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From Nuclear to Cogeneration – How a natural disaster can change the policy of a country

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Abstract

One of the main lines of research that the author of present paper was particularly interested in [1] at the World Gas Conference in Paris, WGC2015, is the development of a new fuel for the Model Cell Systems in Japan. After the great Fukushima earthquake in 2011, when many nuclear power plants were shut down, alternative sources of alternative energy had to be found to meet the high demands of the industry and the Japanese population.

In this research and publication work, we believe that through scientific research and technological innovation, we can demonstrate the great ability to understand and solve major development problems, stimulate economic growth and towards the development of a country. In addition, the following points are discussed: Change in Japanese energy policy, the emergency measures taken and by what methods to achieve these objectives?

Keywords: energy, nuclear, cogeneration, energy policy, development

Kulcsszavak: energia, nukleáris, kapcsolt, energiapolitika, fejlődés

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1. Introduction

Fossil-fueled thermal power plants (gas, oil, coal) produce electricity, especially during periods of peak demand (for example, during periods of extreme cold). The combustion of these energies releases heat which is used to heat water and transform it into steam. This is pressurized to drive a turbine coupled to an alternator that produces electricity.

During this process, much of the heat is lost (up to 60%) when it could be used for other purposes. The installation of a cogeneration system in the installation makes it possible to recover this heat which was previously lost, thus limiting the overall losses.

2. Change in Japanese energy policy

After the great earthquake in Fukushima, eastern Japan, which officially caused 16,000 deaths and 2,500 disappeared, Japan changed its energy policy by shutting down all nuclear power plants until security was restored of its facilities.

At present, the share of fossil fuels (petroleum, liquefied natural gas and coal) in the Japanese energy mix has increased to 88%, compared to 62% before the earthquake [2]. The change in this energy mix has not been without consequence and has caused many adverse side effects for Japan.

On the one hand, there has been a negative environmental impact and, on the other hand, the decline in the economic situation. At the environmental level, CO_2 emissions increased by 14% due to increased energy consumption of fossil fuels and from an economic point of view, the trade balance became negative because Japan had to import an enormous amount of fuel to meet its energy deficit [2].

3. Emergency measures taken

In this context, Japanese policy makers have defined energy policy by:

- The need to increase renewable energy [3];
- The creation of the Japanese hydrogen company;
- The Japanese government has set a very ambitious target of installing 1.4 million fuel cells by 2020 and 5.3 million fuel cells by 2030 (two cumulative targets). The fuel cell is a cogeneration technology (see *Fig. 1*) that produces electricity and heat by chemical means, there is a reaction to energy consumption. It contributes to the primary energy saving by its high efficiency.

Generally, in the power of the conventional system, only 40% of the primary energy can be used because about 60% will be lost as heat to the power plant or through losses during power transmission.

On the other hand, fuel cells allow about 95% of energy use with local heat and power. The result is a reduction of 1.3 tons of CO_2 emissions and a reduction in operating costs per year (a comparative example of consumption for a house in the Tokyo area using a gas boiler).

4. Which methods to achieve these objectives?

The list of challenges facing Japan in the coming years focuses on:

- Continued cost reduction through technical innovation and mass production: A new (4th generation) fuel cell model was updated;
- Improved performance of key devices (battery, fuel processor): The total cost has decreased through improved installation, commissioning and

transportation. For example, installation has become easier by reducing the total weight of the system. The commissioning time is also reduced by 40%.

- Reduction of the number of components by simplifying the whole system: The number of components has been reduced by 15%, and also the weight of the whole system is reduced by 15% (from 90 kg to 77 kg);
- The increase in the use of standard components: There is a 20% reduction in the platinum-metal alloy used for the battery (the component used to generate electricity from hydrogen).
- The expansion of the customer base of urban areas through development.
- Of a specific model of apartments: lower prices for the end user compared to the previous model and a 50% reduction compared to the first model published in 2009).
- The advanced development towards the hydrogen society (development of fuel cell system for a pure hydrogen energy source).

5. What is cogeneration?

Cogeneration (or co-generation: co = whole and generation = production) is the simultaneous production of two different forms of energy in the same power station.

The principle of cogeneration consists in producing mechanical energy (converted into electricity) and heat at the same time and in the same installation (an installation for several applications) and from the same source of energy. In the case where the heat is also re-used to produce cold, the term "tri-generation" is used.

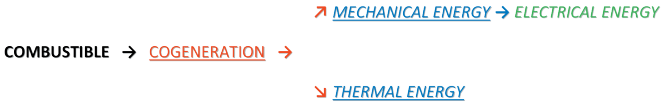

Fig. 1. Diagram of cogeneration
1. ábra Kapcsolt energiatermelés sémája

An engine (external or internal combustion), a turbine or a fuel cell is activated to produce electricity through some of the heat produced (the fuel may be natural gas, wood, fuel oil, biogas etc.). The remaining heat is used directly to heat water or produce steam.

In addition to reducing costs, the Japanese increased the product's durability to 70,000 hours and adopted DC power generation in the device [2].

In addition, it was launched a new model with the product heater for the outdoor market. Based on the large difference in demand for heat and cost between electricity and gas prices, one dares to believe that it has a strong potential market in European countries.

6. Problem statement

The serious problem facing Japan is the difference in the composition of the gas and the use of the fuel cell used in Japan and Europe:

- In Japan, gases are imported from abroad and purified during the liquefaction process. On the other hand, European countries import gas from pipelines from several sources. This results in instability in the fluctuation of the gas composition with a higher level of impurities in the gases compared to the LNG.
- In Japan, fuel cells are installed outside of each house and the demand for heat comes mainly from the hot water used for the bath, whereas in Europe, fuel cells are located inside the house (mainly in rooms and/or kitchens), which requires more air exhaust system (safety controls) and the heat is mainly intended for the heating of the spaces of the house. Research is underway in this area.

7. Conclusions

It can be concluded that the fuel cell is considered the key technology for smart homes. The introduction of cell fuel, in most homes and moving towards the concept of a city with a friendly environment and a pleasant and safe city with a goal of reducing CO_2 emissions by 70% compared to level of two decades ago.

Another application of cogeneration, which could become global is the incineration of large quantities, always increasing, of household waste. The burned waste produces heat. By installing a cogeneration system, this heat is recovered to produce water vapor that drives a turbine to produce electricity. This electricity can be consumed by the incineration plant or transferred to the electricity grid.

Also, the current trend in the field of research and innovation of technology goes towards the realization of a carbon-free hydrogen society at a reasonable cost and also move towards the evolution and expansion of the system fuel cells with high efficiency. Fuel cell is the basic technology for building the hydrogen society of the future in order to contribute to a better life and in part can contribute to the solution of environmental and climate cooperation and in harmony with various global partners.

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