

Final Report on Penn State-cosponsored

2009 ConocoPhillips Energy Prize Program

Chunshan Song

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Summary

This is the final report on the Penn State-cosponsored ConocoPhillips (national) Energy Prize Program in 2009 for which I served as one of the five judges and a technical representative for Penn State during February-October 2009. The ConocoPhillips (COP) Energy Prize is a joint initiative of ConocoPhillips and Penn State* to recognize new ideas and original, actionable solutions that can help improve the way the nation develops and uses energy in three aspects: developing new energy sources, improving energy efficiency and combating climate change. [*EMS Dean Easterling initiated the Penn State involvement in co-sponsoring this energy prize program in 2007 and assigned Chunshan Song to work on behalf of Penn State for this program since 2007].

This year the COP Energy Prize Program received over 170 applications via online submissions. Numerous ideas (devices, processes, systems, etc.) related to all aspects of energy and all sources of energy (renewable, fossil, nuclear) were presented in the award applications. Through review and evaluation, we developed the list of top 30 applications by total scores. The top 30 entries have a strong focus on renewable energy although fossil energy and nuclear energy were also reflected.

With the coordination of ConocoPhillips, we had a telephone conference among all the five judges on August 10th, 2009 in which we selected the top 5 entries and the alternate top 5 entries. The following top 5 finalists were selected. All the finalists were initially given the award of \$25,000 (from ConocoPhillips) to help further develop their concepts.

During Oct 18-19th, 2009, we reviewed and selected the winner and the two runner-ups based on the presentations by each of the 5 finalist teams in Houston. The winner will receive an additional \$100,000, the first runner-up will receive another \$50,000, and the second runner-up will receive another \$25,000 (from ConocoPhillips).

The Penn State-cosponsored COP Energy Prize program has generated a great deal of publicity for Penn State with numerous (hundreds of) web sites containing the news report as of today on the prize “ConocoPhillips and Penn State have awarded the 2009 ConocoPhillips Energy Prize to”. I am honored to serve as one of the five judges and excited to see the new innovations from the 2009 prize program outlined below.

Top 5 Finalists from 170 Applications

Scott Anderson and Team

ECO-Auger

Andres Clarens

Gas Expanded Lubricants: Improving Turbine Efficiency Using “Smart” Fluids

Alan Fox

Improved Wind Powered Electricity Generation Through the Use of Pressurized Hydraulic Fluid

Bob Gumm and Team

Equinox Solar System

Kevin Lampe and Team

Focusing Wind Energy to Make Urban and Suburban Wind Farms

Winner and Runner-up of 2009 Energy Prize

We conducted the final review and selection of the Winner, the 1st Runner-up and the 2nd Runner-up from the top 5 finalists (by the five judges including myself) on October 19, 2009, in Houston, TX, where each of the finalist team gave a 30-min presentation followed by 20-min questions and answers time, and a second round of Q&A time before the final selection. The award ceremony was held at the Headquarters Building of ConocoPhillips in Houston during 5-6 pm on Oct 19th, 2009.

William Easterling, Dean of College of Earth and Mineral Sciences is the official representing Penn State, and the EMS Energy Institute of Penn State is the official co-sponsor of this Energy Prize program. Alan Scaroni, Associate Dean in the College of Earth and Mineral Sciences, represented Penn State in the 2009 award program and gave a speech in the award ceremony. A’ndrea Messer, Public Communications (media) from Penn State also attended the award program in Houston.



Winner Selected

2009 ENERGY PRIZE WINNER

Scott Anderson and Team for the ECO-Auger™

ECO-Auger™ is a hydrokinetic machine that converts moving water from river and ocean currents to renewable electric energy. Its hydraulic storage pressure compensation system guarantees constant energy output regardless of tidal current strength. Designed with tapered helical leads on each end rather than sharp edges, the machine does not impact marine wildlife.

2009 ENERGY PRIZE FIRST RUNNER UP

Andres Clarens for Gas Expanded Lubricants: Improving Turbine Efficiency Using "Smart" Fluids

Wind turbines operate under a wide range of weather conditions which directly influence the temperature and loading on mechanical components. These natural variations have been shown to cause a large number of the reliability problems in modern wind turbines. This concept proposes a new type of lubricant called Gas-Expanded Lubricants (GELs) with properties that could be changed in response to prevailing weather conditions.

2009 ENERGY PRIZE SECOND RUNNER UP

Kevin Lampe and Team for Focusing Wind Energy to Make Urban and Suburban Wind Farms

This concept suggests a roof-mounted vertical axis wind turbine (VAWT) system that addresses two principal impediments to broad-scale use of wind farms – cost per unit of energy production and the unreliability of sustained optimal wind speeds. In this proposal, VAWT systems are mounted on top of flat-roofed buildings that are fitted with four-sided "wind funnel roofs". The wind funnels direct air that flows over the top of the building onto the working side of the turbine while preventing air from flowing into the VAWT's return path.



Photo of the Winner (Scott Anderson, center) and the 1st Runner-Up (Andres Clarens, left) and the 2nd Runner-up (Kevin Lampe, right) in the 2009 Penn State-cosponsored ConocoPhillips Energy Prize Program in Houston, TX, Oct 18-19, 2009.

Background:

Dean William Easterling assigned Chunshan Song to represent and work on behalf of Penn State in this award program and its development when the idea was developed in 2007, in his meeting with Alan Scaroni (Assoc Dean, EMS), Yaw Yeboah (Head, EME Dept) and Chunshan Song in 2007.

The inaugural 2008 Energy Prize program was very successful, as reported by Chunshan Song in October 2008. The 2009 Energy Prize program was announced in Feb 2009 (on the web <http://live.psu.edu/story/37655>).

The 2009 program received over 170 applications (through online submissions). Each of the applications was reviewed and evaluated on the same criteria as indicated below.

