

DOE FINAL REPORT

For: Energy Challenge 2004: A Paper Snow Board Competition

Covering Period: April 1, 2004 – June 30, 2004

Date of Report: April 24, 2009 for project close-out

Recipient: Institute of Paper Science and Technology at Georgia Tech

Award Number: DE-FC36-97GO10220

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Project Objective:

1. Promote energy efficiency concepts in undergraduate and graduate education.
2. Stimulate and interest in pulp and paper industrial processes, which promote and encourage activities in the area of manufacturing design efficiency.
3. Attract both industrial and media attention.

Background and executive Summary:

In 1997, the Institute of Paper Science and Technology in conjunction with the U.S. Department of Energy developed a university design competition with an orientation to the Forest Products Industry. This university design competition is in direct alignment with DOE's interests in instilling in undergraduate education the concepts of developing energy efficient processes, minimizing waste, and providing environmental benefits and in maintaining and enhancing the economic competitiveness of the U.S. forest products industry in a global environment. The primary focus of the competition is projects, which are aligned with the existing DOE Agenda 2020 program for the industry and the lines of research being established with the colleges comprising the Pulp and Paper Education and Research Alliance (PPERA).

The six design competitions were held annually for the period 1999 through 2004. No competitions were held after June, 2004. The **Summary Table** (page 7) shows the winning results from the six competitions.

Budget Data:**Fourth Quarter: April 1, 2004 – June 30, 2004**

| Quarterly Financial Status Report Project Numbers 1146A4179 and 1146658 For Period: 4/01/04 - 6/30/04 | | | | | | | | |
|----------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------|-------------------------------|-------------------|------------------|-----------------------------|-------------------|------------------|
| <i>Phase / Budget Period</i> | | | <i>Approved Spending Plan</i> | | | <i>Actual Spent to Date</i> | | |
| | | | <i>DOE Amount</i> | <i>Cost Share</i> | <i>Total</i> | <i>DOE Amount</i> | <i>Cost Share</i> | <i>Total</i> |
| | <i>From</i> | <i>To</i> | | | | | | |
| <i>Year 1</i> | <i>04/23/97</i> | <i>10/20/98</i> | <i>100,000</i> | <i>100,000</i> | <i>200,000</i> | <i>147,220</i> | <i>177,757</i> | <i>324,977</i> |
| <i>Year 2</i> | <i>10/21/98</i> | <i>10/20/99</i> | <i>100,000</i> | <i>103,081</i> | <i>203,081</i> | <i>52,780</i> | <i>83,372</i> | <i>136,152</i> |
| <i>Year 3&4</i> | <i>10/21/99</i> | <i>06/30/01</i> | <i>226,120</i> | <i>230,689</i> | <i>456,809</i> | <i>166,358</i> | <i>111,554</i> | <i>277,912</i> |
| <i>Year 5-9</i> | <i>07/01/01</i> | <i>06/30/06</i> | <i>584,313</i> | <i>584,313</i> | <i>1,168,626</i> | <i>387,750</i> | <i>378,568</i> | <i>766,318</i> |
| Totals | | | 1,010,433 | 1,018,083 | 2,028,516 | 754,108 | 751,251 | 1,505,359 |

Status:

During the fourth quarter (calendar 2003) the most successful Energy Challenge competition to date was concluded. Of the 16 teams that submitted proposals, 13 teams were selected and competed in the Energy Challenge 2004 Paper Snowboard competition. Ten teams were sponsored directly through the joint IPST and DOE design competition. Two teams were sponsored by the National Renewable Energy Laboratory (NREL) and one team competed at its own expense. Previously, a maximum of ten teams competed in the Energy Challenge college design competition.

