Innovations in Energy: E+Co's Investment in Tecnosol

Globally, approximately 1.8 billion people lack access to electricity and 2.4 billion people use wood fuels for cooking. The poor are spending roughly $20 billion per year for ad hoc solutions, such as kerosene lamps, candles, charcoal, firewood, dung fires, and batteries, just to meet basic energy needs (The World Bank, 1999). Lack of modern forms of energy, particularly electricity, prevents people from escaping poverty and becoming more productive, and these substandard substitutes are often more expensive and more damaging to human health and the environment than modern alternatives. For these reasons, electricity access has been a top priority for world governments, multilateral development organizations, and nongovernmental organizations (NGOs) for more than 50 years. However, the number of people without access to modern forms of energy has remained approximately the same despite these efforts.

THE INNOVATION

It is possible to provide clean and affordable energy to the poor using sustainable distributed (off-grid) energy technologies. The success of E+Co's investment in Tecnosol, a rural distributed energy company in Nicaragua, demonstrates that local entrepreneurs can succeed with market-based solutions to solve critical problems at the bottom of the pyramid.

In 1994, E+Co (pronounced "E and Co"), a rural energy finance company, was formed to pioneer a different approach to the global energy problem. Focusing on local entrepreneurs, E+Co combines the traditional training and

support services of an NGO with the capital investment strategies of private equity and banking firms. The result has led to a dramatic rethinking of how to reach and provide access to energy for the world's poor.

Over 10 years, E+Co has invested in 90 energy enterprises, reaching more than 200,000 people with modern energy across a variety of technologies and geographical contexts. The firm has intentionally cast a broad net by working in more than 20 countries on multiple continents as it has sought to experiment with, replicate, and prove its model. This phase of experimentation has revealed four main conclusions:

- There is a willingness and capacity to pay for modern forms of energy at the bottom of the pyramid.
- Renewable energy technologies are an appropriate and increasingly reliable solution.
- Private enterprise can be highly effective at providing clean energy to rural markets.
- Local entrepreneurial talent with rural reach is a crucially valuable and widely available resource in communities around the world.

As evidenced by one of E+Co's investments, Tecnosol in Nicaragua, energy entrepreneurs in developing nations might be the key to efficiently scaling up sustainable distributed energy solutions that could become the preferred energy source for billions of people whose demand for access to modern energy is growing. The results might be even broader as the mass production of clean, renewable energy enables new levels of innovation and affordability, not only among the poor, but also in richer, developed countries.

This transformation is not without challenges. Both E+Co and Tecnosol must address the critical problem of access to capital that comes with their success in proving the viability of the model. This growth also poses additional challenges as E+Co departs from the experimentation phase and becomes increasingly driven by and dependent on the forces of private equity markets.

A Growing Demand for Modern Energy

The U.S. Department of Energy projects the world's total energy consumption will rise by 59 percent between 1999 and 2020, from 382 to 607 quadrillion BTUs.[1] Most of the growth will occur in the rapidly developing parts of the world, including unelectrified areas surrounding urban centers, led by rapidly developing parts of Asia and Central and South America (EIA, 2002, pg. 5, see Figure 1). According to the World Energy Assessment, "In developing

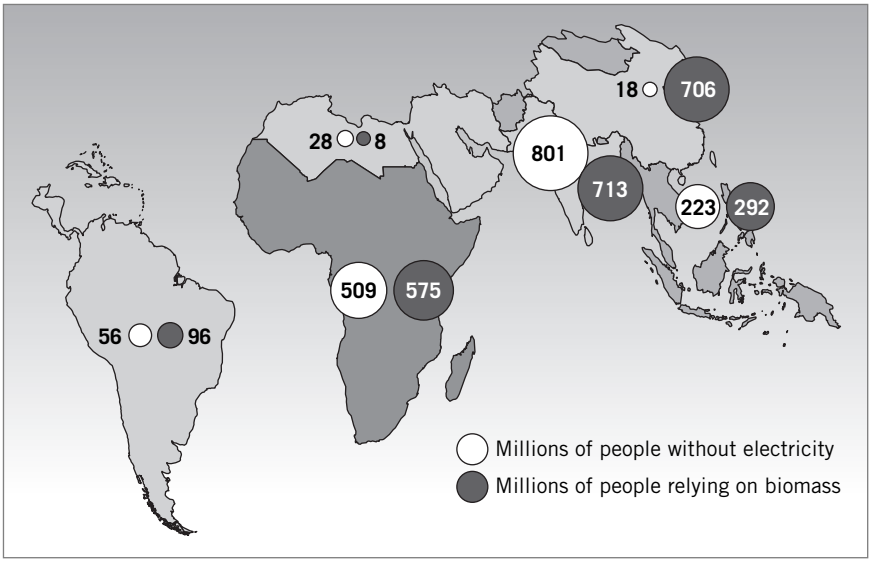

Figure 1 The energy poor. *Source:* IEA analysis.

countries, primary energy demand is expected to grow at about 2.5% a year as industrialization and motorization proceed and living standards improve . . . [and] it will require considerable investment on the order of 2% to 2.5% of the GDP of developing countries over the next 20 years" (The World Bank, 2000). Electricity demand is expected to grow even faster at 4.6 percent, compared to 1.6 percent in Organization for Economic Cooperation and Development (OECD) countries (see Table 1).

Accompanied by this predicted growth in energy is a trend toward privatization of the public provision of energy services. The past decade has seen a wave of privatization of infrastructure activities; seventy-six developing

Table 1 Summary of Energy Investment Needs in Developing Countries

Prediction	Source
Rural market worth $2.5 billion by 2005	Strategies Unlimited
To provide 500 kWh per year to every person in the world by 2020 represents a needed $30 billion per year investment	World Energy Council
Over $1.7 trillion needed investment by 2020	World Energy Outlook, International Energy Outlook
$200 billion to supply minimal energy services to 400 million households	E+Co estimate

countries introduced private participation in energy. These countries awarded the private sector more than 700 energy projects, representing investments of almost $187 billion (The World Bank, 2000). Although private sources provided only one-third of the necessary energy financing in the late 1980s, they account for more than 80 percent in today's larger market (The World Bank, 1996).

The demand for electricity in rural unelectrified areas is largely driven by the need for basic lighting and productive uses such as irrigating fields or operating machinery. One light bulb can keep a store open through the night or provide light for reading, household chores, and even basic security. An electric water pump can save hours of time fetching water. In addition, as globalization continues, there is increasing demand for telephone and Internet service. In the Voices of the Poor study conducted by the World Bank, 60,000 people were asked to name the number one thing they wanted. "They said technology and information, not food and charity. Poor people know that what keeps them poor is lack of competitiveness and knowledge" (Narayan et. al., 2000). Without electricity, there is little or no possibility of realizing these aspirations.

Poorer countries tend to have the lowest levels of electrification; per-capita income and the percentage of a country that has electricity are unequivocally correlated (see Figure 2). This is further supported by the observation that when a country's per-capita income is less than $300, typically 90 percent or more of the population uses firewood and dung for cooking. However, once incomes exceed $1,000 per capita, most people are able to switch to modern fuels, which further perpetuates their ability to earn greater income (Barnes & Floor, 1996).

The Solar Electric Light Fund estimates that families in rural areas of developing countries spend approximately $10 per month on energy, which can represent between 10 percent and 30 percent of a family's income (*Self*, 2002). According to Dan Kammen at the University of California, Berkeley, "A billion people in rural markets have the ability to pay for energy, with many of these billion people spending $5 to $10 a month exclusively for lights" (Lipschultz, 2001). In a study sponsored by the Renewable Energy Policy Project, rural customers around the world are estimated to spend between $8 and $12 per month for lighting services, including candles, kerosene, dry cells, or battery charging (Philips and Brown, 1998). These sources of energy are dirty and inefficient, and on a per-kilowatt-hour basis they cost anywhere from 5 to 100 times more than modern fuels and electricity. The paradox is that the poor are spending a disproportionate share of their income on a product that richer people can get cheaper at higher quality.

Although the cost of energy would appear to be the main driving concern of rural households, experience indicates that high quality and reliability are the most valued attributes of an energy system. Willingness to pay for electricity that is reliable, safe, and of high quality is often higher than what is currently spent on energy services.

