Development of Renewable Energy for Rural Economy Households with the Blended and Participatory Learning Processes in Kalasin Province in Thailand

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[Abstract] To investigate and develop renewable energy for use in households in a rural economy, blended and participatory learning methods that represented were used; they used multi – stage to assess a sample of 30 families. A knowledge-measuring framework, behavior perceptions, and renewable energies were used. Using the renewable energy of the rural economy households with blended learning process techniques composed six categories: using energy in the rural households, the affective energy use of the experimental training with the participatory learning, the energy knowledge, the development of energy methodology, the household administration, and the follow-up and assessment of household practices. Energy knowledge and behaviors of their quality renewable were significantly differentiated (ρ<0.05); the household's outcomes were the differences between the pre- and post- renewable energy with the blended learning process techniques and were significantly differentiated (ρ<0.05).

[Keywords] bended learning; development; investigation; kalasin province; participatory learning; renewable energy; rural economy households

Introduction

Renewable energy is generally defined as energy that comes from resources which are naturally replenished, such as sunlight, wind, rain, tides, waves and geothermal heat (Thebulletin.org, 2011). Renewable energy replaces conventional fuels in four distinct areas: electric generation, hot water/space heating, motor fuels, and rural energy services (Thebulletin.org, 2011). Renewable energy resources exist over wide geographical areas, in contrast to other energy sources that are concentrated in a limited number of countries. Rapid deployment of renewable energy and energy efficiency is resulting in significant energy security, climate change mitigation, and economic benefits. In international public opinion surveys, there is strong support for promoting renewable sources, such as solar power and wind power (United Nations Environment Program, 2007, p. 3).

While many renewable energy projects are large-scale, renewable technologies are also suited to rural and remote areas and developing countries where energy is often crucial. The United Nations' Secretary-General, Ban Ki-moon, has said that renewable energy has the ability to lift the poorest nations to new levels of prosperity (World Energy Assessment, 2001, p. 21).

Based on the Renewable Energy Policy Network for the 21st Century (REN21's 2014) report, renewable energy contributed 19 percent to our energy consumption and 22 percent to our electricity generation in 2012 and 2013. Modern renewable forms, such as hydro, wind, solar and biofuels, as well as traditional biomass, contributed in about equal parts to the global energy supply. Electricity generation from fossil fuels and nuclear accounted for about 78 percent, and worldwide investments in renewable technologies amounted to more than US$ 214 billion in 2013, with countries like China and the United States heavily investing in wind, hydro, solar and biofuels. At the national level, at least 30 nations around the world already have renewable energy that contributes more than 20 percent of the energy supply. National renewable energy markets are projected to continue to grow strongly in the coming decade and beyond (The Renewable Energy Policy Network for the 21st Century, 2014, pp. 13-17).

Overview

Renewable energy involves natural phenomena. Wind power is growing at the rate of 30% annually, with a worldwide installed capacity of 282,482 MW at the end of 2012, and is widely used in Europe, Asia, and the United States. At the end of 2012, the photovoltaic (PV) capacity worldwide was 100,000 MW, and PV power stations are popular in Germany and Italy. Solar thermal power stations operate in the USA and Spain, and the largest of these is the 354 MW SEGE power plant in the Mojave Desert. The world's largest geothermal power installation is the Geysers in California, with a rated capacity of 750 MW. Brazil has one of the largest renewable energy programs in the world, involving production of eternal fuel from sugar cane, and ethanol now provides 18% of the country's automotive fuel. Ethanol is also widely available in the USA (Leone, 2011).

As of 2011, small solar PV systems provide electricity to a few million households, and micro-hydro electricity has been configured into mini-grids that serve many more. Over 44 million households use biogas made in household-scale digesters for lighting and/or cooking and more than 166 million households rely on a new generation of more-efficient biomass cookstoves. The United Nations' Secretary-General Ban Ki-moon has said that renewable energy has the ability to lift the poorest nations to new levels of prosperity. Renewable energy resources and significant opportunities for energy efficiency exist over wide geographical areas in contrast to other energy sources that are concentrated in a limited number of countries. Rapid deployment of renewable energy, energy efficiency and technological diversification of energy sources would result in significant energy security and economic benefits. Renewable energy replaces conventional fuels in four distinct areas: electricity generation, hot water/space heating, motor fuels and rural (off-grid) energy services (The Renewable Energy Policy Network for the 21st Century, 2014, pp. 19-25). From the end of 2004, worldwide renewable energy capacity grew at rates of 10–60% annually for many technologies. For wind power and many other renewable technologies, growth in 2009 accelerated to the level of the previous four years. More wind power capacity was added during 2009 than any other renewable technology. However, grid-connected PV increased the fastest of all renewables technologies, with a 60% annual average growth rate. In 2010, renewable power constituted about a third of the newly built power generation capacities (Jacobson & Delucchi, 2011) as seen in Figure 1.

