

The Development and Promotion of High School Energy Technology Curriculum

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Abstract

The teaching of life cycle energy is not only an important topic on today's current energy shortage and preservation, but also plays a considerable role in advanced technology. However, how to generate energy efficiently, take advantage of and investigate energy is a lesson that must be learnt in our basic education. This study, which has received an award from the national science council, has introduced our school's utilization of smart grid technology as well as the implementation hydrogen batteries, solar energy, and biomass energy as primary energy sources. With the importation of our "Energy Monitor System" and its app, we established and commercialized the life cycle energy teaching aids. There are four main parts within this study: 1. Innovation, research and development training for students 2. The construction of life cycle energy forum 3. The exploitation and programming of life cycle energy models 4. The commercialization of our investigation results: collaborate with industry to commercialize the life cycle energy models.

Keywords: Energy House, Solar

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Introduction

Since the Industrial Revolution, humans have been immoderately consuming environmental resources in order to attain economic development. After several energy crises, we gradually discovered that resources on earth are actually limited, and that eventually, it is possible that those natural resources will become exhausted (Executive Yuan 2013, R.O.C). Therefore, the exploitation of wind power generation, photovoltaic, biomass energy, geothermal energy, and marine energy is becoming a pivotal topic on Green Energy and Environmental Protection (Ministry of Economic Affairs 2014, R.O.C). Moreover, the former vice president of Taiwan Industrial Research Institute, Dr. Hsin-Sen Chu, likewise promotes the concept of Sustainable Energy, a goal that is worth pursuing for the sake of sustaining earth's resources.

The curriculums regard to the topics above, are now seldom appear. Thus, the Mingdao High School Natural Science work team manages a series of courses in the area of Physics, Chemistry and Biology. For example, it has courses in Renewable Energy, Energy Conservation, Hydrogen Fuel Cell, Biomass Energy, and Biotechnology on the topic of Renewable Energy and Green Energy. These classes have been incorporated into senior high school curriculum and have already been put into effect after careful evaluation. During the time of progressing, we got the remarkable chance to investigate achievements and got approval from the students. In order to continue the research achievements of the energy extension, the investigation will share the result with the school's Energy Monitoring Information to develop an APP.Rise students' interests through environmental projects

永續能源政策綱領

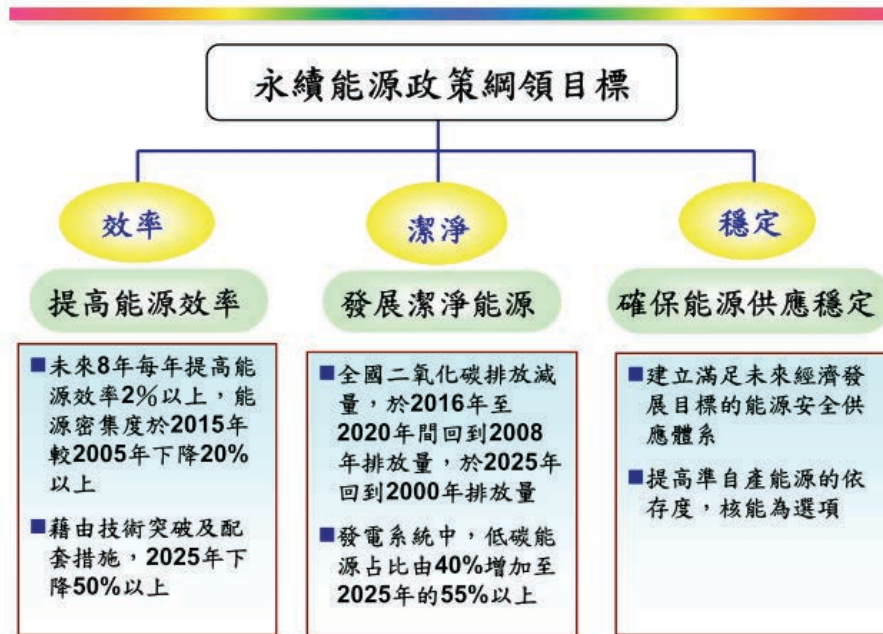


Figure 1. Sustainable Energy Policy Statement (Dr. Hsin-Sen Chu's speeches)