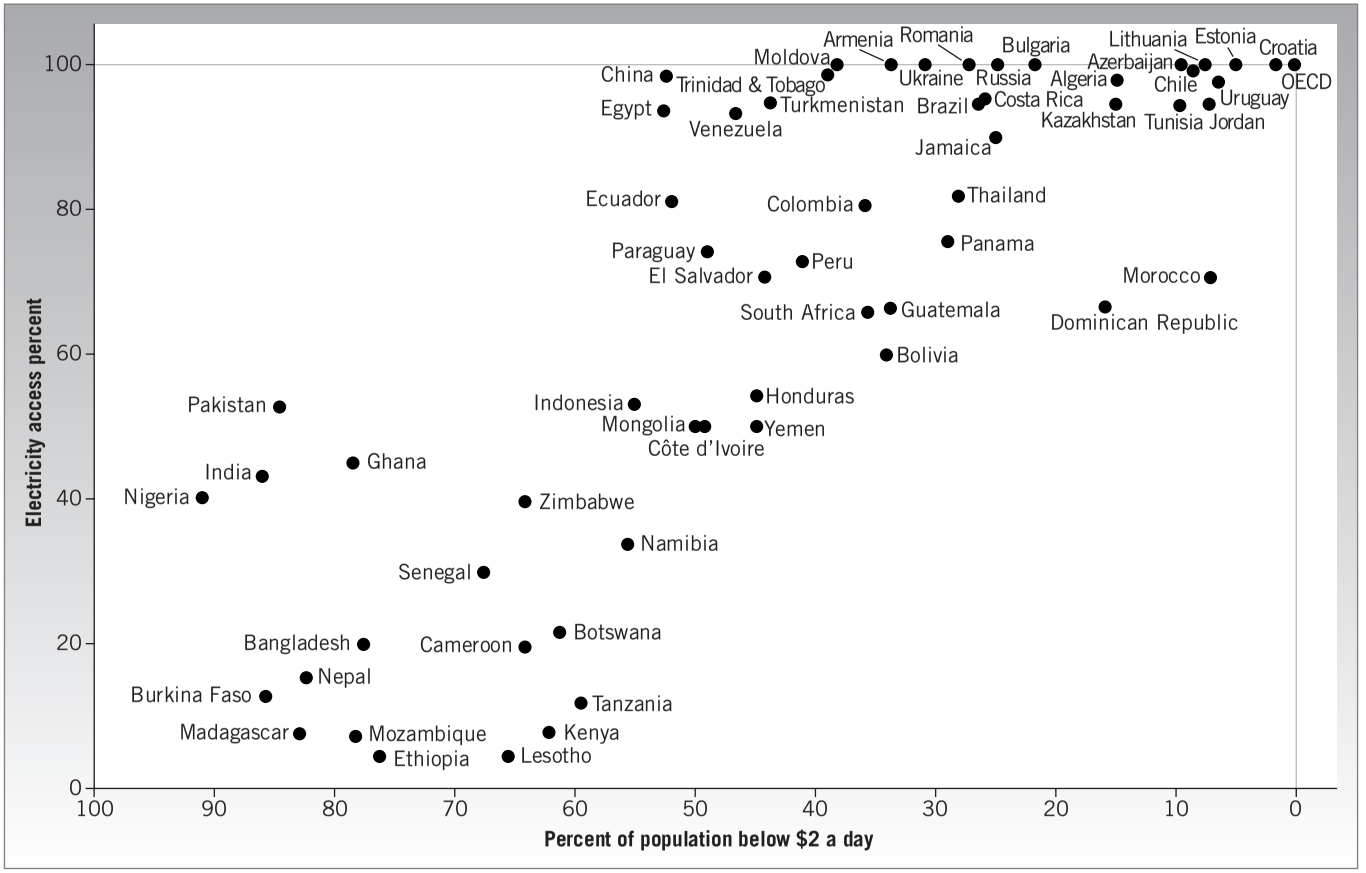

Figure 2 Correlation between electricity access and income. *Source:* International Energy Agency, 2002.

Distributed Renewable Energy Technologies

Thomas Edison envisioned a world of decentralized electrical supply where power would be generated at or near the site where it would be consumed. However, for a variety of reasons, the opposite has transpired, and the dominant model for delivering electricity in industrialized nations is through a network of large centralized power plants linked by a regional transmission grid. Although this model has proven to generate economic growth for many nations, it has led to significant concerns over inefficiency, pollution, climate change, and national security.

As a result, a new distributed generation paradigm is emerging, which more closely resembles the idea originally conceived by Edison. Driven by the growth of small-scale and renewable energy technologies, this alternative model for power delivery has caused utility representatives to claim, "The era of big [power] is certainly over" (Dunn, 2000). As described in the book *Small Is Profitable* produced by the Rocky Mountain Institute, there are at least 207 reasons why small-scale energy systems produce more social and economic value compared to large centralized generation (Lovins, 2002). Although most of these technologies are being invented and built in developed countries, their suitability and potential for wide-scale dissemination might be first exploited in the developing world.

Potential for a Renewable Energy Future

Modern distributed energy in developing nations might take many forms, but among the most exciting is the potential for wide-scale adoption of renewable energy technologies (RETs). Renewable energy is characterized as an energy resource that is inexhaustible in a reasonable period of time. The global renewable resource base is considered large but is currently being utilized far below its potential. The most advanced RETs include hydropower, geothermal, biomass, wind power, and solar photovoltaics (PV) (see Tables 2 and 3). A main advantage of RETs is that the majority of the cost is up front and the "fuel" costs are for the most part free.

Advances in technology and improving economies of production in RETs have driven renewed interest in the potential of alternative means to generate electricity. Prices have fallen with costs leading to an expansion of the market that is expected to continue as technologies and markets continue to develop. Wind power and solar PVs in particular have been growing at over 20 percent per year, as conventional sources of energy are barely growing or declining (see Table 4). The learning curve (the logarithmic relationship between price and cumulative sales) for PVs has been over 20 percent, resulting in an 80 percent

Table 2 Renewable Energy Resource Base (Exajoules per Year)

Resource	Current Use	Technical Potential	Theoretical Potential
Hydropower	9	50	147
Biomass energy	50	>276	2,900
Solar energy	0.1	>1,575	3,900,000
Wind energy	0.12	640	6,000
Geothermal energy	0.6	5,000	140,000,000
Ocean	NA	NA	7,400
Total	56	>7,600	>144,000,000

Source: United Nations Development Program, 2000.

Table 3 Renewable Energy Electricity Generation Technologies

Technology	Description
Solar photovoltaics	Photovoltaic energy is derived by conversion of sunlight into electricity through a photovoltaic (PV) cell, commonly called a solar cell. A PV cell is a nonmechanical device usually made from silicon alloys. The electrical output is dependent on the level of sunlight that falls on the solar cell panel.
Wind energy	Wind is used to drive a rotor (blades) that is connected through a power shaft to an electric generator. The amount of energy is mainly dependent on the wind speed and the diameter of the rotor.
Biomass energy	Plant or animal matter is used directly as a fuel or converted into gaseous or liquid fuels. Biomass typically refers to agricultural or municipal organic waste, forestry by-products, wood or process waste, or special-purpose energy crops.
Geothermal energy	In geological zones that have been volcanically active, steam and hot water can be extracted through deep wells to provide a direct or indirect heat source for electric power generation or other uses.
Hydroelectricity	Moving water is used to drive a turbine that powers an electric generator. Large hydroelectric plants operate through the damming of rivers, whereas microhydroelectric plants can use the natural flow of a river to spin turbines.

cost reduction since 1980 (Maycock, 2002; see Table 5). Wind power, currently the world's fastest-growing energy source, grew at an annual rate of 32 percent between 1998 and 2002; in locations with good wind resources it is considered to be the lowest cost energy option (American Wind Energy Association, 2003). Biomass, geothermal, and microhydro also have demonstrated cost reductions and, depending on the location, are viable and cost-effective solutions.

Table 4 Global Trends in Energy Use, 1990–2000

Source	Average Annual Growth Rate (Percent)
Wind power	25.1
Solar PVs	20.1
Natural gas	1.6
Oil	1.2
Nuclear power	0.6
Coal	–1.0

Source: World Watch Institute, 2001.

Table 5 Current Status and Potential Future Costs of Renewable Energy Technologies

Technology	Increase in Capacity: 1995–2000 (% Per Year)	Energy Production 1998 (Twh)	Turnkey Investment Costs (U.S. $ Per Kilowatt)	Current Energy Cost (Cent/kWh)	Estimated Future Energy Cost (Cent/kWh)
Biomass energy	~3	160	900–3,000	5–15	4–10
Wind electricity	~30	18	1,100–1,700	3–13	3–10
Solar PV	~30	0.5	3,500–10,000	25–125	5–25*
Microhydro	~3	90	1,200–3,000	4–10	3–10
Geothermal	~4	46	800–3,000	2–10	1–8
Electricity grid extension	~1–3	11,129	500–1,300	2–10 (urban) 20–70 (rural)	2–10 (urban) 20–70 (rural)

Note. *The large decline is a result of economies of scale and technological improvement. *Sources:* United Nations Development Program, 2000, and Energy Information Administration, 2003.

RETs in Developing Countries

Given that grid extension can cost up to $10,000 per kilometer, RETs are often a more cost-effective and appropriate solution to meeting the energy needs of rural noncontiguous areas in developing countries. According to Samuel Baldwin, Chief Technology Officer of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy, "Most growth in global demand for energy in decades ahead will be in developing countries; the modularity and small scales of many renewable energy technologies are well-suited for these markets" (Baldwin, 2002). Taylor Moore from the Electric Power Research Institute adds:

> *The capital-intensive nature of large-scale generation and delivery infrastructure development can make high-cost distributed technologies a cheaper alternative in*

many cases in developing countries, especially considering the small amounts of power typically needed in rural settings. (Moore, 1998)

Adoption of RETs to meet energy needs in rural areas offers an opportunity to "leapfrog" the traditional development paradigm characterized by centralized electricity generation by fossil fuel power plants. Similar to how many developing nations are overcoming the high cost and geographical challenges of a wired network infrastructure by leapfrogging into wireless technologies, "Renewable energy offers a similar bridge to the future for developing economies—a future in which they consume cleaner energy than many industrial nations" (Bruno, 2001).

Amplifying the suitability of RETs in developing countries is the large renewable resource base present in many rural locations.

Solar insolation [in equatorial regions], for example, is two to three times greater than in northern regions of industrialized countries, and seasonal swings are much lower. For this reason, developing countries may enjoy a five-to-one advantage in using direct solar technologies. (WEA, 2000)

Similarly, there is an abundance of hydro resources in Central and South America and in southeast Asia.

