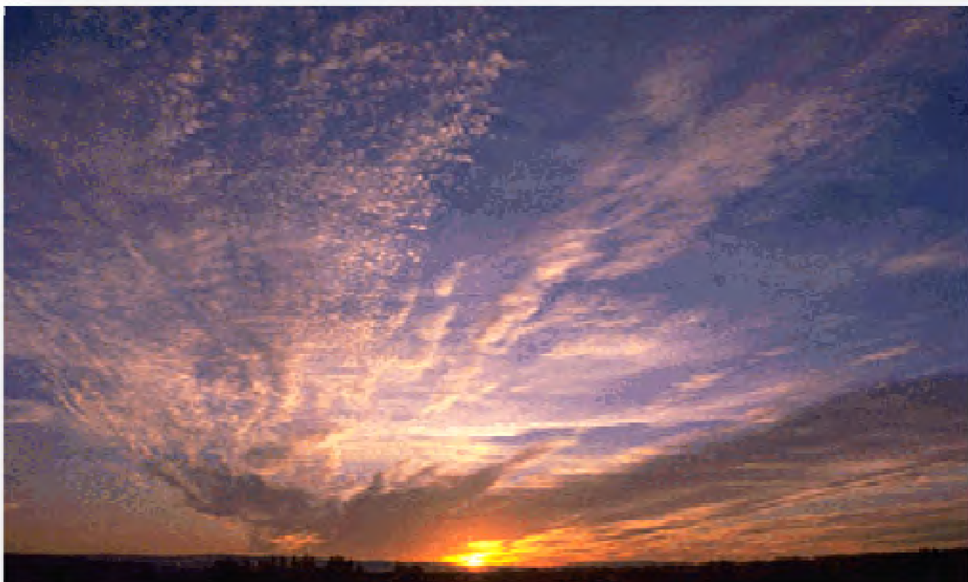
Hawaii Innovation Indicators

Hawaii Innovation Initiative



Department of Business, Economic Development and Tourism

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INTRODUCTION

Hawaii is embarked on a long-term quest to transform and diversify its economic base to be less dependent on just two or three major industries. As we have learned over the years and are reminded of with the current economic slowdown, it is vital that we have a range of economic activity on which to rely and to help us create high-paying, high-skilled jobs for the future.

Hawaii's strategy for transformation and diversification includes developing our capacity to support innovative economic activity, helping to develop innovative businesses in the technology and creative sectors, and encouraging the dispersion of high skills and technology throughout the economy. This is an ambitious agenda that encompasses a multitude of efforts in education, workforce development, infrastructure revitalization, and facilitation of innovation sector growth.

To ensure that this effort is effective we must be able to measure our progress in each of the phases of transformation. The set of innovation indicators presented in this report is meant to serve as that measurement tool. It provides pivotal metrics that will tell us how well our innovation capacity is developing, how this capacity is translating into an innovation sector, and how this capacity and the development of the innovation economy is raising our overall productivity, competitiveness and standard of living.

The indicators, compiled and analyzed by DBEDT's Research and Economic Analysis Division, draw from among the best models for such measurements nationwide, as well as past efforts in Hawaii. They will allow us to continually monitor our progress in economic transformation and provide insight into what efforts are most effective.

DBEDT wishes to thank the many individuals and agencies that helped review the indicators presented here and their very helpful comments and suggestions for improvement. Hopefully, these will provide government and the private sector with the essential measurement tools to guide our efforts and shared goal of a prosperous and globally competitive Hawaii economy.

Theodore E. Liu

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I. Executive Summary

What is Innovation?

Innovation is the process whereby new ideas and new approaches are conceived and introduced into the economy, resulting in new or substantially improved products and services. The concept of innovation as a driver of economic activity has been rooted in economic growth theory for several decades. Research has shown that most economic growth in the U.S. has been the result of the application of technology and innovation to the economy.

Economic Transformation through Innovation

Hawaii faces a number of challenges if it is to compete effectively in the more global and technology-driven economy of the 21st century. The State's ability to maintain a prosperous economy and to preserve its quality of life depends on transforming the economy through innovation to compete in the new global economy. Innovation promotes economic diversification by creating higher paying jobs in knowledge intensive firms. But it is not just new industries benefit from innovation. Traditional and even sunsetting industries can increase their productivity and find new markets for their core competencies though innovation. The overall result of effective innovation is an increased standard of living and a more competitive economy.

Measuring & Tracking Innovation

The system of indicators presented in this report draws from many efforts to construct relevant measures of innovation progress in both Hawaii and across the nation. Through those efforts has emerged a view of how innovation works and how it might be measured. While the process has been explained and broken down in many ways, the innovation process can be seen as having three fundamental components that represent phases in a successful innovation process.

- First there must be capacity for innovation, which then leads to,
- A thriving innovation sector and supporting assets, prompting,
- Economic transformation and a strong, prosperous and sustainable economy.

The important feature of this innovation process is that the components are sequential. That is, before a prosperous efficient and sustainable economy can emerge, there must be a well-developed and thriving innovation sector to drive that overall prosperity. But to have that thriving innovation sector, there first must be the capacity to develop a highly skilled workforce and generate the ideas, research and development such a sector needs.

Summary of Indicators

The indicators presented in this report have been structured under these three components of the innovation process. The table below provides a snapshot of the indicators. Both the current performance level and current trend for each indicator are represented. Green symbols mean that the performance level exceeds the national benchmark or that the recent trend is positive. Red symbols are used for performance below the national level or if the most recent trend data show deterioration. Amber symbols indicate performance near the national benchmark or a flat recent trend. The analysis section for each indicator should be consulted for more complete interpretation of current status and trends.

Summary of Indicators

INDICATOR	Hawaii	U.S.	Performance[1] (compared with nation)	Latest Trend[1] (improving or worsening)
Capacity for Innovation				
Education				
H.S. grad. rate (2005)	75.10%	74.70%	0	↑
H.S. dropout rate (2005)	4.70%	3.90%	–	↑
College Readiness (2008, Ave. SAT score)	987	1017	–	↓
College going rate of H.S. grads (2004)	51.60%	55.70%	–	↑
Freshman retention 4 yr colleges (2004)	72.2%	76.5%	–	↑
Freshman retention 2 yr colleges (2002)	45.0%	54.8%	–	↑
Percent of High school graduates ultimately earning a:				
4 yr college degree (2005)	43.10%	52.10%	–	↓
2 yr college degree (2005)	26.30%	24.10%	+	↓
Entrepreneur training* (2006)	0.35%	na	na	↑
Education attainment -% coll. degrees (2006)	39.20%	34.38%	+	↑
Research & Development				
R&D spending in public sector- $ per $1000 GDP (2004)	$7.14	$7.06	+	↑
R&D spending in private sector- $ per $1000 GDP (2004)	$2.61	$17.26	–	↓
Patents issued per 1,000 workers (2007)	0.13	0.61	–	↓
Capital Availability				
Venture capital investments per $1,000 GDP (2007)	$0.08	$2.18	–	↓
Innovation Research Grants per $1,000 GDP (2004)	$0.29	$0.17	+	↑
Tech Transfer Grants per $1,000 GDP (2004)	$0.024	$0.018	+	↑
Workforce Development				
% College 2006 degrees in Sci & Tech	18.3%	na	na	↑
Rapid Response Custom Training	na	na	na	na
Life-long learning -% of 25-44 yr olds. (2004)	6.70%	6.50%	+	↔
Worker recruitment H-1B Visas per 1,000 workers (2006)	1.84	2.85	–	↑
Worker recruitment: Ex-Kama`aina	na	na	na	na
Infrastructure				
Connectivity – Megabits per second download speed (2008)	1.7	2.4	-	-

INDICATOR (continued)	Hawaii	U.S.	Performance[1] (compared with nation)	Latest Trend[1] (improving or worsening)
Innovation Sector & Support Assets				
Technology sector				
% jobs in tech sector (2007)	2.8%	4.8%	−	↔
% Growth in tech jobs (2002-2007)	17.9%	31.5%	−	↑
% jobs in R&D (2007)	0.4%	0.4%	−	↑
% growth in R&D jobs (2002-2007)	41.1%	34.0%	+	↑
Creative sector				
% jobs in creative sector	2.3%	2.2%	+	↑
Highly Trained Technical Workforce				
% of workforce in STEM occupations (2007)	7.2%	8.4%	−	↓
Average earnings in STEM occupations (2006)	$49,195	$60,614	−	↓
Technology Diffusion				
STEM occupations in non Tech Industry (2007)	5.7%	5.9%	−	↑
Entrepreneurial Activity				
Startup companies per 1,000 workers (2006)	5.9%	3.9%	+	↓
Economic Transformation				
Growth & Efficiency				
Technology Contribution to Growth (2001-2006)	42.9%	56.3%	−	↔
Labor productivity - real GDP per worker (2006)	$77,917	$78,180	0	↑
Diversification				
Diversification -% alignment with U.S. (2006)	87.3%	na	na	↑
Global Integration -merch exports per $1,000 GDP (2006)	$4.68	$78.60	−	↑
High Wage Jobs				
Jobs above $50K (2006)	18.1%	18.3%	0	↓
Median Income				
Median family Income (2006)	$70,277	$58,526	+	↑
Median household income (2006)	$61,160	$48,451	+	↑
Energy Efficiency				
Energy efficiency - mil. BTUs used per $1,000 GDP (2007)	7.1	8.8	+	↑

[1] +: above nation. −: below nation. 0: same as nation. ↑: improving. ↓: worsening. ↔: **no change.**

*Percent of class registrations in entrepreneurial program classes, Kapiolani CC.

