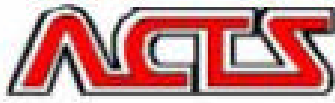
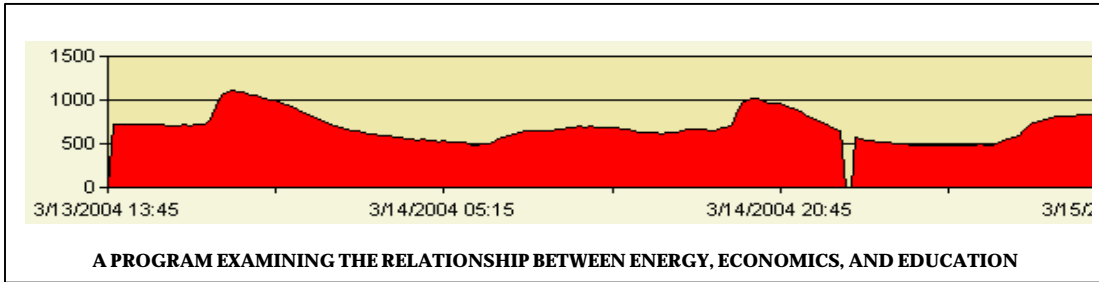


FINANCING EDUCATION THROUGH ENERGY CONSERVATION



**ACTION, COMMUNICATIONS, TECHNOLOGY & SCIENCE
PRODUCTIVITY-CENTERED, SERVICE-LEARNING IN ECUADOR**

IN COLLABORATION WITH



INSTITUTO NACIONAL GALAPAGOS



MINISTERIO DE EDUCACION Y CULTURA



SOLARQUEST®



PROJECT DESCRIPTION

SolarQuest® copyright 2005

PROGRAM RATIONALE

Consumers in developing countries generally pay more for basic infrastructure and consumer services---where available---than consumers in developed nations, often at the expense of basic human services such as health and education. In Ecuador, the average household electricity bill (excluding government subsidies) averages USD \$30 monthly, 11% of GDP per capita at purchasing power parity of USD \$3,200 (Global Giving Country Statistics). By comparison, consumers in the United States spend USD \$938 on household electricity, representing 2.6% of the GDP per capita at purchasing power parity of \$36,300. Electricity consumption in other sectors---institutional, municipal, and industrial---demonstrates similar inequities.



**REFUELING IN THE GALAPAGOS
SAN CRISTOBAL ISLAND**

In 2004, SolarQuest® conducted an energy education project in the Province of the Galapagos (Ecuador) to examine the potential to reduce energy demand in the household, commercial, and residential sectors by 44%, 37%, and 14% respectively. The goal of the project was to study the potential for a Demand-Side-Management (DSM) program to complement a 2-megawatt renewable energy project, further reducing the dependency on polluting fossil fuels to power the Province. The outcomes of the study exceeded expectations: Utilizing handheld data monitoring devices to collect building energy data, measuring grid demand remote monitoring equipment, and collaborating with electrical engineers in Italy and the United States via Information and Communications Technologies (ICTs), students identified the potential to reduce the electricity demand on the grid by 1.4 megawatts. They discovered that refrigeration represents 40% of the electric demand, that 36% of the refrigeration units are malfunctioning (operating continuously), and that a DSM program (high-efficiency refrigeration and lighting) at a value of \$5 million to reduce 1.5 megawatts is feasible.

The preliminary results, along with the project data, were presented to the Ministry of Energy and Mines (MEM) and the United Nations Development Program (UNDP) in Quito. The MEM and the UNDP subsequently scheduled a meeting in San Cristobal, Galapagos, to review the project with ElecGalapagos (the local electric utility) and project partners, including teaching staff from Colegio Ignacio Hernandez and the local SolarQuest® project coordinator.

