Overview
FirstEnergy Corp. is an electrical utility company highly concerned with the safety of its workers. The electrically resistant gloves used are bulky, hot, inflexible, not customizable, and not recyclable. Improving these undesirable qualities of the personal protection equipment would improve the safety culture in the company, and an accurate portrayal of the costs of these gloves would provide additional motivation for change.

Objectives
There were two main objectives of this project. The first was to come up with an accurate representation of the costs incurred by FirstEnergy in maintaining their PPE gloves, and the second was to suggest a new material and process for producing gloves in the future to combat the issues outlined above.

Approach
- Visit FirstEnergy site in Akron, OH to obtain background project knowledge
- Gain insights on materials by consulting materials science professors
- Analyze current glove data provided by Materials Characterization Lab
- Gather information on all aspects of PPE costs
- Consult campus resources for 3-D printing test samples and testing equipment
- Obtain thermoplastic polyurethane (TPU) 3-D printable filament
- 3-D print test samples
- Run dielectric breakdown tests to compare new material to current glove
- Perform statistical analysis of breakdown strength test
- Put together complete cost analysis for company
- Research potential processes and costs for 3-D printing

Outcomes
- TPU withstood an average of 28,053 V in dielectric breakdown testing
- Thickness of material can be reduced to approximately 1 mm to obtain same electrical resistance, but adding flexibility
- Total cost of maintaining these PPE at FirstEnergy is $2,215,187.78 per year
- Cost per pair of gloves after all considerations accounted for is $219, as compared to $125 paid to buy gloves
- If 3-D printing is perfected and processes can be controlled, this new material and 3-D printing can replace the current purchase and processing of the gloves

Figure 1: Dielectric breakdown testing of candidate replacement material.

Figure 2: Breakdown of costs experienced by FirstEnergy for current rubber PPE.