Conclusions:

Capacity for technology and innovation: Hawaii is not yet meeting national standards for most indicators. An important challenge is better preparing graduates for two- and four year colleges. Hawaii also trails the nation in getting high school graduates into college and keeping them there long enough to get their degrees or certificates. Investment in research and development has risen to the national level in the public sector but trails far behind in the private sector. Capital availability is also a challenge. Venture capital investments appear to be miniscule in Hawaii compared to investments nationally. However, with State help, very small firms in Hawaii are doing a better job of securing capital in the SBIR and

STTR grant programs. In workforce development, Hawaii is behind in turning out graduates in science and math. Hawaii is doing a little better than the nation in getting working adults back into post secondary training, but the rate is less than 7 percent. Hawaii is behind in attracting skilled workers from abroad, and there is no measure at this time reflecting efforts to attract skilled, former residents (Kama`aina) back to Hawaii.

Innovation Sector and Support Assets: Hawaii is behind national levels for most indicators. The overall technology sector in Hawaii is understandably smaller relative to the nation, since Hawaii is not a competitive place for mass manufacturing. Still, there has been little increase in the proportion of this sector in the economy over the last five years. However, within the technology sector, there has been marked growth in the proportion of research and development activity over the last five years, paralleling similar increases at the national level. Creative industry employment is a bright spot in the innovation sector, with a proportion of total jobs well over the national level. However, Hawaii's lead over the nation in this area has been slipping in the last three years. Hawaii is behind the nation in the proportion of high skilled (STEM) occupations and the pay levels for those jobs. There are indications that theses gaps are narrowing. Small business startups continue to exceed the national rate, probably driven by Hawaii's stronger economy in recent years.

Economic Transformation: The picture is mixed in terms of performance compared to the nation, but most trends are positive. The estimated contribution to economic growth through technology and innovation has been about 43 percent so far this decade, somewhat lower than the 56 percent nationally. Labor productivity has slipped from well above national levels to about the national average in 2006. Diversification of the economy has shown improvement over the last several years. Global integration measured by exports is low compared to the nation and has shown little long-term growth during the current business cycle as a proportion of the economy. Of course, globalization is more than exports of goods, and efforts are underway to develop both qualitative and other quantitative measures of this concept. The proportion of workers earning over $50,000 (inflation adjusted) in the state has declined recently from above the national level to about matching that level. This is possibly the result of inflation increasing faster than wages. Median household and family income are higher than the respective U.S. medians. Recent inflation has not dampened that differential. However, this metric must be interpreted carefully because of the structural cost-of-living difference between Hawaii and the national average. This cost-of-living differential tends to make higher income levels less reliable as an indicator of standard of living. Finally, Hawaii is more energy efficient than the nation as a whole, but the nation is clearly catching up, while Hawaii has not been improving.

II. Innovation and Hawaii's Economy

What is Innovation?

Innovation has become the mantra of U.S. economic development in recent years. Nearly all states, as well as the Federal government, have been focusing on understanding the innovation process and how it can be harnessed for economic prosperity. The U.S. Department of Commerce is currently engaged in an intensive effort to establish data sharing among the multitude of Federal statistical programs to better measure innovation at the national and state levels.

However, the concept of innovation as a driver of economic activity is not new. It is a concept that has been rooted in economic growth theory for several decades. Until the mid 1900's economists viewed economic growth as mainly a matter of adding more capital and labor in optimum proportions to the economy. Adding more capital was seen as the major driver of productivity. But better ways of measuring economic growth in the latter half of the 20th century showed that increases in capital and labor alone explained only about half of economic growth taking place in the U.S. The balance of growth appeared to be due to the application of technical change to improve the entire production process. This technical change also included better education and improved skills on the part of the workforce. What generates that technical change is the innovation process.

From a functional standpoint, innovation is the process whereby new ideas and new approaches are conceived and introduced into the economy. These can range from improved technology, to more efficient ways to organize and manage production. However, the ultimate result is new or substantially improved products and services. Innovation links people, knowledge, and natural assets to create and transform ideas, and inventions into new processes, products and services.

Economic Transformation through Innovation

Hawaii faces a number of challenges if it is to compete effectively in the more global and technology-driven economy of the 21st century. According to recent studies that have looked at the performance of Hawaii's economy, there are several, core problem areas that are of concern:

- Hawaii's economic growth currently depends heavily on filling thousands of modest-wage jobs in service industries. Attracting or keeping that workforce is made more difficult by Hawaii's relatively higher cost of living, particularly the cost of housing.
- Per capita income (inflation adjusted) in the state has been growing slower than the national average for several decades.
- In several important areas of the economy there are growing workforce shortages, including the visitor industry, teaching, health care, law enforcement and the technology sector to name a few. From 2004 to 2014 the economy is expected to create a demand for nearly 24,000 new workers per year including the replacement of retirees and others leaving the workforce. Compared with that demand, only about 12,000 to 14,000 Hawaii youth come of workforce age each year.
- The rapid aging of Hawaii's workforce will likely lead to accelerating retirements over the next several decades. This will not only contribute to the overall worker shortage but will also prompt younger workers to be moved into more responsible positions faster than in the past. This will make incumbent worker training to prepare these employees a more critical need.
- Roughly 60 percent of all openings during the 2004 to 2014 period will likely require some formal post-secondary education or training. About 24 percent of those opening will require completion of formal academic programs at the university or community college level.
- Hawaii has a fairly well-educated workforce overall compared to other states, but it currently has a lower percentage of its 9th graders making it through to post secondary education and college degrees than nationally. Hawaii is also one of the few states in which workforce entrants are less educated on average than the incumbent workforce.

On the other hand, Hawaii has assets that provide unique opportunities to compete in many niche and even mainstream markets. Hawaii's mid Pacific location, geology, ocean resources, climate and other strengths as well as a diverse population, provide a number of advantages for a range of economic activities. These range from alternate energy to being a center for Asia-Pacific commerce.

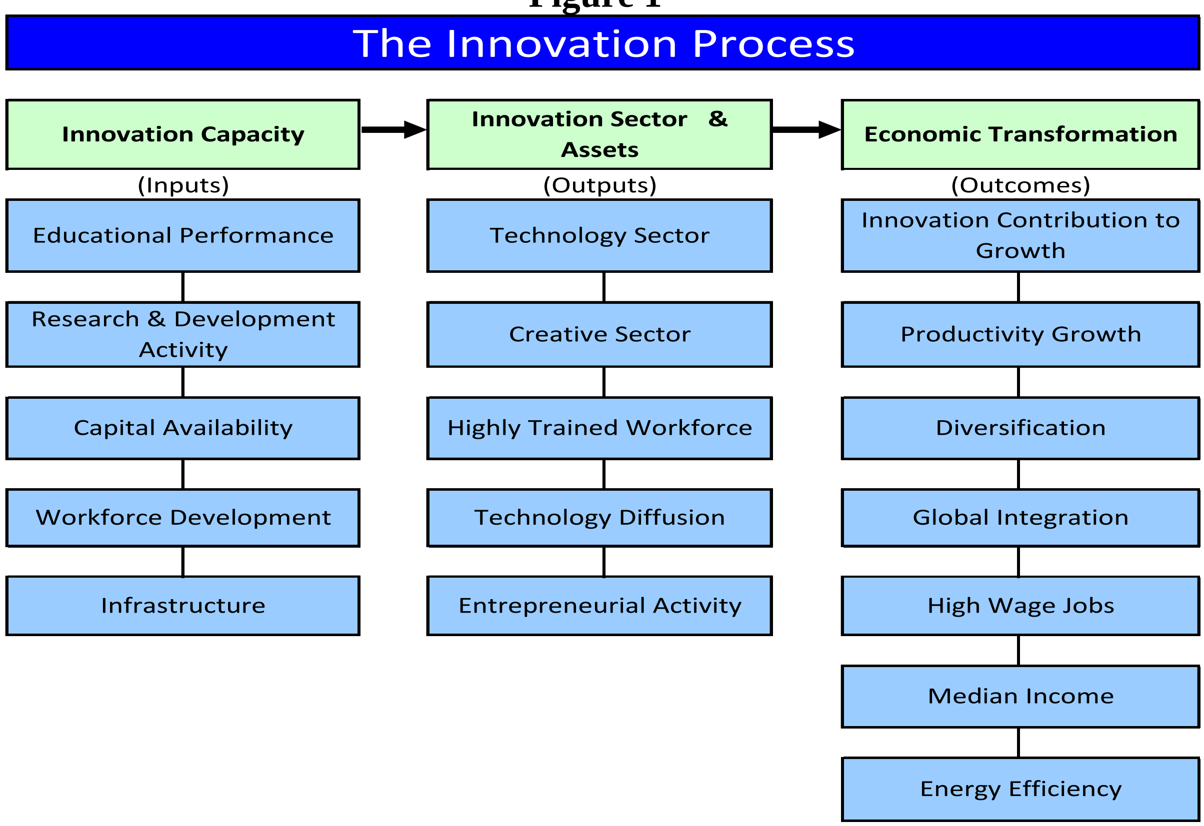
Hawaii's ability to take advantage of these assets, improve the competitiveness of its existing industry base and maintain a prosperous economy will require harnessing the power of innovation. Innovation can promote economic diversification by creating higher paying, knowledge intensive firms and jobs. Both new and existing industries benefit from innovation, which can help traditional and even sunsetting industries increase productivity and find new markets. Innovation can increase Hawaii's standard of living through steady growth in productivity. The result is a more competitive Hawaii in global export markets, and a Hawaii better able to substitute competitive local production for imports.