In terms of the renewable energy in development countries, renewable energy can be particularly suitable for developing countries. In rural and remote areas, transmission and distribution of energy generated from fossil fuels can be difficult to produce and expensive. Producing renewable energy locally can offer a viable alternative. Technology advances are opening up a huge new market for solar power for the approximately 1.3 billion people around the world who don't have access to grid electricity. Even though they are typically very poor, these people have to pay far more for lighting than people in rich countries because they use inefficient kerosene lamps. Solar power costs half as much as lighting with kerosene. An estimated 3 million households get power from small solar PV systems. Kenya is the world leader in the number of solar power systems installed per capita. More than 30,000 very small solar panels, each producing 12 to 30 watts, are sold in Kenya annually. Some countries are also turning to solar power to reduce their costs and increase their sustainability. Renewable energy projects in many developing countries have demonstrated that renewable energy can directly contribute to poverty reduction by providing the energy needed for creating businesses and employment. Renewable energy technologies can also make indirect contributions to alleviating poverty by providing energy for cooking, space heating, and lighting. Renewable energy can also contribute to education, by providing electricity to schools (Bullis, 2012), as seen in Figure 1.

Training and practicing

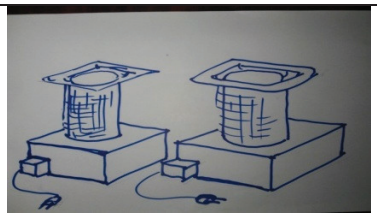
High Efficiency Brazier

Using renewable energy in rural household families

Selected renewable energy global indicators	2008	2009	2010	2011	2012	2013
Investment in new renewable capacity (annual) (10^9 USD)	130	160	211	257	244	214
Renewables power capacity (existing) (GWe)	1,140	1,230	1,320	1,360	1,470	1,560
Hydropower capacity (existing) (GWe)	885	915	945	970	990	1,000
Wind power capacity (existing) (GWe)	121	159	198	238	283	318
Solar PV capacity (grid-connected) (GWe)	16	23	40	70	100	139
Solar hot water capacity (existing) (GWth)	130	160	185	232	255	326
Ethanol production (annual) (10^9 litres)	67	76	86	86	83	87
Biodiesel production (annual) (10^9 litres)	12	17.8	18.5	21.4	22.5	26
Countries with policy targets for renewable energy use	79	89	98	118	138	144

Table shows selected renewable energy global indicators (Bullis, 2012).

High efficiency charcoal brazier



Economy brazier model for invention

Training and practicing, succesful

Testing production

Biomass technology

Bicycle water pump

Using rural renewable energy

Figure 1. Growth of Renewable Energy in the project of Karasin Province in Thailand

Focus on renewable energy in Thailand shows that Thailand has potential to become energy hub in ASEAN. Thailand's strong agricultural base and long-standing experience in the biofuels sector could position the country to become the Brazil of ASEAN, and the government has already stated its objective of becoming a hub for ethanol trade. Thailand has to mainly rely on energy imports. Findings from the 2011 data show that over 60 percent of primary commercial energy demand was derived from importation; oil import took a high proportion at 80 percent of the total domestic oil consumption, but has not kept up the increasing trend since it cannot increase domestic petroleum production to meet the demand. Substance development on energy will reduce dependency and imports of oil and other energy resources, additionally sharing the risk in providing fuel for power generation, which previously depended on natural gas at over 70 percent. Renewable energy would be counted as target fuel expected to significantly substitute for natural gas for power generation, especially solar energy, wind energy by type of wind turbine farm, micro-hydro, biomass, biogas, and waste/garbage. Just in case such those renewable energy technologies would cost less, getting broader acceptance could develop it as major

energy for Thailand power generation in the future. The government, therefore, assigned Energy Ministry to establish the Renewable and Alternative Energy Development Plan goal for 25 percent in 10 years; the so-called as AEDP 2012-2021, will identify the framework and direction of Thailand's renewable energy development. Promoting community to collaborate broadens production, and consumption of renewable energy will be emphasized as Thailand's policy. Promoting and supporting production of energy from MSW in the medium and small-sized Local Admin Organizations (The Ministry of Energy, 2012).