Criteria and Judges for the Energy Prize:

Submissions for the ConocoPhillips Energy Prize are evaluated by a panel of expert judges. Concepts are judged on the basis of creativity, scalability, commercial viability, and sustainability.

The same group of the 5 judges** for 2008 Prize program continued to serve as judges to review all the proposals/applications for the 2009 program. Through hard working over the summer, top 30 candidates were selected and complied by the 5 judges. The 5 judges then reviewed the top 30 applications in more detail in a telephone conference discussion.

Dr. Charles Bierbauer

Dean, Mass Communications and Information Studies
University of South Carolina

<http://www.conocophillips.com/EN/tech/energyprize/judges/pages/bierbauer.aspx>

Dr. Ralph Cicerone

President
National Academy of Sciences

<http://www.conocophillips.com/EN/tech/energyprize/judges/pages/cicerone.aspx>

Dr. Peter Jackson

Senior Director, Oil Industry Activity
Cambridge Energy Research Associates (CERA)

<http://www.conocophillips.com/EN/tech/energyprize/judges/pages/jackson.aspx>

Dr. James Kimble

Fellow, Biofuels and Long-Range Technology (retired)
ConocoPhillips

<http://www.conocophillips.com/EN/tech/energyprize/judges/pages/kimble.aspx>

Dr. Chunshan Song

Director, EMS Energy Institute, Professor of Fuel Science and Chemical Engineering, epartment of Energy and Mineral Engineering, and Department of Chemical Engineering, The Pennsylvania State University

<http://www.conocophillips.com/EN/tech/energyprize/judges/pages/song.aspx>

Evaluation Work

By the official rule of the prize program, I act on behalf of Penn State but can not tell or discuss with anyone on the contents of any applications until after the announcement of the finalists. Due to the extremely broad areas of ideas presented in the award applications, the evaluator needs to have a very broad knowledge and also needs to learn new topics in depth. So it took me a great deal of time and efforts for reviewing all the applications and for studying the related materials/literature reports for judging the sciences, technologies/inventions on a broad range of topics in the Summer 2009.

On August 10th, 2009, we had a teleconf on the program (coordinated by Andrea Ferdinand of ConocoPhillips) involving all of the 5 judges and the public communication offices from COP and PSU. After 3 hrs teleconf discussion, we selected the top 5 candidates, and the next (alternate) 5 candidates.

During Oct 18-19, 2009, we have conducted the on-site evaluation of the top 5 finalists in Houston, where each of the finalists teams gave 30-min presentation coupled with the display of proto-type devices of their invention. I am pleased to report the ideas and technical concepts of the award-winning finalists selected at the Oct 18-19 Houston evaluation meeting, as outlined below.

Acknowledgment

This summary report marks the completion of my work and involvement for the 2009 COP Energy Prize program.

I would like to thank Dean Easterling for initiating the Penn State co-sponsorship, for assigning me to work on this program since 2007, and for supporting my efforts on this COP Energy Prize program in 2008 and 2009. I am also grateful to Eva Pell, Tom Richard, Alan Scaroni, Yaw Yeboah and Andrew Zydney for supporting my work on this program. I would like to thank Alan Scaroni for representing Penn State in the 2009 and 2008 award ceremonies in Houston. Many people in both ConocoPhillips and Penn State have supported this program. I wish to thank those at ConocoPhillips who were involved in the Energy Prize program including Lou Burke and his colleagues, particularly Andrea Ferdinand of ConocoPhillips for coordinating all the events since January 2009, Andrea Messer (and formerly Vicki Fong) of Penn State for her support and help in the communications and press releases, Tom Massaro for helping us to craft the contract and MOU with ConocoPhillips and Nicky Rigg in the EMS Energy Institute for coordinating my schedules including meetings and teleconferences. The COP Energy Prize program has generated great publicity for Penn State and COP in numerous web sites and news media, will likely continue for several more years, and I look forward to seeing more energy innovations through this program.

Best wishes,

Chunshan

Concepts and Ideas of the Top 5 Finalists and the Winner in 2009:

http://www.conocophillips.com/EN/newsroom/news_releases/2009news/Pages/10-20-2009.aspx

<http://live.psu.edu/story/42374/rss49>

10-20-2009

ConocoPhillips Energy Prize Winner Announced

ConocoPhillips, Penn State Recognize Innovative Ideas To Diversify Energy Sources, Improve Energy Efficiency

HOUSTON and UNIVERSITY PARK, Pa., Oct. 20, 2009 --- ConocoPhillips [NYSE:COP] and Penn State have awarded the 2009 ConocoPhillips Energy Prize to Scott Anderson and team for their innovation, the ECO-Auger™, a hydrokinetic machine that converts moving water from river and ocean currents to renewable electric energy. Its hydraulic storage pressure compensation system guarantees constant energy output regardless of tidal current strength.

The ConocoPhillips Energy Prize recognizes new ideas and original, actionable solutions that can help improve the way the United States develops and uses energy. The Prize focuses on innovative ideas and solutions in three areas: developing new energy sources; improving energy efficiency; and combating climate change.

"We are proud to champion the ConocoPhillips Energy Prize to encourage and assist the nation's brightest minds in bringing their energy-related ideas to reality," said Jim Mulva, ConocoPhillips chairman and chief executive officer. "Along with our partners at Penn State, we are pleased to recognize Scott Anderson, his team and the finalists for their innovative ideas to help create a more secure energy future."

"Securing the nation's energy future will require innovative ideas that maximize existing resources, create sustainable and diverse energy supplies, and significantly reduce greenhouse gas emissions," said Dr. William Easterling, dean of Penn State's College of Earth and Mineral Sciences. "Like ConocoPhillips, Penn State is pleased to recognize these individuals for their innovative strides towards the development of clean, sustainable energy and improved energy efficiency."

More than 150 proposals were submitted for evaluation by a panel of energy and environmental experts, which selected five finalists. Proposals were judged on the basis of creativity, scalability, commercial viability and sustainability.