Measuring & Tracking Innovation

The system of indicators presented in this report draws from many efforts to construct relevant measures of innovation progress in both Hawaii and across the nation. Among the Hawaii efforts have been the Hawaii Pathways to Advancement project in 2005, sponsored by the National Governors Association (GA), reports by the Hawaii Institute for Public Affairs (HIPA) and work by such groups as Enterprise Honolulu, the economic development boards of Hawaii, Maui and Kauai Counties, the Hawaii 2050 Task Force, Hawaii Science and Technology Council, and the Workforce Development Council. National efforts include the New Economy Index published by the NGA, work by the Milken Institute, a number of state efforts, and work to identify an innovation framework by the U.S. Council on Competitiveness.

Through this body of work and effort has emerged a view of how innovation works and how it might be measured. While the process has been explained and broken down in many ways, innovation can be seen as having three fundamental components. Those components and their key elements are shown in Figure 1.

Figure 1



The first component is the ***capacity*** to innovate. This requires a well performing educational system that brings out the full educational potential of individuals, including the building of strong skills in **science, technology, engineering and math**, referred to as **STEM** skills. Basic capacity also includes well-supported research and development efforts, in the university system and in the private sector. Capital availability is a critical input if innovation is to be commercialized, as well as the development of workforce skills that can help translate innovation capacity into leading edge products and services. Finally, innovation capacity must include the infrastructure needed to support a digital economy.

The result or output of effective innovation capacity leads to the second component of the process – a thriving ***innovation sector and key support assets*** in the economy. This sector and support assets commercialize creativity. They consist of firms developing and applying various forms of creativity and technology, highly trained occupations and entrepreneurial activity. This component includes not only core technology development, but also the creative sector of the economy that fuses technology with arts and entertainment to produce such products as digital music, digital entertainment productions, animation and electronic games. Other key measures of this component include the proportion of high-skilled workers the economy and entrepreneurial startup activity.

The third component represents what we would expect to be the outcome of healthy innovation capacity and a thriving innovation sector. That outcome is *economic transformation*, resulting in a strong, prosperous and sustainable economy. Such an economy derives a high proportion of growth through the application of technology and innovation rather than simply adding more labor, or physical development. It has high productivity growth, increased trade and export activity, and an expanding global reach. It is also increasingly more efficient in the use of energy and most importantly, generates a rising level of household and family income based on a high proportion of jobs that pay a relatively high wages.

The indicators that follow have been structured under these three components of the innovation process. Effort has been made to select pivotal indicators along the continuum. For some of the indicators, data are not available to establish the metric at this time. However, because they relate to important underlying components of the innovation process, they are introduced with the expectation that data will become available in the future. For some components of the innovation process, better or more comprehensive indicators are needed and research is ongoing to locate those.

These indicators are not set in stone. As data sources change and new components are identified for measurement, the mix of indicators will also evolve. Likewise, indicators that do not appear to be adequately representing critical real-world elements of innovation will need to be replaced.

Most importantly, stakeholder review and input are an essential part of choosing, evaluating and adjusting indicators. DBEDT seeks continuous feedback on the structure and performance of the indicator set so that the best possible measures and data sources are used to track Hawaii's innovation process.

III. Innovation Indicators

A. CAPACITY FOR INNOVATION

These indicators track the basic ingredients that provide capacity for innovation. The first is a well performing educational system that can generate a strong human resource base for innovation. The second is a robust research and development component focused on marketable innovations. Third is adequate access to capital. Fourth is the workforce development task of delivering skilled workers to the economy through post-secondary education, attracting them from outside the state, or retraining incumbent workers to give them cutting edge skills. Fifth is the infrastructure to support Innovation sector development. Without these key ingredients it is very difficult to develop a sustainable commercial technology-innovation sector in the economy.

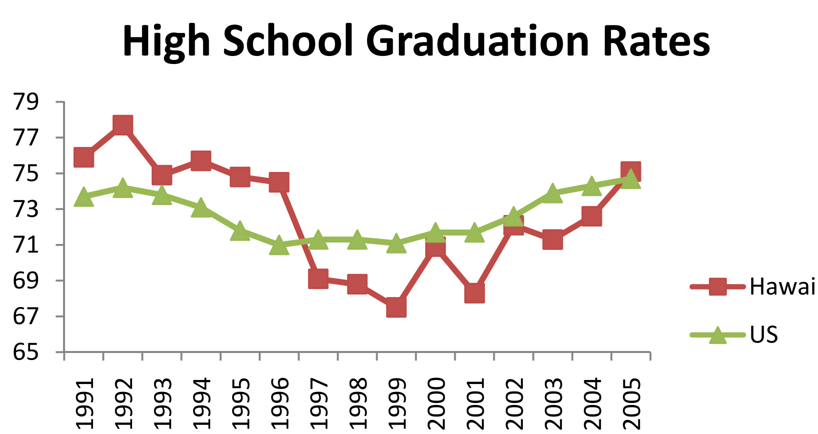
1. Education Attainment & Progress through the Educational Pipeline

All children in Hawaii must be given the opportunity and motivation to achieve their highest potential by adulthood. This means we must move them along the educational pipeline from kindergarten (or before) through post secondary education efficiently and lose as few as possible in that process. Further, there must be an emphasis on making sure that all high school students acquire strong STEM skills to provide them with the maximum program options at the post-secondary level, be that four year colleges, two year colleges or specialized training. Finally, having prepared them, it is clearly essential that as many students as possible actually start and complete a post secondary program so that that they are ready for specific, well-paying occupations in Hawaii's transforming economy.

Data for the following indicators are, for the most part, taken from reputable national compilation efforts for which there are national benchmarks for comparison. Some are subject to criticism for their limited methodology or data, but they are the best nationally benchmarked indicators available at this time. Additional indicators generated internally by the University of Hawaii and have been graciously provided for this report and appear in Appendix C. These indicators are limited to the University of Hawaii system and cannot be readily compared to national benchmarks. However, they have the advantage of providing targets for future performance.

High School Completion and College-Going

Public high school graduation rate:



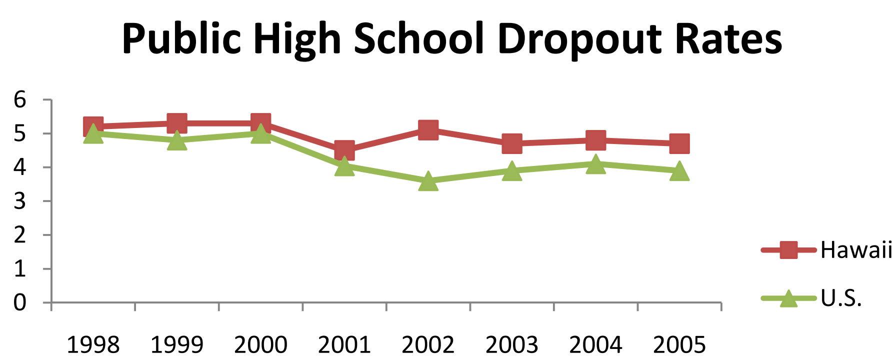
Source: U.S. Dept of Education, National Center for Education Statistics, 1998-2005.

What is this? The graduation rate is the percentage of students entering high school who go on to receive a high school diploma or equivalent four years later. Data are from the National Center for Education Statistics (NCES), which uses the **averaged freshman graduation rate** method to estimate the proportion of public high school freshmen who graduate with a regular diploma 4 years after starting 9th grade. The rate focuses on public high school students as opposed to all high school students or the general population and is designed to provide an estimate of on-time graduation from high school. Those who do not graduate within four years represent a combination of drop outs and students with insufficient credits to graduate on time. There has been considerable discussion in recent years about the proper way to measure graduation rates. The National Governors Association (NGA) has recommended a formula that many states including Hawaii are adopting. For Hawaii, the change to the NGA method will occur in 2010.

Why is it important? Successful graduation from high school is arguably the primary objective (although certainly not the only objective) of the elementary and secondary school system. Thus, it becomes an important overall performance measure for the public educational system as a whole.

How has Hawaii performed? For the latest data year (2005) Hawaii graduation rates are at about the U.S. average. This follows an eight-year period of below average graduation rates, before which Hawaii rates were above the U.S. average. While exhibiting more volatility, the Hawaii trend does appear to have tracked the national experience of falling rates in the 1990s and improving rates in the early 2000s. As indicated, Hawaii will convert to a formula for calculating graduation rates recommended by the NGA in 2010.