In terms of the Kalasin Province, Kalasin is one of the northeast provinces (*changwat*) of Thailand. The province was established by the *Act Establishing Changwat Kalasin, BE 2490 (1947),* which came into existence 1 October 1947. In the past, a goal of the Government of Thailand was for all households in the country to have access to electric power. Consequently, the installation of an electric power generation system for renewable energy project was created in villages that had no electric power. The aim of the government project is to promote the use of renewable energy, especially solar PV systems. Solar Home System (SHS) is the first solution for the no-power supply problem. The purpose of this research was to survey by questionnaire to obtain a sample solar home system use in rural villages in Kalasin Province's project for enhancing renewable technology use and to support a good rural health, good demand, good income, and good daily life. However, the rural people Karasin users do not have enough knowledge for operating and maintaining the renewable system, which is a disability. The policy of the Kalasin Provincial Governor has emphasized an important project to take care and select volunteers from the villages for training and practicing the renewable energy use, which means someone, is going to make renewable energy technology for using in the household families within the micro community and the micro grid. Kalasin is an agricultural province producing sticky rice and other cash crops, such as manioc (cassava) and sugar cane. Families are generally poor in this essentially rural area and make ends meet by producing baskets and the silk for which the region is renowned (Wikipedia 2014).

Focusing on the blended learning shows a formal education program in which a student learns at least in part through online delivery of content and instruction with some element of student control over time, place, path, or pace. While still attending a "brick-and-mortar" school structure, face-to-face classroom methods are combined with computer media activities. Proponents of blended learning cite the opportunity for data collection and customization of instruction and assessment as two major benefits of this approach. Schools with blended learning models may also choose to reallocate resources to boost student achievement outcomes (Strauss, 2012). The concept of blended learning has been around for a long time, but its terminology was not firmly established until around the beginning of the 21st century. One of the earliest references to the term appears in a press release in 1999, when the Interactive Learning Centers, an Atlanta-based education business, announced its change of name to EPIC learning. Technology-based training emerged as an alternative to instructor-led training in the 1960s on mainframes and mini-computers. The major advantage that blended learning offers is scale, whereas one instructor can only teach so many people Technology-based training emerged as an alternative to instructor-led training in the 1960s on mainframes and mini-computers. The major advantage that blended learning offers is scale, whereas one instructor can only teach so many people. Blended learning has a strong dependence on the technical resources with which the blended learning experience is delivered; these tools need to be reliable, easy to use, and up to date in order for the use of the Internet to have a meaningful impact on the learning experience (Garrison & Kanuka, 2004).

A list of participatory learning techniques that group promoters should use during group formation and development of income-generating enterprises is presented here. The list is intended as a guide only. Be creative when using methods. Try to use drawings rather than words as much as possible. Use pictures, drawings, flannel boards, puppets, and so on. Write and draw on poster-size sheets of paper. Special attention should to be paid to someone's roles and work. The participatory learning environment can refer to any sort of environment in which users can co-construct or at least communicate through some form of computer-mediated communication. This definition includes most modern educational technologies (which we will not further elaborate) to specific forms of advanced learning environments that are based on both situated and constructionist principles. Networked *and* situated micro worlds might be an appropriate description for these.

Researchers whose status is as a committee of the Project of Invention on Renewable Energy Technology for Sufficiency Economy and Sustainable Energy of Rural Household Families in the Kalasin Province at the local household level and emphasizes the 10-Year Plan, the Policy of UNAP on renewable energy, and the 10-Year Plan and Policy of the Ministry of Energy of Thailand, giving priority to three main strategies Thailand has taken with regards to intervention in rural or fundamental technologies to support the families in Karasin Province. How can this project management support the poor household families learning development for inventing the renewable energy technology for families' use? What are ways the volunteer and rural community have representation and support from this project and high quality to create it or manage it successfully? How can committees for this project promote renewable energy use that facilitates people's daily lives, develop a blended learning technique using the participatory learning method so that volunteers can enhance their social skills and create the qualifications they need to support the economy of the basic household family sufficiently? This study ought to answer the questions of how to formulate a common concept and guidelines for rural household's volunteer developing skills; provide concrete operational plans for effective mobilization, management, and resource utilization of the use of households' outcomes; to provide guidelines for data and information collection; and to incorporate volunteer development as an integral part of developing renewable energy for rural community reform.

Research Objectives

1) To investigate individual characteristics of general households that using renewable energy data about volunteer participants who are selected to participate in the Project of Invention on Renewable Energy Technology for Sufficiency Economy and Sustainable Energy of Rural Household Families in Kalasin Province.
2) To develop the use of renewable energy in households by using participatory learning techniques.
3) To investigate the effects of developing renewable energy by volunteers from households to determine such issues as knowledge levels and, energy and renewable energy behaviors.
4) To compare the knowledge, behaviors of the individual household families who volunteer to analyze the pre- and post- use of energy and renewable energy in the six-month period of the blended learning process.
5) To administer the household family's change in economy in the six months using the blended learning process.