Research Methods

In this study, we first investigated the structures of Energy House and Smart Grid, then developed them into teaching patterns, below are the followings:

(1) The structure of the Energy House

Energy House is a energy system composed by solar, wind energy, hydrogen and various types of green energy, as shown in figure 2. There are two ways to produce hydrogen:

- Food waste hydrogen production: Utilizes, retrieves, ferments and decomposes the leftovers in order to create hydrogen.
- Algal hydrogen production: Purges the hydrogen by taking advantage of algal's special characteristic that can purify water.

Stores the electricity produced by solar, wind energy and hydrogen into the batteries in advance so it can be utilized when it is needed.

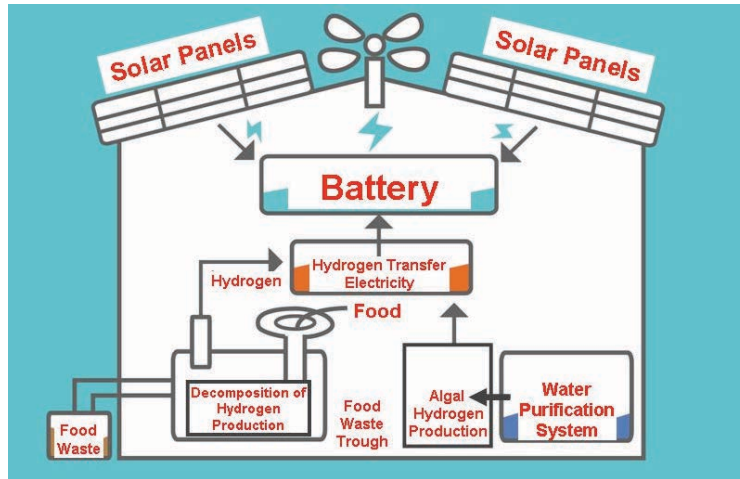


Figure 2. Conceptual diagram of Energy House

(2) The Architecture of Smart Grid

Smart grid is a concept of community composed by several solar houses, shown in figure 3. Each family within the community could form joint adoption for the power supply system of the public facilities(for example: public streetlights), utilizing centralized control to accomplish sufficient power supply for the public facilities and, at the same time, lower the rate of consuming supply mains.

