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The Intersection of STEM Education and the Green Economy: Incorporating the Latino Community

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Abstract

This paper discusses the nexus of advanced Science, Technology, Engineering and Mathematics (STEM) education in the Latino community, and the corresponding attainment of high-tech employment in the green economy. It begins with an overview of the economic opportunities within the green economy, and the potential benefits to the Latino community in capturing employment and wealth building. The next section defines policy strategies and goals and provides an overview of challenges in STEM educational attainment. In the conclusion, policy recommendations and examples of successful programming that are currently assisting Latinos in attaining STEM education and high-tech employment in the green economy are outlined.

Latinos and the Green Economy

The green economy is a rapidly emerging, billion-dollar global market consisting of government and private sector investments in a range of industries that include: clean technologies, renewable energy, alternative fuels, water services, low-emission transportation, waste management, efficient buildings, land use, and sustainable agriculture and forests (United Nations Environmental Program). Along the backdrop of one of the most potent economic recession periods in generations, the green economy has been espoused as a beacon of hope and opportunity. The Obama Administration and the 111th Congress have identified the development of the green economy as a policy priority, as well as part of a national economic recovery and job creation strategy (Johnson 2010). Likewise, the market activity around the clean technology sector—which includes renewable energy and advanced biofuels and battery storage—has experienced substantial growth while most other sectors have seen significant decline (Makower et al., Clean Edge).

Latinos and other minority communities have a significant role to play in the development of the green economy, and stand to benefit from the job creation activities produced by it. It has been well documented that Latinos will benefit from participation in "green-collar jobs." (Pollin et al. 2009) Among the most highlighted have been opportunities for Latinos in the construction, agriculture, and blue-collar manufacturing fields–areas where many Latino workers currently have skills sets but are currently unemployed (Bureau of Labor and Statistics). As a result, emphasis has been placed on job training programs intended to reintroduce displaced workers to new or recalibrated industries with a focus on low to medium skilled jobs that are labor-intensive and have low barrier-to-entry positions. This integration of workers has been largely achieved by the funding of job-training and adult education programs through the national community college system, the non-profit sector, and statewide workforce investment agencies (Feldbaum et al. 2009).

While this paper recognizes the importance of a strategy to increase green-collar jobs in order to curb unemployment, promote working class mobility, and attain economic stabilization, such an approach falls short of including Latinos in the full potential of the green economy. Furthermore, such an incomplete strategy could be potentially harmful for the long-term development of human capital, as these jobs generally do not require an advanced degree. Also, while these jobs generally offer "family-supporting wages," (Green for All) they likely offer little opportunity for long-term upward mobility and wealth building.

An important facet of the green economy beyond green-collar jobs is directly linked to specialized Science, Technology, Engineering and Mathematics (STEM) fields. The green economy is a high tech economy, relying on the expansion of cutting edge technology and continued scientific advancement (Henton et al. 2008). In order to sustain the new high tech economy in a globally competitive market, the nation will require a ready corps of highly trained, highly skilled scientists and engineers that can perform the research

and development needed for innovation. Latinos can and should be included in this facet of the green economy as well as the more labor-intensive, green-collar jobs.

This paper recommends the following five policy strategies to increase Latino participation in the green economy through an increased focus on STEM disciplines:

1. *Support Non-profit and Non-Governmental Organizations (NGO's) in creating innovative mechanisms to supplement k–12 STEM curriculum and promote environmental/green issues.*
2. *Increase k–12 teacher recruitment and training in STEM education.*
3. *Support development of online/ distance learning modules and cyber capacity building for under-resourced schools.*
4. *Leverage new and existing policy to direct funding to Hispanic-Serving Institutions focused on STEM disciplines.*
5. *Support private sector efforts to target and recruit Latino workers in the STEM-focused green economy.*
6. *Increase funding and competitive grants to Latino/minority- focused STEM organizations, non-profits, and agencies.*

Goals of Latino inclusion in the STEM-focused Green Economy

The policy recommendations in this analysis are guided by three overarching goals that help frame benchmarks for success and pitfalls to be avoided. These three goals will help ensure an equitable inclusion of Latinos in the green economy, and avoid shortcomings of past economic periods:

1. Ensure that Latinos are not excluded in economic prosperity.

The economic waves of the past decades have netted substantial wealth to regional economies and individual communities, but have left minority communities out of the economic windfall (Collins et al. 1999). Examples such as the dot-com and information technology boom of the early 1990s, and the recently collapsed housing and financial services sectors, all disproportionately included fewer financial benefits and opportunities for minorities to build wealth—particularly Latinos and African Americans (May 2002). Efforts to promote Latino participation in all facets of the green economy will help ensure that they are not excluded from the resulting prosperity.

