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Economic Outcomes for Colorado Companies

A Survey of Colorado SBIR Award Winners

In May 2002, the CU Business Advancement Center completed a survey of Colorado SBIR/STTR award winners as part of the Colorado Federal and State Technology (FAST) program. The survey was designed to determine the extent to which SBIR/STTR research is creating jobs and wealth in Colorado, and to identify ways to assist Colorado companies to successfully commercialize research results. Of the approximately 270 firms contacted, 82 companies completed the survey, a 30.3% response rate.

As might be expected, most Colorado companies with SBIR/STTR grants are small in size and annual sales. Forty-two percent of the companies responding to the survey had fewer than four employees and less than 9% of the firms had more than 25 employees. Almost half of the responding firms expected to make less than $1 million in sales over the next year.

Still, 65% of responding firms have experienced increased sales revenues as a direct result of the SBIR/STTR research. The companies indicated that SBIR/STTR research generated sales revenues from both new and improved products, processes, and services. About 81% of the SBIR/STTR award winners benefited from a new product, process, or service and 76.8% used the research to improve their products or services. It is estimated that SBIR/STTR research by these 82 responding firms alone resulted in the following economic benefits: 415 new products, processes, or services; 360 improved products, processes, or services; 96 patents received; 164 patent applications filed; 165 license agreements; 360 new research jobs added; 260 new nonresearch jobs added; and 11 spin-off companies .

About 61% of the firms received additional research funding from non-SBIR/STTR sources; however, companies were less successful in obtaining additional financing for commercial efforts. Only 15% of the companies indicated an increase in capital received, and half of those received less than $500,000. The companies indicated the top factor needed to commercialize their SBIR/STTR research is funding after Phase II, followed by finding strategic partners, developing a business strategic plan, finding people to license their technology, and developing a marketing plan.

Only 26 of the 270 Colorado award winners, and 7 of responding firms are located outside Front Range counties. According to the companies surveyed, the most important factors in deciding where the company is located are the quality of life, availability of technical labor force, access to high-speed Internet, proximity to research facility, and the cost of doing business. The majority of companies indicated they plan to stay where they are currently located or move within 10 miles of their current location.

Companies conducting research in environmental or software areas were given the opportunity to express their level of interest in the services offered by the FAST program. Sixteen percent of respondents were interested in exploring rural Colorado as a business location and 20% were interested in assistance to locate a rural partner or licensee. As expected, the most popular service was introduction to investors, followed by participation in an industry SBIR roundtable and partnering forums in local communities. About 30% were interested in direct commercialization services.

A copy of the full report is available on the CU Business Advancement Center Web site at <www.colorado.edu/cubac> under "Reports and Studies."

From the editor . . .

This issue features research conducted by the BRD in the CU-Business Advancement Center that examines the impact of various areas of technology in Colorado. For additional information about this research, contact our offices. Look for our next issue that will highlight the 2003 Colorado Business Economic Outlook Forum.

Richard L. Wobbekind

Vietnam Urban Environmental Management Exchange Project

Colorado environmental businesses are discovering economic opportunity in Vietnam through the Vietnam Urban Environmental Management Exchange Project. Hanoi, Ho Chi Minh City, and other rapidly growing urban areas in Vietnam are facing major environmental problems with water contamination, air pollution, industrial discharges, municipal wastes, and urban decay. Outdated and poorly maintained equipment in industrial plants and leaded gasoline used in transportation have both significantly contributed to pollution. With a population of around 79 million and a predicted population of 100 million by 2020, the Vietnamese government appears to be aware of its challenging task to harmonize rapid economic development with a healthy environment and sustainable natural resources.

Colorado is addressing these needs as part of a long-term economic development strategy to help small environmental companies participate in international markets by building personal business relationships with key contacts in the region. A unique partnership between the University of Colorado Business Advancement Center and the Colorado Environmental Business Alliance (CEBA) is matching state environmental technologies and expertise to Asian interests under a grant awarded by the Council of State Governments (CSG) State Environmental Initiative Program.