Research Methodology

The research on investigating the development of renewable energy among rural economy households using the blended learning processes in Kalasin Province in Thailand used research and development techniques from the participatory and blended learning methods. It used volunteers from rural household families for training and practicing the use and development of renewable energy for the Project of Invention on Renewable Energy Technology for Sufficiency Economy and Sustainable Energy of Rural Household Families in Kalasin Province.

Sample

A Project of Invention on Renewable Energy Technology for Sufficiency Economy and Sustainable Energy of Rural Household Families in Kalasin Province developing and using rural volunteers to enhance and support renewable energy in their household communities was administered with a sample size of 30 persons from 30 rural household families throughout Karasin province. Using multi-stage cluster random sampling and sample random sampling this project took 9 months of research from May 2013 to January 2014. This study administered and selected of the sample size as follows:

Step 1. Using Cluster Random Sampling Technique. Using cluster random sampling, lots were drawn to obtain the rural household families from throughout districts of Kalasin province; this sample was from Khammung District's rural household families.

Step 2. Using Cluster Random Sampling Technique. Using cluster random sampling, the members of the rural household families from the throughout sub-districts of the Khammung District were chosen. This sample was from Nabon Sub-district's rural household families.

Step 3. To select a sample size from the readiness families. To control a sample size, persons who were less than 65 years old were chosen; additionally, they had to be able to read, write, and communicate in Thai, to have household energy source assets and the ability to develop these assets to renewable energy for sufficient economic energy. The project used a sample size of 30 persons from 30 rural household families who volunteered.

Research Procedures

The research used both qualitative and quantitative methods in a three-step approach as follows: 1) *Apply Learning Design.* To support and develop renewable energy using volunteers from rural household families, to apply the participatory learning technique designed to build thinking of the volunteers as a group dynamic process considering the local context made up of the following: local problems, the methodology that best satisfied each local community, local sources, local folk wisdom, and all aspects of the local environment. Learners were able to analyze and synthesize their assets, which produced investment from the implementation of renewable energy in their household families. 2) *Train and Practice the New Innovation and Technology.* Rural volunteers needed to agree with the new innovations and technology for their training and practice using the renewable energy technology; trainers, who were experts in the renewable energy technology and the blended learning method, provided quality and quantity analysis for the project plan. 3) *Plan for Developing Renewable Energy Integrations.* Researchers used assessment thinking for building the participant project using blended learning methods to study the quality and quantity of the research first; then, they used quantitative research to support the research objectives, which it controlled by the whole factors of this study shown in Figure 2.

$$O_1 \quad X_R \longrightarrow O_2 \longrightarrow X_D \longrightarrow \longrightarrow O_3$$

Figure 2. Designed step on this research procedures

O_1: To investigate of renewable energy data, such as using main energy (fuel, electricity, gas, ant etc.), using renewable data and problems of renewable energy development.

X_R: Developing processes of administration.

O_2: Developing assessment

X_D: Resulting development from the first stage process of project

O_3: Post assessing development of the project

Developing Renewable Energy for Household Family' Uses

This step investigated the development of renewable energy use in the rural household family, composed of the following:

1. To investigate of main and renewable forms of energy used in the rural household families.
2. To reflect of effects of the using energy and renewable energy in the rural household families.
3. To learn the use of energy and renewable energy in the rural household families.
4. To administer of the using energy and renewable energy in the rural household families.
5. To follow up of the renewable energy use in the rural household families.
6. To develop the participants' skills by training and practicing the innovative methods and technology used within the context of group dynamics and qualitative research through interviews, observations, analysis, and synthesis between groups.

7. The effects of the training and practicing questionnaire; this questionnaire was to assess the participants' perceptions of their training and practice workshop of the renewable technology.
8. To study the curriculums of the renewable energy and technology classes for supporting and understanding development of the volunteers in the rural household families using the participatory learning techniques.
9. Using techniques for developing the renewable energy technology, volunteers must be trained and practice from experts in renewable energy technology from the Ministry of Energy and the Committee of this project.
10. To assess the volunteers' abilities and skills to be able to use the renewable energy technology in their families.

