

## Investigation of green hydrogen production with using geothermal energy and potential hydrogen demand in Kumamoto prefecture

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### Abstract

#### Background

An electricity grid limitation is one of the issues to be solved to accelerate the introduction of renewable energy. To avoid the increase of social cost from the enhancement of electricity grid, hydrogen production with using surplus renewable energy is considered. In this study, we focused on the combination of the not-used geothermal steams, because of the electricity grid limitation, in Kumamoto prefecture and Solid Oxide Electrolysis Cells (SOEC) (see Figure 1). SOEC operates at high temperature (around 800 degC), and by supplying steam as a hydrogen resource, it can produce green hydrogen with higher efficiency than other technologies, i.e. polymer electrolyte membrane (PEM). The potential amount of hydrogen usage around Kumamoto area was also researched.

#### Results

A green hydrogen production system with unutilized geothermal energy was designed, and the effect of using unutilized geothermal energy was evaluated from the view point of hydrogen production cost. As a result, the system might can produce green hydrogen with low cost, but to realize the system, several issues have to be solved, i.e., the difficulty of securing the site and water because the geothermal power plant is located among mountainous, the less hydrogen production efficiency of SOEC at not-rated operation conditions.

A potential hydrogen demand in Kumamoto area was also investigated. It is expected that large amount of hydrogen utilization is expected in the industrial areas. On the other hand, considering the narrow road conditions around the hydrogen production site, the hydrogen transportation cost may increase because the trailers and the lorries, which can transport large amount of hydrogen efficiently, cannot be used.

Conclusion

It seems that the hydrogen production cost can be reduced by using SOEC systems with unutilized geothermal energy. As a next step, the hydrogen transportation cost should be compared with the cost of electricity grid enhancement, and it has to be evaluated if hydrogen really can contribute to accelerate the introduction of renewable energy.

#### Acknowledgment

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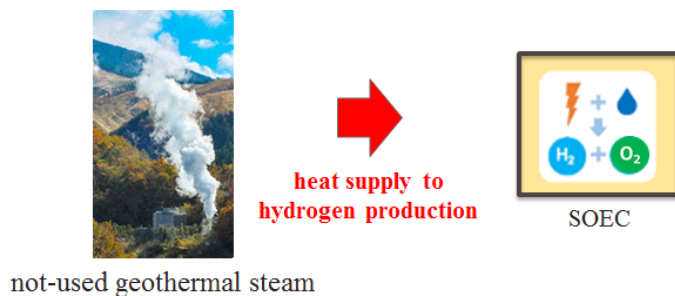


Figure 1. Concept of hydrogen production with not-used geothermal steam.