2. Ensure that Latinos are not relegated to labor-only job functions.

In addition to being excluded from the major economic booms of the recent decades, Latino communities are also overrepresented in labor-intensive jobs that offer lower compensation and few, if any, opportunities for advancement. Much of the current literature on "green-collar jobs" focuses on low-skill, entry-level work that does not require previous experience or education. Many of these jobs are accessible to men and women who face barriers to higher-level employment — including low levels of educational attainment, low English skills, previous incarceration records, and disabilities (Pinderhughes 2007).

However, Latinos must also participate in other facets of the green economy, particularly those that require advanced STEM degrees to diversify their skills base, and attain employment opportunities that offer higher wages and greater ability for wealth building and upward mobility.

3. Ensure that the United States remains competitive by educating its youngest and fastest growing population group.

A third goal of increasing national importance is the imperative to retain U.S. competitiveness in the development of new commercial technology. As cited earlier, technology and innovation will drive the new high tech green economy, and competition will be on a global scale. Rising nations such as China and India are making substantial investment in research and capacity building related to the green economy, and will challenge the United States' economic and technological advantage in this sector (Friedman 2009).

Concurrently, US census projections report the rapid growth of the Latino population, which will consist of 25 percent of the total workforce in the next decade (Bureau of Labor and Statistics). The Hispanic population boom is projected to yield more than 20 million Latino youth between the ages of 5 and 17 by the year 2050 (Chapa and De La Rosa 2006; Dowd et. al. 2009). If this population is not well educated, the outlook for all sectors of the workforce, and consequently, the U.S. competitive advantage over other nations, will continue to decline (Trager 2010). As the future workforce of this country, it is imperative that Latino workers be well-educated.

In order for the US to retain its competitive advantage in the economic and technology race, and increase Latino participation in the green economy, strategic efforts to educate and train Latinos—the nations' fastest growing demographic—in the STEM fields must be implemented.

STEM disciplines that will drive the Green Economy

Advances in the science and technology fields allow for economic growth due to the development of goods, services and jobs (Stine and Matthews 2009; Schacht). The US has long stood as the key developer of advanced technologies that are dependent, in large part, upon the creative talent and innovation of a highly educated and trained workforce in STEM disciplines. Maintaining the U.S.'s global competitive edge in the technology and innovation sectors is dependent on educational development and training.

The following STEM disciplines are crucial to the development of the green economy. While not exhaustive, they are a sample of the vast array of functions within the green economy that can be achieved with advanced training in a variety of STEM fields.

STEM Focus	Green Sector
Electrical Engineering	Renewable Energy Smart Grid Technology Energy Efficiency
Automotive/ Transportation Engineering	Fuel Efficiency Emissions Reduction Mass Transit
Civil/Structural Engineering	Building Efficiency Sustainable Materials Coastal/Habitat Protection
Chemistry/Biology	Alternative/Bio fuels Eco-Friendly Products Water Treatment Carbon Capture & Storage
Computer Science	Smart Grid Programming and Security

Challenges in advancing Latino participation in STEM

Currently, the Latino community is significantly underrepresented in STEM careers (5 percent), compared to non-Hispanic Whites (77 percent) (U.S. Census Bureau). This disparity directly correlates to a gap in STEM educational attainment among Latinos. A study conducted by the National Science Foundation (2006) determined that of the more than 400,000 bachelor degrees awarded in the science and engineering disciplines, seven percent were awarded to Latino students, while 65 percent were earned by white, non-Hispanic students. The same study noted that only about four percent of master's degrees and four percent of doctorates in the STEM fields were earned by Latinos (National Science Foundation). The following section provides a brief overview of the challenges in advancing Latinos' participation in and completion of a STEM education.

Challenges in k–12 education

Inadequate educational institutions and poorly trained educators are two major challenges in k–12 and STEM education. It has been determined that 66 percent of all school districts, and over 90 percent of high minority-serving districts had great difficulty recruiting qualified math or science instructors (U.S. Congress 2006; Taningco et. al. 2008). Because of this shortage in quality faculty, the U.S. Department of Education determined that 45 percent of high school students in biology/life sciences and 30 percent in math are receiving instruction from faculty that do not hold a major or minor in the subject areas taught (Department of Education statistic, 2004).