Research Instruments

This study was planned to administer the research instruments, such as;

1. The type and technical survey instruments; this instrument was used for survey, analysis, assessment, and evaluation of the volunteers' participation of this project with an observation, digital record camera, motive video recording camera, and sound tape recorder.
2. The questionnaire on group dynamic discussion; this instrument used for volunteer's perceptions of their using the main and renewable energy of their energy source assets and problem's use.
3. The test of household knowledge; this instrument was the yes or no responses, and used for testing the knowledge of volunteers' using the renewable energy technology in the rural household family.
4. The questionnaire on volunteer behavior; this instrument composed with the 4 Rickert's ranking scale and used for volunteers' perceptions of their behaviors to their using the renewable energy technology in the rural household family.
5. The storing foundational data instrument; this instrument used for reporting the payment electrical outcome per month, which it has supported from the Office of Thailand Research Fund (TRF) with the project of good personal, good health, and good income of Karasin Province.
6. The reflective effects of the training and practicing questionnaire; this questionnaire was to assess the volunteers' perceptions of their satisfaction to their training and practicing workshop of the renewable technology for use.

Research Analysis

Qualitative Data Analysis. The qualitative research techniques (meeting, group dynamic discussion, sub-group discussion, observation, deep interview, individual questions, recording worksheet, recording sound tape, recording transcript, and video recording tape) were analyzed using qualitative data, such as data-based activity reform, group data organization, data synthesis, and data pattern with content and description analysis techniques; quality codes were used for qualitative analysis.

Quantitative Data Analysis. Using foundation statistics (mean average and standard deviation) were used to analyze the volunteers' responses to using the renewable energy in their households. Associations between the volunteers' responses on the use of renewable energy that was built from the Wilcoxon statistic form (IOC index). Testing the hypothesis, comparisons were made between volunteers' training and practice skills of using the renewable energy to the volunteers' abilities to use renewable energy, and discrimination with other item reliability correlation was assessed.

Results

This study includes qualitative and quantitative data interviews from a volunteer group of representative memberships of the Project of Invention on Renewable Energy Technology for Sufficiency Economy and Sustainable Energy of Rural Household Families in Kalasin Province, who indicated that the volunteers' household family problems due to their abilities and skills for using renewable energy technology and to learn, train, and practice this project to achieve the response's high quality, incorporating thinking ability and problem-solving with blended and participatory learning methods.

This results indicated that a volunteer group composed of 18 males and 12 females, whose ages were 45 – 54 years, having an educational classification at grade 9, 1 single person, members of a household family was 4-5 persons, and incomes of their family was 5,000 – 10,000 THB, approximately. In terms of using the energy and renewable energy of the rural household family, most of them used the electrical energy (97%) for household energy, a charcoal brazier for their cooking was highest energy (93%), and using fossil fuel for transportation were important outcomes. The investigation focused on using energy and renewable energy from the data of the qualitative study; there were too many vehicles (trucks, cars, motorcycles, tractors, lawnmower, and water pumps for agriculture and transportation), which indicated that bills were 2,000 – 3,500 THB/month.

Focusing on renewable energy types for rural household families' uses, namely biogas, Chinese braziers, charcoal braziers, biomass braziers, solar energy ovens, a water bicycle from underwater, solar cells, and charcoal economy briquettes for cooking were investigated. This study reflected that rural household families have emphasized the important roles of the renewable energy for their daily lives , volunteers were able to invent and learn for foundational knowledge, to train and practice the charcoal brazier and charcoal economy briquettes efficiently for supporting household family economics and could be applied to inventing renewable energy for their economic purchase. However, there were higher problems of volunteers' management; it was high cost, not enough was budgeted for investment, lack of instrument for supporting household economics, lack of raw materials, and it was too difficult (see in Figure 1).

In terms of the developing methodology, it was a guideline to self-development and self-skills of this volunteer group to build group learning in support of group power; information and promotion; increasingly promoting income; to invent sustainable, renewing technology suitability in rural households, and to make sense of comparisons between incomes and outcomes of rural household family life. The rural household families have had other renewable energy development, such as pork husbandry in a plug animal group, taking plant for supporting feed for pork, and using the biogas invention with manure fertilization in the 200-lit metal water jar for community use; the charcoal kilns were invented for developing renewable energy training and practice ; this kiln has a capacity of 200 lit that it made from burning weeds to the efficiency coal; the volunteers have been interested in this innovation and were able to invent this kiln at this family and share it with their community. The biomass energy made from rice-husks is a popular, renewable energy technology for volunteers; it is made from iron rings 5 inches in dimension and surrounded by sieve iron, which is attached on an iron box 12x12x24 $inch^3$. This renewable technology supports cooking and water boiling very efficiently.

In terms of the quantitative data, the volunteers indicated that their learning knowledge responses were changed from of the pre- to the post-knowledge assessment and were significantly differentiated at the level .05. Using renewable energy behavior, the volunteers' perceptions of their behaviors' responses were differentiated between the pre- and post-behaviors at the level .05. To compare the pre- and post use of the energy and the renewable energy of this volunteer group was statistically significant at a level of .05. Focused on the rural household family expenses of the volunteer group, the expenses' cost for electrical power, fuel energy, and fossil energy for agriculture, cooking, or transportation were lower than previous expenses. It is suggested that the rural household families in Kalasin Province have turned to the use of household energy with the renewable energy and are able to take the community power for inventing renewable energy in their families and to produce a sufficiently sustainable economy.