In December 2004, the MEM and the UNDP requested a planning meeting in Quito with SolarQuest® project directors to discuss the potential to extend the energy education project in the Galapagos and on mainland Ecuador. The MEM, the UNDP, and SolarQuest® are examining the potential for a nationwide DSM education program to reduce the electricity demand on the grid by 1%, or 30 megawatts, over the next five years. The goal: Create a DSM industry in Ecuador totaling USD \$7.5 billion over the next decade. The means: Stimulate development of a DSM sector through productivity-centered, service-learning programs totaling USD \$150 million of which USD \$30 million will be leveraged over the next five years to improve technology education. The benefits: Improve education for thousands of school-aged youth, reduce consumer expenditures on electricity, and eliminate millions of dollars of government subsidies for electricity.

2004 PILOT PROJECT IN THE GALAPAGOS

The Galapagos Archipelago is the destination for more than 84,000 tourists annually, representing approximately \$250 million in gross revenues. Powering the engines of this economy requires the import of large quantities of fossil fuel--- fuel to power the electricity grid on the islands, and fuel for the numerous tour boats and transportation services. Dependence on imported fuel is placing the Galapagos Islands at environmental and, consequently, economic risk by gradually destroying unique marine ecosystems with pollution and hazardous waste spills.

Risk turned reality at approximately 2200 local time (UTC-6) on January 16, 2001: the tanker *Jessica*, owned by Acotramar, ran aground and sank at Schiavoni Reef, about 800 meters from Puerto Baquerizo Moreno on San Cristóbal Island. The vessel had just arrived from the port of Guayaquil on the Ecuadorian mainland, carrying 160,000 gallons of diesel fuel destined to be delivered to the dispatch station on Baltra Island, plus 80,000 gallons bunker fuel (IFO), which were to be used to fuel the tourist vessel *Galápagos Explorer II*. A major oil spill occurred which continues to have long-term effects on the health of marine wildlife in the Galapagos.

In response to this tragic event, the United Nations Foundation (UNF) and the United Nations Development Programme (UNDP) are supporting a Renewable Energy Program for the four inhabited islands in the archipelago.

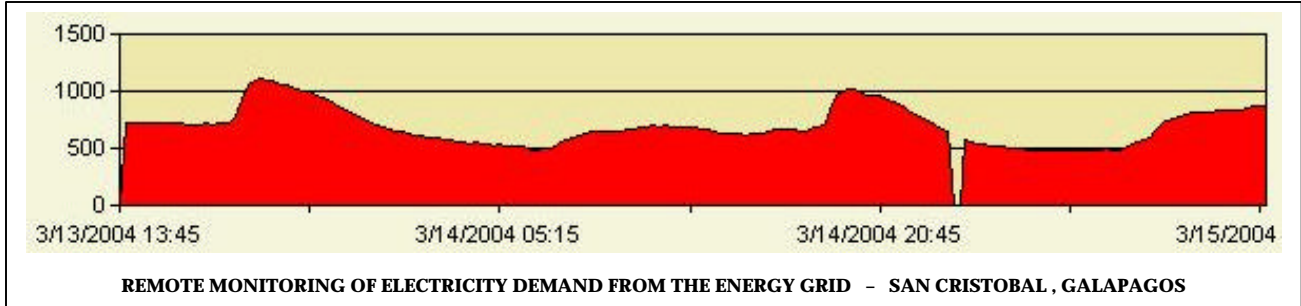


The tanker *Jessica*, January 16, 2001
San Cristobal Island
(Photo by Heidi Snell)

Providing leadership for this program is the e7 Fund for Sustainable Development (e7). The e7 signed a memorandum of understanding in April of 2003 with the Ministry of Energy and Mines of the Republic of Ecuador to undertake a wind energy project with a 2 megawatt generating capacity, displacing more than 50 percent of the electricity presently being produced by diesel-powered generators.

In a complementary initiative, e7 companies AEP, Ontario Power Generation and Hydro-Quebec funded SolarQuest® to install ICTs in local schools to improve education. SolarQuest® installed a satellite connected Wireless Local Loop (WLL) providing Internet services to Colegio Tecnico Ignacio Hernandez in Puerto Baquerizo Moreno (San Cristobal Island), and to Colegio Nacional Galapagos, in Puerto Ayora (San Cruz Island). In collaboration with program partners---PGG, INGALA, and MEC---SolarQuest® developed the Action, Communications, Technology, and Science (ACTS), a productivity-centered, service-learning program to demonstrate the efficacy of developing youth education programs to build human capacity for sustainable economic development.

