The project was conducted with EnerjiSA Üretim with the purpose of helping them in their future plans. EnerjiSA Üretim is Turkey's largest electricity distribution and retail company. The main focus of the project was on their Çanakkale Wind Power Plant, which was established in 2011, and has an installed capacity of 30 MW with its 13 wind turbines. The main goal is to build a road map for future improvements in their energy storage systems. Throughout the span of this project we investigated the feasibility of different energy storage systems used in storing electricity.

To come up with a favorable storage system, we created a multi criteria decision model that consists of 8 different criteria that we have found to be crucial. For each technology, all the criteria values were researched and gathered to come up with a table. According to their respective values, for each technology, all the alternatives were given a score between 0 to 5, 0 being the worst and 5 being the best. At that step, each criterion was assigned a weight that was calculated by using AHP method to come up with a final total score. According to our findings, Li-ion battery systems were found to be the most favorable when the assigned weights are put into account.

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The project was successfully completed using multicriteria decision making. Battery types and energy storage systems were evaluated on 8 main criteria: Storage Capacity, Response time, Cycle Time/ Life Time, Risk and Safety, Energy Efficiency, Investment Costs, Ease of Installation and Tech Maturity. While making these evaluations, many different sources and real-life examples were used, list of other sources can be found in the references part of this poster. Through this study; lead acid, sodium sulfide, li-ion, redox, flywheel, compressed air, pumped hydro, flywheel and compressed air energy storage systems were compared.

The criteria and energy storage technology alternatives were analyzed using AHP hierarchy, which is then utilized to build the pairwise comparison matrix. The weights of the criteria were estimated for this. This was accomplished by the measurement of AHP. After forming a pairwise comparison matrix, we went on to calculate the weights for each criteria. We examined if the formed matrix was inconsistent or not. After examination, we concluded that the ratings were transitive but they were not numerically consistent. Therefore the pairwise comparison matrix was inconsistent, and to calculate the weights of the inconsistent matrix geometric mean method was selected. As the first step of the method, we normalized each column. Since our matrix was 8x8, it was challenging to normalize columns one by one by hand. Therefore we wrote a python code to normalize the matrix using scikit-learn library.

As the second step of the method, after normalizing each column, we calculated the geometric mean for each row. The geometric mean of a row gives the weight for the criterion related to that row.

The main purpose of energy storage systems is to store the generated energy and use it whenever it is necessary. Energy storage systems benefit the company in many ways. Firstly, renewable energies have unsteady natures causing fluctuations in the generated energy output, which might cause hardships while trying to meet the demand. Energy storage systems could help to smooth these fluctuations resulting in reducing the unmet demand. Second most important aspect of energy storage systems is peak shaving. When demand fluctuates daily and even at every moment of time, peak to valley differences occur during the day. As a result, peak shaving and load leveling are required to store created power and provide vacant power during peak loads. (Chen, T., et al., 2020)

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