In addition, a low percentage of the qualified instructors serve in schools with a high number of minority youth (Taningco et. al. 2008). This lack of teacher knowledge and enthusiasm for the subject, in turn, blunts the potential interest by minority youth in STEM courses. Studies show academic preparedness in high school is positively correlated with student selection of, and persistence in, the STEM fields at the postsecondary education levels (Cole and Espinoza 2008). Studies also indicate that having a well-trained instructor is key in preventing students from dropping out of STEM, or switching to a non-STEM discipline (Tan 2002; Taningco et. al. 2008).

Challenges in higher education and the university setting

While low academic preparation contributes to the diminished interest of Latinos in the STEM disciplines, there are other factors that inhibit this population from transitioning to higher education training in STEM. Increasing costs as well as limited institutional capacity have been cited as serious challenges to Latino success in higher education (Santiago 2009). In addition, Latino students are more likely than other students to be the first person in their family to pursue higher education, which may limit the students' knowledge of college options and may lead to additional burdens on the students. More concerted efforts to support and retain Latino students in the STEM educational pipeline are needed.

Unfortunately, the higher education system appears to be structured in ways that limit the success of Latino college students. For example, Latinos received, on average, the lowest amount of financial assistance of any ethnic group (Santiago and Cunningham 2005; Santiago and Brown 2004). Even if Latino students are able to acquire the necessary financial assistance to pursue and persist in a higher education, many of them encounter feelings of isolation and alienation attributed to issues of cultural incongruity once inside the academic setting (Gloria and Rodriguez 2000). Additionally, although the number of Latinos enrolling in higher education has doubled over the past 20 years, this participation rate has not extended specifically into the STEM disciplines (Cole and Espinoza 2008).

Nevertheless, there are some programs that have been shown to be effective in retaining and graduating Latino students in the STEM fields. Some of these programs make themselves available to first-generation students to assist in the transition to higher education, and serve as a source of information on funding, mentoring and tutoring as well as providing advice on future career and research opportunities. This type of access to university-sponsored mentoring and tutoring programs is an important factor for Hispanic success in college. Additionally, the role of faculty support has been shown to play a significant role in satisfaction in the college experience as well as persistence to degree completion (Cole and Espinoza 2008; Gloria et. al. 2005; Hernandez 2000; Hernandez and Lopez 2004).

Finally, the need for students to observe faculty that are of similar background and experience as them (Jan 2006; Collins and Kritsonis 2006) positively impacts the success of students and serves as motivation to degree completion. Latino faculty, however, are not well-represented in colleges and universities. For example, in 2001, Hispanic faculty represented three percent of the nation's faculty (Snyder et. al. 2004), while Hispanic students represented eight percent of first year undergraduates at four-year institutions (NSF 2004; Stine and Matthews 2009). Diversifying the professoriate, therefore, also serves to enhance the educational experiences of Latino students.

Policy Recommendations

The following policy recommendations are based upon the assessment of challenges and opportunities related to creating a sufficient pipeline of Latinos into STEM fields.

Support Non-profit and NGO's in creating innovative mechanisms to supplement k–12 STEM curriculum and promote environmental/ green issues.

As noted in the previous sections, numerous barriers exist in creating a sufficient pipeline of college-bound k–12 graduates into STEM disciplines — including lack of funding and lab resources, inadequate faculty, insufficient class time, and lack of student academic preparation. With many urban schools—where Latinos are over-represented- stretched tightly for resources and staff, it is not likely that focus and resources will be directed at STEM activities, much less towards specialized curriculum relating to the environment and the green economy. Due to this constraint, non-profit organizations and NGO's can serve as effective vehicles in promoting and supplementing a k–12 STEM education curriculum. The specialized nature of these organizations makes them well suited to creating innovative learning mechanisms that could relieve pressure on schools, engage Latino students, and expand STEM resources to k–12 students.

Several non-profit organizations are already engaged in these kinds of activities. For example, the Infrastructure Academy, a Los Angeles-based organization serving predominately Latino inner-city youth, has created an environmental technology curriculum program to supplement high school science classes and which will be accredited to fulfill the University of California "A-G" (college-ready) academic requirements. This program also incorporates leadership development, job training and employment programs to further strengthen the pipeline of Latino youth into STEM careers. As another example, the NCLR *Escalera* Program promotes economic mobility for Latino youth through increasing educational attainment, career planning, and access to information about advanced STEM careers. This model has been used to launch two pilot programs that serve high school students living in rural areas who are disconnected from education and employment opportunities.

