



# CALIFORNIA SCIENCE & ENGINEERING FAIR 2018 PROJECT SUMMARY

<b>Name(s)</b> <b>Jonathan Ko; Abhi Upadhyay</b>	<b>Project Number</b> <b>S1007</b>
<b>Project Title</b> <b>Power Outlet Adapter to Autonomously Reduce Standby Power Losses Using Machine Learning</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b> Standby power, the power consumed by appliances that are plugged in but not in active use, wastes an estimated 23% of residential electricity. Existing methods to reduce standby power (unplugging, powerstrips, timers, and remote-controlled outlets) are inefficient due to human negligence. Using machine learning, this project proposes an autonomous power outlet adapter for reducing standby power waste.</p> <p><b>Methods/Materials</b> The adapter was built with an Arduino Uno, a current sensor, a relay module, and an outlet switch. A machine learning algorithm was trained to determine whether an appliance is on standby. The adapter was designed to disconnect an appliance when it is on standby, periodically reconnecting to "check" if the appliance needs to wake up (disconnecting again if still on standby). The adapter was tested by measuring the standby energy consumed by a speaker playing intermittent audio over four hours both with and without the adapter.</p> <p><b>Results</b> The adapter saved 61.4% of standby energy with 14-second intervals between checks. Increasing the interval between checks saves more energy, but also delays wake-up time. "Checking" every 10 seconds(s), 20s, 30s, 40s, 50s, or 60s would save 34.5%, 67.2%, 78.2%, 83.6%, 86.9%, or 89.1% of the speaker's expended standby energy, respectively.</p> <p><b>Conclusions/Discussion</b> The adapter design can successfully reduce standby power waste with the tradeoff of delayed wake-up time. If implemented universally, the adapter is projected to reduce household energy consumption by up to 20% (60-second checking), saving \$16.9 billion in the US yearly. The estimated reduction in US carbon emissions is equivalent to that of 45 coal plants.</p>	
<b>Summary Statement</b> We designed, built, and tested a power outlet adapter that effectively eliminates up to 89.1% of standby power losses by detecting whether an appliance is on standby or in active use and disconnecting or reconnecting from power accordingly.	
<b>Help Received</b> None. We designed, built, and tested the adapter ourselves.	