High School Dropout Rate:



Source: U.S. Dept of Education, National Center for Education Statistics, 1998-2005.

What is this? The public high school dropout rate reflects the percentage students who leave the school system before graduation. This measure is also from the National Center for Education Statistics and uses the **event dropout rate** method to estimate the percentage of high school students who left public high school between the beginning of one school year and the beginning of the next without earning a high school diploma or its equivalent such as a GED. The formula for computing the rate is explained in Appendix A along with the data on this indicator.

Why is it important? Regardless of the quality of education delivered by the school system, or absorbed by students, no learning or skills acquisition can take place if the child is not in school. This statistic indicates how successful we are at keeping students in the educational pipeline at the secondary school level.

How has Hawaii performed? Hawaii's dropout rate has been consistently above national rate and the gap has widened somewhat in the early 2000s.

Proportion & Performance of Students in High School STEM Programs:

What is this? Following the success of CISCO, construction and other academy programs in the high schools, the State is embarking on an effort to extend the concept to the disciplines of Science, Technology, Engineering and Math, or 'STEM' education. The proportion of students in these programs and their success compared with similar students not in the STEM academies will measure the effectiveness of the specialized programs.

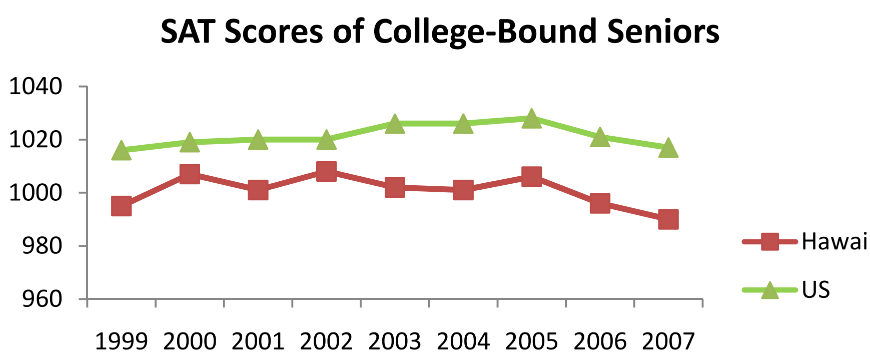
Why is it important? Research suggests that Hawaii's economic future depends on a workforce that is sufficiently skilled to permit development of a range of knowledge and technology intensive industries. Post secondary education and STEM skills in particular, are a basis for that highly trained workforce.

How has Hawaii performed? Because STEM programs are not yet widely available, there is not a current measure for this indicator at the secondary level. A project partially funded by the National Governors Association, as well as the Hawaii P-20 Partnership for Education, are working to develop such measures to be in place as these programs take root.

There is, however, an indication of the trend in STEM education at the post-secondary college level. Appendix C includes a chart showing recent and targeted graduations in STEM fields from the University of Hawaii System. After declining from 1997 to 2004, STEM field graduations began increasing. The goal for STEM field graduations is a 25% increase by 2015.

Improving STEM performance and college readiness at the secondary education level could be an important factor in the ability of the UH system to achieve this goal.

College Readiness:



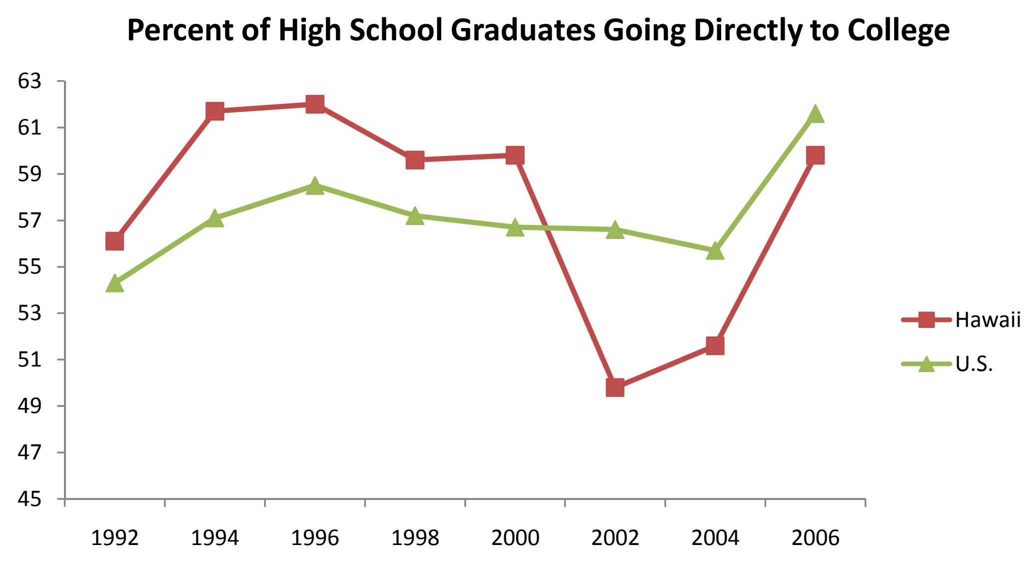
Source: The College Board, New York, NY, College-Bound Seniors, 1999-2007.

What is this? The SAT (Scholastic Aptitude Test) is a common national test for students in public, independent, and religiously affiliated high schools contemplating a four-year college program after graduation. The test includes verbal and mathematics sections. The State Education Data Center (SEDC) of the Council of Chief State School Officers reports a 61% participation rate among Hawaii high school senior test takers compared with 49% nationally.

Why is this important? This is a measure of how prepared high school students are to meet college standards for math and English. Core high school and college standards for math and English should be aligned so that most graduates can move in to first year college math and English without special remediation courses to bring them up to standard.

How has Hawaii performed? Hawaii scores are below U.S. scores. Part of the difference may be the percent of students taking the test in Hawaii compared to the nation as a whole. Nevertheless, Hawaii SAT scores appear to have shown no long-term improvement trend.

College going of high school graduates:



Source: National Center for Higher Education Management Systems, 1992-2006.

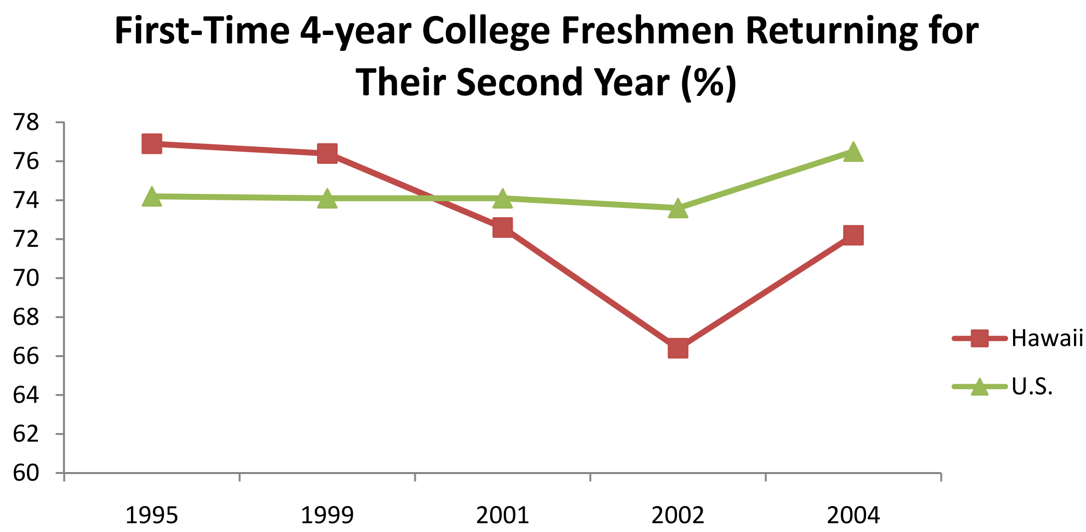
What is this? This is a measure of number of high school graduates entering a post secondary college program directly after graduation.

Why is this important? It is vitally important to the students and the economy that high school graduates enter post-secondary training. Post secondary training provides the skills to command self-sufficiency wages and the highly trained workforce needed to transition the economy to a 21st century knowledge based economy. This indicator reflects both the quality of students' high school education and the motivation they have received to pursue training beyond high school.

How has Hawaii performed? Hawaii performed better than the nation in this indicator in the 1990s but has fallen below the national average since 2000. Interestingly, both national and Hawaii trends appear to mirror respective economic conditions. College-going rates appear to be higher in poor economic climates and lower as the economy improves. The validity of this relationship warrants more research. But it suggests that a silver lining in economically difficult times might be more rapid accumulation of higher-skilled human capital. On the other hand more intensive efforts to channel high school graduates into post secondary education may be needed in prosperous times.