The ACTS program was co-designed by SolarQuest® and the Colegio Tecnico Ignacio Hernandez to fulfill the public service requirement of the MEC for students in the fifth-level, or 11th grade by US standards, while strengthening core academics and introducing students to computer science.



ACTION, COMMUNICATIONS, TECHNOLOGY, AND SCIENCE (ACTS)

From February to December 2004, Solar Quest®, in partnership with Colegio Tecnico Ignacio Hernandez, managed the Action, Communications, Technology, and Science (ACTS) program in which 23 students, utilizing advanced ICTs and data monitoring devices, provided 200 hours of community service to monitor and analyze the characteristics of energy consumption on the electric grid in San Cristobal by sector---residential, commercial, and municipal---in order to determine the potential to reduce electricity demand through energy efficiency.

The ACTS program contains four key service-learning activities from which the program takes its name:

<p>- <u>ACTION</u>: Students are required to conduct research and participate in activities that will provide knowledge and exposure of community issues. ACTS students will research the relationship between energy production and its impact on the economy and environment of the Galapagos, and make proposals related to energy management in order to reduce the conflict between development and conservation.</p>	<p>- <u>COMMUNICATIONS</u>: Students are required to be involved in oral and written communications activities that demonstrate their knowledge of community issues. ACTS students will collaborate on an energy conservation master plan. They will conduct interviews, present results, and propose solutions at a series of community meetings and media presentations on radio and television.</p>
<p>- <u>TECHNOLOGY</u>: Students are required to demonstrate their knowledge of information and communications technologies, including the ability to collect data and use the data for analysis. ACTS students will utilize information technologies and monitoring equipment to collect and analyze data, and use electronic communications technologies to disseminate the results to the general public and international community.</p>	<p>- <u>SCIENCE</u>: Students are required to conduct original science research utilizing the scientific method. ACTS students will conduct original research on the electric grid in San Cristobal and collaborate on this research with engineers located in the US, Canada, and Italy in order to determine the role of energy conservation in the re-powering of the Galapagos Islands with renewable wind energy.</p>

COLLABORATIVE RESEACH

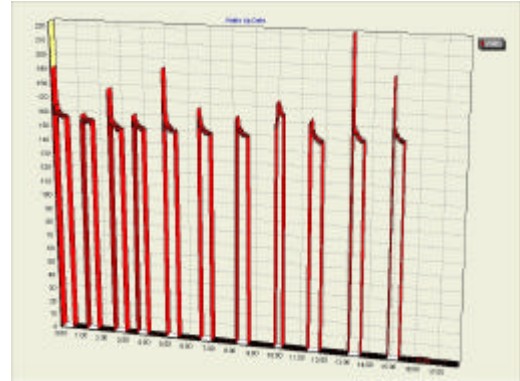
ACTS students collaborated with engineering specialists in energy efficiency from the participating e7 companies in the Canada, Italy, and the United States utilizing ICTs and distance learning technologies. A key element in the design of a hybrid wind-diesel electric generating system for San Cristobal is a detailed understanding of the characteristics of the demand on the electric grid by sector. Students worked with these engineers over the Internet to profile energy demand by sector.

Previous research on the energy demand in San Cristobal indicated that private residences and commercial shops are responsible for the majority of energy consumption, whereas the industrial sector consumes a negligible amount of electricity (5%). Previous research did not provide sufficient data to permit an accurate assessment of electricity demand patterns, or to design intervention strategies utilizing high-efficiency appliances.