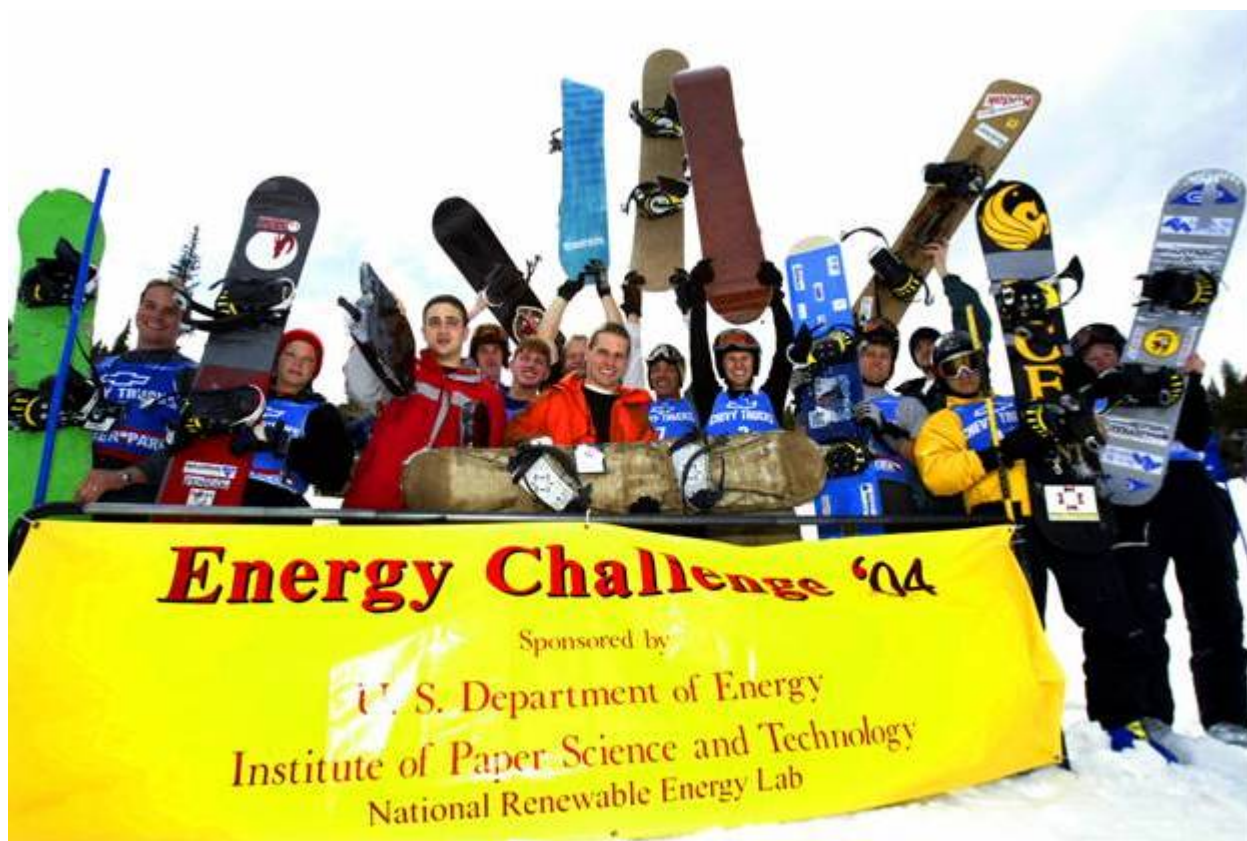
In addition to sponsoring 2 teams, NREL provided a tour of their facilities in Golden, Colorado. Energy Challenge themes of energy conservation, resource conservation, and biomass (fiber) utilization align well with the mission of the national laboratory. NREL also hosted the opening reception which included keynote addresses by Buddy Garland, DOE Program Manager - Industrial Technology, John Kerston, DOE Manager - Golden Field Office, and Jessie Harris, NREL Associate Director.

This was the seventh year and sixth competition in the ten year Energy Challenge program. The Energy Challenge program has afforded college and university students a unique opportunity to participate in a hands-on engineering project. They gained a myriad of experience interacting with industry representatives, as sponsors and mentors, along with DOE personnel, while converting technical theory to practical application. Energy Challenge is a vigorous and challenging engineering design and construction project. Many of the competing colleges and universities use the program as their senior design project. Energy Challenge is a multi-disciplinary design contest. A high value is placed on design innovation, novelty, and originality, leveraged resources, effective use of prior art, and cost effectiveness. An additional

unique aspect of the contest is the emphasis placed on interaction with related industries by the competing teams.

The competition is not a single event but rather a complete process and the teams' efforts over the course of the competition are evaluated in a quantitative manner. The specific elements are mid project report, final project report, physical testing of construction, project documentary video, oral project presentation, and competition race results. Prior to the fourth quarter, the mid project reports and final project reports were evaluated. These comprehensive and detailed reports cover competition themes involving energy efficiency, waste minimization, and fiber content; design, construction and innovation; cost accounting including fundraising, sponsorship, and team support; and safety. The mid project report was worth 10% and the final report worth 20% of the overall competition score.

13 Colleges Compete in Energy Challenge 2004 at Winter Park, Colorado



The competition required the construction of two identical snowboards. One was to be used for the downhill race and the other was submitted to IPST for physical testing. Physical evaluation included non-destructive and destructive tests. To ascertain the strength and physical soundness of the construction, five physical properties were evaluated. These were density, flexural stiffness, compression strength, puncture resistance, and abrasion resistance. A major goal of the

design project was to maximize fiber content. The percent fiber content of the snowboard was used as a multiplier of the physical properties score. Testing protocols were based on TAPPI Test Methods T-220, T-836, T-825, T-803, and T-476, respectively. For each test, ten points were awarded to the team's board with the highest performance. Pro-rated points were awarded to the remaining teams based on their board's performance as related to the range of performance values. Thirty percent of the teams score was based on physical performance. Testing was completed at IPST by Robert Hall, Michael Schaepe and Tim Patterson.

