



## INTISARI

Peningkatan kebutuhan listrik setiap harinya semakin meningkat seiring dengan pertumbuhan ekonomi dan masyarakat. Penggunaan energi fosil sebagai pembangkit listrik dirasa kurang baik terhadap isu lingkungan, sehingga perlu adanya peralihan ke energi baru dan terbarukan sebagai solusi. Namun, energi terbarukan memiliki keterbatasan, salah satunya sifatnya yang tidak konstan. Penggunaan *energy storage* menjadi salah satu solusi untuk mengatasi permasalahan ini. *Compressed Air Energy storage (CAES)* adalah salah satu sistem *energy storage* yang telah dikembangkan dengan tiga komponen utama, yaitu kompresor, *pressure vessel*, dan ekspander. Proses perancangan ketiga komponen tersebut menjadi bagian penting untuk meningkatkan efisiensi sistem. Ekspander, sebagai komponen yang mengubah energi fluida bertekanan menjadi daya listrik, memerlukan efisiensi tinggi untuk mencapai performa optimal. Simulasi sistem CAES menggunakan perangkat lunak Aspen HYSYS telah dilakukan untuk mengevaluasi kinerja sebelum manufaktur. Hasil simulasi menunjukkan bahwa sistem CAES pada kondisi tertentu mampu menghasilkan daya ekspander sebesar 0,626 kW, yang melebihi target awal 0,5 kW. Kompresor memiliki efisiensi 87%, sedangkan *pressure vessel* dirancang sesuai standar ASME VIII dengan bentuk silinder vertikal. Desain awal ekspander untuk kapasitas daya 0,5 kW telah memenuhi kriteria dan dapat digunakan sebagai dasar pengembangan lebih lanjut. Dengan hasil ini, sistem CAES dinilai layak untuk diimplementasikan dalam skala manufaktur guna mendukung kebutuhan energi terbarukan yang lebih stabil dan ramah lingkungan.

**Kata kunci: CAES, Perancangan, Ekspander, Simulasi, HYSYS**



## ABSTRACT

The increase in electricity demand every day will increase along with the increase in economic growth and society. The use of fossil energy as a power plant is not good for environmental issues. Until now, the use of fossil energy as the main raw material in the electricity generation process has made changes. The use of new and renewable energy makes one of the solutions to existing problems. In addition, the transition from non-renewable energy to renewable energy makes a way out to deal with environmental problems. However, renewable energy still has several limitations, one of which is its inconstant nature. The use of energy storage is one solution to make the nature of renewable energy solved. Compressed Air Energy storage (CAES) is one of many energy storage systems that already exist. The development process of this system makes one of the efforts in the existing electricity generation process. CAES consists of three main components, namely compressor, pressure vessel, and expander. The design process of these three components is an important part of improving the efficiency of the CAES system. Expanders, as components that convert compressed fluid energy into electrical power, require high efficiency to achieve optimal performance. Simulation of the CAES system using Aspen HYSYS software was conducted to evaluate the performance before manufacturing. The simulation results show that the CAES system under certain conditions is capable of producing 0.626 kW of expander power, which exceeds the initial target of 0.5 kW. The compressor has an efficiency of 87%, while the pressure vessel is designed according to ASME VIII standard with a vertical cylindrical shape. The initial expander design for a power capacity of 0.5 kW met the criteria and can be used as a basis for further development. With these results, the CAES system is considered feasible to be implemented on a manufacturing scale to support the need for more stable and environmentally friendly.

**Keywords: CAES, Design, Expander, Simulation, HYSYS**