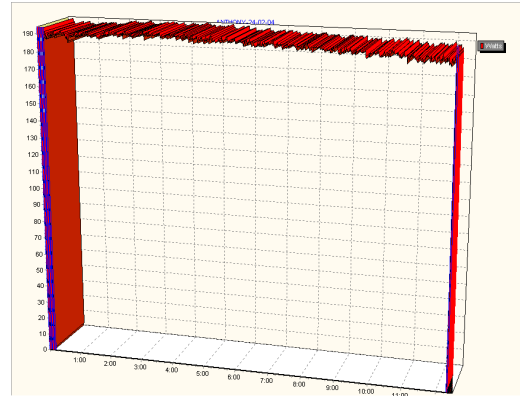
ACTS students applied newly acquired computer skills to monitor and report consumption data for electric appliances in the residential and commercial sectors. Utilizing the SolarQuest® Virtual Schoolhouse distance learning technology, students posted data (building and appliance electricity consumption audits) for access by e7 engineers. The engineers provided technical support for both data collection and analysis. This research collaboration provided critical decision support services for the proposed wind turbine farm on San Cristobal.

Student research identified that in 36% of household refrigerators (graph 2 and 3 at right) rarely cycle off. They calculated that if these refrigerators were replaced with high efficiency refrigerators (40 watts) as shown below, energy demand on the electric grid would be significantly reduced. As a consequence of this study, a DMS planning project is proposed for the 2005 academic year with the goal to implement a 1.4 megawatt, USD \$5 million energy efficiency program in 2006.

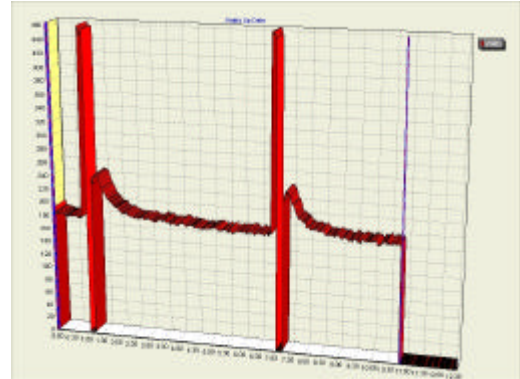
GRAPH 1: REFRIGERATOR 200 W, GOOD CONDITION



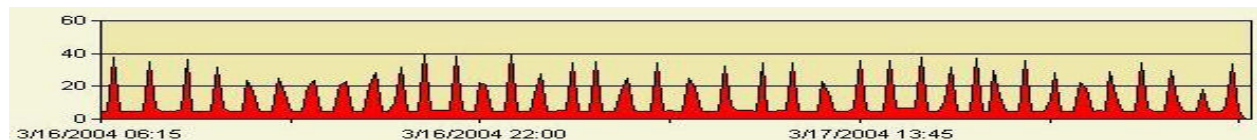
GRAPH 2: REFRIGERATOR 200 W, POOR CONDITION



GRAPH 3: REFRIGERATOR 200 W, FAILED DURING TEST



GRAPH 4: HIGH EFFICIENCY REFRIGERATOR AT SOLARQUEST® RESEACH FACILITY



2005 PROGRAM EXPANSION

SolarQuest®, in collaboration with program partners INGALA, MEC, and Chasquinet are planning the expansion of the ACTS program in Galapagos in 2005, and, in collaboration with the MEM and UNDP (Quito), are planning for program expansion in the mainland of Ecuador. Program expansion would require a budget of \$1 million over a 2-year period as follows:

GALAPAGOS:

- Academic Year 2005: Continuation of ACTS at Colegio Ignacio Hernandez; expansion of the ACTS program to Colegio Nacional Galapagos; upgrade of MEC network for enhanced distance learning (video-conferencing) capacity; identify specific energy conservation measures (including intervention technologies), and identify DMS consumer universe.
- Academic Year 2006: Obtain DSM financing and implement DSM interventions as a vocational education program; provide program financial analysis and project management for program replication.