The first runner-up was Andres Clarens for Gas Expanded Lubricants: Improving Turbine Efficiency Using "Smart" Fluids, which proposes a new type of lubricant with properties that could be changed in response to prevailing weather conditions. Second runner-up was Kevin Lampe and team for Focusing Wind Energy to Make Urban and Suburban Wind Farms, which suggests a roof-mounted vertical axis wind turbine system that addresses two principal impediments to broad-scale use of wind farms – cost per unit of energy production and the unreliability of sustained optimal wind speeds.

The remaining finalists were Alan Fox for Improved Wind Powered Electricity Generation Through the Use of Pressurized Hydraulic Fluid, and Bob Gumm and team for the Equinox Solar System.

Each of the five finalists received an award of \$25,000 to further the development of their concept. The winner received an additional \$100,000; the first and second runners-up received an additional \$50,000 and \$25,000 respectively.

The awards were presented yesterday at a ceremony held at ConocoPhillips Corporate offices in Houston following formal presentations by the five finalists to the panel of judges.

The judges were: Charles Bierbauer, *Dean, Mass Communications and Information Studies, University of South Carolina*; Dr. Ralph Cicerone, *President, National Academy of Sciences*; Dr. Peter Jackson, *Senior Director, Oil Industry Activity, Cambridge Energy Research Associates*; Dr. James Kimble, *Fellow, Biofuels and Long-Range Technology (retired), ConocoPhillips*; and Dr. Chunshan Song, *Director, EMS Energy Institute, Professor of Fuel Science and Chemical Engineering, Department of Energy and Mineral Engineering, The Pennsylvania State University*

In 2008, ConocoPhillips and Penn State awarded the first ConocoPhillips Energy Prize to David A. Gonzales II to further develop the Layered MagWheel, a new technology for magnetic acceleration and frictionless braking for vehicles that increases energy conversion and efficiency. Since winning the award last year, Gonzales has formed a company to coordinate the development of the Layered MagWheel and expects to complete and test the prototype in the coming months.

More information about the ConocoPhillips Energy Prize and the finalists is available at www.conocophillips.com/energyprize.

About ConocoPhillips

ConocoPhillips is an international, integrated energy company with interests around the world. For more information, go to www.conocophillips.com.

About the Penn State EMS Energy Institute

Penn State is a national public university that is prominent for its energy and environmental sciences, technology and policy research. The EMS (Earth and Mineral Sciences) Energy Institute at Penn State is a leading research and development organization focused on clean energy technologies that will assist the nation in meeting its growing demands. For more information, go to www.energy.psu.edu.

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<http://www.conocophillips.com/EN/tech/energyprize/09finalists/Pages/Anderson.aspx>

Prize Winner

2009 Energy Prize Winner Scott Anderson and Team for the ECO-Auger™

ECO-Auger™ is a hydrokinetic machine that converts moving water from river and ocean currents to renewable electric energy. Its hydraulic storage pressure compensation system guarantees constant energy output regardless of tidal current strength. Designed with tapered helical leads on each end rather than sharp edges, the machine does not impact marine wildlife.

The ECO-Auger™ is activated as moving water forces the machine to rotate. This rotation is directly coupled through planetary gears to a high pressure hydraulic pump located in the machine's nose cone. The cone, which is tethered to bridges or anchored in moving water, stabilizes the torque generated from the rotation and transfers it to the hydraulic pump. The pump supplies variable volumes of high pressure fluid at set controlled pressure, regardless of the direction or speed of rotations. This pressure feeds an oil-driven electric generator that delivers constant current.



Constant power generation is achieved through the ECO-Auger™'s unique hydraulic pump. As the ECO-Auger™ rotates, the high pressure oil flows through check valves to an array of standard air oil accumulators that are connected directly in line to the oil motor driving the electric generator. The oil to the electric generator is sized below the maximum gallons per minute of the ECO-Auger™'s hydraulic pump, allowing the pumped oil to be supplied to the motor, while

the excess volume is stored in the accumulator. This storage system, which is monitored by a computer to assure maximum energy stability, stores enough energy to supply the generators during the slow down of tidal flow.

ABOUT THE TEAM:

Winfield Scott Anderson

After a lifetime of developing multiple patents, products and companies, this engineer, entrepreneur and fishermen understands the power of moving water, and his solution to harnessing that power may be his most impressive solution yet. An entrepreneur since 1947, Scott was trained as an industrial engineer. His entire commercial experience was in manufacturing a variety of different products, including packaging and plastic package decorating products, flood venting products, insect feeding and storage and urethane dispensing, among others. Scott received a B.S. in business and industrial engineering from Drexel University. During this time, he learned hydraulic circuit design, which gave him the knowledge to create hydraulic circuits for a scaled hydraulic model train that

could pull 25 adults. As a part-time Alaskan resident, Scott was intrigued by the 28-foot high tidal change in many Alaskan rivers. This curiosity led to the conception of the ECO-Auger™ to utilize the abundant energy from moving water in Alaska. However, with winters spent in Florida, Scott discovered that the possible energy of the tidal inlets could also be harnessed. Scott now believes that with a minimal investment, the Eco-Auger™ could be deployed in millions of sites all over the world.

Michael J. McNamara

Michael's interest in alternative energy began in the remote rain forests of east Maui, where he lived for more than 20 years. There, Michael used a variety of alternative energy designs, including solar, wind and water, to supply his power needs. After purchasing property in New Zealand, Michael noticed a unique point of land that caused waves to peel with a consistent, cylinder-like quality for 1.6 kilometers. The consistent wave action caused him to consider them as a source of energy; however, Michael noticed something more consistent than wave action: the tide. The tides delivered steady, predictable energy four times a day. Upon seeing the concept for the ECO-Auger™, he was convinced that the design was perfectly suited to extract this source of energy. Michael joined Scott Anderson and the ECO-Auger™ team and assisted in building and testing an auger prototype. Michael holds an exclusive license to the ECO-Auger™ technology for all of New Zealand and is developing a program for a New Zealand deployment.