Discussions

To investigate and develop renewable energy for rural economy households using blended and participatory learning processes in the Kalasin Province in Thailand is a main goal. The primary goal was to select volunteers to enter training and practice the creating rural renewable technology for the Project of Invention on Renewable Energy Technology for Sufficiency Economy and Sustainable Energy of Rural Household Families in Kalasin Province. This renewable energy research is to invest in renewable energy for the development and demonstration projects that accelerate deployment of renewable

energy. Further goals are to use or advance market adoption of innovative renewable energy technologies, to simplify interconnection to support policies that enable sustainable, renewable energy generation, integration, security, and use, especially to use of this production of renewable energy technologies in rural household families. It also uses the qualitative and quantitative techniques to investigate and develop volunteers' skills, learning, and assessment of their perceptions to their experiences with a curriculum of blended and participatory learning methods. In order to maximize the investment benefit to Kalasin Province rural renewable energies and natural gas customers, the research focuses on deployment and integration projects targeted at three key process scales: utility scale, community scale, and building scale.

Using the qualitative technique to include the focus group, group dynamic discussion, sub-group discussion, observation, deep interview, individual asking, recording worksheet, recording sound tape, recording transcript, and video recording tape; results were analyzed with the qualitative data, such as data-based activity reform, group data organization, data synthesis, and data pattern with content and description analysis techniques; using quality codes for their opinions from a group of village leaders, the sub-district administration headers and memberships, folk wisdom, the housemaid groups, the sufficiently economic village groups, and the village committees. These opinions are commendations for the volunteer group for their participating members, such as lack of learning and skills, reducing data for investment and cost, too costly for inventing a renewable energy technology for use in their local community areas; volunteer membership is not experienced enough to investigate a self-interested curriculum that has been used the local source, material, household environment, community conservation, and self-activities. The host of this project ought to demonstrate inventing renewable energy with the local environment resources and be able to reduce use of this local source.

Meeting the Ministry of Energy of Thai nation's energy needs (Ministry of Energy, 2012), maintaining a strong economy, and reducing emissions of greenhouse gases are inextricable goals. Solutions must include the development of carbon-free energy sources that are environmentally sustainable and economically viable. Renewable energy sources, including rural renewable energy with the efficient charcoal energy, wind, manure gas, composed fertilizer, sufficient brazier for cooking, solar energy, and biomass/biofuels are the most rapidly growing energy sectors within the rural renewable energy technology for the rural household families were investigated in Kalasin Province and hold the promise of becoming a significant portion of Thailand's energy supply.

In the USA, renewable energy sources depend on improved atmospheric information to be economically viable and successfully integrated into the U.S. electrical grid system. Further, proposed ocean-based renewable energy technologies, including hydrokinetic energy and ocean thermal energy conversion, will require research about ocean conditions and processes before they can be developed. NOAA can contribute to the development and integration of renewable-energy sources into the U.S. energy system through better atmospheric and oceanic observations, models, forecasts, and analysis tools. There is considerable uncertainty about the impacts of renewable energy farms on the environment, weather, and climate across a range of spatial and temporal scales. Similarly, the effects of natural variability and human-caused climate change on renewable energy potential need to be assessed. NOAA is uniquely qualified to perform the research needed and to develop products that address these areas to help inform decision makers.

The proposed U.S. Smart Grid is supposed to replace the antiquated current U.S. electrical grid. The Department of Energy describes the U.S. Smart Grid as a 21st century U.S. electric system connecting everyone to abundant, affordable, clean, efficient, and reliable electric power anytime, anywhere. Nevertheless, it is clear that more users will be impacted by meteorology, e.g., home users of electricity will make decisions based, at least in part, on weather forecasts. NOAA's capabilities to improve short-term forecasts of wind and solar radiation could support the wide-scale use of renewable energy by the future U.S. Smart Grid. Additionally, radiation anomalies in the ionosphere, in the form of solar storms, affect the electric grid. NOAA's forecasting of these solar storms can help grid operators prepare for these events to mitigate their impacts (Department of Energy, 2013). Similarly, the results of this research indicated that the renewable energy to investigate, invent, and find the rural renewable energy

technologies at the same situation in the renewable energy for home users in USA.