MAINLAND ECUADOR:

- Academic Year 2005: Identify school sites for program participation; build ICTs infrastructure at selected schools, provide professional development training for teachers in computer science, including technology skills required for DSM education; identify preliminary DSM project targets by sector in collaboration with the MEM and UNDP; develop DSM education database applications and upgrade distance learning technology.
- Academic Year 2006: Implement ACTS program nationwide to identify approximately USD \$30 million in DSM projects for implementation in 2007; provide capacity building for government, industry, institutional, and public sectors on energy conservation and DSM in order to stimulate private sector development of DSM industry in Ecuador.

OUTCOMES

The USD \$1 million ACTS/DSM education project will result in improved technology education programs for hundreds of students throughout Ecuador. The exact number of schools and students that will benefit from the program will be determined during academic year 2005, as school sites and infrastructure cost requirements are assessed. Priority will be placed upon upgrading existing technology education facilities as well as providing new facilities at schools lacking science and technology education infrastructure. As project economic performance is further evaluated, the accrual of DSM revenues, estimated at USD \$30 million over 5 years, will be quantified. Revenue projections will vary according to the direct costs of DSM interventions. Project sustainability beyond the two-year funding requirement will be derived from self-generated DSM project revenues.

In the past two decades, Ecuador has nearly doubled annual kilowatt hour electricity consumption per capita. Research has proven that the availability of electricity directly impacts economic development and productivity of a nation. In order for Ecuadorian economy to continue to grow, electricity demand will need to increase substantially. As new, low-cost hydropower resources are limited, Ecuador's primary strategy to increase the availability of low-cost electricity is to increase the productivity of the existing electricity grid through energy conservation. The advantage for Ecuador is three-fold: i) existing consumer revenues can be leveraged to fund DSM projects; ii) increased electricity demand met through energy conservation avoids high-cost investments in new electricity generation; and iii) government subsidies for electricity---USD \$.098 in the Province of the Galapagos---can be eliminated for every kilowatt hour avoided, reducing government expenditures and the consumer tax burden.

PRODUCTIVITY-CENTERED, SERVICE-LEARNING

AN ALTERNATE REPRESENTATION OF SCHOOLING:

“Productivity-based, service-learning is a mutually supportive intentional group of inter-generational learners who utilize a wide array of public and private resources---including traditional academics---to enrich the learning experience, and who are committed to a process in which they apply new information to acquire knowledge and share that knowledge with other learners and the general public in order to identify and solve critical social and economic problems for the betterment of their community with the specific goal to improve the general well-being of that community through the benefits of increased economic productivity.

- *Allan E. Baer*

In 1979, SolarQuest® president, Allan E. Baer, pioneered an alternative to traditional teaching and learning methodologies to meet the needs of low-income and minority learners in urban and rural communities throughout the United States. A general contractor and constructional technology educator, Mr. Baer developed productivity-centered, service-learning over three decades from the traditional disciplines of vocational education and school-to-work programs, to the emerging concepts embodied in experiential- and service-learning. In 1998, SolarQuest® partnered with the White House Millennium Council and various agencies of the United States Government, including the United States Department of Energy, the State Department, and United States Agency for International Development, to examine the development potential of productivity-centered, service-learning integrated with ICTs in deep rural communities in developing countries.

In developing countries where Traditional Environmental Knowledge systems are preferred over Empiricism, where the emphasis is on “learning-by-rote” rather than the application of the scientific method, where information and knowledge transfer by socialization rather than individual problem solving, and where visualization reflects real-world environments rather than the abstract concepts of numeracy, productivity-centered, service-learning has proven to accelerate learning in science and technology while preserving traditional values.

REPLICABILITY, SCALABILITY, AND APPLICABILITY

Productivity-centered, service-learning is a teaching and learning methodology with the potential for replication globally. Project-based service-learning, school-to-work, and vocational technical training---the building blocks of productivity-centered, service-learning---are standard pedagogies taught in institutions of higher learning and applied in secondary schools throughout the world.