Michael J. Graham

Michael has worked in the manufacturing and engineering sector for the past 30 years. His experience started with a tool-making apprenticeship along with an engineering education. Some of his experience includes manufacturing semi-automated detonator explosive loading equipment, project management for a military fuse development company, design and management of production for semi and automated equipment for accelerometer and various other products. Michael also implemented and operated an assembly plant for dollar bill recognition. In addition, he successfully directed and managed the conversion of a Piezo film research and development facility into a 120-employee production and engineering plant. As a Six Sigma black belt, he successfully implemented multiple projects that dramatically increased profitability through statistical variation reduction. In 2000, he led the development of flood products for the consumer market. These products are sold nationally through a network of 500 dealers. Michael is a tenacious leader that understands how to bring a product to market. His greatest skill is the development of leaders, and his most prized asset is his ability to make decisions that create profitability.

<http://www.conocophillips.com/EN/tech/energyprize/09finalists/Pages/AndresClarens.aspx>

First Runner-Up

2009 ENERGY PRIZE FIRST RUNNER UP

Andres Clarens for Gas Expanded Lubricants: Improving Wind Turbine Efficiency Using "Smart" Fluids

Wind turbines operate under a wide range of weather conditions which directly influence the temperature and loading on mechanical components. These natural variations have been shown to cause a large number of the reliability problems in modern wind turbines. Of these, nearly one-third occur in components that are heavily lubricated. This concept

proposes a new type of lubricant called Gas-Expanded Lubricants (GELs) with properties that could be changed in response to prevailing weather conditions.

Conventional lubricants are petroleum-based mixtures with characteristics, such as viscosity, that tend to decrease with temperature. GELs are binary mixtures of lubricants and liquid carbon dioxide whose characteristics can be tuned dynamically by controlling the pressure or composition of carbon dioxide in the mixture. In this fashion, GELs can decouple temperature and viscosity as well as other important properties that protect wind turbine components. The synthetic lubricants envisioned for GEL applications could be derived from either petroleum or bio-based sources.



Preliminary experimental results confirm that CO₂ pressure and composition are directly related to dynamic viscosity of the mixture. The experimental results hold over a range of shear rates, which is important in mechanical components. Modeling results demonstrate that GELs could reduce power losses through some bearings by as much as 20%. There are secondary benefits associated with heat dissipation that could assist in protecting mechanical devices. This technology could

represent a transformative technology in wind turbines, subsequently improving the effectiveness of the nation's wind power sector.

ABOUT THE FINALIST:

Andres Clarens is an assistant professor of civil and environmental engineering at the University of Virginia and the Director of the Virginia Environmentally Sustainable Technologies Laboratory. His research focuses on pollution prevention and green engineering with an emphasis on reducing greenhouse gas emissions from manufacturing, power and transportation systems. He has more than eight years of experience applying his formal training in surface chemistry to problems in metalworking, coal-fired power production and carbon sequestration. He has been particularly interested in the use of high-pressure mixtures of bio-based lubricants and gases as an alternative to petroleum and water mixtures in various applications. In his spare time, Professor Clarens enjoys running, backpacking, fly-fishing and traveling. He holds a B.S. in Chemical Engineering from the University of Virginia and an M.S.E. and Ph.D. in environmental engineering from the University of Michigan. He has also served in the United States Peace Corps developing water drinking systems for rural villages on the Dominican/Haitian border.

<http://www.conocophillips.com/EN/tech/energyprize/09finalists/Pages/KevinLampeandTeam.aspx>

Second Runner-Up

2009 ENERGY PRIZE SECOND RUNNER UP

Kevin Lampe and Team for "Focusing Wind Energy to Make Urban and Suburban Wind Farms"

This concept suggests a roof-mounted vertical axis wind turbine (VAWT) system that addresses two principal impediments to broad-scale use of wind farms – cost per unit of energy production and the unreliability of sustained optimal wind speeds.

In this proposal, VAWT systems are mounted on top of flat-roofed buildings that are fitted with four-sided "wind funnel roofs". The wind funnels direct air that flows over the top of the building onto the working side of the turbine while preventing air from flowing into the VAWT's return path. This technique enhances the wind energy interacting with the turbine, which improves efficiency and decreases the need for large, expensive turbines. Wind deflector panels are positioned within the funnel's main walls to ensure maximum wind capture when the wind direction is not perpendicular to one side of the funnel.



Though the system will vary in size depending on the roof dimensions, it will be considerably smaller than systems typically used in wind farms, allowing for easier production and installation. By installing the systems on preexisting rooftops, the technology places electric production close to areas of greatest use, reduces the need for utilization of undisturbed land, alleviates

issues of aesthetics and allows for concurrent installation of solar panel arrays.

ABOUT THE TEAM:

This team consists of four members, all of whom reside and work in southeastern Pennsylvania. The team's collaboration formed around a common concern for environmental sustainability and a philosophy that there should never be a question of whether or not something can be accomplished, but only the matter of how to accomplish it.

Kevin Lampe, the team leader, is an assistant professor of biotechnology. Kevin has spent most of his professional life pursuing various areas of biological research, yet continues a life-long passion for environmental science and mechanical engineering.

David Adams is a chemist and chemical engineer who works in the pharmaceutical manufacturing industry. His side interests include biology and other natural sciences.

Michael Schwarz is a LEED Accredited senior mechanical engineer and works for an international architecture, engineering, planning and interior design firm. Some of his expertise includes computational fluid dynamics modeling, energy simulation and sustainable design of buildings. Michael recently received *Consulting-Specifying Engineer's* "40 Under 40" award.

William Brownlowe, associate professor of engineering, has twice been honored as Who's Who Among America's Teachers. He and Kevin are collaborators on multiple National Science Foundation grants supporting advanced education in science and technology.

