Greenhouse gas (GHG) emissions reduction potentials by SOFC: case for distributed and centralized electricity generations

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ABSTRACT

Global energy supply and demand are increasingly dominated by shortage of oil supply, price increase, climate change, rising population levels and per capita energy consumption. Concern about global climate change and natural resource pollution has prompted interest in trend in energy system development. Some alternatives with focusing on fuel cell technologies have been developing for sustainable and environmental-friendly energy supply needed by growing world population. Solid Oxide Fuel Cell (SOFC) as a promising technology for power with high efficiency has attracted to be implemented as distributed and centralized generation. The current interest in distributed generation leads to SOFC as power and heat source for residential house application. This distributed generation can lead to increased energy efficiency due to cogeneration options and reduced losses from electricity transmission. Example of this concept in the residential house application is SOFC based micro-combined heat and power (m-CHP). Based on reported data available for Kansai area, Japan, SOFC based m-CHPs fueled city gas have been able to provide solutions to reduce primary energy consumption besides providing less greenhouse gas (GHG) emissions. Although the excess power from the system could not send to the grid electricity, but the energy cost savings are still beneficial compared to the power from centralized grid power with the heat from city gas based boiler. However, it is known that the SOFC based m-CHP systems are still expensive. Economic realities constrain individuals` decisions to purchase the system without subsidies from government. For an economic feasibility, the SOFC based m-CHP needs development to lower the cost investment

and at the same time provides lower cost production per kWh where they can prove more competitive than centralized generation. Despite the problems with the centralized generation using fossil fuel, their continued large-scale and widespread applications in the power generation are essential in order to maintain current economic growth throughout the world. Alternatively, as the promising technology for high efficiency, lowest GHG emissions, and low cost energy production per kWh, preliminary analyses on integrated coal gasification fuel cell combined cycle (IGFC) including carbon capture and storage (CCS) will be introduced.