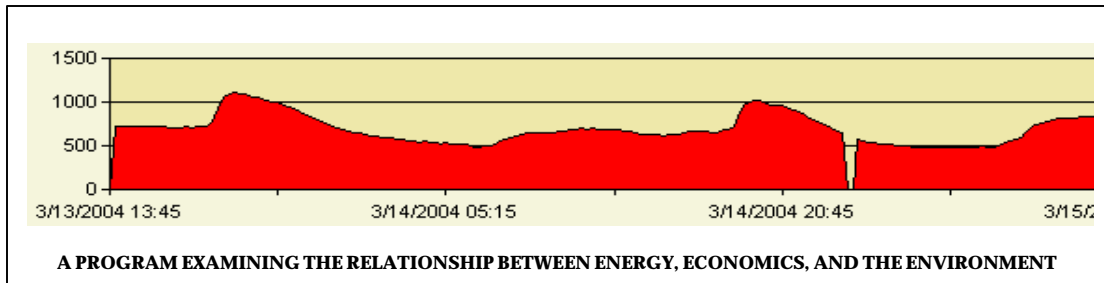


**ACTION, COMMUNICATIONS, TECHNOLOGY & SCIENCE  
PRODUCTIVITY-CENTERED, SERVICE-LEARNING IN THE GALAPAGOS ARCHIPELAGO**



**MICROSOLAR DISTANCE LEARNING PROGRAM  
IN COLLABORATION WITH**



**MINISTERIO DE  
EDUCACION Y CULTURA**



**COLEGIO TECNICO  
IGNACIO HERNANDEZ**



**SOLARQUEST®**



**THE e7 NETWORK FOR EXPERTISE  
ON THE GLOBAL ENVIRONMENT**

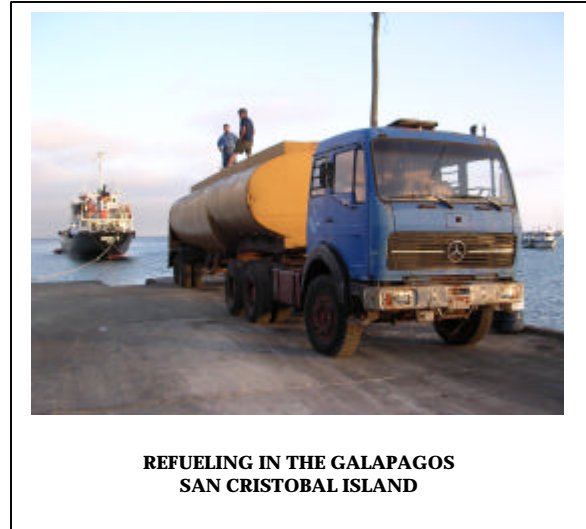
**EXECUTIVE SUMMARY**

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## GALAPAGOS, AN ARCHIPELAGO AT-RISK

The Galapagos Archipelago is the destination for more than 84,000 tourists annually, representing in excess of USD \$250 million in gross revenues for the Republic of Ecuador. Powering the engines of this economy requires the import of large quantities of fossil fuel--fuel to power the electricity grid on the inhabited 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. And it is 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.



**REFUELING IN THE GALAPAGOS  
SAN CRISTOBAL ISLAND**

## e7 FUND FOR SUSTAINABLE DEVELOPMENT, AN INTERNATIONAL RESPONSE

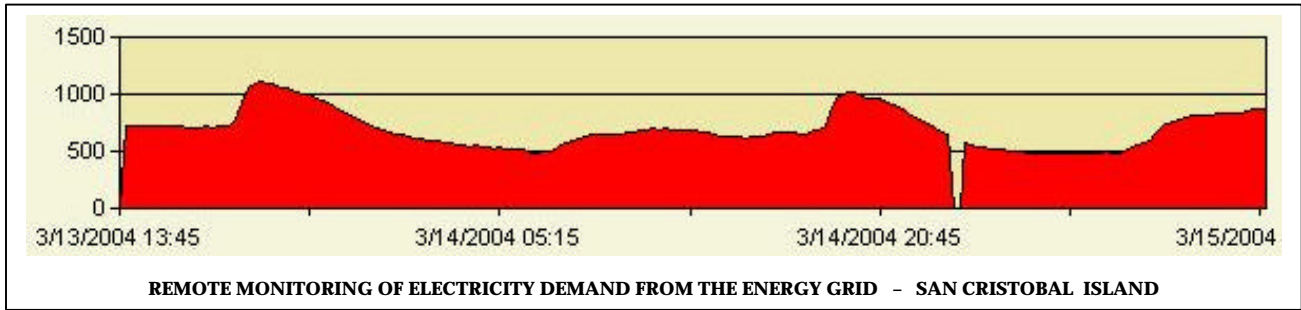
In response to this tragic event, the United Nation Foundation (UNF) and the United Nations Development Programme (UNDP) are supporting a Renewable Energy Program for the four inhabited islands in the archipelago. Providing leadership for this program is the e7 Fund for Sustainable Development (e7). The e7 signed a memorandum of