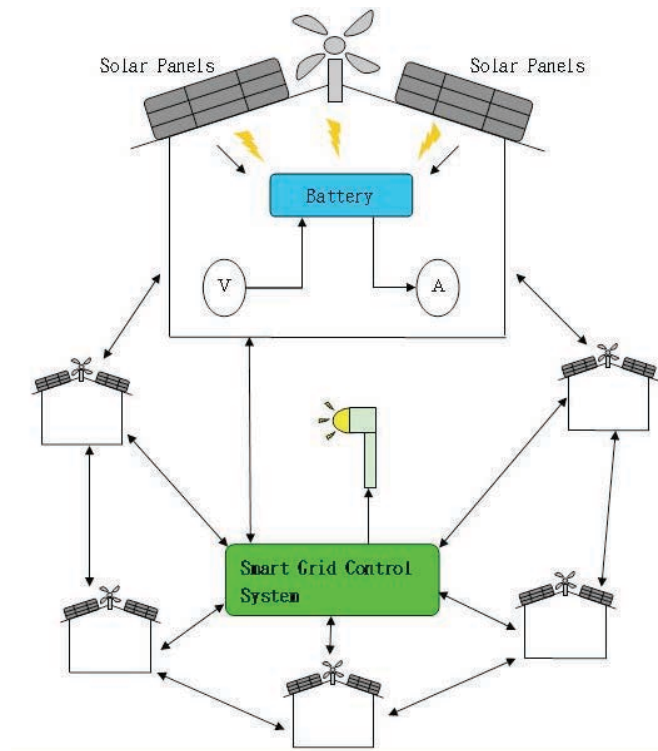


Figure 3. Conceptual diagram of Smart Grid

(3) Curriculum Development Method

The development and architecture of the solar house requires five main factors, including Energy System, Biotechnology, Interior Design, Electronic Circuit and Mechanical Structure. The solar house elaborates into smart grid, as a part of its future development. As smart grid designs situational stories for students to more easily comprehend and integrate into the course content, it plays an important role in relative courses in schools, like communication, programming, and APP courses (Figure 4).

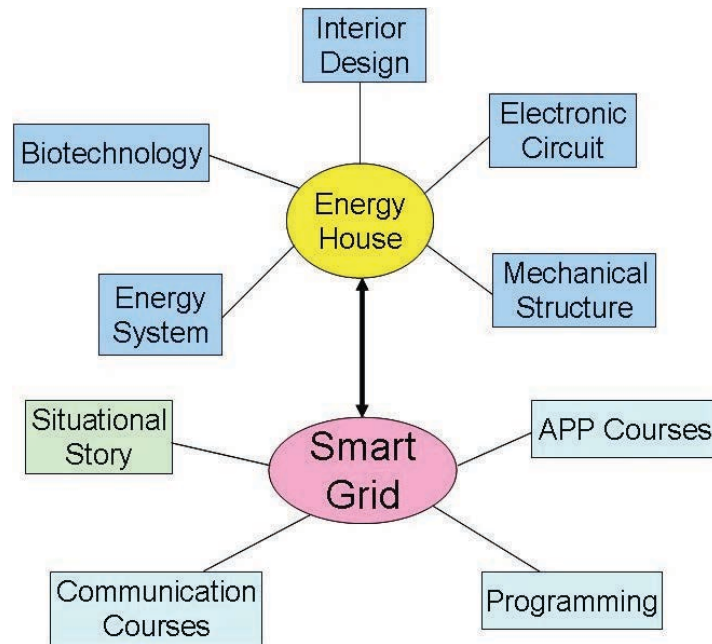


Figure 4. Curriculum Development Model

Outcomes and Discussion

Through the research study process in this paper, the outcomes are listed below:

(1) The Architecture of Developing Smart Grid Control.

The concept of smart grid control is shown in figure 5, the descriptions are explained below:

- (a) Connect the Solar Panels, Battery and Load with the Solar Controller and Monitor.
- (b) The data of the Solar Controller should be converted from RJ11 to RS232, and format into RS485.
- (c) Transmit and receive transmission through ZigBee wireless internet to Coordinator.
- (d) Coordinator should connect to phone server through WiFi to transmit data.
- (e) May transmit commands to remote the On/Off of load by opening up APP displayed data in phone.