On the day prior to the snowboard race, the competition judges gathered to review and evaluate the project documentary videos. These videos were to introduce the project teams; document the design and construction methods; showcase the novelty of design, material engineering, and aesthetics; address competition themes of energy efficiency, waste minimization, and fiber content maximization; and outline safety in design, construction, and racing. Production of a video would provide an avenue for the teams to express their creativity – also an evaluation factor. Ten percent of the overall competition score was based on the video.

Competition day started with team oral presentations. Using various visual aids including the competition snowboard, the presentations required that the teams describe the design and construction methods used, highlight the novelty of design, material engineering, and aesthetics, address competition themes of energy efficiency, waste minimization, and fiber content maximization, describe sponsor involvement, and discuss safety. The seven competition judges evaluated the presentation for content and professionalism. The scores for the presentation accounted for 10% of the overall competition score.

Seven judges evaluated the mid project reports, final reports, team documentary videos, and oral presentations. The judges were: Dr. Timothy Patterson, IPST; Michael Schaepe, IPST; Doug Hooker, DOE; Dr. Bonnie Hames, NREL; Robert Jeyseelan, Tyco Healthcare; Dr. Michael Shaffer, UCF-retired; and Dr. Stan Kozalak, UC-Berkeley-retired. The judges donated their time to evaluate the reports and attend the competition where they judged the oral presentations and videos. Additionally, they contributed to the efficient operation of the competition by answering team member questions and providing the odd hand at the competition starting line, awards ceremony, and reception. Without their contributions the competition could not have been executed with such success. Also contributing to the success of the program were MG Whitaker, IPST Project Manager, Anna Martinez-Barnish and John Horst, DOE, as well as other NREL, DOE, and IPST staff.

The competition was held in Winter Park, Colorado – a perfect venue for the snowboard competition and conveniently located near the Golden, Colorado offices of DOE and NREL. The venue host was Winter Park Resort. Winter Park Resort and its staff donated time and facilities to make this competition safe, comfortable, efficient, effective, and fun. Patty McCarthy was especially remarkable in coordinating functions and facilities at the competition venue. Without Winter Park Resort's contributions the competition would not have been possible.

A detailed media coverage plan was initiated by John Horst of the DOE. Additionally, David Bell of IPST contributed to execute a broad and extensive media coverage campaign. This resulted in 22 radio interviews with competitors, coverage in more than 100 publications and web sites, PR Newswire coverage seen by 118 journalist and 2,494 public viewers, and 35 television stories including Fox News with an estimated 777,000 viewers.

Two Competitors Navigating the Course



The Energy Challenge race, which requires a team member to compete on the product their team constructed, is the culminating event of this ambitious student engineering design and construction project. The race accounts for 20% of a team's total score and is the final activity of Energy Challenge. As usual, scoring at this point in the competition was close and the race finale served as exciting event conclusion. It is also a real world test for the product's performance as well as for the team's resilience. The race course was a moderately sloped slalom with rollers at the top and a jump at the base of the hill. These course features tested the board's robustness in a way unlike the testing in the controlled environment of the laboratory could. Here, the excitement of the competition and the desire to win caused the racer to push the board to its limit. The race, aside from being very exciting, was a visually and physically validating conclusion to the year long Energy Challenge project.

Energy Challenge 2004: Final Results

| | TEAM | SCORES | | | | | | TOTAL |
|----|------------------------------|------------------------------|---------------------------|----------------------------------------|--------------------|---------------------------|---------------------------|-------|
| | | Mid-Term Report (max. 10) | Final Report (max. 20) | Performance & Engineering (max. 30) | Video (max. 10) | Presentation (max. 10) | Race Results (max. 20) | |
| 1 | Miami University | 7.5 | 16.0 | 24.2 | 8.8 | 8.8 | 18.3 | 83.8 |
| 2 | SCAD | 8.7 | 17.9 | 17.0 | 9.0 | 9.3 | 16.7 | 78.5 |
| 3 | Pasadena City College | 7.7 | 15.9 | 13.8 | 8.3 | 8.2 | 20.0 | 73.9 |
| 4 | University of Maine | 8.2 | 16.2 | 16.3 | 8.3 | 8.7 | 15.0 | 72.5 |
| 5 | NC State University | 8.2 | 17.0 | 17.6 | 8.8 | 9.7 | 6.7 | 67.8 |
| 6 | Lamar University | 7.3 | 14.4 | 14.9 | 6.8 | 7.7 | 11.7 | 62.7 |
| 7 | SUNY/Syracuse | 7.6 | 15.6 | 8.8 | 7.9 | 8.4 | 13.3 | 61.6 |
| 8 | Mississippi State University | 3.7 | 12.8 | 14.6 | 7.9 | 7.3 | 10.0 | 56.2 |
| 9 | Spartan School Aero. | 7.1 | 13.6 | 14.4 | 6.3 | 8.3 | 5.0 | 54.6 |
| 10 | Georgia Tech | 7.4 | 15.7 | 12.8 | 7.6 | 8.3 | 0.0 | 51.8 |
| 11 | Univ. Central Florida | 6.2 | 13.6 | 9.6 | 6.3 | 7.7 | 8.3 | 51.7 |
| 12 | Temple | 7.5 | 14.3 | 7.3 | 6.3 | 6.9 | 1.7 | 44.0 |
| 13 | Univ. of Colorado | 7.0 | 10.2 | 0.0 | 0.0 | 6.3 | 3.3 | 26.7 |