Research on renewable energy in the developing countries, rural areas continue to be home to the majority of the population in Africa. The importance of providing modern energy to rural areas cannot, therefore, be over-emphasized. Despite numerous efforts by governments and donors in the region to promote solar photo-voltaics for rural electrification, (almost every country in the region has had a rural electrification PV project), access to modern energy in rural Africa continues to be woefully low. In addition to being unaffordable to the rural masses, solar PV has the limitation that it can only be used for lighting and powering low-voltage appliances. This article reviews emerging trends in the rural energy sector of sub-Saharan Africa, and discusses the limitations of over-reliance on solar PV. It suggests possible options that could have greater impact on rural clean energy development. For the majority of rural households in the region, biomass fuels will continue to be the dominant fuel of choice. Efficient technologies for the use of biomass would, therefore, ensure that scarce biomass resources are effectively utilized and reduce the negative impacts of biomass on women's and children's health. Solar thermal, wind pumps, micro/pico hydropower and cleaner fuels, such as kerosene and LPG, have not received adequate attention from policy makers. These energy options could significantly improve the performance of rural small and micro enterprises (Karekezi & Kithyoma, 2008). The results of this research indicate that the renewable energy technologies and use by the rural household families in Karasin Province of Thailand and African countries share similarities. The main principles of traditional rural household activities for their daily life for using renewable energy for supporting themselves are in the same situation.

To compare of this research and a research on renewable energy for supporting rural household in China, research has provided the National Renewable Energy Laboratory (NREL) and been prepared in accordance with special tasks in the US – China Energy Efficiency and Renewable Energy Protocol. The report offers an in-depth feasibility analysis of off-grid renewable energy systems and a comprehensive socio-economic assessment of renewable energy utilization in Western China. The Center for Energy and Environmental Policy (CEEP) is solely responsible for the findings and recommendations of the report. The cooperation and advice of China's Ministry of Agriculture, the Chinese Academy of Science — Institute of Policy Management, and the Center for Renewable Energy Development (CRED) are much appreciated. During the past twenty years, China has provided hundreds of millions of rural people with access to electricity (China Electric Power Yearbook, 1996).

The major approaches to rural electrification have been the extension of power grids and the exploitation of small hydropower or micro-hydro. Despite these accomplishments, over 60 million people living in rural China, one-fifth of whom are in Western China, still have no access to electricity (China Electric Power Yearbook, 1996). Due to the prohibitive cost of extending grid services and the lack of hydropower resources in these remote locations, exploring appropriate ways to provide electricity to these communities has been a key issue for the Chinese government. Under bilateral agreements between the U.S. Department of Energy and the Chinese Ministry of Science and Technology (the U.S-China Energy Efficiency and Renewable Energy Protocol), the National Renewable Energy Laboratory (NREL) and the Center for Energy and Environmental Policy (CEEP) at the University of Delaware have conducted a four-year research project examining off-grid renewable energy options for rural electrification in Western China (Zhou et. al., 2001).

As stated above, energy policy tends to be written by and for an urban population. This ignores half of all world citizens and undermines their ability to improve their livelihoods and to contribute to broader social, commercial, and environmental goals. Rural areas represent 90% of all territory households and 56% of the population. They generate 43% of all economic value and support 55% of all employment. The communities are increasing, increasingly diverse, and increasingly mirror the spread of commerce and services seen in urban communities. Despite this, policy makers responsible for rural areas tend to focus only on agriculture – important, yes, to the economy and identity of rural communities but only a small (and shrinking) part of the story. Rural communities face considerable challenges. Income per inhabitant ranges from 21% to 62% lower and, although the picture is not uniform across the world, unemployment tends to be higher too, as does fuel poverty. They need help and support, therefore,

particularly when it comes to energy choices, which they are not currently receiving from world's regulators (Morris & Chapman, 2010).

Many homes or rural households and businesses are off-grid and other rural technologies, with no access to mains gas and, in some cases, electricity. This could be an opportunity to embrace renewables, but in fact access to a genuinely diversified energy mix is generally limited. This means that rural communities have a higher carbon footprint than they need to and often higher, per person, than their urban compatriots, rural communities are forced into choosing high-polluting energy sources, such as coal, heating oil or wood, and energy efficiency in housing is expensive, limited, and, therefore, scarce. In Thailand, for example, half of all rural households are predated with little incentive to insulate and little access to rural renewable energy technologies; these rural household families in the villages throughout Thailand are likely to remain energy inefficient. Much of the rest of the world faces a similar situation.

