



international association for hydrogen energy
Clean and Abundant Energy for Sustainability

1st International Association for Hydrogen Energy Hydrogen Design Competition

Guidelines

Last Revised

September 15, 2009

For Questions or Clarifications, Contact:

Professor Matthew Mench

327 Reber Building

University Park, PA 16802, USA

1-814-867-0060

mmm124@psu.edu



Eligibility:

All students (graduate, undergraduate, and mixed teams) involved in an IAHE Student Chapter are eligible. Groups can become eligible by forming a new chapter at their University if one does not already exist. There is no fee to participate in the competition or to form a Student Chapter. Please contact Prof. Mench at mmm124@psu.edu for details.

Important Dates:

November 15, 2009: **Registration deadline.** All student groups participating in the competition must register for the competition via email to Matthew Mench at mmm124@psu.edu. There is no limit on the number of student submissions from an individual Chapter. *That is, each chapter can submit multiple projects if registered in advance.*

February 15, 2010: Submission deadline of written report and upload of final YouTube video presentation.

March 15, 2010: Invitation of selected finalist teams to attend 18th World Hydrogen Energy Conference in Essen, Germany (<http://www.whec2010.com/>). (Registration fee for student participants will be waived - Participants are not required to attend the WHEC)

April 14, 2010: Registration deadline to attend the 18th World Hydrogen Energy Conference in Essen, Germany.

May 16-21, 2010: 18th World Hydrogen Energy Conference. Winners will be announced at WHEC and by email.

Submission Guidelines:

Written Report:

Note: All completed written reports will be included in a special edition of the *International Journal of Hydrogen Energy* (IJHE), the official journal of IAHE and a top-ranked journal in the energy field. All participating teams must submit a written report to summarize their project and results. The format of the report is as follows:

- 1) 12 page maximum, including figures but not cover page, references or Appendices.
- 2) 10 point font or larger.
- 3) A minimum of 1 inch margins on all sides of pages.
- 4) Submissions should be in English.

The suggested general format for the written report is as follows, with deviations acceptable as necessary to best convey results:

- I) Cover page: Include the title, school, student contact person email address, signature of faculty liaison, and internet location of YouTube video presentation file
- II) Executive summary: 1 page maximum
- III) Background Information
- IV) Goals and Objectives
- V) Methods of Analysis
- VI) Results and Discussion
- VII) Summary and Conclusions
- VIII) Budget Summary (Applied Projects Only)

Please email written reports to Prof. Matthew Mench at mmm124@psu.edu by midnight (EST) Feb. 15, 2010. Please indicate “*IAHE Design Project Submission*” in the subject line.

Video Presentation:

All participating teams are required to upload a video presentation (maximum 10 minutes) to www.Youtube.com to describe their team’s project goals, analysis, and results. The particular format of this presentation is up to the student teams, but it must convey the method of approach used and main results. Please be sure to include the website URL of the YouTube.com video in your written report cover page, as mentioned above. All information for uploading videos to YouTube is available at www.Youtube.com. Note that the links to your presentations will be made available to all IAHE student chapters and professional members via the Spring 2010 e-newsletter.

Categories of Projects:

1) Applied Study

Applied studies are designed for IAHE chapters with some available resources and facilities to build and evaluate material projects. This year, there are two applied study topics:

Applied Topic A: Portable Fuel Cell

For this competition, teams will attempt to produce the greatest measured sustained power from a fuel cell stack (including all bipolar plates, compression materials, gaskets, flowfields, current collectors, etc.) that is 1 cm high or less, and a maximum of 6 cm x 6 cm in length and width. There is no restriction on type of fuel cell or storage of fuel/oxidizer or anything else not stated.

Not included in the 1x6x6 cm³ volume is the fuel and oxidizer storage, power conditioners, or any fans or other ancillary equipment besides the stack itself. Analysis included in the written report must include:

- 1) An experimental plot of the current versus time for 1-hour operation at chosen operating conditions. This plot must be verified by the faculty liaison for your Student Chapter by signature on the cover page of the written report.
- 2) Estimated analysis of what the total *system* volume (including fuel and oxidizer storage, fans or pumps, and other equipment required to operate besides the external load) would be to operate at the chosen experimental test conditions without refueling for 1 hour.
- 3) Estimated total useful electrical work produced by a full system at chosen test conditions for 1 hour, including losses from any parasitic pumps or fans that would be needed for a complete system.
- 4) Estimated total system efficiency at chosen test conditions, including losses from any parasitic pumps or fans needed.
- 5) Estimated system gravimetric density, in kg (total system) per cm³.

Other calculations and analysis can be used to help present your results. The results will be evaluated based on a combination of the analysis and presentation, with a high weight on the actual measured performance of the fuel cell and the design of the overall potential system.