Finalist (One of the Five)

<http://www.conocophillips.com/EN/tech/energyprize/09finalists/Pages/AlanFox.aspx/o>

2009 ENERGY PRIZE FINALIST

Alan Fox for Improved Wind Powered Electricity Generation through use of Pressurized Hydraulic Fluid

This concept suggests a wind generation technology that requires fewer generators than traditional models and employs hydraulic fluid to increase power output by storing and utilizing energy during periods of low wind activity.

In this design, rows of wind towers are connected by a piping system containing hydraulic fluid, as well as a catwalk to facilitate safe access. As wind turns the blade on each tower, a single piston or rotary drive system in the blade captures wind force and transmits energy into the hydraulic fluid. In turn, a hydraulic-powered gear transmission system shifts, causing the pressurized hydraulic fluid to flow in a single direction. The combined energy created within the fluid from the wind towers is transferred by the piping system into a series of holding tanks.

Each sealed holding tank contains hydraulic fluid at a progressively increased pressure. The final pressurized tank transfers kinetic energy of the hydraulic fluid to a single generator system, located at ground level for accessibility. After the energy has been used by the generator, the fluid automatically drains into a holding tank, where it is eventually re-pumped via a vacuum system to the lead wind tower and reused.

This technology eliminates the need for a nearby traditional alternative power source, as energy is indefinitely stored within the pressurized hydraulic fluid.

ABOUT THE FINALIST:

Alan started his own business at age 28 and has been running it for the past 23 years, along with renovating and selling real estate. He also designs and builds specialized industrial equipment specific to his company. Several years ago, Alan learned that sufficient wind exists in the United States to supply a significant portion of the nation's current energy needs. Recognizing that the costs associated with current wind technology prohibit the full utilization of this renewable energy source, Alan began working on ideas for more economical ways of generating energy from wind technology and for storing energy during times of little or no wind.

Alan and his wife Mary live with their three children in Grand Ledge, Michigan. He enjoys spending time with his family, cooking, landscaping and reading about science, technology and history. His hobbies include physical fitness, Tae Kwando, and scuba diving. Books that he has read recently include "Internal Combustion" by Edwin Black and "Outliers" by Malcolm Gladwell.

Finalist (One of the Five)

<http://www.conocophillips.com/EN/tech/energyprize/09finalists/Pages/BobGumm.aspx/o>

2009 ENERGY PRIZE FINALIST

Bob Gumm and Team for the Equinox Solar System

The Equinox Solar System is a passive integral collector storage (ICS) solar thermal system that uses patented heat control and heat retention technology to produce hot water up to 180 degrees Fahrenheit.

Its economical design utilizes lightweight polymer materials to minimize the need for expensive, heavy metal components. The Equinox panels are fully insulated and include mounting brackets that facilitate rapid, cost-effective installation.

Designed with a heat control valve, the Equinox Solar System is able to withstand dramatic climate changes. The valve also enables the use of cross-linked polyethylene (PEX) tubing to transport water, thus eliminating the need for expensive copper tubing. Heat loss is reduced through a heat shield consisting of a thin, double-walled polycarbonate cover that is sealed and evacuated of atmosphere. Another unique component is a plastic high-density polyethylene roto—molded heat exchanger, immersed in an ABS tank.

The Equinox Solar System was specifically designed to be economical, with a projected cost of \$1,800 for a one-panel system, compared with \$4,000 to \$5,000 for systems currently on the market. Utilizing this system, a household of three adults could potentially save approximately 2,600 kilowatt-hours annually.

ABOUT THE FINALIST TEAM:

The Equinox Solar System is the latest invention of Bob Gumm, who has been involved in the solar industry since 1977. A lifelong resident of Redding, California, Bob is a well-known and highly regarded expert on solar thermal technology. His prior inventions include a portable solar system for field use by the military and the Solarizer drain-back system that was widely deployed throughout Northern California in the early 1980s. Through his years of experience installing various types of solar thermal systems, Bob identified the need for an efficient, low-cost solar water heater that would be much easier to install than the heavy and cumbersome panels made from glass and metal.

Teaming up with Gary Johnson, a local building contractor, Bob designed a prototype system using polymer materials that would provide similar thermal output to conventional systems. This innovative new system contained several unique features, such as a plastic heat exchanger, a thermal regulating valve and special couplings that would enable the system to be plumbed to the storage tank using PEX tubing, obviating the need for more expensive copper piping. Once commercial production begins, Bob intends to market the Equinox Solar System through a nation-wide network of franchisees that will be developed by Michael Palmer, who has a strong background in business-to-business and consumer marketing. Bob is confident that the Equinox System can be installed for approximately half the cost of comparable metal and glass systems, reducing the pay-back period to approximately three years.

More Details on COP Energy Prize:

More details on the contest rules and the 2009 and 2008 **COP Energy Prize** programs can be found in the following web site:

<http://www.conocophillips.com/EN/tech/energyprize/Pages/index.aspx>

<http://live.psu.edu/story/42374/rss49>

Appendix

Report on 2008 COP Energy Prize Program

In order for everyone to see the major differences in the topics of the top 5 finalists between the 2009 and 2008 programs, I also attached the report below for the 2008 COP Energy Prize program.

From: Chunshan Song [mailto:csong@psu.edu]
Sent: Thursday, October 16, 2008 12:31 PM
To: 'William Easterling'
Cc: Alan Scaroni; 'vicki fong'; Yaw Yeboah; Tom Richard; 'Bruce G. Miller'; Sarah Haner; Kelly Rhoades; Andrew Zydney; Joan Andrews
Subject: Summary Report on the ConocoPhillips Penn State Energy PrizeYr1 Program 2007-2008

Dear Bill,

Greetings. This is my summary report on the ConocoPhillips-Penn State Energy Prize Program. My efforts on this program began in August 2007 when you first assigned me to work on this at a meeting involving you, Alan, and Yaw.