**e7 MICROSOLAR PROGRAMME SATELLITE SERVICES**

understanding in April of 2003 with the government of Ecuador to undertake a wind energy project that will generate approximately 1,800 kilowatts of electricity, displacing more than 50 percent of the electricity presently being produced by diesel-powered generators on San Cristobal Island. (See <http://www.e7.org>) In a complementary initiative, e7 companies AEP, Ontario Power Generation and Hydro-Quebec funded the Micro-Solar Distance Learning Program (managed by SolarQuest®), where solar panels, or photovoltaic systems, are installed in learning centers to power advanced information and telecommunications technologies for distance learning and other human capacity building activities.





**ACTION, COMMUNICATIONS, TECHNOLOGY, AND SCIENCE (ACTS)**

Solar Quest® managed the ACTS program in collaboration with Colegio Tecnico Ignacio Hernandez and the Ministry of Education of the Republic of Ecuador. Information and Communications Technologies (ICTs), specifically distance learning technologies, provided the capacity for SolarQuest® to manage the program remotely. Profession development for teachers was provided by SolarQuest® (USA). e7 engineers in Canada, Italy, and the United States collaborated with student researchers and analyzed patterns of energy consumption---residential, commercial, and municipal---on electrical grid. Student research was rigorously evaluated by engineers using advanced computer models in order to verify accuracy and to assess the potential to reduce electricity demand through energy efficiency.

The ACTS program was designed to fulfill the public service requirement of the Ministry of Education and Culture for students in the fifth-level (11<sup>th</sup> grade by US standards) while strengthening core academics and introducing students to computer science and productivity-centered, service-learning. Students also directly engaged community stakeholders in matters pertaining to the role of information services in sustainable economic development.

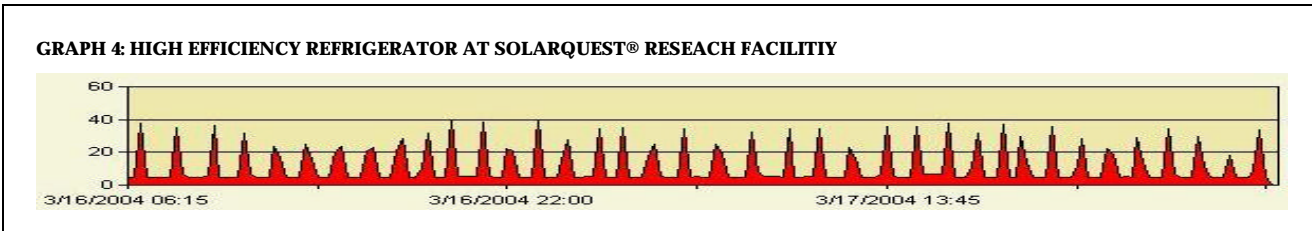
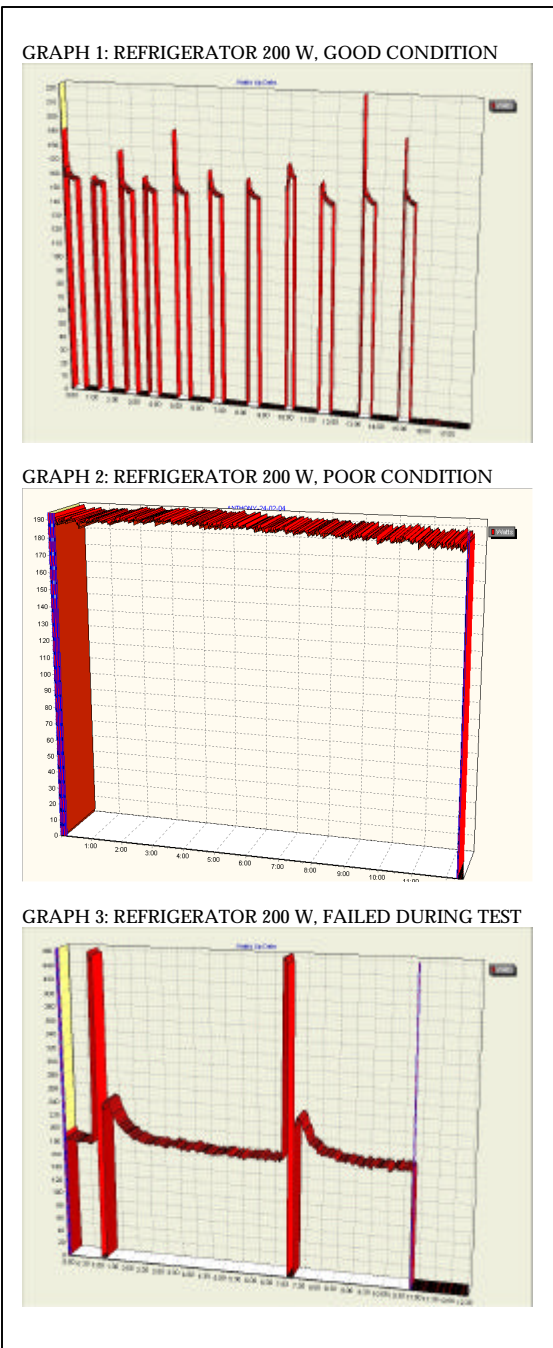
<p>- <b><u>ACTION</u></b>: Students are required to conduct research and participate in activities that will provide knowledge of and exposure to community issues. ACTS students will research the relationship between energy production and its impact on the economy and environment of the Galapagos, and will make proposals related to energy management in order to reduce the conflict between development and conservation.</p>	<p>- <b><u>COMMUNICATIONS</u></b>: 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>- <b><u>TECHNOLOGY</u></b>: 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>- <b><u>SCIENCE</u></b>: 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 with engineers located in the Canada, Italy, and the United States in order to determine the role of energy conservation in the re-powering of the Galapagos Islands with renewable wind energy.</p>