Project emphasis has been on strategies for planning and infrastructure development that will prevent or reduce future pollution, and reduce other environmental consequences of urban growth. Vietnamese leaders have been introduced to a variety of cleaner development solutions offered by Colorado companies, including renewable energy, energy efficiency, municipal water purification, ground-water management, solid waste, nonpoint source pollution prevention, advanced vehicle technology, urban growth planning, industrial pollution reduction and control strategies, ISO-9000/ 14000, and sustainability practices.

The 15-month project has involved academia, government, and business participants from Colorado, Malaysia, and Vietnam in a program to explore strategies for planning and infrastructure development that prevent or reduce future pollution and environmental consequences of urban growth and industrial development. Partner organizations focused on two traditional production villages near Hanoi that produce wood furniture and woodcarvings. The greatest source of pollution in these villages is solvents applied in paints and finishes on the traditional wood pieces. Colorado small businesses with technical expertise in areas of energy, solid waste, water, community sustainability, and wood furniture cleaner production have intimately participated in the project, developing long-term relationships, joint ventures, and strategic partners for future business opportunities.

Although a significant source of Vietnam's gross national product (GNP), the Hanoi government and Peoples Committee have been seriously looking at traditional production villages as significant and historically overlooked sources of pollution. Most production equipment in these villages is at least 40 to 50 years old. Addressing pollution becomes even more critical as the government seeks to increase GNP and family income through increased production of exportable products.

Lien Ha Village, meaning Lotus River, is a typical production village in northeastern Hanoi. The main occupations in Lien Ha are agriculture (cattle and fish production) and the traditional handicrafts of wood engraving, textiles, and embroidery. Handicrafts compose 73% of its economy. Indeed, half the population in this commune work in the woodcraft occupation. For the past 5 to 10 years, its wood resources have primarily come from Cambodia and Laos.

A significant component of the wood-crafting process is painting and lacquering of the finished product. This industry raises a number of environmental issues regarding water and air quality, solvent use and storage, sawdust proliferation, and energy efficiency. Since much of the production is traditionally home-based, it also wrestles with worker and family health and safety issues from poor ventilation and exposure to toxic and hazardous substances.

The project partners have assisted the villages with recognizing and addressing health and safety issues resulting from the production process. The project team accomplished the following steps toward cleaner production in Lien Ha and Van Ha:

- Retrofit two paint spray booths with proper ventilation and filtering systems;
- Establish relationships with nontoxic solvent vendors in the United States and Asia;
- Provide new spray paint guns and training in the proper use of equipment;
- Introduce design specifications for new exhaust designs and air filtration systems for planned industrial parks;
- Initiate a composting area to turn wood wastes into a useful commodity;
- Train and lay a foundation to develop lotus pond conservation techniques to revitalize their historical, cultural, and ecological significance

for potential use as a measurement of water quality, as a fresh-water storage pond to provide alternative sources of increasing rural livelihoods, and as a marketing symbol for village products;

- Initiate an epidemiological health study;
- Provide data on water and air quality and contaminants; and
- Provide access to strategic technical expertise in air, water, energy, solid waste, community sustainability, occupational health and safety, and community health issues.

In addition, the project exposed Vietnam partner organizations to best practices and new technologies appropriate to their larger urban environmental challenges. Since partners represent leaders in industrial and environmental organizations, their knowledge is expected to impact policy and practice in Hanoi and Vietnam into the future. For example:

- Partners were introduced to electric and hybrid-electric vehicle technology as one possible solution to the air quality problems from vehicle exhaust in Hanoi City.
- Sustainable development concepts were presented both formally and through a visit to a community in Golden, Colorado, that is based on sustainable concepts. Furthermore, sustainable concepts were used throughout work-group planning activities specific to identifying appropriate short- and long-term strategies to address problems and opportunities at the village level.
- Clean energy technologies are important to Vietnam for meeting the increased energy demands required for industrial development, while maintaining and improving air quality. Biomass-to-energy and biomass-to-ethanol technologies are appropriate to use with village wood waste, as well as Vietnam's agricultural and green waste. In addition, wind technology has been identified in Vietnam's Renewable Energy Plan as the most effective way to bring electricity to rural mountainous communities not connected to the grid. The partners learned about the most current research and application of these technologies through formal presentations by Colorado companies, as well as on-site visits to the National Renewable Energy Laboratory and to working biomass production facilities.
- Partners were encouraged to advocate the addition of toxic chemicals prevalent in wood finishes to a list of controlled or prohibited imports, and to require labeling in Vietnamese on containers of hazardous materials imported into the country.
- Many areas of North Vietnam are experiencing growth and change involving new construction of commercial and residential buildings. Partners were exposed to the idea of using natural and green building materials, some of which could be manufactured in Vietnam from sawdust, rice hulls, and other fibers. They visited a model residence showcasing many natural and "green" materials in building, insulation, carpet, and interior furnishings.
- Vietnam partners were introduced to the environmental concerns and experience of Malaysian partners who are active in ASEAN. They heard presentations from Malaysian partners on environmental policy and on lotus pond conservation. A Vietnam project partner has already tapped into Malaysian expertise in hazardous solid-waste management and hazardous waste incineration.

Project success is best indicated by evidence that partner activities will continue past the funded project timeline. Based on project-developed strategies, Hanoi Institute for Socio-Economic Development Studies (HISEDS) was able to obtain a small grant to implement some of the group recommendations. These funded activities will support training, waste collection, and separation in the villages in the near future. Project partners have identified many aspects of pollution prevention and environmental protection in the production villages that will require additional funding. Pursuit of financing to support future activities is of interest to the project partners. Interest in continuing established partnerships has been verified through a signed memorandum of agreement between HISEDS and CEBA. In addition, a Colorado company has made a long-term commitment to trade in Vietnam by opening a Hanoi office.

Participating Colorado businesses include AMB Environmental; Resource Recovery; 2MS, Inc.; All American Energy; Peter Engel and Associates; and Partnership Architecture.

In addition to environmental companies, the project has drawn on the Colorado expertise of the Denver Mayor's Office of Economic Development and International Trade, the Colorado Office of Economic Development and International Trade, the Rocky Mountain Institute, the Colorado Renewable Energy Society, the University of Denver, the Colorado Department of Public Health and Environment, and the Sustainable Futures Society.

The CU Business Advancement Center at the University of Colorado at Boulder <www.colorado.edu/cubac> (CU-BAC) served as project administrator. CU-BAC supports technology-based

continued on page 6

CU Represented on StEPP Foundation Board

Funded Projects to Benefit Communities and Environmental Industry

Increasing the number of energy efficiency, renewable energy, and pollution prevention projects in Colorado that benefit communities harmed by environmental violations is part of the mission of the nonprofit Strategic Environmental Project Pipeline (StEPP) Foundation. A new program, working in cooperation with the Colorado Department of Public Health and Environment, aims to do just that.

The StEPP Foundation, based in Golden, brings together government and the businesses responsible for environmental violations. Agreements are forged that direct portions of enforcement settlements at positive environmental outcomes for affected communities through projects overseen by the foundation.

Karen Eye, director of the CU Business Advancement Center at CU-Boulder serves on the foundation's board of directors, which includes representatives from environmental organizations, companies, and professional services. She believes that the work of the foundation will have a positive impact on the Colorado environmental industry.

"In addition to benefiting communities, these renewable energy, energy efficiency and pollution prevention projects also create markets for environmental businesses," Eye notes. "While public or nonprofit entities will usually receive the funding, they will contract with environmental companies for products and services necessary to implement the projects."

In the short term, the StEPP Foundation will match projects to communities where funding currently is available. However, in the long term, the foundation is creating a database that will help to match proposed environmental projects with businesses and funding sources across the country.

"Through the work of the StEPP Foundation, appropriate community-based projects are identified and can be best-matched to potential funders for review and selection," said Ellen Drew, the foundation's executive director. "Once a project is selected for funding, the StEPP Foundation then handles project oversight and review on behalf of the parties involved."