As you know by now, we just completed this year-long project on Penn State-co-sponsored ConocoPhillips Energy Prize program successfully in Houston early this week. I worked with Becky Johnson and then Anna Kaplan of ConocoPhillips, Vicki at PSU, and all the four other judges.

There were five judges [Charles Bierbauer, dean, mass communications and information studies, University of South Carolina; Ralph Cicerone, president, National Academy of Sciences; Peter Jackson, senior director, oil industry activity, Cambridge Energy Research Associates; James Kimble, fellow, biofuels and long-range technology (retired), ConocoPhillips; and Chunshan Song, director, EMS Energy Institute, professor of fuel science and chemical engineering, Department of Energy and Mineral Engineering, Penn State). We the judges did technical evaluation, had friendly and yet serious discussions on each and every one of the top entries, and came to agreement for selecting the final winner and the two runner-ups, as shown in the attached announcements.

At the award ceremony, Sig Cornelius, SVP of ConocoPhillips gave the welcome remarks and thank-you notes to the participants, and Alan gave the remarks on behalf of you/EMS college and Penn State. Lou Burke and Alan Scaroni handed out the award plaques. Lou also asked us to give his regards to you.

This ConocoPhillips Energy Prize Program was a very good learning experience for me. Certainly I did not realize how much work this will involve when you first assigned me to work on this program. I initially expected there would be 70 to 90 proposals in the inaugural year.

ConocoPhillips team expected between 50 to 80, as Kristi told me on last Monday.

Frankly, we were all surprised and somewhat overwhelmed by the very large number of proposals we rec'd (302). We each spent numerous days and nights associated with reviewing and judging the merits of the proposals in a very broad range of topics ranging from biomass on earth to energy harvesting from outer space. For selecting the award winners, we first narrowed the top list down to 40 proposals, and had a telephone conference on Aug 20 involving all the judges and selected the top 10 and then the top 5 finalists.

On Sunday and Monday-Oct 12-13, we met with all the finalists and heard the formal presentations from the 5 teams, and then selected the winner.

The attached press release contains the brief summary of the award winner and the other finalists, which represent a broad range and do not have overlap in between.

The program has created a very positive publicity in the society and among the inventors for Penn State's contribution to advancing energy R&D, which is also enhanced further by the quotes from you for the press release in April (public announcement for the program) and in October 2008 (for the announcement of the winner). I hope you and all will be pleased with the outcome of our selection of the 4 finalists (descriptions attached below).

This summary technically marks the completion of my work and involvement for the inaugural year of this Penn State-cosponsored Energy Prize program that you have initiated with ConocoPhillips in August 2007.

I would like to thank you for initiating this project and for your support of my efforts on this program. I also wish to thank Vicki Fong for her support and help in the program development and communications, Tom Massaro for helping us to craft the contract and MOU with ConocoPhillips, and Alan for representing Penn State at the award ceremony. The program will likely continue for several more years.

Best wishes,

Chunshan

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PS: Attached below is the press release:

<http://live.psu.edu/story/35256>

CONOCOPHILLIPS, PENN STATE ANNOUNCE ENERGY PRIZE

Tuesday, October 14, 2008



- Houston — ConocoPhillips and Penn State have awarded the first ConocoPhillips Energy Prize to [David A. Gonzales II](#), San Antonio, to further develop the Layered MagWheel, a new technology to provide magnetic acceleration and frictionless braking for vehicles, increasing energy conversion and efficiency.

2008 marks the inaugural year of the ConocoPhillips Energy Prize, which recognizes new ideas and original, actionable solutions that can help improve the way the United States develops and uses energy. The Prize focuses on innovative ideas and solutions in three areas: developing new energy sources; improving energy efficiency; and combating climate change.

Sig Cornelius, senior vice president, finance, and chief financial officer of ConocoPhillips, said, "Developing diverse sources of sustainable, reliable energy; reducing greenhouse gas emissions; and significantly improving energy efficiency all require technological advances.

"Along with our partners at Penn State, we are pleased to recognize [David A. Gonzales II](#) and the finalists for their innovative ideas to maximize our existing resources and identify new opportunities," he added.

William Easterling, dean of Penn State's College of Earth and Mineral Sciences, noted, "Like ConocoPhillips, Penn State believes that the nation needs fundamentally new knowledge and applications of that knowledge to diversify its energy supply, while simultaneously improving the efficiency by which it generates and utilizes that energy. The development and commercialization of energy technologies based on novel ideas, such as those represented by the ConocoPhillips Energy Prize, will assist the United States in meeting its energy needs while spurring economic growth."

More than 300 proposals were submitted for evaluation by a panel of energy and environmental experts, which selected five finalists. Proposals were judged on the

basis of creativity, scalability, commercial viability and sustainability.

The first runner-up was [Corban Tillemann-Dick and team](#) of the Greater Washington, D.C., area for the Radial Expansion Engine, which increases the efficiency and decreases the weight and cost of internal combustion engines by increasing the percentage of the combustion chamber reacting productively and capturing energy otherwise lost through the exhaust system.

Second runner-up was [Logan Bryce and team](#) of Belt, Mont., and Seattle, Wash., for the Micro Wind Distributive Power Generation, a small form-factor turbine to harvest power from wind at velocities of 12 mph and below, using an inverter system that allows direct connection to power mains.

The remaining finalists were [Miguel Bagajewicz](#) of University of Oklahoma for the Acoustic Mass Pump, and [Greg Rau](#), Institute of Marine Sciences, University of California, Santa Cruz, for the Carbon-Negative Electrolytic Hydrogen.

Each of the five finalists received an award of \$25,000 to further the development of their concept. The winner received an additional \$100,000; the first and second runners-up received an additional \$50,000 and \$25,000, respectively.

The awards were presented Oct. 13, 2008, at a ceremony held at ConocoPhillips Corporate offices in Houston following formal presentations by the five finalists to the panel of judges.