Organizations like these have benefitted from participation in competitive grant programs put forward by the federal government, most recently through the American Recovery and Reinvestment Act (ARRA) of 2009. These grants provided funding based upon an organization's ability to develop innovative programs that would train k–12 students in "green jobs" through related curriculum and activities. Many of these grants also required funds be leveraged with state, local, or private sector funding – encouraging programs to be fiscally solvent beyond the life of the grant. Federal policy priorities should include a continuation of competitive grant programs, along with funding for pilot projects providing innovative STEM education.

Increase k–12 teacher recruitment and training in STEM education

As previously noted, the majority of the current STEM k–12 educators lack the training necessary to teach in the STEM disciplines. This deprives students of an engaging, thoughtful lesson from the instructor in these disciplines and may ultimately limit their interest in these professions.

Typically, university students who excel in the STEM fields continue to graduate school or industry and rarely pursue a career teaching k–12 education. Thus, it is necessary to provide incentives to enter the STEM education field for those who may not be initially interested in becoming an educator. Some constructive incentives would include loan forgiveness, scholarships, and other means to encourage talented students in STEM to transition to a STEM teaching career. Our youth deserve to be trained by educators that are enthusiastic and passionate about the subjects they teach. Providing incentives to talented future educators allows for the development of a better trained student body that can pursue and fill STEM workforce positions.

The STEM disciplines are constantly changing due to rapid technological advancements; therefore, greater efforts to build relationships between k–12 educators and innovators in the private and public sectors should be encouraged. The Obama administration, in conjunction with the Department of Education, recently launched the National Lab Day campaign, which encourages scientists in academia to bring their research to the k–12 classroom. Individuals developing technology in the private sector should also be encouraged to participate in this movement. Exposing youth to cutting edge science in the classroom allows the student to witness what a STEM career is all about. Moreover, targeting these programs to minority serving k–12 schools would allow for the students in the classroom to receive instructorship from experts in the fields. This relationship would also benefit the STEM teacher in his/her instruction in the classroom.

Support development of online/distance learning modules and cyber capacity building for under-resourced schools.

Technology in the classroom has proven to be both a tremendous asset when available and properly deployed (Klopfer 2009). Technology in classrooms can be especially important to schools that are located in low-income urban and rural areas with insufficient funding and resources – schools where minority populations are likely to attend. As noted earlier, these classrooms are not likely to have sophisticated lab

equipment or adequately trained teachers. A potential equalizer for under-resourced schools is the use of online learning models to supplement STEM curriculum and provide remote scientific laboratory learning experiences.

The Massachusetts Institute of Technology (MIT) is currently developing such online STEM laboratory modules. These *iLabs*, are "real laboratories accessed through the Internet – that can enrich science and engineering education by greatly expanding the range of experiments that students are exposed to in the course of their education," (iLabs). Available for scientific experimentation in a range of STEM disciplines, remote laboratories can help alleviate the financial and geographical disadvantages of under-resourced schools. Strategies to spur the use and development of iLabs can include increased funding, partnership agreements, and incentives for private sector to equip cyber capacity in school.

Leverage new and existing policy to direct funding to Hispanic-Serving Institutions focused on STEM disciplines.

Hispanic Serving Institutions (HSIs) are defined by federal law as accredited degree-granting public or private higher education institutions with a total undergraduate Hispanic full-time equivalent enrollment of at least 25 percent (Santiago, 2009). As of 2007, 265 institutions in 16 states met this definition (Santiago, 2009); though the number is expected to continue to increase as the Latino population continues to grow. Although these institutions compose only eight percent of postsecondary institutions, 54 percent of Latino undergraduate students attend these institutions (Santiago, 2006) and 30 percent receive their baccalaureate degrees in science and engineering from these institutions. Thus, HSIs play a crucial role in training the future Latino STEM workforce. In March 2009, Congress recognized the important function of HSIs in training a diverse workforce and authorized the National Science Foundation (NSF) to establish a program to award competitive grants to improve STEM education (ARRA, 2009).

HSIs thus play an integral role in STEM degree production, though significant strides must continue to be met in order to produce a highly competent, diverse and innovative workforce. With the continued expansion of the Hispanic population and the growth of current HSIs, as well as the emergence of emerging HSI institutions, sufficient grant funding to meet this continued growth should be recognized and funded by Congress and institutions such as the National Science Foundation.

Support private sector efforts to target and recruit Latino workers in the STEM-focused green economy.