Applied Topic B: Portable Hydrogen Generator

Until a complete hydrogen infrastructure is built, there will be a need to develop portable, small-scale hydrogen generation systems. The groups involved in this project will construct a solar powered portable hydrogen generation unit, using a method of their choice (e.g. Photovoltaic-Electrolysis, Photothermal, Photochemical, Photoelectrochemical, Biological). The main objective of the project is to produce the most hydrogen given the constraints of the project:

- Sunlight is the only source of energy.
- Hydrogen production units must be portable and have a dimension less than 1m³

Points will be awarded based on:

- Creativity of the design
- Measured hydrogen generation in 1 hour
- Overall portability of the device (includes weight, size, shape)
- Safety*
- Estimated cost (\$/kg of H₂) produced

*Participants in this project should follow all laboratory safety regulations, and perform a strict safety analysis before constructing the device. Please seek your faculty advisors explicit approval for this work.

2) Paper Study:

In every country in the world, the energy requirements, usage, and future needs are different. This year, the paper study topic is:

Vision for a Sustainable Hydrogen Economy

In this study, you are asked to present a vision of what a truly independent and sustainable hydrogen based economy in a chosen country would take to achieve, and what the costs and benefits would be. There is no restriction on the country chosen for study. It can be a large county such as China, or a small island nation. Islands as part of other nations can also be considered (e.g. Okinawa). Specifically, projects will consider the current energy budget in the chosen country of interest including the energy imported and locally generated. Using available and documented information and reports with some scientific evaluation and reasonable assumptions, teams will envision the best possible pathway to reaching a completely sustainable hydrogen energy economy. This would include generation, storage, transportation, and usage infrastructures. You can assume all current technology but must identify where advances are needed, and the assumptions you will have to take to arrive at your conclusions. It will be important in this project to have some vision, and make reasonable assumptions to determine the feasibility of certain options. The components of the report should contain at least the following information:

- 1) Summary estimates of present energy budget and energy importation costs.
- 2) Comparison of potential hydrogen production and usage options, and solutions to meet future predicted energy requirements (e.g. solar, biomass, nuclear, or other sustainable production, and fuel cell, hydrogen combustion, or other usage, etc.).
- 3) Estimation of infrastructure and storage requirements, time, and cost.
- 4) Estimation of reduction in pollution (e.g. particulates, green house gases, etc.) achieved with self-sustained hydrogen economy, and other benefits to society for this activity.

Please take care to identify assumptions required to make calculations, and resources used to find necessary data.

Evaluation Process:

All submissions will be collected and evaluated by members of the IAHE Board of Directors and other highly qualified reviewers for the following criteria:

Applied Study:

- (40%) Obtainment of the specific applied project goals
- (25%) Presentation quality (written and YouTube explanation video)
- (15%) Documentation of references used
- (10%) Originality
- (10%) Total budget (the lower total budget for the most output will be viewed favorably. Please itemize the components used.)

Paper Study:

- (25%) Depth of study
- (25%) Accuracy of facts presented
- (25%) Presentation quality (written and YouTube explanation video)
- (15%) Documentation of references used
- (10%) Originality

Categories of Awards:

There will be three main categories of awards presented at the 18th WHEC meeting event.

- 1) Overall Champion
- 2) Winner, Applied Design Competition A
- 3) Winner, Applied Design Competition B
- 4) Winner, Paper Design Competition

Second and third place winners, as well as honorable mentions in both project categories will also be awarded. Exceptional written reports will be selected for submission to the International Journal of Hydrogen Energy.

Other Notes:

Future Changes:

This document is subject to changes and clarifications up until the registration deadline of Nov. 15 2009. All IAHE Student Chapters will be notified of any changes via their email accounts.

Budgets and Limitations:

There is no set limit of budget for these activities. However, for the applied studies, the written report must include an itemized list of the materials purchased for the project and an estimate of the total system cost.

Faculty Involvement:

The faculty liaison for the student chapter should be responsible to oversee the project and verify that all activities are safe. While help in final editing or to give general suggestions and guidance are appropriate, faculty are not expected to directly prepare the written report or the video submission. Project output should be solely the student participant responsibility.

Fuel Cell Components:

For the applied projects, no team should purchase an off-the shelf complete product. However, individual components such as fuel cell membranes, electrodes, etc., can be purchased to complete the project. A list of some suppliers of fuel cell components is below (Courtesy of Jane Yang at Princeton University)

Fuel Cell Earth:

http://fuelcellearth.com/index.php?page=shop.browse&category_id=4&option=com_virtuemart&Itemid=26

Clean Fuel Cell Energy: <http://www.cleanfuelcellenergy.com/electrode.html>

Fuel Cell Store: <http://www.fuelcellstore.com/en/pc/viewCategories.asp?idCategory=83>

Fuel Cell Suppliers: http://www.fuelcellsupplies.net/electrode_backing.html

Liability:

The IAHE assumes no liability or responsibility for accidents or injury related to this competition.