Renewables also are a good solution in many developing markets because the amount of power they provide comes in scales that are appropriate to the demands of the market. Depending on the size, a PV array on the roof of an individual household can provide enough electricity to power a few lights, a radio, and a television. A small wind turbine can pump water to irrigate a farm or to charge batteries. Microhydro or hybrid power systems (combinations of solar, wind, and often diesel) provide greater amounts of electricity that could power an entire village. Biomass, geothermal, and most hydroelectric power plants range in size from 10 kilowatts to 10 megawatts and have the potential to power small regions or businesses.

This large potential market for RETs implies that with wide-scale dissemination, further cost reductions can be achieved (often 20 percent for every doubling of production), making RETs more affordable in both developing and developed country markets. Dr. Florentin Krauseof the International Project for Sustainable Energy Paths summarized the opportunity:

*Rural electrification in developing countries represents enormous market-creation potential for renewables. Through such development, a broad set of societal and global goals for advancing electrification would be directly linked with a potential for technology cost reductions that also would benefit our domestic economy and global competitiveness. The developing world is where technological development can find the largest market and where the dynamization of energy and technology export for the United States is potentially the greatest by far. Orienting our development focus to those in the greatest need can help bring about the cost reductions in technologies that the whole world needs in order to deal with the risk of climate change. (*EPRI Journal*, 1998)*

Indeed, emerging markets are partly driving the current growth in RETs and are expected to play an even larger future role. With regard to PVs, approximately 1.3 million solar home systems have been installed throughout the developing world during the past two decades. According to Strategies Unlimited, a market research firm in Mountain View, California, "Roughly 40%, or $1.2 billion, of the $3 billion worldwide solar business last year came from rural markets [in developing countries]." However, although substantial when measured in total sales, this represents a penetration rate of only about 0.1 percent, leaving a tremendous potential for expanded use of solar power (Duke et al., 2002).

For a range of contexts, RETs are a cost-effective and suitable solution for meeting the energy needs of rural populations. Although currently considered expensive in industrialized countries, these technologies are relatively inexpensive, and higher quality, compared to what is being used for energy in poor areas today.

E+Co

At the heart of this revolution in distributed energy is a series of success stories developed over the past decade. E+Co is transforming how the bottom of the pyramid obtains and uses energy by emphasizing "energy through enterprise," the delivery of clean energy through local entrepreneurs. Phil LaRocco, E+Co's executive director, commented on the situation near the time of E+Co's formation in the early 1990s:

> *Many of these technologies, while mature, were not commercially proven in the field. Theories on business models for serving the rural poor were generally speculative since few projects had achieved any significant scale or had been attempted in multiple locations. Knowledge of the market did exist, but much of it rested in silos since each foray into rural energy was generally performed as a one-off project, with project leaders moving on to other things once the project was completed.*

In general, the prevailing view was one of large-scale, project-oriented investing implemented through government programs or grants to in-country NGOs. Many of these projects took the form of aid financing programs sponsored by multilateral institutions such as the World Bank Group for electricity grid extension or for subsidized "giveaway" programs to the rural poor. The expectation was that access to modern energy would generate a host of additional benefits, including greater economic prosperity. This prosperity would allow the government to repay the aid financing and would support further organic growth of the energy infrastructure.

The fundamental flaw in many of these programs was how they distorted or ignored fundamental market forces and issues when targeting underdeveloped areas. Christine Eibs Singer, E+Co's deputy executive director, explained:

> *We would see grid extension projects in areas where people were subsistence farming. The government or an NGO would install power lines, lights, you name it and then expect to charge a monthly bill at the same rates as for people in the city. Of course, these farmers had no significant disposable income so the project would eventually fail.*[2] *In other cases NGOs would get a grant to install a certain number of solar panels at no cost in a region. This would be fine until the panels stopped working because of faulty installations, worn out batteries, or other problems. Well before then, the NGO would have filed their final report with details on how many installations had been accomplished, how many households had been served, etc., and would have moved on to the next grant proposal. Many of these programs just were not sustainable in any kind of business sense.*

Steve Cunningham, E+Co's chief financial officer and past vice president of Soluz, Inc., one of the first privately developed solar energy companies, added:

> *In some cases, programs would unknowingly undercut and sometimes destroy the business of a small local entrepreneur who had seen the market need and created a business selling energy solutions in these communities. After all, who will choose to pay for something when the next handout program could be just around the corner and the price of the good or service is a significant portion of one's income?*

In contrast to the top-down structured plans of the multilateral institutions and aid agencies, E+Co proposed to seek out and invest in entrepreneurs in developing markets who would develop new products and services to meet the energy needs in their communities. Because many of these entrepreneurs would not have significant business or even energy experience, the investment would be coupled with significant support services provided on a nonprofit basis.

This combination of capital and support services was not entirely unique in the developing world; the model had been pioneered in many respects by institutions such as the United Kingdom–based Commonwealth Development Corporation (an arm of the U.K. Treasury) and the U.S.–based Small Enterprise Assistance Fund. However, in the early 1990s these initiatives were geographically constrained, in the case of the former to the ex-colonies of Great Britain[3] and in the latter case to Eastern Europe.[4] In both cases, the institutions typically targeted their efforts toward the growth of existing, profitable enterprises in economically disadvantaged areas. E+Co proposed to go down to the next level: seeding brand-new ventures using, in some cases, state-of-the-art technologies imported from the developed world and explicitly targeting the development of new business models.

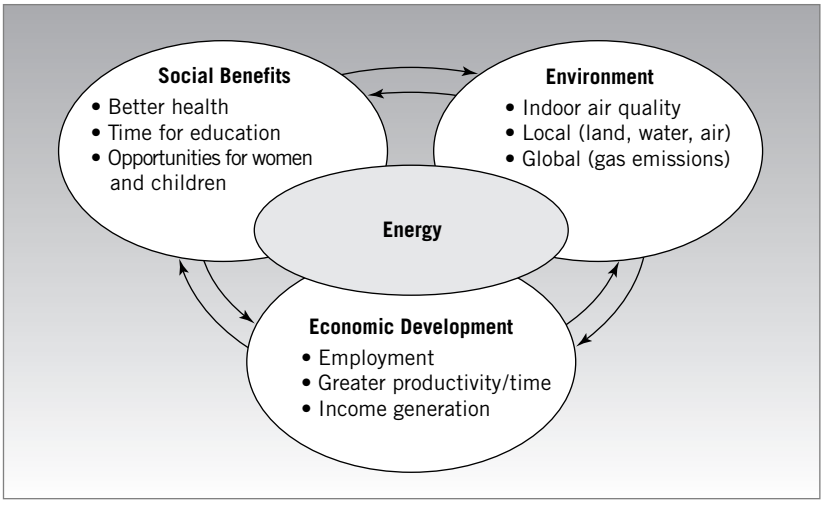

Figure 3 Modern energy is the key link to eliminating poverty, by stimulating social benefits and economic development in an environmentally sustainable manner. *Source:* Adapted from the 2003 E+Co business plan.

More important, rather than focusing broadly on growth finance across multiple industries, E+Co was designed from the outset to accomplish a specific mission: the provision of clean, modern energy to the world's poor via locally developed, market-based solutions. By focusing on energy, E+Co expects to have substantial social, environmental, and economic benefits that will reinforce continued growth in each community in which it invests (see Figure 3). Well beyond accomplishing a major feat of economic and social development, this strategy has important implications for the growth of E+Co and its investment portfolio. If successful, E+Co and its investors would realize a real return on their seed capital and create substantial opportunities for follow-on investments by commercial institutions.

History

E+Co had its genesis in 1990 through pilot activities chartered by the Rockefeller Foundation and led by Phil LaRocco to develop new concepts for public–private partnerships in the area of rural energy. They saw an opportunity to install a fundamental building block that would support and reinforce every other important social need in rural societies, including increased economic output, greater access to information and education, and improved health, especially from the reduction of pollution from wood, kerosene, and other fuels.

The foundation recognized, however, that unlike many other transformations it had pioneered since its formation, rural energy did not have a one-size-fits-all solution that could be developed in a lab, easily replicated, and scaled worldwide. In fact, the historical focus on the expansion of electric grids was increasingly seen as an economically unviable solution for the remote energy poor. At the same time, a host of alternative solutions including wind, hydro, and solar power had not yet been proven in the field or were difficult to scale up globally for a variety of regulatory, market, and geophysical reasons.

LaRocco was an interesting choice for this effort. Although new to the field of energy, he had recently retired as Director of World Trade and Economic Development for the Port Authority of New York and New Jersey, one of the world's largest and most successful public–private partnerships. The pilot activities demonstrated the viability of stimulating investment in new clean energy enterprises by offering a combination of reasonably priced capital and grants along with coaching, advice, and support via established local partners to eligible local entrepreneurs. Once these businesses were seeded and proven, they would become eligible for commercial capital. By developing the market in this way, entire new industries might be launched and eventually scaled to address the vast and complex demand for clean, reliable, modern energy worldwide. The foundation signed on, and in 1994 E+Co was launched as a not-for-profit corporation with a multiyear funding commitment and a charter to change the world.

The organization quickly evolved and by 2002 had grown to include regional offices in South Africa, Nepal, and Costa Rica with an affiliate office in Bolivia and a global (main) office in Bloomfield, New Jersey. Altogether, these offices managed a $9 million loan and equity portfolio encompassing 62 active investments in more than 20 countries. In addition, a new office was in the process of being launched in northeastern Brazil as an extension of E+Co's Latin American presence. The core staff of 22 was augmented through close relationships with eight local NGO partner organizations based in the countries where E+Co was invested. This raised the total number of E+Co team members to close to 60.