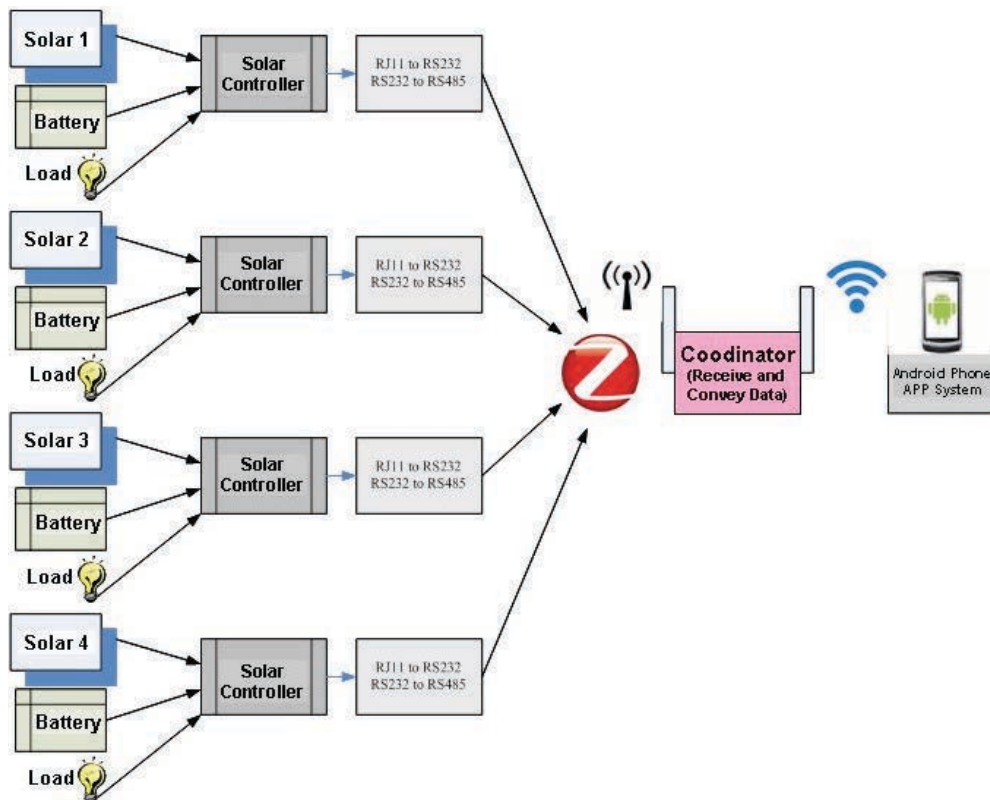


Figure 5. Smart Grid Control

(2) Result of APP Development

After being created by the solar energy, the power is saved into rechargeable battery then to cellular APP through WIFI, enabling us to control the switch of the load (light bulb). Therefore, we are able to control the load remotely. As shown in figure 6 to figure 8.



Figure 6. APP Home Page



Figure 7. APP Content Data 1



Figure 8. APP Content Data 2

(3) The design of Energy House model

Using the distinct architectural styles applying to different design of Energy Houses, and making Solar panels as part of the building, we not only achieve the concept of eco-friendly, but also beautify the environment. There are three types of design so far, as shown in figure 9 to figure 11.

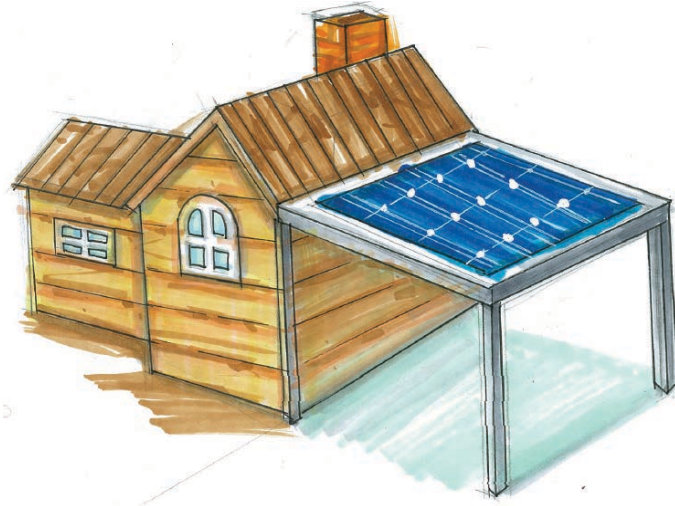


Figure 9. Chinese Style Energy House Model



Figure 10. Japanese Style Energy House Model



Figure 11. Nordic Style Energy House Model

(4) Solar energy workshop

In the workshop, there are instructions of series connection and parallel connection of Solar panels and rechargeable battery, giving students the knowledge of Solar Energy in real experience. As shown in figure 12.