Over the past few months, the StEPP Foundation has worked with the Colorado Department of Public Health and Environment on a community grants program that will fund identified environmental projects in communities that include northeast Denver, Weld County, and Pueblo County. StEPP held workshops in each community to outline criteria for the projects and encourage submittal of appropriate projects. Proposals are submitted through an online system that collects strategic information so that a review panel can make decisions on the environmental return on investment, and the capability of the proposed implementation team to produce a successful outcome that will maximize community benefits.

During November, StEPP subcommittees reviewed the proposals submitted for these three communities and will make preliminary recommendations to the StEPP board of directors for final funding decisions in the near future.

As a result of a recent CDPHE negotiated settlement, StEPP will issue a new RFP to solicit proposals for projects in Mesa, Rio Blanco, or Garfield Counties. This RFP will apply to individuals, small businesses, nonprofit organizations, and governmental agencies. Funds are earmarked for projects that include alternative energy, pollution prevention, and other environmental projects. The RFP and specific criteria will be available on the StEPP Foundation Web site.

The StEPP Foundation simplifies the process of identifying and managing projects for state and federal agencies by identifying best-match scenarios, collecting information, and keeping track of project progress for up to three years on behalf of the agencies.

"The StEPP Foundation will greatly reduce our burden once a settlement has been reached with a business that includes a requirement for an environmental project," said Doug Benevento, director of environmental programs for the Colorado Department of Public Health and Environment. "The foundation really takes the ball and runs with it. Project oversight is something that has challenged our resources, and to have the assistance of a nonprofit group is truly a benefit to affected communities in Colorado."

For the past several years, the Colorado Department of Public Health and Environment and other regulators often have negotiated settlements that include requirements for environmental projects to benefit affected Colorado communities. A portion of financial penalties agreed upon can be targeted at funding such projects, thereby benefiting the communities harmed by the violations.

"These kinds of innovative projects and approaches to enforcement are an important tool for state regulators that are supported by both businesses and communities," Colorado House Majority Leader Lola Spradley, R-Pueblo, said. "Other states are catching on to what we are doing here in Colorado, and have begun to pursue agreements that are more satisfying

continued on page 6

Colorado Photonics Industry Analysis

In a research project supported by the Colorado Photonics Industry Association (CPIA), the Business Research Division and the CU Business Advancement Center recently released the *2002-2003 Colorado Photonics Directory*. This brief write-up highlights some of the key points from the research conducted for the CPIA.

In 2002, the Colorado photonics cluster consisted of 241 organizations. Based on NAICS classification, almost 83% of the companies are directly involved as manufacturers or in research and development. About 50% of the organizations produce end products, while about 20% produce components.

The products and services of Colorado photonics organizations were classified into 24 categories. As has been the case in past studies, research and development is the service most frequently provided by the organizations. Other areas of concentration include optical components, lasers, and optoelectronic devices. Compared to previous research, it appears that the industry has more depth in terms of products and services offered.

Similarly, the company products and services were categorized into the industries that might use them. Because photonics technology is a core technology, in many cases a company's products will have use in a number of industries. As in the past, the top application for Colorado products and services continues to be aerospace. Other major areas of application include military/defense equipment, medical equipment, telecommunications, optical coatings, electronics, cameras, electronic imaging, and laboratory research.

Since the publication of the last directory in 2001, the industry appears to have become more geographically diverse. Photonics companies are now found in 38 cities and 16 counties. The cities with the greatest concentration of companies are Boulder (30.7%), Longmont (12.0%), and Colorado Springs (10.8%). The counties with the greatest concentration of companies are Boulder (48.5%), El Paso (12.5%), Denver (7.9%), Larimer (6.6%), Adams (5.8%), and Arapahoe (5.9%).

The 241 organizations in the directory have an estimated total level of employment of 37,200. This represents 1.7% of the state's 2002 estimated workforce. It is projected that 11.3%, or 4,225 employees working at these companies, are required to have some knowledge or use of photonics. The photonics workforce is based primarily in manufacturing as about 78% of the employees work in this sector.