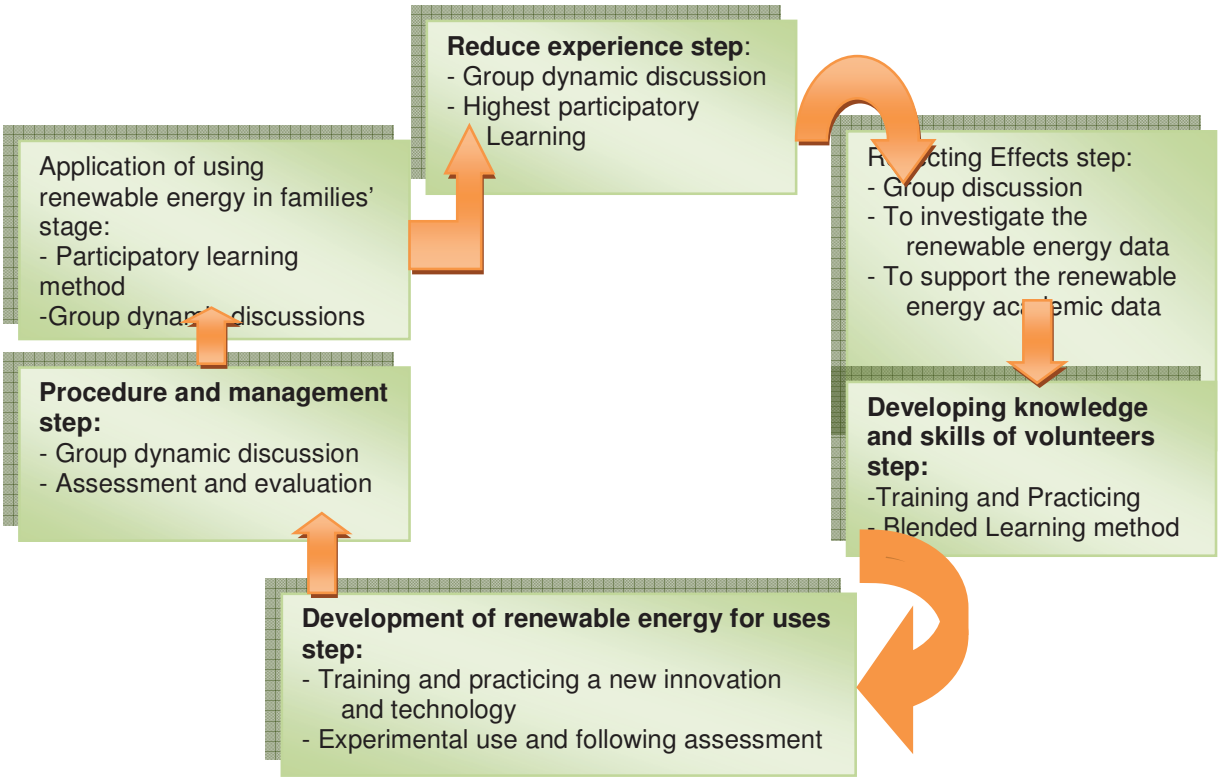


Figure 3. Significance of the development of renewable energy model for rural household uses

This research study reflects that having access to a variety of energy solutions that are accessible, inexpensive and/or supported by government will help rural communities bring themselves out of energy poverty and maximize their potential. Figure 3 shows the processes of the developing renewable energy for the rural economy household families of the results of this research study (see Figure 1 and 3).

Suggestions

There are many options for using renewable energy at home, including solar panels and small wind turbines. Solar panels are the most popular form of renewable energy today. They can be used to generate heat, electricity, and indoor and outdoor light. However, if someone lives on at least one acre of land with an ample wind resource, he can generate his own electricity using a small wind electric system. People can also use a small wind turbine for pumping water or to charge a sailboat battery. They may have also heard of using a geothermal or ground-source heat pump to heat and cool a home. While not technically a

renewable energy technology, this energy-saving technology makes use of the constant temperature near the earth's surface for heating and cooling. In addition to using renewable energy in their home, someone can buy electricity made from renewable energy, like the sun, wind, water, plants, and geothermal from their utility company. Checking with their local utility for more information, this situational status is an area of the modernization countries.

However, if someone lives in a developing country and is too poor for management of his daily life, what should he do? This article has reported information from various sources, books, journals and websites that have been collated first. After providing an overview of the world energy usages, the status of energy use in India has been summarized. Subsequently, the renewable energy technologies must be used for people who live in the rural villages throughout Thailand and other countries, namely solar energy, bio-mass energy, manure animal fertilization, sufficiency charcoal brazier, bio-fuels, and others (these are the focus areas of this paper) have been examined in more detail. Suitable suggestions have been indicated wherever appropriate. A country's economy depends upon its energy production and consumption to try to increase the production rate. Another option is import it from the rural household families in Kalasin, Thailand, and other countries, but it costs much. For a strong economy, researchers ought to have self-dependence over their energy resource and have a huge proven coal reserve, ultimately.

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