Deployment of Fusion Energy in Future Global Market and Implication of Hydrogen production

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Fusion energy is currently investigated by collaboration between developed countries, and expected to be technically feasible in late 2030s by first generation DEMO plants succeeding International Thermonuclear Experimental Reactor, ITER. Despite rapidly growing countries are not very much interested in fusion research today, majority of fusion energy will be used by them in the future, probably more than by the developed countries where fusion is mainly studied now. Because, while developed countries already have mature energy market where small room is anticipated for newly introduced energy to replace already established share and infrastructure such as fission energy, growing countries require large scale carbon-free energy source to satisfy their expanding demand from limited options of advanced energy technologies in the future.

Synthetic fuels such as hydrogen for transport, industrial heat and dispersed electricity have larger market than electricity in the future. And moreover from the aspect of reduction of carbon emission, to replace this fuel sector is far more important than to take electricity share, because significant portion of the electricity is already generated by carbon-free source, while very little fuel will be made from the source other than fossil even in the future.

This paper will consider and review the possible deployment scenario of fusion energy in the global market. Potential of fusion in future energy market is analyzed with global energy and environment model. The result quantitatively suggests the considerable contribution of fusion, and if hydrogen production by fusion is technically feasible, its share in primary energy market would be further significant.

Although conventional electrolysis is a possible hydrogen production technique by fusion, by taking advantage of the feature of fusion that can gradually improve the output temperature using advanced blanket, efficient high temperature process is expected to be applicable in the development scenario. The authors' recent result showed the possibility of hydrogen production process by endothermic reaction above 900 degree C with biomass. Because it is free from Carnot's efficiency limit, total energy efficiency is estimated to be much higher than that of electrolysis or other methods. This process requires high temperature heat above 900 degree C that is possible with advanced fusion reactor. Some types of blanket such as dual coolant LiPb with SiC material is expected to be developed for Fusion Power Plants succeeding ITER, by generations of improved blankets to be tested in ITER and first generation power plants.