Each regional office, led by an E+Co manager, is responsible for sourcing deal flow, managing existing investments, and preparing investment recommendations for opportunities throughout its region. In addition, E+Co's three regional officers are responsible for maintaining and growing relationships with partners, government development officials, important banks, and other potential sources of area funding. In a move toward decentralization, the New Jersey office has gradually withdrawn from managing portfolio investments directly and focuses on contract management, fundraising, information systems, and financial controls. All investment decisions also are passed through the New Jersey office prior to approval by the board.

The E+Co Model

E+Co's goal is to develop sustainable, modern energy businesses in generally poor rural or periurban communities. By targeting the entrepreneur, E+Co shifts the focus away from technology, demonstrations, and donor programs to enterprise, markets, and competitive growth. A key metric of success is the ability of the businesses to grow to a point where they are self-sustaining or are able to access larger, commercial sources of investment. E+Co's approach identifies market opportunities and business models through direct interaction with entrepreneurs and then provides them with the tools, training, and capital to mature their concept into successful, commercially viable businesses.

The initial relationship between the entrepreneur and E+Co or its partners is an opportunity to evaluate each other's goals and expectations. Contact between an entrepreneur and an E+Co representative typically begins with a training session in a given region publicized through local partners. During this "market opening," E+Co staff and local partners present success stories, describe the E+Co investment process, and provide general comments about opportunities that could qualify for potential investment. Basic business planning resources are distributed, including a detailed Energy Business Plan Toolkit. During this and subsequent events, serious entrepreneurs are identified and engaged in more detailed discussions with investment officers who eventually select a limited number to participate in a more formal and detailed program of Enterprise Development Services (EDS). Roughly one in five entrepreneurs that E+Co has any substantial contact with are selected to receive significant EDS support. One in 20 might actually receive an investment.

An important aspect of this combined program is that successful entrepreneurs come to appreciate the importance of community support and institutions like E+Co and its partners. Well beyond creating sustainable businesses in areas that are often desperate for economic development, E+Co entrepreneurs can become community leaders, employing others and bringing prosperity through responsible business.

However, many entrepreneurs in E+Co's target markets might have little formal business training and might be new to the energy field entirely. Consequently, the program of services also encompasses a wide range of business and finance planning needs, including leveraging E+Co's global experience with a wide range of business models, policy frameworks, and technologies (see Figure 4).

Investments are made based on the strength of the business plan that results from the EDS process and the recommendation of the local investment officer. The entire process can take from nine months to two years. Seed capital investments take the form of attractively structured loans and, in certain instances, equity. Loan structures for seed capital investments are generally not dramatically below market interest rates, but might have longer terms, more flexible payment schedules, more flexible or no guarantee or collateral

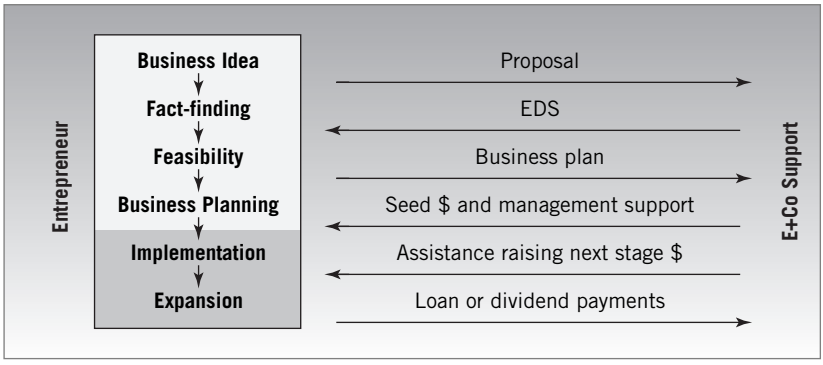

Figure 4 The E+Co process: Finding an entrepreneur to making an investment.

requirements, and be of a larger size than would otherwise be available to the entrepreneur. However, many seed investments represent only a portion of the funding required by the business to achieve commercial success. Thus, an important feature of all E+Co investments is that the entrepreneur is able to establish a credit history that enables him or her to access financing from commercial institutions at a later date. "This has been part of our plan from almost the beginning," says LaRocco. "Achieving this goal would be less likely if the business received grants or zero-interest finance. Banks and other institutions would consider the enterprise to be only a demonstration project, not a real business worthy of commercial investment."

The scope of E+Co's investments, although sometimes beginning at only a few thousand dollars, should not be confused with microfinance, which is generally designed for incremental economic activity such as short-term working capital for the purchase of individual livestock. Although the average E+Co investment is just over $110,000, it varies widely by region, with the mean investment in Africa being less than half that amount. E+Co also provides substantial support in attracting and negotiating follow-on investments for portfolio companies and in assisting them in raising their stature in their community. In many cases, the investment might trigger increased access to commercial capital, better vendor financing terms, and increased positive attention from government policy officials.

Strategy

Operating in an area between traditional development programs and commercial capital, E+Co's strategy incorporates elements of both approaches to investing. In combining these styles, the firm has pioneered several innovative strategies to meet its needs for investment capital, operational funding, and increased organizational impact in providing access to modern energy.

As a provider of quasi-commercial capital, E+Co cannot earn true market rates of return on its early-stage investments. Thus, to create a pool of investment capital, E+Co has targeted the philanthropic community to generate low-interest loans or outright grants from foundations, socially oriented investors, and corporations such as The Body Shop seeking a triple bottom line return.[5] In most cases, the loans are revolving, so that only the nominal interest, typically 2 to 5 percent annually, is paid over time. Applying traditional private equity management guidelines, E+Co takes a small percentage of the funds under management, about 1.5 percent to 3 percent, depending on the specific arrangements, as an annual management fee to cover a portion of the firm's operating expenses.[6]

Steve Cunningham commented on E+Co's financial performance:

> *E+Co's portfolio is looking pretty good when you consider the markets we are in. Across 62 active seed capital stage investments at the moment, we are earning between 5% and 8% returns. We do have a 9% default rate, but that's pretty good—better than many banks in the United States. After collecting our management fee and paying the interest on our loans, we are able to reinvest the remainder into new investments.*

This long-term strategy has resulted in a gradual increase in investment capital as the portfolio of investments grows organically and as new sources of funds are added. In addition, it is an attractive proposition to potential philanthropic donors—rather than making a single donation that is applied once, over time the investment grows and provides a modest payback to the donating foundations, allowing them to increase their charitable activities. There are, however, some important shortcomings, as explained by Cunningham:

> *We are always short on investment capital for the number of opportunities we find, so we would really like to increase the amount of funds under management. Another consideration is that to date, we've been entirely focused on making seed capital investments. Some of our companies get to the point where much more substantial growth capital is required. These later-stage investments can provide much better returns, upward of 15% to 20% or better. In many cases, we've done much of the risky, patient work to get them there, but are not in any position to reap the rewards of participating in these later stages. We just don't have the capital.*

E+Co also has established itself as a sophisticated manager of international development aid programs. For E+Co, these programs provide the operating funds and strategic relationships to support its global operations. For development agencies, the programs have demonstrated a new and powerful way to deploy scarce resources to solve a critical infrastructure problem. By pioneering the investment in individual energy entrepreneurs, E+Co has tested and

demonstrated the viability of dozens of business models and proven the scope and size of the demand for modern energy through real, quantifiable, on-the-ground results. Each program follows the philosophy of the E+Co model, incorporating access to pools of investment capital and close partnerships with local business development advisors, legal counsel, and other business support infrastructure.

E+Co's strategy has been to develop these partnerships in a specific region, establish a track record, and then replicate and build out the program across multiple regions (see Table 6). For example, working with the United Nations Foundation, the United Nations Environment Program, and local NGOs, E+Co established the Rural Energy Enterprise Development (REED) program initially in Africa. The program was later expanded to Brazil and most recently to China. Similarly, in 2000, E+Co won a contract from the U.S. Agency for International Development to launch a program based on the E+Co model in

Table 6 Example E+Co Country Partners

Africa
▪ **Tanzania Traditional Energy Development and Environment (TaDEDO)** is a coalition of professionals, individuals, artisans, farmers, and community-based organizations.
▪ **ENDA TM** is working in Senegal to create better technical, economic, and socioeconomic understanding of the energy challenges in Africa.
▪ **Kumasi Institute of Technology and Enivronment (KITE)** is headquartered in Ghana and committed to enterprise development and policy formation for clean energy.
▪ **Mali-Folkecenter (MFC)** promotes the use of renewable energy and technologies with special focus in rural areas.
▪ **Centre for Energy, Environment, and Energineering in Zambia Ltd (CEEZ)** collaborates with government institutions in the fields of energy, environment, and engineering.
Central America
▪ **Biomass Users Network–Central America (BUN–CA)** develops production capacity through the sustainable use of natural resources.
Brazil
▪ **Instituto de Desenvolvimento Sustentavel Energias Renovaveis (IDER)** is working in northeast Brazil to promote integrated sustainable development utilizing renewable energy technologies.
▪ **Instituto Eco-Engenho (IEE)** brings substantial technical expertise to renewable energy and sustainable development projects.
China
▪ **The Nature Conservancy (TNC)** works with international partners to protect biodiversity.

the poorest regions in Latin America (the FENERCA program). The program was subsequently renewed and expanded twice and now overlaps in some regions with REED-sponsored activities. Although the funding sources and program names vary, to the local entrepreneur the opportunity is always to work with E+Co and to leverage their access to seed capital and global experience base.