College Completion

Freshman retention rate:

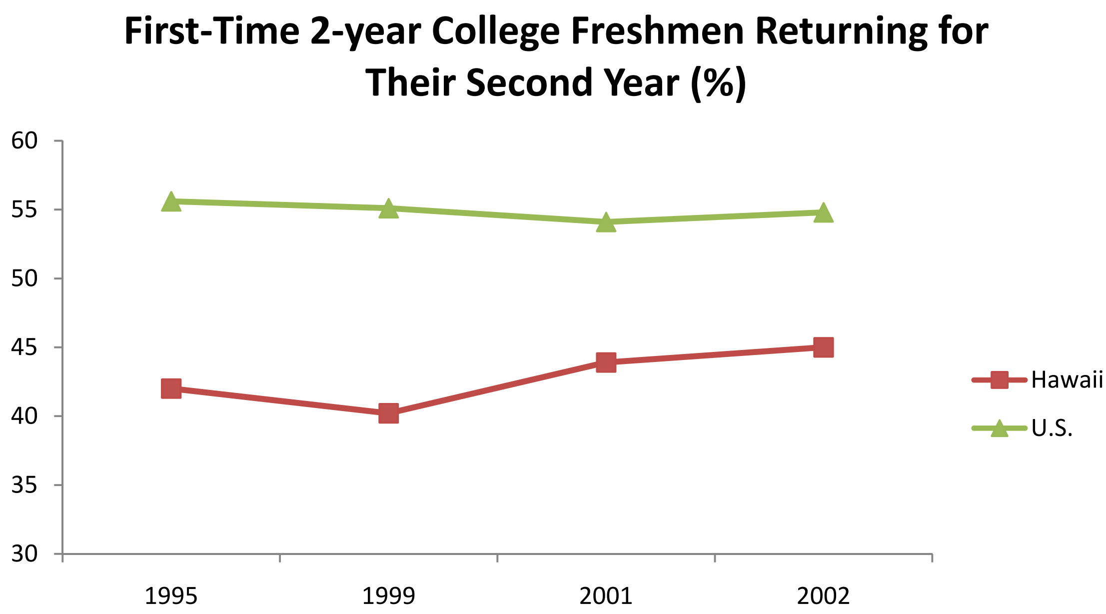


Source: National Center for Higher Education Management Systems, 1992-2004.

What is this? This is the percentage of first-year college students in four-year institutions who enroll for the second year of college

Why is it important? The highest loss of students from post secondary education is between the freshman and sophomore years. Reducing this loss is critical for developing a workforce that meets an innovation economy's need for high skills and to give labor force entrants opportunities for high wage jobs.

How has Hawaii performed? From above average return rates in the late 1990s, Hawaii 4-year college freshmen returning for a second year declined nearly 18 percentage points below the national average by 2002. That has since improved to about a five percent difference. As in the case of the college going rate, this may reflect some influence from a sharply improving economy in the Islands.



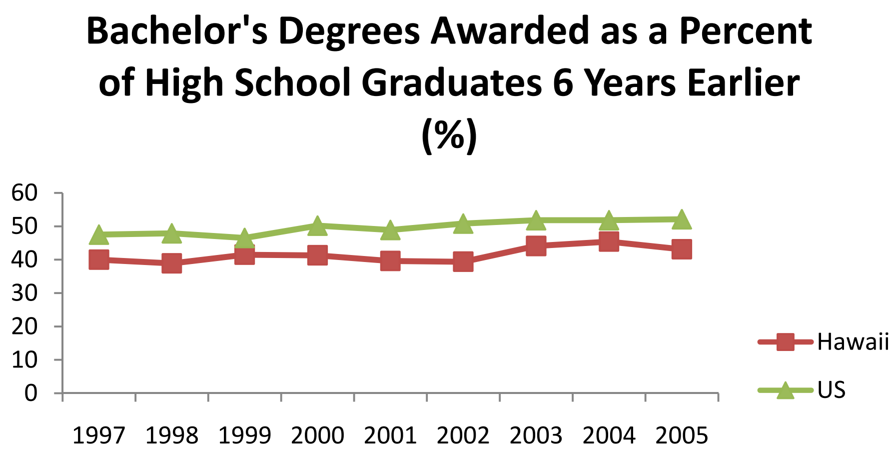
Source: National Center for Higher Education Management Systems, 1992-2004.

What is this? This is the percentage of first-year community colleges students who enroll for the second year of college.

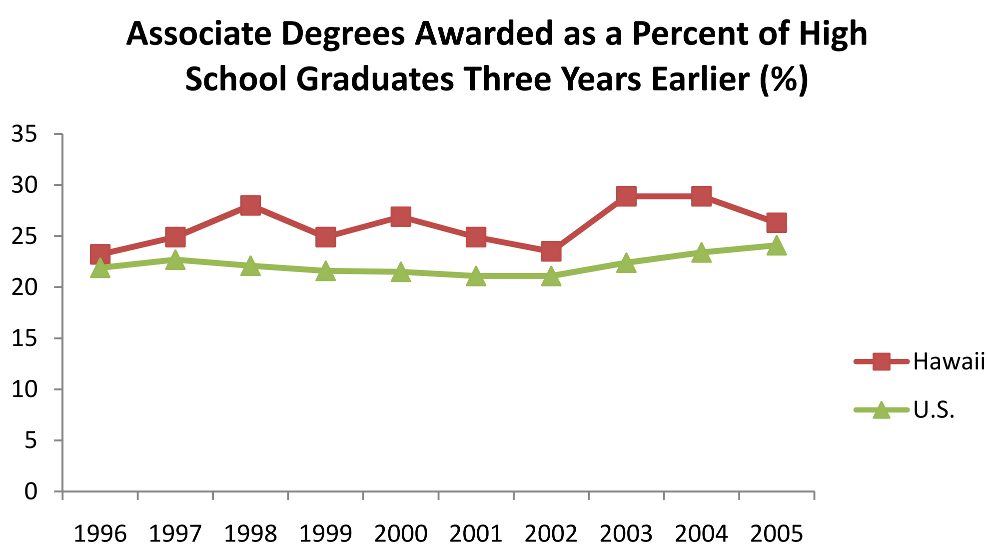
Why is it important? As in the case of four-year colleges, the highest loss of students from community colleges is between the freshman and sophomore years. Community colleges train the lion's share of technicians in the workforce in a wide range of fields. The higher the retention rate of these students, the more likely they are to graduate with important skills, maximize their lifetime earning potential and provide Hawaii with the high skilled talent workforce it needs.

How has Hawaii performed? Return rates for two-year college freshman in Hawaii have been ten to fifteen percentage points below national return rates since at least the mid 1990s. While there has been some improvement in recent years, the gap is still significant.

Bachelors & Associate Degrees Awarded:



Source: National Center for Higher Education Management Systems, 1992-2004.



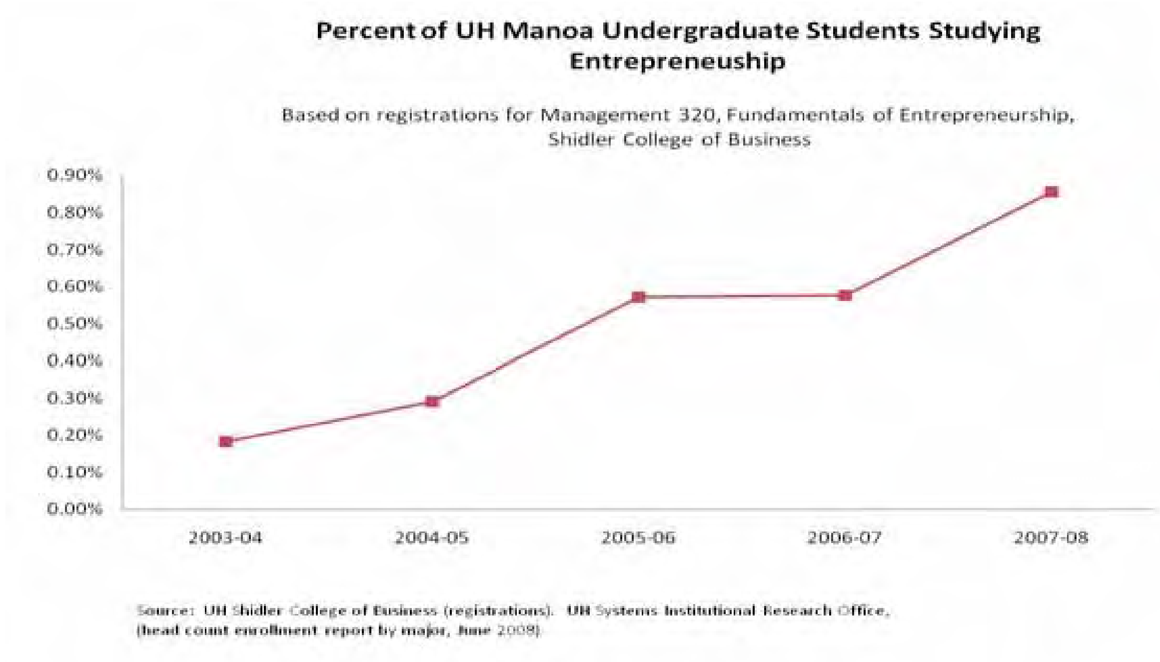
Source: National Center for Higher Education Management Systems, 1992-2004.