**COLLABORATIVE RESEACH**

The MicroSolar Distance Learning Program was the first international demonstration project in which students in a remote area of the world collaborated with engineering specialists on renewable energy design for sustainable development. A key element in the design of the future hybrid wind-diesel electric generating system for San Cristobal (now under construction) was a detailed understanding of the patterns of electricity demand.

Previous research on the energy demand in San Cristobal did not provide sufficient data to permit an accurate assessment of energy consumption patterns to engineer a hybrid power plant. ACTS students applied their newly acquired computer skills to monitor and report on detailed consumption data for appliances used in the residential and commercial sectors. Utilizing the SolarQuest® Virtual Schoolhouse distance learning technology, students posted demand and consumption data for access by e7 engineers who, in turn, provided technical support for data collection and analysis. This research collaboration provided critical decision support services not only for the planned renewable energy program but also for what emerged as a student generated plan for a Demand-Side-Management (DSM) project. Their plan financially outperformed the wind turbine project proposed by the e7.

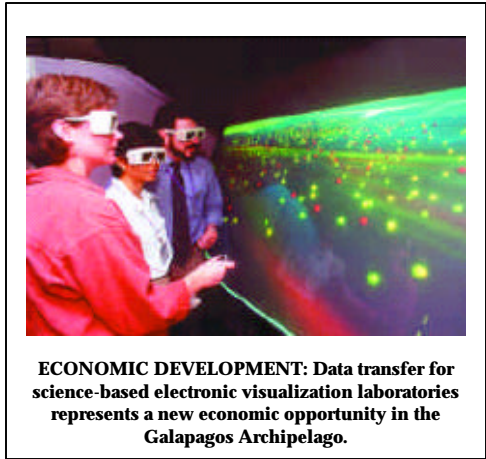
THE RESULTS: Student research concluded that in a low-energy consuming household that 20% of the energy bill is for domestic refrigeration, and that in 36% of the households monitored the refrigerators (shown in graph 2 and 3 at right) rarely cycled off. Students concluded that if these refrigerators were replaced with 40 watt high efficiency refrigerators (as shown below), energy demand on the Islands' electric grids would be reduced by 1.4 megawatts. The DSM project cost would be \$3.5 million (including other measures) compared to \$10 million for the e7 wind power project that will reduce electricity demand by 1 megawatt. Consumers would save \$2 million annually.



**HUMAN CAPACITY DEVELOPMENT (FUTURE PROGRAMS)**

The objective of the e7 MicroSolar Distance Learning Programme pilot phase was to demonstrate the efficacy of renewable energy combined with advanced information and communications technologies (ICTs) to accelerate human capacity building in remote areas of developing countries beyond the reach of the conventional power or telecommunication grids. The 2004 ACTS program was a unique case study that demonstrated this potential.

SolarQuest® and local agencies in the Galapagos are now planning the development of an information economy based upon the export of science education content. 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 the research Charles Darwin conducted in the Archipelago in 1835.



Skills and knowledge acquired with technical assistance from SolarQuest® under the ACTS program in the future will be applied to environmental monitoring, data collection and management, and trend analysis required for advanced science research and an information economy based on science education content. As a consequence, students throughout the world will be able to collaborate with world's leading scientist and student peers in the Galapagos. The Ministry of Education of the Republic of Ecuador, the Galapagos National Institute (the Office of the President of Ecuador in the Galapagos), and SolarQuest® are now planning this model for sustainable economic development that will employ a new generation of knowledge workers in the Galapagos.

What was once a dream and the subject of murals (below) at Colegio Tecnico Ignacio Hernandez is now a reality. Information and Communications Technologies (ICTs) are transforming education, culture, and the economy of the Galapagos. While this transformation is being engineered through a collaboration of educators, engineers and scientists, the vision is being driven by a technologically advanced generation of students committed to conserving the environment of the Galapagos Archipelago and contributing to the advancement of science and human knowledge systems.