The combined resources of these partnerships and investment capital have allowed E+Co to make between 10 and 20 investments per year. "In fact, our organizational capacity is geared toward closer to 30 investments a year, and it could be even higher as we improve our processes," said Cunningham. "What is limiting us is the amount of investment capital at our disposal. I know that sounds like a broken record, but it's true. The deals are there to be done both at the seed and growth capital stage, and we have the talent and experience in the field to do them."

"One of the most valuable features of our success in building out the REED and USAID programs is that we have secured enough operating funds for the next full two years. That's pretty much unheard of in the nonprofit and development communities," noted LaRocco. "We have an opportunity to use this two-year runway to revamp our processes and expand our investor base to become much more self sustaining."

This window has taken on real importance within E+Co. Christine Eibs Singer noted that working with the development and philanthropic community has its pluses and minuses. "On the one hand, they provide us the resources to work in places where seed capital is critically important but just won't work on a pure commercial basis. On the other hand, we've learned the philanthropic community can be very fickle. There is really a flavor-of-the-month approach to choosing what to fund."

However, Eibs Singer also noted the E+Co brand has become an important tool in continuing to build support for the E+Co vision:

> *Our success in the field has led to more people recognizing our name and what we do. Sometimes we worry about people copying our model and then not performing at the same level as we would. Still, our brand and experience add considerable credibility to anyone we invest in or to any partnerships we establish. This is very important since our success depends on our companies getting the access and attention they need, whether at the local bank or at the highest government ministry levels.*

Relationships with major development agencies also have an important secondary benefit. Working at the highest levels in the development community allows E+Co to provide input on important policy issues at both the local and international levels. Within the REED program, local government agencies are considered essential partners. As E+Co has demonstrated the power of local enterprise, government ministries have become increasingly receptive to

the private-sector approach and more willing to consider energy policy reforms in the context of sustainable development.

A Diverse Portfolio

In its early days, E+Co's portfolio was substantially concentrated in PV (solar) businesses, in part due to the publicity surrounding these technologies and the growing number of technology suppliers to developing countries in this field. Once established, however, E+Co realized the danger in being concentrated in one technology and one set of business models and also saw that substantial opportunities existed in its target communities to diversify into a broader portfolio of businesses. "For a time, we were actively trying to spread the model around, to demonstrate the potential and breadth that exist in the market. This growth and diversification have now become a concern for us," remarked Eibs Singer. "It does not make sense to have only one or two investments per country. The cost of managing those investments is too high."

"E+Co operates in some of the most difficult economic environments on the planet," said Cunningham, "but we are doing it successfully. That's a tribute to the entrepreneurs we are working with and the significance of the market opportunity that modern energy affords." The choice of countries in which E+Co operates involves careful analysis of the underlying macroeconomic fundamentals in the country and region. Market forces, including regulatory policy, must be aligned with the potential for entry of new enterprises. There also must be a viable legal framework for managing contracts and investments as well as opportunities to partner with local representatives. There must be a need for E+Co's special brand of financing either due to a lack of local capital sources or because of the perceived risk of investing in this area. Finally, there must be sufficient sponsor interest in targeting the region to support a program of EDS and investment capital.

Investments are identified and managed by their stage of maturity and their likely development path (see Table 7). Stage 1 investments are in very small or start-up companies and often require a "full package" of EDS leading to a modest seed capital investment of often less than $50,000. Some of these firms will fail completely during market entry or due to forces beyond their control (e.g., flood, landslide), but some will progress to Stage 2. Stage 2 companies can be on one of three paths:

- **Path A:** Might need assistance to secure access to commercial credit and capital.
- **Path B:** Will stabilize as a small, sustainable business.
- **Path C:** Will need additional development support and patient or growth capital.

Table 7 Different Stages of Enterprise Development

	Stage 1: Small and Very Risky (e.g., <1,000 Solar Home Systems)	Stage 2: Medium Size, Still Risky (e.g., 1,000–10,000 Solar Home Systems)	Stage 3: Investment Grade (e.g., >10,000 Solar Home Systems)
Strategy	Demonstrate the market	Build the brand	Scale up
Source of finance	Own funds and seed capital	Growth or "patient" capital	Later stage capital and debt
Investor role (management support)	Hand-holding	When needed	Arm's length

Examples of Companies in Each of the Three Different Paths

Path A: Clean Thai	Path B: Vacvina	Path C: NOORWEB
Clean Thai builds biogas power plants designed to be operated on-site at food processing facilities. A short-term loan and later equity investment by E+Co allowed the company to complete its first project. The project has generated over 20 percent returns and is scheduled to be replicated elsewhere.	Vacvina develops small biogas solutions for rural farmers in Vietnam. With EDS and an $80,000 loan from E+Co, the company has been able to sell more than 3,000 systems. The evolution of the company is to focus on improving the efficiency of their biodigestor structures	NOORWEB has installed thousands of solar energy systems throughout Morocco. After initial infusions of seed capital from E+Co, the company has still not been ready to access next-stage capital. The company continues to require capital to be sustainable.

Companies on Paths A and C will likely progress to Stage 3 and into sustainable businesses with or without commercial capital.

Tecnosol

E+Co's ideal investments are companies that have successfully penetrated the market with unique, defendable strategies and are now in a position to expand their business through next-stage growth capital. One such example is Tecnosol in Nicaragua. Tecnosol sells and installs distributed solar PV, wind, and hydroelectric power systems to mostly rural unelectrified populations throughout the country. Despite generally unfavorable economic conditions and a chronic shortage of working capital, the company has still been able to double its sales each year.

Tecnosol has been able to succeed primarily on the strength of a market strategy that allows it to reach deep into rural markets with a clearly differentiated and well-publicized offering. Tecnosol also has been able to leverage universal and regional knowledge in the field of rural and especially solar-based power business through close consultation with E+Co and its partners' broad experience base. This has allowed Tecnosol to significantly advance the sophistication of its business plan and has opened opportunities for new sources of capital—in particular, a major loan from E+Co. The combination of a superior market strategy and access to both dedicated business advisory support and growth capital is allowing Tecnosol to find new avenues for growth to better serve the large market for electricity in rural areas of Nicaragua.

The company was founded by Vladimir Delagneau, an electrical engineer by training, who realized the market potential for affordable renewable energy systems in a country where 45 percent of the population does not have access to electricity (see Table 8). After taking advantage of a three-month NGO-sponsored renewable energy seminar in Germany, Delagneau began to seriously explore the opportunities for a wide variety of RETs, culminating in the launch of Tecnosol in 1995.

Since then, the company has installed more than 3,500 PV systems, 20 wind systems, and a few small hydroelectric systems. Growth has been highly organic and has benefited from a reputation for good quality and service. As the firm's reputation has spread, so has its growth. Halfway into 2003, the company had sold three times more systems than it had in all of 2002.

Table 8 Nicaragua Statistics

Country size	129,494 sq. km
Population (July 2001)	4.9 million
Gross domestic product purchasing power parity (2000 est.)	US$13.1 billion
GDP-per capita purchasing power parity (2000 est.)	US$2,700
Exchange rate/US$ (September 2002)	14.67 Córdobas
Inflation rate (2000)	4.84%
Unemployment (2002 est.)	10.7%
Literacy	75%
Total installed grid capacity (MW)	640
Percentage of population serviced by the grid (2001)	55%
Total carbon emissions (January 2001)	1.0 million metric tons

Sources: The CIA World Factbook, 2001; Energy Information Administration, 2002.

A Business Model Focused on Quality and Service

Tecnosol's business model is to sell renewable energy systems to customers primarily on a cash basis. In addition to complete packages for solar, wind, and hydroelectric systems, the company also sells accessories, including lighting systems, electric fencing, refrigerators, fans, water pumps, and water purification devices. If requested by the customer, the company also will place custom orders for various other electrical devices. Although margins on these additional requests are sometimes quite low, they are part of a strategy of providing complete service to meet the needs of the customer.

Tecnosol focuses primarily on customers who can more easily afford renewable energy systems, which mainly includes farmers and landowners. As pointed out by an E+Co investment officer, "Tecnosol taught us a lesson. It is not always necessary to go after the poorest people first—there are often many customers who are willing to pay higher amounts even in what would be considered underdeveloped areas."

A common means of accessing the capital needed to buy a system in such areas is through the sale of livestock. One interviewed customer, who was quite pleased with his purchases, described how he sold six cows for an illumination system and 10 cows for a water-pumping system. Even then, the addition of electricity to his property resulted in real monetary savings (about $40 per month in labor for carrying water and about $8 per month in the cost of kerosene[7]) and an overall increase in property value. To meet the needs of a range of potential customers, Tecnosol offers prepackaged systems for a variety of levels of affordability, including a small 14-watt PV system for the poorer people.

Tecnosol provides full-service installation on all energy systems and gives verbal and written instruction to the customer on proper system maintenance. There are two other smaller companies that sell renewable energy systems in Nicaragua, but Tecnosol distinguishes itself by focusing on quality and customer service. Technicians will travel any distance to reach a customer (on horseback, if necessary) and, if a problem is reported, a technician responds promptly to solve the problem. One lesson of previous rural electrification companies around the world is that quality is a key value driver in many rural markets because many people are skeptical that the new technology will function as advertised, especially when compared to traditional solutions such as buckets (for carrying water), candles, and wood. Because word of mouth through existing customers is a primary driver of new buyers, quality and service satisfaction take on added importance. To support this spread of information, the company also uses a variety of media, including radio, newspaper, and market fairs to advertise its products throughout the country.