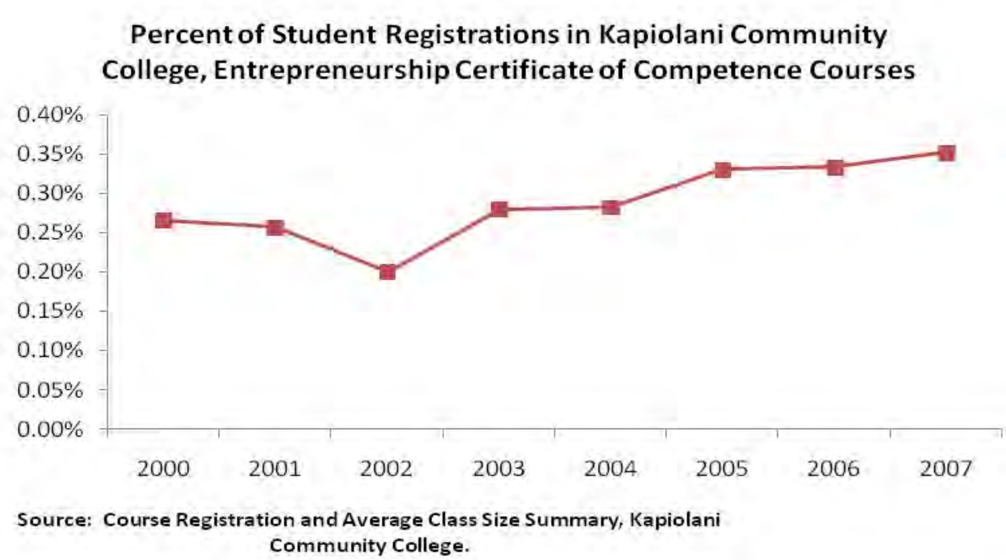
What is this? These indicators estimate the percentage of high school graduates who go on to earn a post-secondary college degree within a reasonable time. The bachelor's degrees awarded indicator estimates the percent of first-time, full-time students completing a bachelor's degree within 6 years of enrolling. The associate degrees awarded indicator estimate the percent of first-time, full-time students completing an associate's degree within 3 years of enrolling.

Why is it important? Earning a postsecondary degree is the culmination of hard work by students and efforts of the secondary and postsecondary systems to keep students on track for those degrees. Degrees mean higher earnings for these students and provide the economy with its most highly skilled workers. Poor performance in this final measure of educational success will negatively impact the effort to build an innovation-based economy.

How has Hawaii performed? Taken together, these two data sets suggest that relatively more high school graduates in Hawaii are opting for community college associate degrees than four-year baccalaureate degrees.

Entrepreneurial Training:





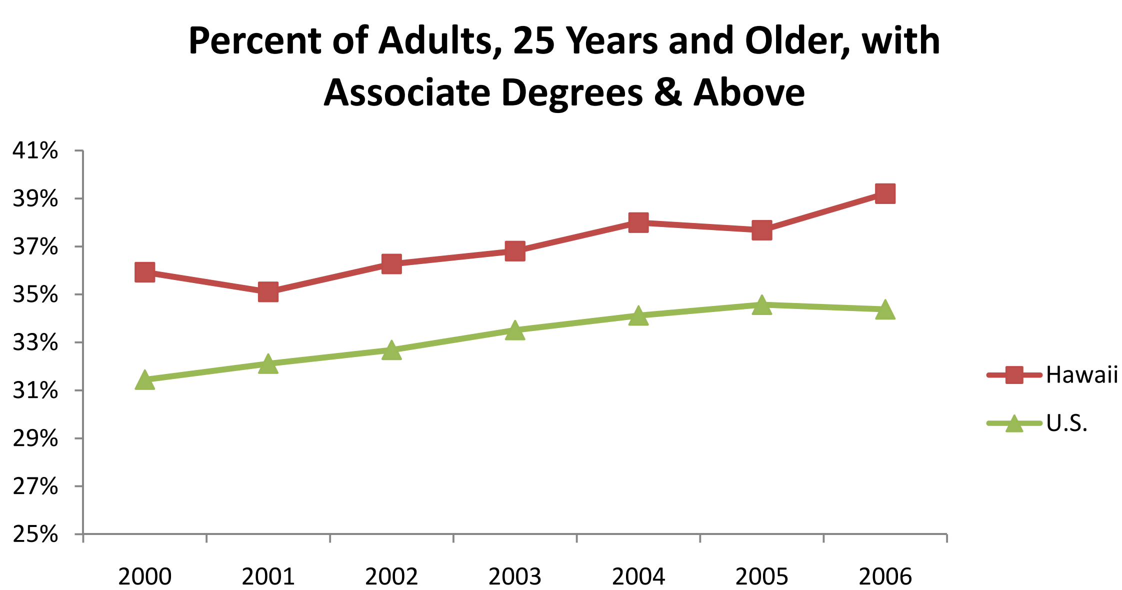
What is this? The first chart represents the percent of UH Manoa undergraduates enrolled in the basic entrepreneurship course at the Shidler College of Business. The second chart is the percent of students at Kapiolani Community College (KCC) enrolled in courses leading to an entrepreneurship certificate of competence. Kapiolani community college appears to have the only credentialed program among Hawaii's public colleges and universities for entrepreneurship. The Shidler College hopes to have an undergraduate major in entrepreneurship by fall 2009 and a graduate certificate program for all majors by summer 2009. There is no readily available national comparison to this metric.

Why is it important? Entrepreneurs are the catalysts for much of the transformation of innovation into commercial activity. The innovation economy depends on them to invent or identify new technologies, find markets for the technology, create firms to bring products to market and when those firms were on sound footing, and then start the process over again. This process has a high failure rate on average. But the rewards for successes generally eclipse losses from failure. Hawaii is not known for its entrepreneurial depth. Programs that teach prospective entrepreneurs both business skills and risk management are a key resource for reversing this.

How has Hawaii performed? Interest in the Shidler College entrepreneurship class and the Kapiolani certificate program appears to be increasing over time with the percent of all registrations rising steadily. The Kapiolani certificate program had registrations of 75 in 2007, up from 54 registrations in 2000. The Shidler College Management-320 course registrations jumped from 24 in 2003-04 to 115 in 2007-08, thanks to the addition of two additional classes over the period. The current enrollment represents about 15% of all undergraduate business majors at the UH, up from just 3% in 2003-04. Notably, while interest in entrepreneurship is up, overall undergraduate business majors at UH Manoa declined over the same four-year period by about 11%.

The elevation of the Shidler College entrepreneurship classes into an undergraduate major and a graduate certificate program could be a significant step in accelerating the development of entrepreneurial talent in Hawaii.

Educational attainment of the Adult Population:



Source: U.S. Census Bureau, American Community Survey, PUMS data, 2000-2006.

What is this? This is the percent of the adult population (25 years and up) with post secondary degrees. This will encompass people who have progressed through the Hawaii educational system and those who have been educated elsewhere and are now residents of Hawaii.

Why is it important? The educational attainment of the population as a whole represents our overall support for innovation through human resources. This is Hawaii's stock of highly skilled human capital.

How has Hawaii performed? Hawaii is outperforming the nation in this metric. More research is needed to determine how local resident verses in-migrant education levels are driving this measure.

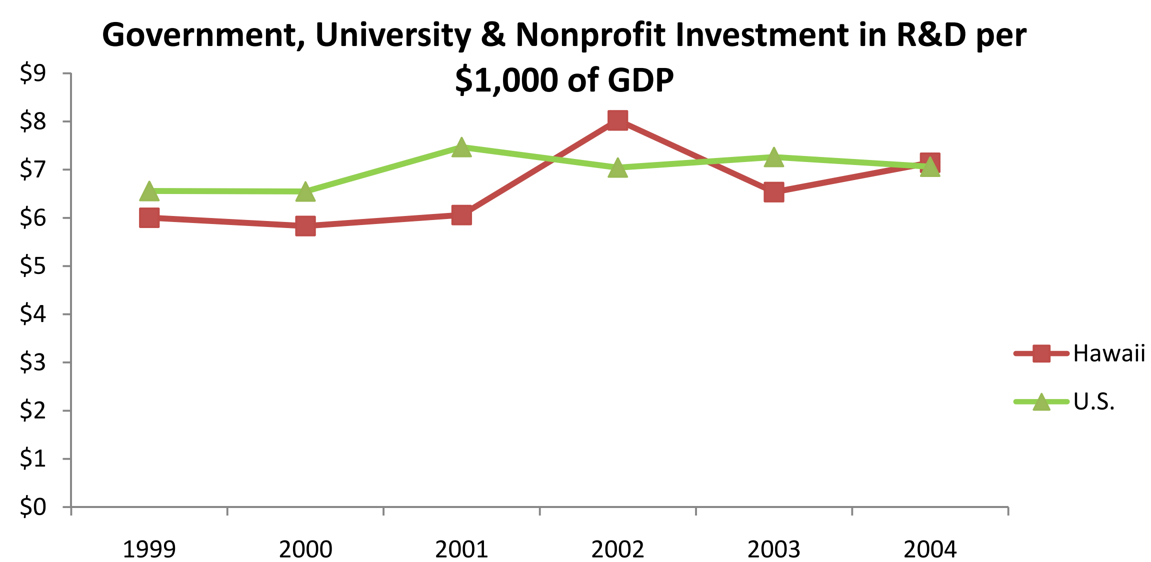
2. Research & Development Effort

The backbone of innovation is research and development. In the development of the U.S. technology sector, the center of R & D activity has been universities. The willingness and ability of University systems to commercialize their research has been a key factor in the development of technology regions such as Silicon Valley in California. There are a multitude of qualitative factors that determine the effectiveness of

University and private sector research efforts that cannot be easily represented as singe dimension indicators. The best single, quantifiable indicator is the investment made in research and development by universities, government and the private sector. Additional, helpful measures are University revenues from the licensing of technology and patents issued in Hawaii. These measures can be found in Appendix C.