The judges were: Charles Bierbauer, dean, mass communications and information studies, University of South Carolina; Ralph Cicerone, president, National Academy of Sciences; Peter Jackson, senior director, oil industry activity, Cambridge Energy Research Associates; James Kimble, fellow, biofuels and long-range technology (retired), ConocoPhillips; and Chunshan Song, director, EMS Energy Institute, professor of fuel science and chemical engineering, Department of Energy and Mineral Engineering, Penn State.

More information about the ConocoPhillips Energy Prize and the finalists is available at www.conocophillips.com/energyprize.

ConocoPhillips is an international, integrated energy company with interests around the world. For more information, go to www.conocophillips.com.

Penn State is a national public university that is prominent for its energy and environmental sciences, technology and policy research. The EMS (Earth and Mineral Sciences) Energy Institute at Penn State is a leading research and development organization focused on clean energy technologies that will assist the nation in meeting its growing demands. For more information, go to www.energy.psu.edu.

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2008 CONOCOPHILLIPS ENERGY PRIZE WINNER

Tuesday, October 14, 2008

Layered MagWheel

The Layered MagWheel concept provides powerful and efficient magnetic acceleration and frictionless regenerative magnetic braking for vehicles. The concept is proposed to work on gas-electric vehicles, electric vehicles and hydrogen fuel cell vehicles. Each Layered MagWheel is built directly inside of the wheel of any vehicle to act as both the vehicle braking system and as the vehicle drive motor. This allows energy to be saved in two ways. For a typical vehicle utilizing an internal combustion engine, less than 20 percent of the energy burned by the fuel reaches the wheels and propels the vehicle. The Layered MagWheel concept will convert upwards of 90 percent of the energy passing into it directly into motion while in drive mode. For most hybrid vehicles on the market today, the generators used to recover braking energy capture less than 20 percent of the braking energy. The Layered MagWheel concept will allow a significantly higher percentage of braking energy to be recaptured. These properties allow the Layered MagWheel to both improve energy efficiency and combat climate change by significantly reducing carbon dioxide emissions.

The Layered MagWheel was designed to be economical to produce on a large scale for

the automobile industry. The core component to each Layered MagWheel is the induction disk layer. Each induction disk layer is manufactured in a manner similar to products in the computer industry through a process called photolithography. With the Layered MagWheel, drivers need not sacrifice performance for gains in energy efficiency. This concept allows performance, efficiency, and safety to all increase.

About the finalist:

David A. Gonzales II

David A. Gonzales II is inventor of the Layered MagWheel with Dynamic Reconfiguration concept, and currently lives in San Antonio, Texas. In 2008, he graduated in three years with a Bachelor of Science with honors from University of Texas at San Antonio. Gonzalez invented the patent-pending technology during his teenage years and has progressed through several years of research and development. He hopes to further refine, optimize and prototype the concept for commercialization within the automobile industry.

Gonzales was born in Dover AFB, Del., in 1987. He is the son of Dr. David A Gonzales (Col Ret.) and Shirley A. Gonzales. His father was in the United States Air Force and David grew up moving frequently, living around the world. This gave him the unique opportunity to experience a variety of cultures and ideas. He also took to a strong interest in science and technology from an early age. His hobbies include astronomy, hiking, biking, paintball, swimming, working with electronics, learning and spending time with friends.

<http://live.psu.edu/story/35270>
2008 CONOCOPHILLIPS ENERGY PRIZE FINALIST

Tuesday, October 14, 2008

Radial Expansion Engine

The Radial Expansion Engine (RXE) is an internal combustion engine that proposes to be more fuel efficient, lighter and less expensive to build than current technologies. The RXE addresses the two largest sources of energy waste in an internal combustion engine: the small percentage of the combustion chamber reacting productively during combustion, and the unused energy which flows out the exhaust pipe in the form of hot gases.

The RXE changes the combustion chamber's design from one piston in a cylinder to four semi-cylindrical "chordons" which act as expanding walls. Existing chamber designs become longer during the combustion cycle, but the RXE chamber expands in radius. This design innovation allows the vast majority of the RXE's chamber surface area to react productively to the forces of combustion by generating torque. In traditional engines an average of less than 25 percent of the combustion chamber's surface area is productive.

In an RXE combustion chamber, that average skyrockets to more than 75 percent of the chamber's surface area. Furthermore, because so much of the chamber is productive, gases can expand further than in an ordinary engine before their productive utility is exhausted and they are pumped out through exhaust valves. This means an RXE captures significant quantities of energy that previously flowed out the exhaust pipe.

The RXE would be compatible with existing infrastructure and with conventional materials, manufacturing practices and many off-the-shelf components. In the future, it can be adapted to run on alternative fuels such as biodiesel, natural gas or hydrogen.

About the finalist team:

Team Radial Expansion Engine

The Radial Expansion Engine team is committed to providing economical, efficient, low-carbon solutions for our energy future. They are developing an extensive portfolio of intellectual property focused on pumps, compressors and internal combustion engines.

Brent Johnson is the project manager and chief technology officer. He has extensive experience in manufacturing, process management and design. Corban Tillemann-Dick is the assistant technology officer responsible for intellectual property development. He has studied engineering at the US Air Force Academy and currently studies economics at Johns Hopkins University. Levi Tillemann-Dick manages legal and business development for the team. He is currently writing his dissertation on clean energy policy in Japan and China. Tomicah Tillemann is responsible for Web design, public relations and is a strategic adviser.

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<http://live.psu.edu/story/35259>
2008 CONOCOPHILLIPS ENERGY PRIZE FINALIST

Tuesday, October 14, 2008

Micro Wind Distributive Power Generation

While wind power is not a new way to produce energy, small wind turbines under 50 kilowatts (Micro Wind) offer room for technological breakthroughs. The market lacks a turbine that can harvest power from wind at velocities of 12 mph and below and still keep a small form factor and slow rotor RPM. Also lacking is an inverter system that can enable a turbine to be directly hooked to power mains, and allow it to be pushed back to the power grid at a reasonable cost.