In the context of DSM energy education, productivity-centered, service learning represents a viable approach to funding technology education in many developing countries with high-costs of electricity or limited low-cost electricity. In many small island nations, such as Grenada, the cost of electricity to the consumer is USD \$.23 per kilowatt hour. In the aftermath of Hurricane Ivan, SolarQuest® secured an agreement with the Ministry of Agriculture, Lands, Forests, Fisheries, Public Utilities, Energy, and MNIB of the Government of Grenada to develop renewable energy and energy conservation programs. The target is 3 megawatts of demand reduction at an estimated project value of USD \$12 million. In Latin America alone, over 215 billion kilowatt hours a year, representing 28% of total energy produced, are generated utilizing expensive (and environmentally harmful) fuel sources. A significant portion of generation from expensive fuel sources can be eliminated through energy conservation. Productivity-centered, service learning can be a catalyst to developing a multi-billion global DSM economy.

Application for productivity-centered, service learning can be developed in various sectors. SolarQuest® is researching applications for e-governance, telemedicine, agriculture, e-commerce, and distance learning services. By example, hundreds of scientists from universities and research institutes worldwide travel to the Galapagos Islands each year to conduct investigations in what is now popularized as a "living laboratory of evolution." More than 600 kilometers in the Pacific Ocean off the coast of Ecuador, the remote islands contain numerous unique marine and terrestrial aquatic ecosystems that allow science researchers to witness evolutionary change within a single human lifetime. Each year in the United States alone, over 52 million students learn scientific concepts---such as evolution and natural selection---that have become almost exclusively identified with Charles Darwin and the research Darwin conducted in the Archipelago in 1835. SolarQuest® is working with INGALA, MEC, the Galapagos National Park Service, and the Charles Darwin Research Station to bring science education to the \$1.4 billion US science and technology education market.



ECONOMIC DEVELOPMENT: Data transfer for science-based electronic visualization laboratories represents a new economic opportunity in the Galapagos Archipelago.

Productivity-centered, service learning, specifically in the example of DSM energy education, represents the ability for a developing nation to redirect limited consumer resources to improve the quality of education short-term, and benefit government, industry, and consumers long-term. It represents the potential to build human capacity in order to apply new information and acquire knowledge to achieve sustainable human development while leveraging the precious financial resources of a nation.

2005-06 PROJECT BUDGET

The total two-year project cost of USD \$1 million is based on allocations for each budget category. Services for each line item, such as ICTs infrastructure, database development, and human capacity building, will vary according to the results of an assessment of field conditions in public schools and database development requirements for intervention measures. The following budget allocations were based on prior program experience:

ACTS / DSM EDUCATION PROJECT BUDGET, 2005 - 06	
ADMINISTRATION /	
Global Giving Transaction Fee	\$100,000
Chasquinet Administrative Fee	100,000
PROJECT MANAGEMENT	
SolarQuest®	175,000
INFRASTRUCTURE	
ICTs	250,000
Database Development	75,000
CAPACITY DEVELOPMENT	
Institutional	50,000
Educational	200,000
CONTINGENCY	
5%	50,000
TOTAL BUDGET	\$1,000,000

FOR MORE INFORMATION ONLINE

SOLARQUEST®

<http://www.inetnews.org>

ACTS™ DSM EDUCATION

<http://www.ecolapagos.com>

FUNDACION CHASQUINET

<http://www.chasquinet.org>

MINISTERIO DE EDUCACION Y CULTURA

<http://www.mec.gov.ec/>**CONTACT INFORMATION**

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ABOUT SOLARQUEST®



SolarQuest® was established in 1998, as an educational program of EcoSage Corporation, and was incorporated as a not-for-profit corporation in the State of Vermont in January 2004. The mission of SolarQuest® is to provide project-based experiential education and service-learning programs utilizing renewable energy systems, broadband telecommunications, and distance education technologies. The organization's primary emphasis is the integration of learning opportunities between "deep rural" communities of developing nations and schools in the United States utilizing advanced Information and Communications Technologies (ICTs). From 1999 to 2001, SolarQuest® worked with governments in sub-Saharan Africa and Latin America under a partnership with White House Millennium Council and various departments of the United States government, including the United States Department of Energy, the State Department, and United States Agency for International Development, to pioneer service-based distance learning technology programs for developing countries.