Energy Challenge 2004: Snowboard Race Results

| | TIME (seconds) | | | Best Time | PLACE |
|------------|----------------|--------|--------|-----------|-------|
| | Heat 1 | Heat 2 | Heat 3 | | |
| Pasadena | 18.97 | 17.99 | 20.00 | 17.99 | 1 |
| Miami-Ohio | 19.02 | 18.44 | 22.77 | 18.44 | 2 |
| SCAD | 18.46 | 23.58 | 20.32 | 18.46 | 3 |
| U Maine | 19.45 | 19.43 | 18.99 | 18.99 | 4 |
| SUNY | 19.24 | 19.02 | 19.90 | 19.02 | 5 |
| Lamar | 38.89 | 24.71 | 22.11 | 22.11 | 6 |
| Miss St | 30.44 | 26.83 | 25.26 | 25.26 | 7 |
| U C F | 49.65 | 30.04 | 25.63 | 25.63 | 8 |
| NCSU | 33.88 | 138.36 | 31.41 | 31.41 | 9 |
| Spartan | 55.95 | | 53.96 | 53.96 | 10 |
| U Colorado | 99.23 | | | 99.23 | 11 |
| Temple | | 137.86 | | 137.86 | 12 |
| GT | | | | | 13 |

Remaining activities include the issuance of the final newsletter and year end report, and updating the Energy Challenge web page. Although DOE has withdrawn funding for next year's program, IPST is investigating options to continue Energy Challenge. Possible funding sources include corporate sponsors and NREL. The plan for next year is to hold a competition to design and build a mountain bike frame or a whitewater kayak. A major change in the scope of the program is in expanding the competition beyond papermaking fibers to biomass. This change will open the competition to more broadly address energy issues and expand the engineering materials that can be used in the competition. IPST is looking forward to another successful and educationally valuable Energy Challenge in 2005

Summary Table: Energy Challenge Competition Results 1999 Through 2004

| | | 1998-99 Thermal Insulated Impact Resistant Liquid Package | 2000 Paper Kayak | 2001 Sailboat Sail | 2002 Sailboard | 2003 Hang Glider Sail | 2004 Snowboard |
|----|-------------------------------|---------------------------------------------------------------------------|----------------------------|------------------------------|--------------------------|------------------------------------|--------------------------|
| 1 | Clarkson | x | | | | | |
| 2 | Georgia Tech Paper Sci | 3 | x | | 1 | x | o |
| 3 | Georgia Tech ME | | | | | | x |
| 4 | Lamar | | | | | | x |
| 5 | Miami University of Ohio | x | 3 | 3 | 2 | x | 1 |
| 6 | Mississippi State | x | x | | x | | x |
| 7 | NC State #1 | x | | x | x | 1 | x |
| 8 | NC State #2 | | | | x | | |
| 9 | NCAT | | | | | x | |
| 10 | Pasadena City College | | | | | | 3 |
| 11 | SCAD | | | | | x | 2 |
| 12 | Spartan School of Aeronautics | | | | | 2 | x |
| 13 | SUNY-Syracuse | | x | 1 | | | x |
| 14 | Temple | | | | | 3 | x |
| 15 | University New Mexico | | | | | | o |
| 16 | University of Central Florida | | | x | x | x | x |
| 17 | University of Colorado | 1 | 2 | | | | x |
| 18 | University of Maine | 2 | 1 | 2 | 3 | x | x |
| 19 | University of Minnesota | | x | | | | |
| 20 | Western Michigan University | x | | | | x | o |
| | TOTAL | 8 | 7 | 5 | 7 | 10 | 16 |

Note: number = place in competition, x = competing team, o = submitted proposal