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Analisis tekno ekonomi pembangkit listrik fuel cell jenis proton exchange membrane (PEM) untuk kebutuhan listrik beban rumah tangga = Techno economic analysis of proton exchange membrane (PEM) fuel cell power plant for household s electricity loads

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Abstrak

[ABSTRAK
Teknologi fuel cell (selbahanbakar) merupakan salah satu teknologi yang menggunakan bahan bakar dari energi baru terbarukanya itu hidrogen. Teknologi ini dianggap bersih dan ramah lingkungan. Efisiensi konversi yang tinggi danemisi polutannya sangat rendah sehingga dampak lingkungan yang rendah juga membuatnya menjadi kandidat yang tepat untuk menggantikan teknologi konvensional ada. Aplikasidariteknologi fuel cell, antara lain untuk transportasi/ otomotif, pembangkitlistrikstasionerdan fuel cell portabel.Untuk teknologi fuel cell jenis proton exchange membrane (PEM) sebagai pembangkit listrik, khususnya di Indonesia masih belum berkembang.
Oleh karena itu perlu dilakukan analisis tekno ekonomi dari pembangkit listrik fuel cell jenis PEM dengan melihat karakteristik kerja dan efisiensi sistem, khususnya peralatan disisi keluaran seperti konverter dan inverter terhadap beban rumah tangga(beban yang dipakai lampu) dari beberapa profil beban seperti profil beban statis dan fluktuatif. Hasil uji kinerja sistem pembangkit listrik fuel cell memperlihatkan karakteristik dari fuel cell, yang berupa kurva polarisasi perubahan tegangan terhadap perubahan arus beban.Dari Kurva polarisasi V-I didapatkan nilai
polarisasi aktivasi () pada saat pembebanan fluktuatif lebih besar dibandingkan pada saat pembebanan statis, sedangkan nilai polarisasi ohmic (r) pada saat
pembebanan fluktuatif lebih kecil dibandingkan pada saat pembebanan statis. Hal ini memperlihatkan proporsi energi listrik yang timbul saat perubahan laju reaksi
pada pembebanan fluktuatif lebih besar dibandingkan pada pembebanan statis. Sehingga reaksi yang terjadi lebih cepat dan mengakibatkan tegangan akan lebih
cepat turun. Dari segi keekonomian biaya energi pembangkit listrik fuel cell jenis PEM untuk kapasitas 500W dan 2 kW masih cukup besar yaitu Rp/kWh10.117,2
dan Rp/kWh 5.330,4. Tetapi untuk kapasitas 5kW ternyata jauh lebih rendah yaitu sebesar Rp/kWh3.048,7. Hal ini di karenakan selain biaya investasi yang
menjadilebihkecil,biaya bahan bakar juga menjadi lebih kecil. Biaya bahan bakar bisa jauh lebih murah dikarenakan konsumsi gas hidrogen berdasarkan arus beban yang dipakai pada kapasitas 5kW hanya dua kali lipat jumlahnya dibandingkan kapasitas 500W, sedangkan
produksi listrik yang dihasilkan sepuluh kali lipat.
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ABSTRACT
Fuel cell technology utilizes fuels from renewable sources i.e. hydrogen. Therefore, this technology is considered clean and environmentally friendly. High
conversion efficiency with very low pollutant emission makes this technology a favorable candidate to

substitute the existing conventional energy conversion
technology. Applications of fuel cell technology include power for transportation/automotive, stationary fuel cell, and portable fuel cell. PEM type fuel cell technology as a power generation has not been developed in Indonesia. Therefore, it is necessary to analyze techno-economic of the PEM fuel cell technology by examining its operation characteristics and system efficiency particularly conversion equipment at output side such as converter and inverter for household load (lighting) at various load profile i.e, static and fluctuated loads. Performance analysis that is presented in V-I polarization curve shows the fuel cells? characteristics. From this curve, polarization activation value () at fluctuated loads is higher than that of static loads, whereas polarization ohm
value (r) is lower at static loads than fluctuated loads. This result demonstrates electricity produced at fluctuated loads is higher compared to that at static load. Consequently, chemical reactions are faster that affect voltage to drop faster. Cost of energy for PEM fuel cell is still considerably high for 500 W and 2 kW that are Rp/kWh10.117,2 and Rp/kWh 5.330,4. While for 5 kW fuel cell system, COE is far lower that is Rp/kWh3.048,7. This is due to cost of investment and
fuels decrease significantly. Cost of fuel can be reduced substantially because oxygen consumption at a 5 kW fuel cell system is only double than that of the 500
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