Tecnosol offers eight main packages for its customers, from a basic lighting system to a complex system for water pumping or refrigeration (see Tables 9 and

10). The strategy of the company is to price its systems $20 to $30 below the competition. Delagneau explained, "These are expensive items, so customers want to know they are getting a good price, but they also want high quality. We try to provide them both things. Even just a slightly lower price makes the customers feel like they are getting a good deal." With higher volumes than the competition, Tecnosol can afford the 1 to 2 percent price reductions.

Table 9 Tecnosol's Most Commonly Sold Systems

14-Watt Solar PV System	**50-Watt Solar PV System**
• 1 14-watt solar panel	• 1 50-watt solar panel
• 1 12V battery (40 AH)	• 1 12V battery (105 AH)
• 1 charge controller (4 amps)	• 1 charge controller (10 amps)
• 2 10-watt lights	• 4 15-watt lights
Cost: $350	Cost: $590
75-Watt Solar PV System	**100-Watt Solar PV System**
• 1 75-watt solar panel	• 1 14-watt solar panel
• 1 12V battery (105 AH)	• 2 12V batteries (105 AH)
• 1 charge controller (10 amps)	• 1 charge controller (10 amps)
• 6 15-watt lights	• 10 15-watt lights
Cost: $790	Cost: $1,150

Table 10 Refrigeration, Water Pumping, and Illumination Systems

Solar-Powered Refrigeration System	**Solar-Powered Freezing System**
• 2 100-watt solar panels	• 4 100-watt solar panels
• 2 12V batteries (105 AH)	• 4 12V batteries (105 AH)
• 1 charge controller (4 amps)	• 1 charge controller (20 amps)
• 1 165 cubic liter refrigerator	• 1 165 cubic liter freezer
Cost: $2,400	Cost: $3,800
Solar-Powered Water Pumping System	**Solar-Powered Lighting and Water Pumping System**
• 2 50-watt solar panels	• 2 100-watt solar panels
• 1 charge controller (24 volts)	• 2 12V batteries (105 AH)
• 1 water pump	• 1 charge controller (20 amps)
	• 6 11-watt lights
	• 1 water pump
Cost: $1,350	Cost: $2,400

Dealer Network

To reach the rural areas of Nicaragua, Tecnosol uses a sophisticated network of nine dealers located as far as two days' travel from its headquarters in Managua. These dealers are allowed to use the Tecnosol name to display and advertise products, similar to a franchise, although without any fees or charges. Advertising expenses are often shared between the company and the dealer, including occasional radio spots. Dealers work on margin, and can earn approximately $130 profit per PV system installed (in addition to a $100 profit margin to the company). One dealer explained that he sells about two or three systems per week, giving him a 50-fold increase from his previous income.

Dealers are slowly given more inventory as they prove they can serve markets successfully and can pay the company on time. Most dealers currently receive a $5,000 credit line to carry inventory, which translates to having about three to four systems and various components and accessories on hand at any one time. Previous to this line of credit, dealers functioned like purchasing agents for potential customers. They would take orders within their community and then drive into the city to place an order with Tecnosol; when the systems arrived in Managua (usually shipped from Spain or the United States), the dealer would come back to pick it up and install it at the site. The entire process could take up to three to four weeks from time of sale and often resulted in high shipping costs because orders were placed in smaller batches.

As indicated through interviews with both a current dealer and a potential new dealer, the current line of credit has been inadequate for keeping up with demand. One dealer claimed:

> *I live very far from Managua. I sell about two or three panels per week, about what I have in my store. I've noticed people coming from over six hours away just to buy an electricity system. But often, I have to turn people away because I don't have the panels I need. I could serve my customers better if I didn't have to make as many trips to the city to get more inventory.*

Tecnosol's Relationship with E+Co

Tecnosol was introduced to E+Co at a 2001 market opening training session organized through BUN-CA, E+Co's local business development partner. Tecnosol was identified by BUN-CA as a potential candidate for EDS and follow-on investment. The EDS phase lasted nearly two years and included a detailed market study to confirm Tecnosol's claims about the market structure and opportunity. During this time Delagneau continued to run and grow the business. The market study confirmed Tecnosol's business model, indicating that 91.4 percent of the population in four target regions in Nicaragua did not

have access to electricity, and 60 percent of the population in those target regions had a strong interest in the company's products and could afford them. The study also determined that people in these areas could pay between $10 and $50 on a monthly basis for energy, and the richest farmers could spend between $50 and $200 per month. This was backed up by results; better targeting and the growing effects from positive word-of-mouth advertising had caused sales to jump to nearly 700 systems per year, from around only 400 in the prior year.

E+Co's investment in the company, completed in early 2003, was designed to increase Tecnosol's working capital and expand the company's creditworthiness. Taking the form of a two-year, $100,000 loan at 11 percent interest, the investment allowed Tecnosol to purchase additional inventory in one large-volume order, dramatically saving on shipping costs. The increase in inventory allowed the company to extend a greater line of credit to its dealers so they could increase their sales volume and carry a larger selection of products. A portion of the loan also allowed Delagneau to extend short-term credit to customers who came directly to the main Tecnosol store in Managua. Whether dealers choose to extend credit to their customers is primarily up to them. Delagneau said, "They know the customers better than I do. However, I do not think many will [extend credit] or it will only be for very short periods of time. Most customers are more than willing to pay in cash. They [the dealers] still have to pay for their inventory from me on time either way."

Prior to E+Co's involvement, Tecnosol was unable to secure the level of financing it needed to grow the business. A banking crisis in Central America had led to the consolidation and closing of nine banks in Nicaragua. Those that remained pursued highly conservative policies. The best Tecnosol could achieve was a six-month, $20,000 revolving credit line with an 18 percent interest rate. Although Tecnosol's business was healthy enough to service these high rates, the small size and expense of the credit line made it difficult to grow the business. This changed once the local banks became aware of E+Co's involvement with Tecnosol. In fact, the E+Co loan structure includes a $30,000 subordinated letter of credit from BANCENTRO at an interest rate of only 14 percent with a term of at least one year.

PV Business Models

Tecnosol is one of many businesses working with PVs (its main line of business) in developing countries. Other companies have had mixed experiences in making PV business work successfully.

PV businesses generally operate on a cash-sales or fee-for-service basis (see Table 11). Pioneered mainly by Soluz, Inc., an early E+Co investment operating in Honduras and the Dominican Republic, in a fee-for-service model the company retains ownership of the PV system, which it rents and maintains for

Table 11 Largest Existing Markets for Solar PV Energy Systems

Country	Number of Systems Sold
India	450,000
China	150,000
Kenya	120,000
Morocco	80,000
Mexico	80,000
South Africa	50,000

Source: Martinot et al., 2002.

a monthly charge.[8] Soluz has a collection rate over 90 percent, indicating that users are able and willing to pay for energy on a monthly basis. Although the company has installed more than 6,000 systems and is making a profit, its markets have been negatively affected by unexpected governmental grid extension projects in regions it serves. In some cases, it is the fact that Soluz has demonstrated the demand and price points in a market that attracts the utility to expand. Without any equity in the systems they are using, customers often abandon their contract with Soluz in favor of switching to the grid.

In contrast, Rural Area Power Systems Ltd., a fee-for-service solar PV business in South Africa, has had greater success working with government and recently won a concession contract to serve 50,000 rural households with PV in a defined service area. Started by Jurie Willemse, currently E+Co's regional manager for Africa, the company uses a unique prepayment system with electricity meters and smart chips to measure system usage and collect payment.

Several other PV companies sell the entire system to an end user on a cash or credit basis, similar to the Tecnosol model. NOOR in Morocco has sold 1,200 systems on a credit basis and expects to sell 7,000 more systems in three years. The Solar Electric Light Company (SELCO) employs 300 people worldwide and sells PV systems on a cash and credit basis in Sri Lanka, Vietnam, and India. The company has sold more than 20,000 systems through a network of "solar service centers."

A common theme among these various firms, all E+Co investee companies, is that they are all owned and managed by successful local entrepreneurs who have pioneered poor rural areas through sophisticated and defensible marketing strategies. In fact, multinationals are beginning to take notice. In negotiations organized by E+Co, Shell International, a subsidiary of Royal Dutch Shell, has taken a 39-percent equity stake in NOOR. Other technology providers have agreed to revise and extend greater amounts of vendor financing. One international provider of solar panels, Isophotón of Spain, outbid several others to become Tecnosol's vendor of choice for a campaign to extend service into even more rural and underdeveloped areas of Nicaragua.