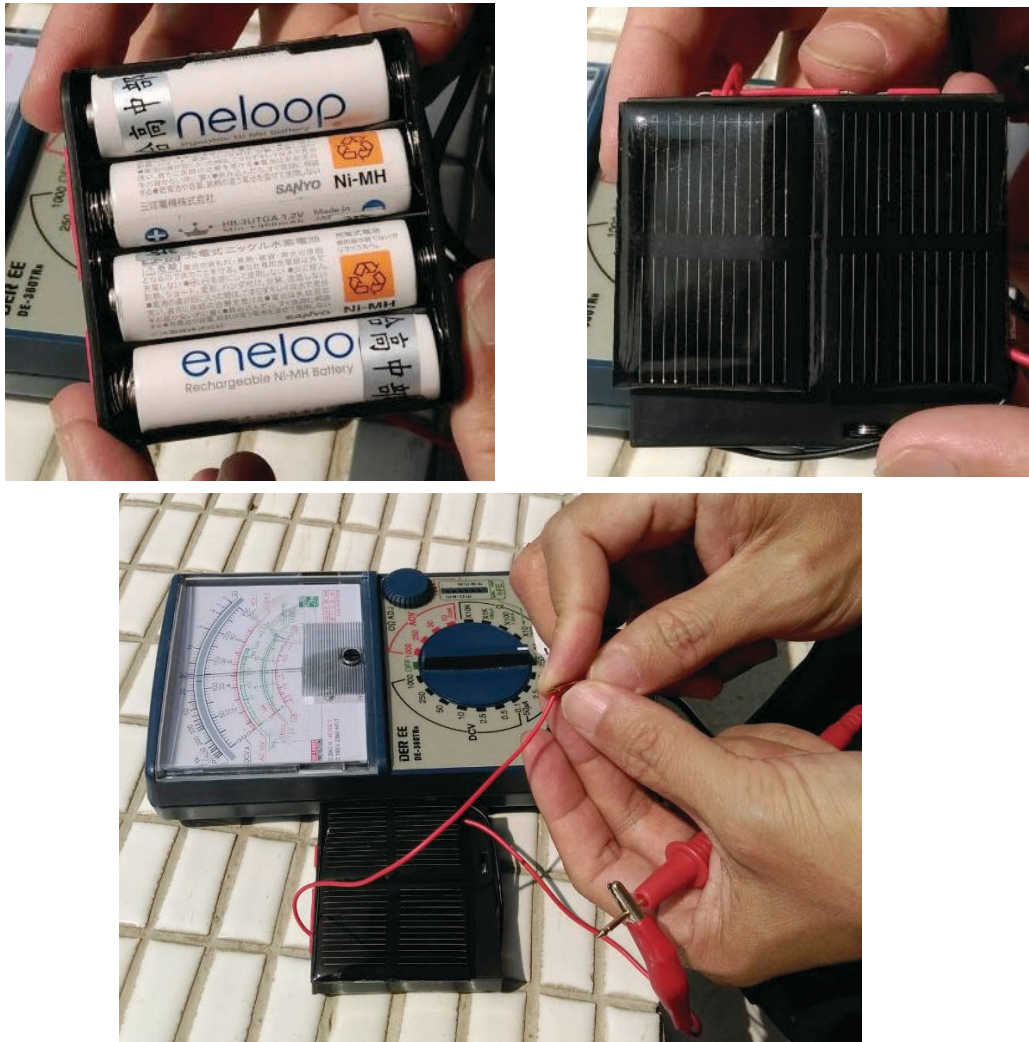


Figure 12. Experiment Model

Conclusion

Above all, this research utilized courses of science and technology as well as experiences of firms. With the designs of delicate Energy Houses, investigation of the Smart Grid, and the development of the APP, we have achieved the following four conclusions

- (1) Students are able to use the research method and process of Most High Scope Program to reinforce the spirit of exploring the science
- (2) Developing the platform of energy education and cellular APP facilitates the energy education and application.
- (3) Designing the three kinds of Energy House with different styles and connotations gives the Energy Houses a sense of local characteristics.
- (4) Integrating with the teaching aid companies to popularize the result of the research more effectively.

In short, energy is a sustainable management and education is a century-long plan. Wish that the result of this research is able to take root of energy education and better our homeland.

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