In May 1999, SolarQuest® co-sponsored the President's Council on Sustainable Development National Town Meeting for a Sustainable America in Detroit, Michigan. In collaboration with industry partners---Intellicom and Electronic Data Systems (EDS)---SolarQuest® provided a live web cast of the National Town Meeting events from self-powered, mobile internet café utilizing broadband satellite and co-sponsored 21 youth representing the Voice of American Youth for the 21st Century. In August 1999, SolarQuest® co-sponsored a White House Millennium Council project to install 100 solar energy systems in community centers, schools, libraries, and medical facilities in remote areas throughout Uganda and Tanzania, and conducted community focus groups on the topic of utilizing ICTs for human capacity building and sustainable economic development.

In October 2000, SolarQuest® established a "deep rural" educational telecenter in Porvenir, Bolivia, in collaboration with the White House Millennium Council and American Electric Power (AEP). In 2001, SolarQuest® participated in rural ICT programs in Honduras, Guatemala, and Venezuela, and signed a Memorandum of Understanding with Hewlett-Packard Company (HP) to reconfigure the technical systems for LINCOS (Costa Rica) remote telecenters under the HP World e-Inclusion program. In September 2001, SolarQuest® was selected to be the prime developer of the E-7 Micro Solar Distance Learning Program, an initiative to install educational telecenters in developing countries throughout the world. The Initiative is a utility sponsored research project to develop low-cost, low-power ICT systems for deep rural communities of developing nations.

From its inception, SolarQuest® has developed and implemented an on-line, project-based, distance education technology---the SolarQuest® Virtual Schoolhouse. The Virtual Schoolhouse utilizes a simple outline format that is the basis of literacy education in most pedagogical settings throughout the world. The Virtual Schoolhouse has been utilized by the United States Department of Agriculture, the State of Vermont, the Government of Honduras, and the North America Alliance for Green Education (NAAGE), a consortium of experiential learning colleges. SolarQuest® is currently developing MicroSolar Distance Learning programs in Chendebji, Bhutan, and in the Province of the Galapagos, Ecuador. In collaboration with the Nacional Institute of the Galapagos, SolarQuest® is developing an information economy based on science education content.

SolarQuest® is headquartered in Chelsea, Vermont (USA) and maintains field offices in the Province of Galapagos, Ecuador.

SOLARQUEST® PROJECT PORTFOLIO 1999 - 2004 (PARTIAL)



1999, SOLAR LIGHTS FOR AFRICA: Students from the US train local students to install solar lighting systems in schools, medical clinics, orphanages, and community centers in Africa.



1999-2002, US/AFRICAN ENERGY MINISTERIAL: Minority students from Historically Black Colleges and Universities educate African energy ministers about energy conservation and renewable energy.



2000, PORVENIR, BOLIVIA: SolarQuest® and local students install the remote telecenter in collaboration with the White House Millennium Council using ICTs and solar energy.



2001, SAN RAMON, HONDURAS: SolarQuest® supports educational development in SolarNet Villages in collaboration with the Honduran Council on Science and Technology.



2001, WORLD E-INCLUSION: SolarQuest® retools the LINKOS telecenter concept for Hewlett-Packard World e-Inclusion program providing remote connectivity in developing countries.



2001-2004, WORLDWIDE: SolarQuest® provides energy education in Bolivia, Honduras, Mexico, Venezuela, Peru, Mexico, Ecuador, Guatemala, Uganda, Tanzania, and South Africa.



2004, GALAPAGOS: Technology students at Colegio Ignacio Hernandez learn basic computer skills, monitor energy data, and collaborate with engineers in the US, Canada, and Italy.



2004, GALAPAGOS: ACTS students present electrical consumption data to consumers on the performance of common household appliances and demonstrate the benefits of energy conservation.



2004, GALAPAGOS: The 2004 graduating class at Colegio Tecnico Ignacio Hernandez. 23 students completed 200 hrs research and community service and are certified as energy auditors.