Research and Development Funding

<u>**University & Government R&D spending per $1,000 of GSP**</u>:



Source: National Science Foundation, National Patterns of R&D Resources.

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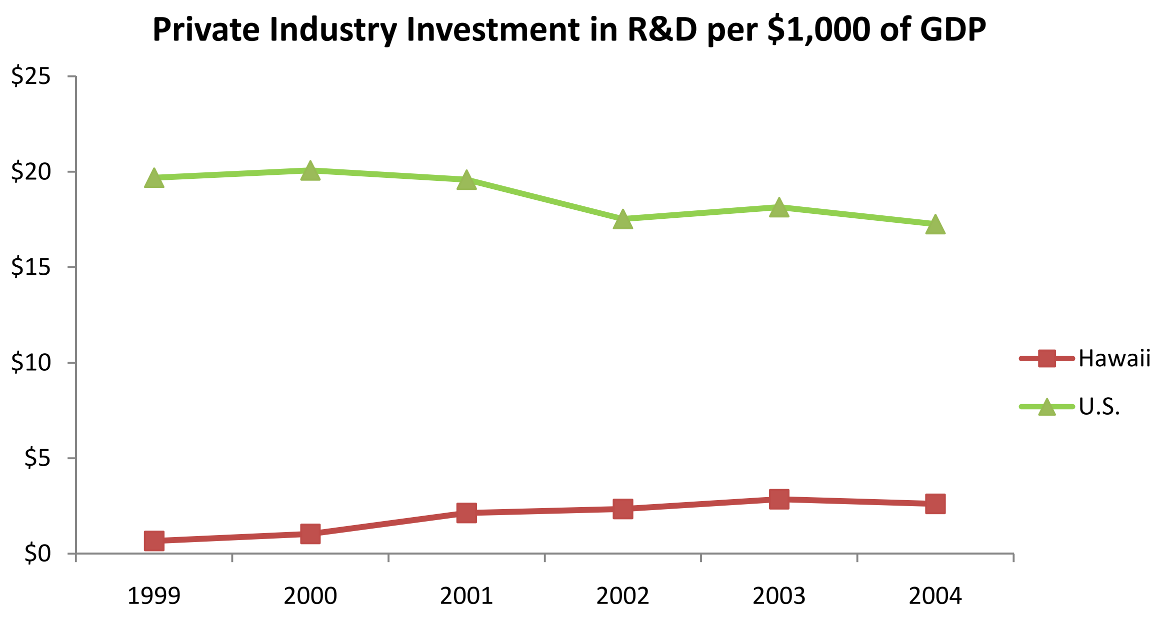
What is this? This is an overall measure of funds applied to public sector scientific research and development activity, primarily in the universities. Much of these funds are federal research grants applied for by researchers and institutions.

Why is it important? The research done in Universities and other public research programs is the genesis for many of our technological breakthroughs. These public research programs are also critical training ground for developing scientists and technicians who will lead innovation in the future. Finally, well financed public research and development programs are better able to

How has Hawaii performed? In the early 2000s, Hawaii's public sector, particularly the University sector, has made significant progress in increasing the level of R&D support. Scaled to the relative size of Hawaii's economy, Hawaii matches the U.S. average for this metric and is poised to exceed national performance.

Private R&D spending per $1,000 of GSP:



Source: National Science Foundation, National Patterns of R&D Resources.

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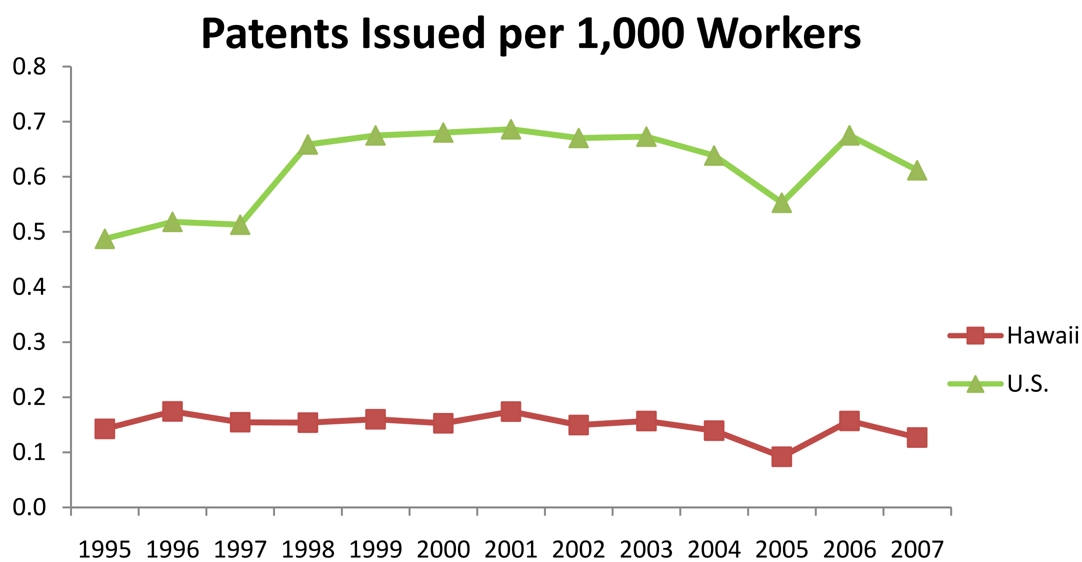
What is this? This is a somewhat rough estimate of the spending on research and development by private industry based on a survey by the National Science Foundation.

Why is it important? R&D is the basis for maintaining a competitive technology industry and private investment in R&D is the major source of R &D effort in the U.S. economy.

How has Hawaii performed? Hawaii trails far behind the U.S. average in R&D investment. However, the proportion has shown general improvement since the late 1990s in Hawaii, while there has been a decline at the U.S. level. More research is warranted into the nature of this gap and whether the general lack of a manufacturing sector in Hawaii might play a role in the gap. Much of national R&D occurs in manufacturing industries where the capital costs of research are high. Hawaii's R&D activity is focused on niche activities in biotech, life science, computer programming and defense-related work rather than manufacturing-intensive activity such as information technology, pharmaceuticals or aerospace hardware. Thus, it is uncertain whether the overall level of R&D investment in

Hawaii will rival the U.S. effort in the foreseeable future. However, steady growth in the relative amount of research in Hawaii would show an increase in the capacity of the Hawaii tech sector for innovations and competitiveness.

Patents Issued:



Source: U.S. Patent Office, Patent Counts by State and Year, 1977-2007.

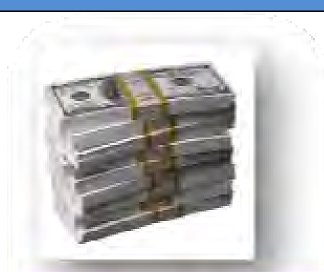
What is this? This is a measure of the relative amount of patents issued for new inventions in Hawaii, scaled to the size of the state's economy.

Why is it important? Patents are another indication of the amount of R&D that is being commercialized. It is an incomplete picture because many new discoveries are not patented for competitive reasons. Also, by counting the amount of patents, the ultimate value of each discovery is not taken into account. Nevertheless, looking at the national and state trends, as well as the national-state gap in patent activity provides additional insight into the innovation process.

How has Hawaii performed? Hawaii falls far below the national average in patents issued, mirroring the gap seen in overall private R&D effort. Over the past decade the amount of patent activity at both the state and national level has shown little growth on a per capita basis. The gap between state and national patent activity and the lack of per capita growth in this metric warrants further research.