The private sector is a critical component of the successful development of the green economy — providing research and development investment, product development, marketing, job-training, and employment. Private firms will be effective vehicles for targeting Latino communities for employee recruitment and educational support in the form of scholarships, internships/fellowships, and research grants.

Examples of such private sector programs currently exist in the investor-owned utilities sector. It has been recognized that 40 percent of electric and water utility employees will be eligible for retirement in the next decade — spurring a strong movement toward increased marketing and recruitment of high-skilled employees with STEM specializations (APPA, 2005). For example, the investor-owned utility company Southern California Edison (SCE) currently has programming in place to support STEM and environmental education in the k–12, community college, and the university system. These programs range from environmental and energy education programming in the k–8 system, to summer job programs for high school youth, and scholarships and internships for college students. While these programs are not Latino-specific, they target low-income and underserved communities, of which Latinos are well represented.

Private sector efforts to invest in STEM education can be bolstered by federal support, including subsidies in the form of tax credits and competitive grants. While many private sector programs are independently funded, additional support can help spur increased programming and incentive for smaller private firms. These private sector activities will directly link STEM students to careers in energy generation and environmental protection – and offer many Latino students opportunities to gainful employment.

Increase funding and competitive grants to Latino/minority focused STEM organizations, non-profits, and agencies.

A significant barrier for students in STEM fields is a lack of peer support and feelings of isolation within the discipline. Because of the sparse number of Latinos in STEM disciplines, national networks that connect students with other peers, industry, and professionals in the field would be highly effective.

Several specialized scientific organizations such as the Society for the Advancement of Chicanos and Native Americans (SACNAS), the Mexican American Engineering Society (MAES) and the Society for Hispanic Professional Engineers (SHPE) have a long history of conducting research on the barriers of higher educational attainment for Latinos and have effectively developed support systems to address these issues. Efforts include affiliated student organizations on individual campuses, along with quarterly regional meetings, and yearly nationwide conferences. During these conferences, students are exposed to professionals in the field, along with industry recruiters, social networking, professional development, and motivational speakers.

Based on the successful track record of these organizations and the current demands to address the needs of the Hispanic population, increase support from the public and private sectors for these organizations is merited. Because these organizations are privately funded, they are subject to periods of economic recession. Competitive grant funding opportunities for these societies should be developed to yield programming to support the development and training of Latino students in the STEM fields.

Conclusion

As the United States moves forward with strategies for economic recovery, growth, and sustained prosperity, it is imperative to strengthen its human capital. Increased human capital, represented by a well educated and highly-skilled workforce, will help facilitate innovation and development of new products and services to compete in global market sectors.

One such market sector, the green economy, is experiencing substantial current and long-term projected growth, reinforced from both public sector policies and private sector investment. Many opportunities for employment will become available to participants in the green economy, from "green-collar" workers who install solar panels and assemble wind turbines, to scientists and engineers who develop them. The latter mentioned roles within the green economy (scientists and engineers) will be more specialized, and thus offer higher pay and opportunities for wealth building. These positions will require the attainment of advanced degrees and training in Science, Technology, Engineering, and Math (STEM).

The United States has long enjoyed a significant competitive advantage in the development of new commercial technologies, and the required human capital to sustain such developments. However, rising global economies will continue to challenge this competitive advantage by investing in their own technological advancement. The development of the green economy and the global competitive advantage of the United States depend, in large part, on the development of human capital in the STEM fields.

Concurrently, the Latino population is the fastest growing demographic group in the United States. As this sector of the population continues to grow, it will represent a greater share of the potential workforce, and thus a greater potential for workforce development. A major challenge faced by the Latino community is insufficient academic preparation. Latinos have the highest high school dropout rate among youth 16-24 (Child Trends Databank, 2004). Because of this lack of academic preparation, Latinos are not represented in high tech, high-paying jobs — and disproportionately overrepresented in lower-paying, labor-intensive jobs.

The Latino community represents a large sector of untapped human capital, who could realize greater economic potential on both micro (individual/community) and macro (national) levels. As a critical mass of the future United States workforce, it is imperative that the skills of the Latino community be well developed. Latinos must be prepared to enter a diverse array of job functions in the future economy, including those that require an advanced STEM degree.

The policy recommendations outlined in this paper are groundwork strategies to increase Latino participation in STEM fields. They will help ensure equitable representation of Latinos in the green economy, as well as strengthen the competitive advantage of the United States in this global market sector. It is in the best interest of the United States that Latinos be well educated in STEM fields, in order to realize the full economic potential of their participation in the green economy.

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