Thirteen of the 150 manufacturers were classified as large employers, with sales greater than $100 million or more than 1,000 employees in Colorado. The remaining 137 manufacturers have combined sales of $1.3 billion.

An analysis of employee wages using ES-202 data suggests that the average wage for workers in the photonics industry is $59,249, compared to an estimated average state wage of $39,365. Wages paid to photonics workers are estimated to be 50.5% greater than the average state wages. Estimated 2002 total wages paid to all employees of companies identified in this directory are 2.8% of projected 2002 state wages, or $86.6 billion. Estimated 2002 wages paid to the 4,225 employees who must have knowledge of photonics or who use photonics are $246.8 million. It is estimated that the companies that are part of the photonics industry employed 37,200 workers in 2002.

Colorado has a well-developed photonics industry cluster that consists of four complementary groups of organizations—industry, education/training, federal laboratories, and business support.

Industry—Many of these companies offer products that are sold worldwide. Although the cluster has some large companies, it also has a significant number of small firms. In fact, companies with fewer than 10 employees make up 43% of the total.

Education/Training—More than 55 professors at the state's four major research universities have research groups that are focused on some aspect of optics and photonics. In addition, Front Range Community College offers an AA degree program in photonics and vacuum technologies.

Federal Laboratories—Colorado is home to four federal laboratories that have significant photonics activities in their research programs, including the National Institute of Standards and Technology in Boulder, the National Renewable Energy Laboratory in Golden, the National Center for Atmospheric Research in Boulder, and the National Oceanic and Atmospheric Administration in Boulder.

Business Support—A variety of economic development agencies, law firms, and other business support organizations with a focus on the photonics industry are included in the cluster. The Colorado Advanced Photonics Technology (CAPT) Center is a unique prototyping and training facility specially designed to meet the needs of small, developing companies. The Colorado Photonics Industry Association (CPIA) offers a wide array of services to support and promote the Colorado photonics

continued on page 6

COLORADO BUSINESS REVIEW

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Vietnam, *continued from page 3*

business and economic development in the state. CEBA provided project direction and coordination <www.ceba.org>. The organization serves the environmental industry with educational programs, international trade opportunities, and market development activities.

The project was funded through the State Environmental Initiative program, administered by Council of State Government's State Trends and Research Group for the United States-Asia Environmental Partnership <www.sei-asia.org>. The US-AEP partnership, sponsored by the United States Agency for International Development, mobilizes U.S. environmental experience, technology, and practice to promote the development and adoption of less polluting and more resource efficient products, processes and services in the Asia/Pacific region.

Funded Projects, *continued from page 4*

to both the communities affected by environmental violations and the parties responsible for the violation that would like to give back to those communities."

The StEPP Foundation has also signed a memorandum of understanding with the National Renewable Energy Laboratory that will directly offer technical expertise to support the quality of renewable energy and energy efficiency projects funded through the StEPP Foundation.

For more information on the StEPP Foundation, environmental projects, the application process, or other related matters, please visit the StEPP Foundation's Web site at <http://www.steppfoundation.org>.

Submitted by Karen Eye, director of CU-BAC, and Ellen Drew, executive director of the StEPP Foundation.

Photonics, *continued from page 5*

industry at local, national, and international levels.

The state has provided funding for a Center of Excellence at CU and CSU, $4.5 million in funding for the CAPT Center, and funding for Colorado Photonics Optics Program (CPOP), a program that has supported collaborative university/industry research in emerging Colorado companies. CPOP-supported research has assisted more than 40 Colorado companies. In addition to providing extended funding, the state has also provided short-term funding for marketing efforts of the CPIA.

Excerpted from the Colorado Photonics Industry 2002-2003: Directory of Companies and Organizations, with Colorado Industry Profile, *published by the CU Business Advancement Center and Business Research Division in the Leeds School of Business at CU-Boulder.*