Governmental and Multilateral Development Programs

In what is an increasingly common revision of policy in many developing nations, the government of Nicaragua acknowledges it does not have the capacity to meet the energy needs of most people in the 45-percent unelectrified population in the country. As stated by Gioconda Guevara, the Director of Energy Policy for the National Commission of Energy:

> *Investment in the energy sector must be from private sources because the government does not have the capacity to make that necessary investment. Thus, Tecnosol or any other company that develops technology for energy projects will be looked upon highly. There are not many companies yet, but it is the government's intention to support private developers in the energy sector to augment the government's capacity.*

As a response to the success of the private sector in serving the energy needs of rural communities, governments and multilateral institutions have started to adopt policies and build programs that support further expansion of private businesses for delivering energy services. A joint initiative among the World Bank, Global Environment Facility, and the Sri Lankan government in 1997, called the Energy Services Delivery (ESD) Project, has provided a model for the structure of other similar programs around the world. The ESD Project incorporated a variety of stakeholders, including government, business, local banks, and microfinance institutions, to mobilize $53 million in funding for the support of private energy enterprises. One result of the program has been the formation of five private PV companies that have collectively sold and installed more than 28,000 solar home systems since 1998.[9]

It is worth noting, however, that in some cases these initiatives can become misaligned with the needs of the private sector. The Photovoltaic Market Transformation Initiative, sponsored by the International Finance Corporation, is an example of a program designed to provide "good" subsidies (ones that promote healthy private enterprise) but occasionally becomes bogged down in process. As a result, typically the most successful and entrepreneurial enterprises are the ones that suffer the most, as substantial resources become tied up in responding to program paperwork and not the core business. A common criticism of many multilateral initiatives is that they often require a level of bureaucracy, due diligence, and risk mitigation that is not well-suited to the resources and entrepreneurial environment of many of these successful energy enterprises.[10]

Nonetheless, in response to the success of programs like ESD and the overall trend toward supporting private enterprise, the Nicaraguan government is

working with the World Bank and the Inter-American Development Bank to create two new programs for rural electrification in Nicaragua's poorest areas. Each program has a component that subsidizes the cost of PV modules for rural enterprises that will install and manage the systems over an extended period. Although organized around the fee-for-service approach (compared to Tecnosol's cash–sales business model) that has been proven successful in extremely poor areas, Tecnosol has placed a bid to participate in both contracts. "This is an opportunity to further expand my business into new areas," says Delagneau. "My current customers understand that for the very poor people there will always be subsidies."

These programs present both an opportunity and a risk to Tecnosol. In addition to the increased challenge of operating in two very different market segments with two different revenue models, the programs also will change the broader market dynamics. Prior to the program in Sri Lanka, there were many small PV companies serving local areas. The opportunities provided by the ESD Program attracted larger outside companies to the market, which eventually resulted in the industry consolidating into two primary companies (although about five still exist). In fact, it was this program that resulted in Shell Renewables making the strategic investment in NOOR as well as in several other growing firms. If the programs in Nicaragua generate the same international interest as in Sri Lanka, Tecnosol might find it difficult to compete against larger companies with more resources. On the flip side, because Tecnosol has a track record of success, ties to regional and international partners, and a committed dealer network, it could be seen as an increasingly attractive investment opportunity for both private investors and multinational corporations like Shell as the market continues to develop.

Scaling up Energy Access at the Bottom of the Pyramid

Investing in the Entrepreneur

E+Co has demonstrated a successful model for energy delivery at the bottom of the pyramid where the local entrepreneur is the driving force in the market. The argument is that to deliver a product such as energy to rural areas, there must be an intimate understanding of the local conditions and culture, demand profiles, and local politics to effectively and sustainably deliver a quality product. Tecnosol is just one example of an entrepreneur who turned an interest in renewable energy and the desire to serve a large unelectrified population into a profitable business serving thousands of rural customers in Nicaragua.

If local entrepreneurs are the means to meet the energy problem, an interesting question to ask is how many entrepreneurs are needed globally to

serve the 300 to 400 million households without access to modern forms of energy. As a starting point, the G8 Renewable Energy Task Force estimates that 800 million people (or about 120 million households) is a reasonable estimate for the number of people who can be provided with modern, clean energy under appropriate social and economic conditions on a global basis over the next 10 years (The G8 Renewable Energy Task Force, 2001). That estimate can be broken down into three submarkets:

- Nonelectricity efficiency investments, especially cookstoves: 200 million people
- Off-grid electricity: 300 million people in rural areas
- Grid electricity based on renewable energy: 300 million people

These markets represent approximately $107 billion in needed investment over the next 10 years.[11] To realize these targets, an estimated 16,500 companies will need to be created.[12] To launch those 16,500 enterprises, an estimated $4 billion is needed for EDS and seed capital, of which over 50 percent would be returned through loan payments, dividends, and capital gains.[13] LaRocco commented:

> *These are scary numbers. $107 billion is almost incomprehensible, as is 800 million people without modern energy. And the idea of creating 16,500 enterprises is frightening. That is a lot of work, and it is not going to be done from the top down, it is going to be done from the market up. But the $4 billion that would be required to seed these enterprises, that is not terribly scary, especially if more than half is recoverable.*

The Capital Markets

Beyond subsidy programs and support for seed capital and EDS is an increasing demand for growth capital for established, profitable enterprises. The lack of this next-stage, "patient" capital is of growing concern to early-stage investors like E+Co. In the late 1990s, several funds were formed to address this concern and the opportunity it presented. One example is the Renewable Energy and Energy Efficiency Fund (REEF) formed by the International Finance Corporation, the Global Environment Facility, FinnFund, John Hancock, and Nuon in 1998. E+Co (through a for-profit subsidiary called Energy House Capital Corporation) participated in the fund management company. This $65 million fund was chartered to invest in renewable energy companies in developing countries. Although earmarked generally for larger investment projects, 20 percent of the fund was specifically allocated to be placed in early-stage companies with significant growth opportunities. Structured as a

traditional private equity fund, REEF expected to make most of its investments in the first few years and to achieve returns significantly in excess of 20 percent. Another similar investment group called Solar Development Capital (SDC) with a $28 million fund set slightly less aggressive expectations—hoping to achieve a triple bottom line return with performance in the midteens. In both cases several factors contributed to limit the potential of these funds.

Severe economic turbulence in emerging markets caused by devaluations in southeast Asia and Latin America in the late 1990s followed by the crash of equity markets following the dot-com bubble resulted in reduced deal flow and dramatically lowered return expectations. Most important, however, many early-stage investments in the targeted markets had trouble meeting the level of due diligence and investment guarantees desired by the investment committees of these funds. With a lot of money sitting idle, the REEF investment committee found itself reluctant to take many small bets on companies with limited size and track records, regardless of its charter. After four years and only one investment (in a company sponsored by E+Co and pushed through after many delays), REEF disbanded. SDC, with a slightly less stringent process, lower expectations, and a management team with substantial experience with solar enterprises in emerging markets, has held together, but has made very few actual investments.

Nonetheless, opportunities still exist for private equity capital. E+Co currently manages a co-investment fund under the auspices of the Multinational Investment Facility of the Inter-American Development Bank that has a net return of 16 percent[14] over the last several years. This is not at all poor performance when compared to similar vintage funds in the private equity sector. Although no exact measures are available, public data recently made available from the University of Texas Pension Fund and the California Public Employees' Retirement System shows that many of the world's premier private equity funds have highly negative returns (in some cases 20–30 percent negative) from this same period (Tenorio, 2003).[15] As of this writing, any fund that invested beginning in 1998 with even a modestly positive IRR is considered to have done quite well. Those that have not are downsizing and many are fighting to stay in business.

A significant question for the future is why some funds targeting emerging markets seem to prosper and others merely spin their wheels. The answer appears to be closely related to the structure and oversight of the given fund, including the location and experience of its management. Although there are few specific data points, indications are that the closer the fund is to the investment targets and the deeper the relationship, the more likely capital will be placed quickly and efficiently. "REEF failed because it wanted all the process and due diligence work that its sponsors typically expected for a major project finance activity. These markets are not prepared for that. We are talking about

early stage, venture capital deals where a knowledge of the territory and the experience of the entrepreneur and investment team are what really counts," said Cunningham.

In April 2003 the E+Co team built an outlook of what they saw as the opportunity and need for capital for the next five years, balanced against the company's infrastructure and reach. The team split up their projected need for capital into three categories: seed capital, growth capital, and operating funds (see Table 12). To reach its targets, E+Co would need to raise nearly $100 million, of which approximately $20 million would be required in operating funds in part to continue supporting EDS. The numbers vary quite a bit by region. In Africa, operating funds are larger—to account for the greater effort required to reach and train entrepreneurs—but investment amounts are typically less. Conversely, the opportunity for larger hydroelectric projects in Latin America resulted in a greater demand for growth capital.

A key question facing E+Co is how the numbers compared to traditional private equity operations and how much of the operational costs would have to be subsidized through grants and programs. Another concern was fundraising, especially in the area of growth capital. E+Co's track record was almost entirely in the area of seed capital. Could the team raise the kinds of funds it would need to establish a serious growth capital initiative? What would this mean for E+Co's operations and culture?

Table 12 Projection of E+Co Deal Flow, Capital Requirements, and Returns: 2003–2008

	Africa	Asia	Latin America	New Jersey (Hdqts.)	Target Gross Returns[1]	Total
Deals per year (Recent average)	8–10	2–3	4–6	–	6.9%[2]	14–19
Five-year pipeline potential (deals)	80–120	40–80	100–110	–	–	220–310
Typical investment size (recent average)	<$50,000	~$100,000	>$100,000	–	–	–
Operations ($M)	$4.8	$2.0	$5.0	$8.7	–	$20.5
Seed capital ($M)	$13.0	$5.0	$10.0	–	8%	$28.0
Growth capita ($M)	$10.0	$10.0	$30.0	–	15–25%[3]	$50.01
Totals ($M)	$27.8	$14.5	$45.0	$8.7	TBD	$98.5

[1]Does not include deductions for management fees and E+Co operation costs. To date, most operation costs have been funded through grants and contract revenues.
[2] E+Co's total portfolio since inception. In recent years, returns have been higher, ranging from 8 to 10 percent. Nearly all investments to date have been of the seed capital variety.
[3]Range of possible returns for individual investments across the various regions.

