teachers for training should be carried out strictly according to the regulations and rules.

Inspection and evaluation should be done once a year to the training organization. The organizations with good results can continue the training, otherwise the qualification of training will be cancelled and rejected, and reselect the training organization.

5. SUGGESTIONS

(1) State Personnel Ministry shall organize the periodical training of RE laws and policies and RE knowledge dissemination within the range of governmental official training, especially pay more attention to the continuation education and training of the leadership of county level and township level.

(2) Ministry of Education arrange the corresponding specialties and subjects and courses with RE in the national long term developing layout, make the personnel education plan for RE power, the financial will be arranged in educational system accordingly.

(3) According to the actual need of rural RE power human resource, to make the plan

of national vocational skill training development. In compulsory education, the content of RE knowledge shall be arranged.

(4) According to the practical need, the village labor force for rural RE power shall be included into the training plan of Labor and Social Security Ministry. The job profile design should be commenced, with collaborating with the Labor and Social Security Ministry as soon as possible.

(5) Assisting the Association of Sciences, Propagation department and Mediums to promote the activities of RE power science propagation, in order to enforce the sense of RE power, especially to have the remote area herdsmen and farmers to possess the primary knowledge.

(6) It is suggested that national RE training organization will be in charge of training quality standard establishing, courses designing, certificate system, compilation of courses, training teachers and so on, and carry out the international collaboration, with cooperating with other involved organization. Provincial RE training organization will be in charge of establishing local training centers and carry out the local training working, assisting provincial DRC to constitute the provincial training plan. The training facility will make effort to the local existent vocational education or skill training organizations to develop the cooperation, and gradually to be absorbed into the normal training facility.

(7) RE sustainable training mechanism should be included into the management service system of off-grid power supply in the rural areas and make it systematized and regularized, especially to execute the system of employment with qualified profession certificate.

contributions and discussion.

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