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## MASSACHUSETTS CLEAN TECHNOLOGY AWARDS

A Program from The Foresight Project Inc; [www.theforesightproject.org](http://www.theforesightproject.org)



Region IV: Northeastern  
Massachusetts

Kevin Wen: Lexington High  
School, Lexington

Honorable Mention, Clean Tech:  
“All Liquid Fuel Cell  
Abstract”

### About Me:

My name is Kevin Wen and I am a 15 year old sophomore at Lexington High School in Massachusetts. Although I have an interest in many different fields of science, my strongest subject in school is mathematics. I participate in my school math team, who went on to win the Massachusetts state meet this year, and I also take many individual math contests, placing in the top 500 high school students in the USA for two years in a row. Besides math and science, I also have a passion for music. I played the trumpet since fifth grade and I am part of my school's wind ensemble, a high class and award winning high school group, and my school's jazz big band. Outside of school, I enjoy playing tennis and Frisbee.

### My Project:

One cause of rising carbon emissions is the burning of gasoline by cars. As an alternative, hydrogen fuel cells are very “clean”, emitting only water (assuming that the hydrogen comes from a “clean” source itself – it does not exist in an uncombined state on earth, but must be produced from another material, which takes energy). A larger problem is that, although hydrogen has a very high energy release when combined with oxygen, because it is a gas, it has a very low energy density (i.e. energy potential per unit volume). In fact, hydrogen is the lightest gas; air itself is about ten times as dense as hydrogen.

My question for this experiment was: are there liquids that can replace hydrogen and oxygen gas in a fuel cell and generate electricity? A working liquid fuel cell would have a much higher energy density, making it much more practical.

In my experiment, hydrogen peroxide ( $H_2O_2$ , 3% solution) and isopropyl alcohol ( $C_3H_8O$ , 91%) were chosen as energy sources, in a pre built hydrogen fuel cell.

I found that the combination of alcohol and hydrogen peroxide is able to generate 660 mV. The voltage output was close to the voltage capacity of a hydrogen fuel cell, which generates 600-700 mV at load. As a comparison, a combination of alcohol and water outside of a fuel cell produces only 84 mV. The difference in the output ( $660 - 84 = 576$  mV) comes from the proton exchange (fuel cell) mechanism. These results prove that liquid fuel cells do have a capability of producing electricity at a small scale. However, the main hindrance of liquid fuel cell in this experiment is becoming more viable is the very low 5mA current output. The problem of finding inexpensive and reliable catalysts before they can become an alternative energy storage device also true for liquid fuel cells.