Micro Wind turbines could offset power used by many devices during operation with power derived by wind. The inverter would achieve seamless power distribution. For example, the Micro Wind turbine can be mounted to the top of light poles and constantly offset the light's estimated power usage from power generated by wind. This would help stabilize the power grid by boosting capacity locally rather than importing power outside of the regional area.

Additionally as more turbines are installed, power generated by polluting sources would be lessened, thus reducing greenhouse gases and pollutants released into the atmosphere.

About the finalists:

Team Micro Wind

Logan Bryce

Team leader Logan Bryce is a wind turbine installer and field engineer who specializes in small wind turbines under 50kW in size. He also has managed a small wind field test site where he tested turbines from many different manufacturers.

Jenni Bryce

For over ten years, Bryce has been involved with renewable energy. She has managed a successful, female-owned, veteran-owned renewable energy business that specialized in sale and installation of wind turbines under 50kW in size.

Bob Gudgel

Gudgel is an electrical engineer with over 15 years of experience designing power electronic products for the renewable energy field. He is credited with designing one of the most popular charge controllers on the market today.

Robin Gudgel

Gudgel is a mechanical engineer with over 20 years of experience designing and manufacturing quality products for use in the renewable energy field. He has designed many best-selling inverters and charge controllers on the market today.

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2008 CONOCOPHILLIPS ENERGY PRIZE FINALIST

Tuesday, October 14, 2008

Acoustic Mass Pump

This concept is aimed at developing an Acoustic Mass Pump for the separation of different mixtures including propane-propylene and enantiomers, among others. The technique may also be competitive for more simple applications such as alcohol-water, multi-component mixtures of hydrocarbons and desalination.

The mechanism proposed is analogous to thermo-acoustic engines. It consists of a long tube in which an acoustic pressure wave is made resonate. The pressure wave induces temperature and density oscillations. A double membrane is placed inside the tube, and inside the space in between these membranes, there is a fluid connected to two reservoirs. In one end, a rich reservoir contains a mixture rich in salt. In the other end, a lean reservoir contains a mixture lean in salt. Under certain conditions of concentration gradient and oscillation frequency, the pressure wave induces a flux of the key component from the lean reservoir to the rich reservoir, a flow against the concentration gradient. To maintain the concentration of both reservoirs constant, the feed solution is used. In addition two product streams are obtained from each reservoir, thus maintaining steady-state conditions.

Refineries, petrochemical, pharmaceutical and other specialty-chemicals industries can benefit from this technology by placing within reach some separations that looked almost impossible. The broader impact is improved efficiency and both initial and operational cost reduction for the processing industry. The technology also can be a good separation technique for complex mixtures, such as hydrocarbons found in crude and refinery fractionation, which are highly energy intensive.

About the finalist:

Dr. Miguel Bagajewicz

Dr. Miguel Bagajewicz is a professor at the University of Oklahoma. He has a bachelor's degree in Chemical Engineering from Argentina and a Master of Science and Ph.D. from the California Institute of Technology. He was a member of the staff of the National Research Council and an associate professor in Argentina. He also worked at Simulation Science in California, where he participated in the development of Datacon. He is the author of several publications on data reconciliation and gross error detection as well as in instrumentation network design and upgrade. On this last subject, he is the author of the only book that reviews the field and presents the cost-optimal paradigm. He also has several publications in the area of heat integration, crude fractionation design (including patents), acoustics-based separations, water management in process plant, product design and financial risk in engineering design and operations

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2008 CONOCOPHILLIPS ENERGY PRIZE FINALIST

Tuesday, October 14, 2008

Carbon-Negative Electrolytic Hydrogen

This concept proposes to use renewable energy, such as wind, wave or solar, for both the production of hydrogen and the simultaneous generation of CO₂-absorbing solutions. While not a naturally occurring energy source of any significance, molecular hydrogen gas (H₂) can be generated from other sources of energy to provide a valuable energy carrier and fuel. H₂ also can be a low- or no-CO₂ -emissions fuel if the means of hydrogen generation does not use fossil energy or if the CO₂ emitted during the H₂ production is captured and sequestered. However, lacking economic incentives such methods are not currently cost competitive with conventional, CO₂-intensive commercial production of H₂. Thus, despite significant effort, the realization of low-carbon, sustainable, and cost-competitive hydrogen has remained elusive.

The model projects that electricity generated from renewable energy can be used to power a novel electrolysis cell that simultaneously splits water and mineral carbonate - for example, limestone - to produce hydrogen gas and dissolved mineral hydroxide. The latter solution would subsequently be used to absorb carbon dioxide from air or from waste gas streams. This method of electrolytic H₂ production has a unique, significantly

negative CO₂ footprint, with CO₂ being captured and stored as dissolved bicarbonate. If placed in the ocean, the alkaline solution produced by the process would help neutralize ongoing ocean acidification and help offset its effects.

About the finalist:

Dr. Greg Rau

Dr. Greg Rau is a senior researcher with the Institute of Marine Sciences, University of California, Santa Cruz, and is also affiliated with the Carbon Management Program at Lawrence Livermore National Laboratory in Livermore, Calif. A native of Washington state, he is a graduate of Western Washington University, and received his Master of Science and Ph.D. from the University of Washington. Postdoctoral work was conducted at the University of California, Los Angeles, and at NASA-Ames Research Center. His subsequent 25+ year research career has focused on carbon cycling and biogeochemistry at cellular to global scales, including the development and evaluation CO₂ mitigation technologies.

Dr. Rau is a member of the American Geophysical Union and the American Society of Limnology and Oceanography, and is a Fellow of the American Association for the Advancement of Science. He and his wife, Vreni, live in Castro Valley, Calif. They enjoy hiking, fishing, and traveling.

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