Private equity firms typically receive between 1 and 3 percent of the funds under management as a yearly fee to cover operating expenses and management incentives. The lower end of this scale is reserved for those funds that primarily disburse into other funds, whereas groups that make direct investments earn, on average, 2 to 2.5 percent. E+Co has had experience managing funds using this structure for foundations and a few social investors on a small scale. Management fees could substantially reduce the amount of money E+Co would have to raise in grants and contract fees. Could E+Co eventually become self-sustaining? Looking at the numbers, the team realized it had even bigger questions. Would traditional financial investors both in the industrialized north and in developing nations, or perhaps investors with a desire to invest in triple bottom lines, be attracted to a return in the midteens? Could the portfolio—companies like Tecnosol—sustain returns on that scale?

Jurie Willemse, regional manager for Africa, is optimistic. "In Africa we are well on our way to establishing a $5.2M fund through a new structure called the African Energy Facility. We are also close to initiating a dedicated fund within Ethiopia . . . once we prove out these structures, we can expand from there." Similarly, Fernando Alvarado, regional manager for Latin America, saw significant opportunities in Latin America. "Because of our global track record and history in Latin America we have a good relationship with the Central American Development Bank. We are talking with them about a $30 million fund for primarily hydro-based on-grid projects. Once we prove we can do this, there is also real opportunity for an off-grid fund as well."

Nick Parker, Chairman of E+Co's Board, summarized the opportunity from a different viewpoint:

> *The fundamental challenge in front of E+Co is accessing the deep pools of capital that are currently not being used. This is capital that is sitting on the sidelines. It's capital that thought the emerging markets were the place to be 10 years ago, and now has been scared away. It's capital that then went into the dot-com boom and that game is over. So this capital is sitting on the sidelines and needs to be accessed.*

Strategy for Scaling Up

At the end of the April meeting, the E+Co team reflected on its mission and the challenges of moving up the investment chain to higher, more sustainable returns. Nick Parker brought everyone back to the big picture: To meet the challenge of scaling up energy access through the 16,500 enterprises needed to deliver energy to 800 million people, the sector must be considered investment grade.

> *To scale up, E+Co has to be bankable, because we are not going to get the $100 or $150 million we are looking for if we are not bankable. We have to be*

attractive and we have to be a safe bet. Essentially, we are trying to solve a problem, and we are trying to solve it by creating enterprises that will address that problem. The enterprise development services and all the other things we do are there to make projects bankable.

The strategy for making businesses bankable and scaling up hinges on two key challenges: obtaining next-stage growth capital for E+Co's current enterprises and efficiently creating and seeding new enterprises. To date, E+Co has relied on a strategy of growing horizontally to serve more people with energy—creating more enterprises in the regions in which it operates. The company has a proven model for doing this, but it has not been in a position to take these enterprises to the next level by offering additional next-stage or "patient" capital. The expectation has been that local financial institutions would finance the subset of enterprises that require this level of capital once E+Co got them off the ground. However, this expectation has not come to fruition, and E+Co has acknowledged losing out on a tremendous opportunity to continue to earn a return on businesses where it has already risked capital. Christine Eibs Singer explained:

Our expectations that certain financing vehicles would be put in place did not happen. Therefore, we have realized we have to look to creating our own sources of second-stage growth capital for our entrepreneurs. This will enable our enterprises to have success, and it also will enable E+Co to get on a firmer financial footing because we then will be able to realize the returns from those enterprises we have seeded.

Although continuing to invest in already established enterprises is a critical component of both scaling up and addressing E+Co's own sustainability, there also has been a realization that to reach the number and scale of investments the company hopes to accomplish, there must be mechanisms for standardization. With 10 years of global experience and having reviewed approximately 700 to 800 business plans, E+Co is in a position to capitalize on its universal base of knowledge to streamline the processes of both finding entrepreneurs and also making new investments.

Although there are considerable opportunities to standardize E+Co investments for replication on a global basis, it is the local customization that makes their enterprises successful. One failure of the traditional multilateral development approach has been to supplant models in multiple countries based on a formulaic strategy. The results from this strategy often have been disappointing because each country has a unique set of political, economic, and cultural norms, which might or might not coincide with the project objectives. However, by working with and assisting multiple businesses in each local context, E+Co can offer advice and strategies to its entrepreneurs to help them achieve solutions that have the highest potential for sustainability.

In this, the local partners and the regional investment officers play a critical role. Yet investing so widely requires a lot of people for investments that are relatively small and require substantial amounts of time per investment. Eibs Singer and Cunningham both pointed out that E+Co has been influenced by what the aid agencies and foundations have been willing to fund to date. But with two years of funding ahead of them, and an extensive and wide range of experiences, perhaps the time is right for the firm to build depth on top of its breadth.

E+Co is at a crossroads, balancing between being a traditional nonprofit organization and an international private equity investment firm. Transitioning to making larger and more investments to scale up its impact will take a combination of the appropriate sources of capital, talent, and effective global management. This strategy must be one that allows for growth at the local, regional, and global levels. LaRocco summarized the challenge:

> *We have to be able to offer growth capital and growth services, so that when the entrepreneur—Tecnosol—is ready to grow, they don't spend three-quarters of their time scurrying around for small amounts of capital; they spend three-quarters of their time doing what they are supposed to do, which is to offer improved goods and services to their customers. So our growth strategy as E+Co is a growth strategy for E+Co, the Tecnosols of the world and all the men and women who will buy goods and services from the Tecnosols of the world.*

Conclusion

Companies selling and installing solar PVs, wind, microhydro, and biomass power systems to unelectrified regions of developing countries are providing a lower cost, cleaner, and faster way to deliver energy compared to traditional approaches. The historical perception of the energy problem as a development issue has been altered by a new approach that emphasizes local entrepreneurship in meeting the energy needs of underdeveloped communities. E+Co has effectively demonstrated that business models, technologies, and willingness to pay are not the limitations in meeting this energy need. The main challenge is bringing the necessary investment to scale up currently profitable enterprises and to build new businesses in unserved markets. This new paradigm emphasizes market forces, sustainable business, and replication over technology demonstration, donor gifts, and individual projects.

Addressing the energy problem at the bottom of the pyramid involves elements relevant to both developing and developed countries:

- Sustainable development
- Clean and distributed energy technologies

- Local knowledge and global reach
- Private enterprise with supporting policies
- Investment (public and private) to reach scale

A new energy future is being sculpted in both developing and industrialized countries reflecting these themes. This future entails energy being generated from renewable sources and delivered close to the site where it will be consumed. Although technologies that are allowing this transition to take place have been largely formulated in the north, developing country entrepreneurs are playing a leading role in their dissemination. The results from this phenomenon could significantly impact the way the energy sector evolves. Through both economies of scale in manufacturing and an approach that emphasizes locally managed and controlled energy delivery, the success of energy enterprises using RETs at the bottom of the pyramid might prove to be the most important innovation in the energy sector for years to come.

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Endnotes

1. Or 111,953 to 177,894 Terawatt hours.
2. In one case, related by a government official in Latin America, a very poor area was given access to the electricity grid via a subsidized program organized by an out-of-country multilateral institution and implemented through the country's utility. When the utility's rate collector began showing up, people in the area had no cash, so they sold off their livestock (chickens, etc.) one by one to pay for the electricity. When the chickens were gone, many people chose to entirely abandon their electrified homes because they could not pay what the utility demanded for the ongoing cost of generation.
3. In 1999 the Commonwealth Development Corporation was transformed into a public–private partnership and renamed the CDC Group. It invests in several industries, including power.
4. SEAF was initially chartered to aid in the provision of capital in former Soviet Bloc countries. It later grew to include funds in Latin America and southeast Asia as well and, like E+Co, is now poised for further growth as one of the premier small and medium enterprise investors in emerging markets around the globe.
5. The triple bottom line: financial, social, and environmental performance.
6. According to Steve Cunningham, to stay as close to true market behavior as possible, pricing of these rates is based on typical private equity management fees prevailing at the time the funds are placed under management.
7. This customer also was aware that the use of kerosene candles could have adverse long-term health effects and was pleased to not be using them any further.
8. Soluz also sells systems on a cash-sales retail basis.
9. In the ESD program, there is a subsidy of $100 per solar home system installed. The program ended in 2002 and is being followed by an additional program called the Renewable Energy for Rural Economic Development Program, which provides an additional $133 million in financing for energy enterprises.
10. The authors were told anecdotal stories about how the costs of due diligence sometimes exceeded the size of the potential investment multiple times over.
11. Nonelectricity: 200 million people in 40 million households at $100 per household ($4 billion); off-grid electricity: 300 million people in 60 million households at 140 watts per household and $10 per watt ($84 billion); grid electricity: 300 million people in 60 million households at 400 watts per household and $800 per kW ($19 billion). *Source:* E+Co Business Plan, April 2003.
12. 4,000 nonelectricity enterprises, such as stove manufacturers, each with 10,000 customers; 12,000 off-grid electricity energy service companies, each with 5,000 customers; and 500 on-grid project developers, each with 50 MW capacity implemented during the 10-year time horizon. *Source:* E+Co Business Plan, April 2003.

13. Seed capital and services averaging $210,000 for each of the 16,500 enterprises, of which 25 percent also will be supplied $100,000 in growth capital. *Source:* E+Co Business Plan, April 2003.
14. The IRR calculations exclude E+Co's operating and EDS costs. However, E+Co covers a large portion of these costs through contract revenues and grants and not through the proceeds of its investments. The calculations also do not include management fees or write-offs.
15. This data was published in a number of online and printed journals and periodicals in late 2002 and early 2003, including *Private Equity Week*.

This report was written by Scott Baron and George Weinmann under the supervision of Professor C. K. Prahalad. The report is intended to be a catalyst for discussion and is not intended to illustrate effective or ineffective strategies.