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Self-sufficient Smart Prosumers of Tomorrow

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Abstract

Due to the abrupt rise in population, the demand for food and energy has increased tremendously. The current challenge is to meet all these demands in future. To tackle the problems of energy crisis and food adulteration, the only solution is to become self-reliant in all means. The spectacular technological innovations in the areas of information and communication have aided to design this lifestyle. This paper delivers the concept of building self sufficient smart homes by coupling the areas of i-energy, aquaponics and vertical farming. Also, provides a scope for developing self-sufficient homes in Kerala. This paper elucidates the architectural design perspective of a house, which is bound to satisfy all the basic needs and encourages each individual to turn to a prosumer.

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Keywords: i-energy; aquaponics; vertical farming; prosumer.

1. Introduction

By the year 2050, urban population is likely to reach a saturation level. This can lead to the scarcity of basic necessities like fresh food, fresh water and power. It is high time to act on this issue. Care must be ensured not to over utilize the available resources by poor management. Kerala, a state with high population density may be deprived of these resources in the near future. Last few years, state is facing power crisis. Moreover, the state highly depends on other states for food crops, vegetables, etc. The real fact is that Kerala is now turning out to a total consuming state. Besides this, with the rise in environmental pollution and food adulteration, common men have to fight with many health issues. Therefore, for the sustainable future, we have to reshape our economies and societies. The state is already marked as a power deficit state where the yearly consumption of power is more than it generates. The energy report published by state govt. of Kerala during the year of 2011-2012 shows that the installed

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generation capacity of the state was 2877.16 MW and the maximum demand was 3348 MW. This infers the imbalance between the generation and consumption of electric power. Out of the total installed capacity 71% is the contribution from hydel generating stations, and the same one is used to meet the energy requirement of the state. The availability of power from these generating stations mainly depends on the monsoon. There is a prominent perception that to reduce the energy crisis in the state by utilizing the solar energy. The state receives an annual average solar insolation of 5.59 KWh/m² /day. An appropriate framework should be build to tap the maximum potential of the solar energy, wider use of this energy will be one of the indispensable solution to bring environmental and social benefits.

The current grid system is composed of centralized power plants, transmission and distribution lines. These grid systems fail to meet the growing demand in future. To overcome this crisis, smart grid has evolved with smarter ideas to optimize supply and demand. Through smart grid, energy system can be managed in both demand side as well as supply side. However, the implementation of smart grid system is a time consuming process. Most of the talks relating to smart grid focus on the benefits to power suppliers, even if there are some advantages to consumers. An energy management integrated system should be developed in a consumer's view point. This leads to the concept of i-energy. For a small and dispersed state like Kerala, decentralized power generation systems provide a better solution.

The state does not have any fairly large area for cultivation as well as for energy harvesting. In a populated state like Kerala, to increase the food production and storage life, agrochemicals are used. When the state lacks control on chemicals added in food for human consumption, the demand for fresh and organic food increases steeply. Also for the availability of chemical-free produce and fish in the salinity prone area or in flood prone area, subsistence farming can be practiced at community or personal level. The aquaponics and vertical farming will provide solutions from the green poisons and the way to escape from the world of "food frauds". With the limited area of land, a high profit farming which feeds only 100% organic and chemical free produce can be developed by these two techniques.

Now, in this twenty-first century to develop a self-sufficient society, all streams of technology have to come under one roof. The fast innovations in technology, particularly in the areas of information and communication technologies have aided to design these twenty-first century infrastructures. This paper discusses an idea of integrating the concept of i-energy, aquaponics and vertical farming for developing a self-sufficient society or a smart neighborhood.

2. Background

2.1 Concept of i-energy

The concept of i-energy was introduced for the smart demand-side management system to improve the energy efficiency. This totally differs from the smart-grid. The i-energy concept mainly concentrates on the demand side, while the smart grid focuses both supply as well as demand side. Instead of regulating the power by the suppliers, the power management in i-energy system is done inside consumer's living spaces. Here, the generation, storage and distribution are handled by consumers themselves. The system aims power balance control, energy cost reduction and also concentrates on reduction of green house gas emission. The development of distributed generation from renewable energy resources will be one of the solutions for global warming and carbon emission.

There are some reasons for concentrating on demand side energy management system. For an efficient electric power network, there should always a balance between power consumed and generated. To maintain this balance, along with the development of supplier oriented smart grid system, consumer oriented system should also be developed. Rather than implementing these ideas in a larger area, it would be better when a small area is concentrated to prove its merits. The concept of i-energy includes the technologies such as smart tap network, priority-based demand system and power trading.[1]

2.1.1 Smart tapping

For executing the ideas of i-energy concept, a smart tap network should be implemented to monitor the power consumed by individual appliances. These taps mainly contains sensors, processors and communication modules.

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