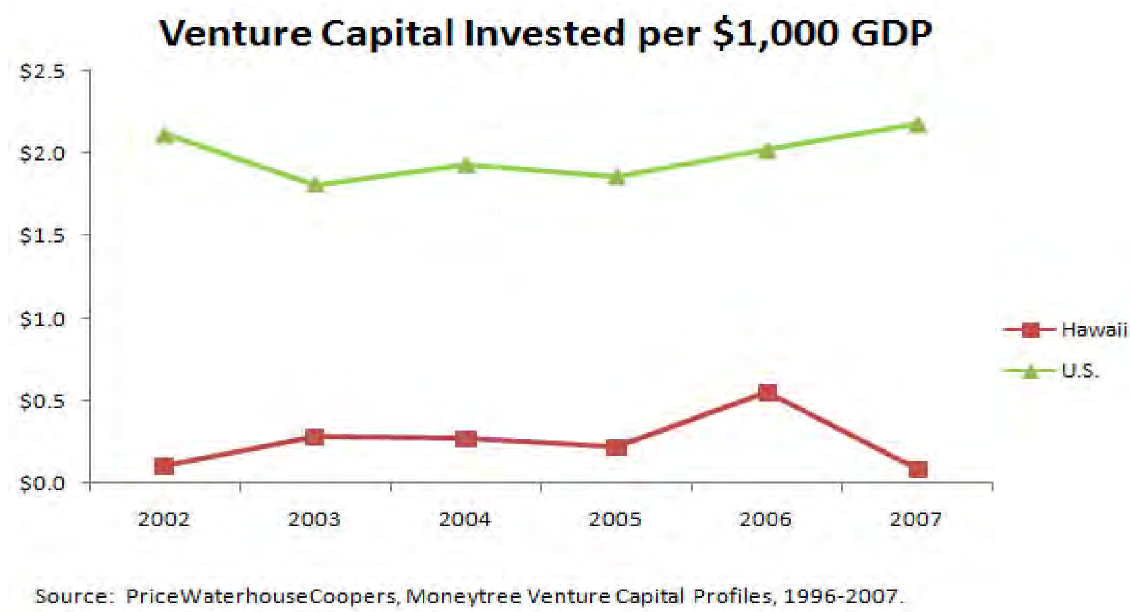
3. Capital Availability

Once technological discoveries are made and practical, commercial activities are identified investment capital is essential to the innovation process. The risks and rewards of investment into technology and



intellectual property have resulted in specialized investment brokers ranging from small 'seed' funds to investment bankers. Venture capital funds can provide a range of investment needs for growing technology companies. For small companies engaged in R&D for federal projects, a source of funding called Small Business Innovation Research grants are available.

Venture Capital Investments:

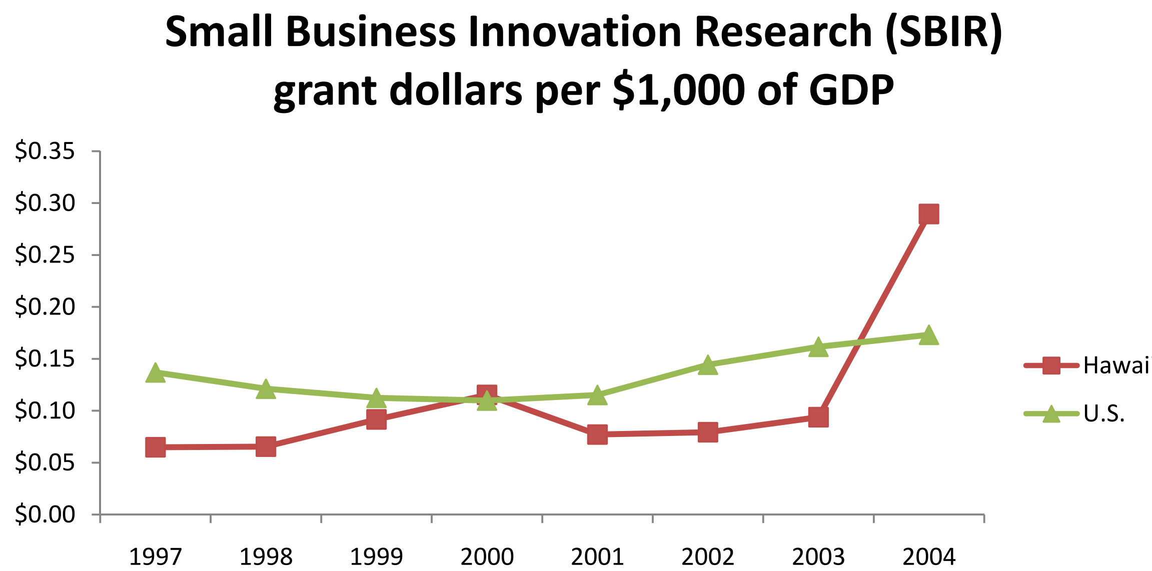


What is this? This is a measure of investments made by venture capital funds in Hawaii and the nation, scaled to the relative size of the economy.

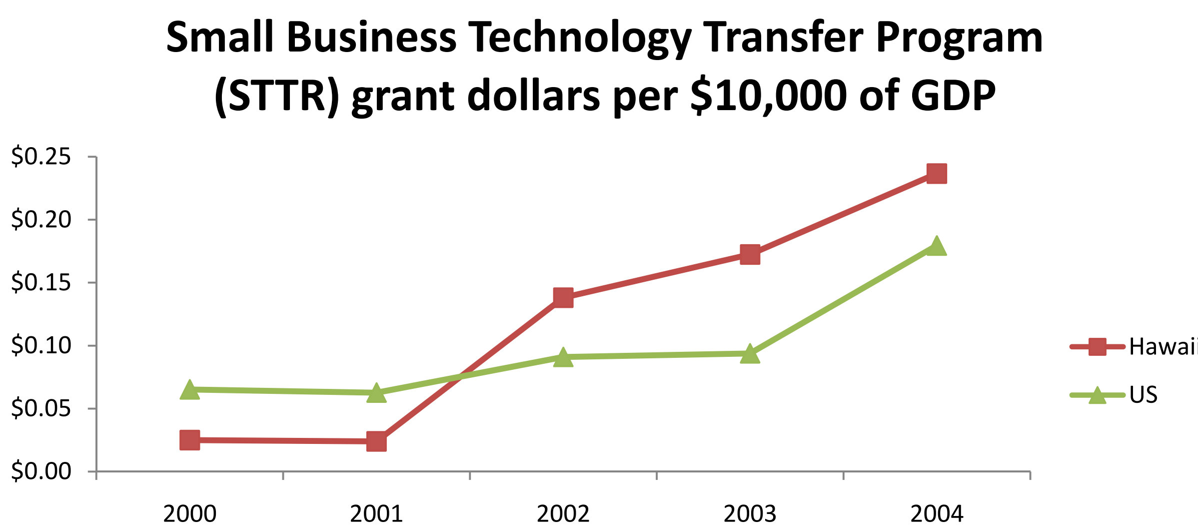
Why is it important? Because reporting for this is voluntary, not all venture capital investments are reported. In a small region like Hawaii where deals are fewer, funds may be reluctant to disclose investments. In such a small place, the confidentiality of specific investments may be more difficult to protect. While imperfect, the data that is available can be an indication of trends in investments in Hawaii by major venture capital firms.

How has Hawaii performed? Venture capital investments in Hawaii are small compared to national levels. No clear trend is evident in this metric, although investments in 2006 were above previous years. Investments in 2007 fell back, but this could be due to the more active investments in 2006.

SBIR and STTR grant funds:



Source: U.S. Small Business Administration, The Small Business Economy, 1997-2004.



Source: U.S. Small Business Administration, The Small Business Economy, 2000-2004.

What is this? Small business innovation research grants are awarded to small firms to develop commercially viable technologies or innovations. Ten federal departments and agencies are required to reserve a portion of their R&D funds for SBIRs. These agencies designate R&D topics and accept proposals organized as a competition. SBIR allows small companies the opportunity to test high-risk theories and develop innovative technologies. To compete for SBIR dollars, small businesses respond to program solicitations issued by participating federal agencies.

Small business technology transfer program grants (STTRs) are modeled after the SBIR program and designed to encourage small companies and researchers at non-profit research institutions (such as universities) to work together as a team to move ideas from the laboratory to the marketplace.

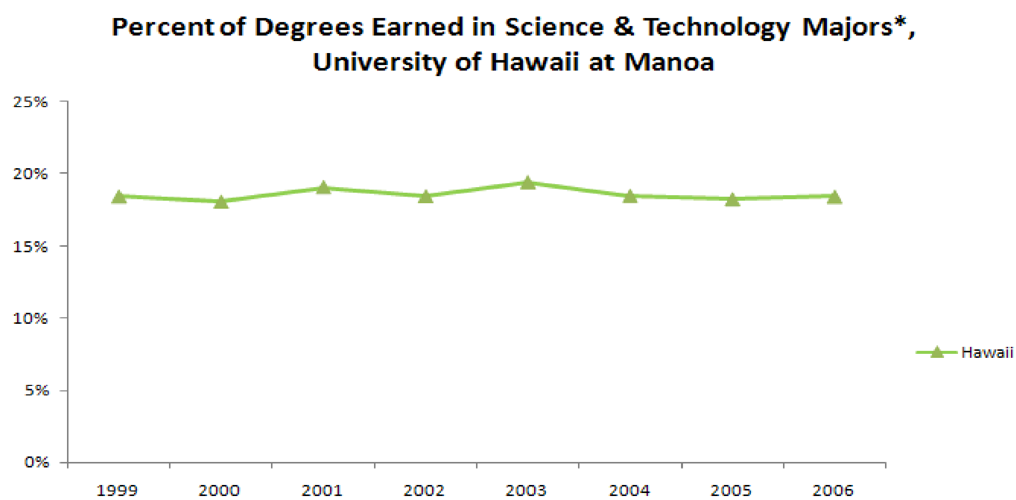
Why is it important? SBIRs and STTRs are major sources of start-up capital for entrepreneurs in the technology sector.

How has Hawaii performed? In contrast to venture capital allocations, SBIR grants are reasonably close to national levels when scaled to the size of the economy, and exceeded national levels in 2004. Hawaii has also outperformed the U.S. with respect to STTRs in the most recent years available. This suggests that there are a significant number of innovators who are competitive and are ready for funding.

4. Workforce Development

Workforce development is the process of providing individuals with knowledge and skills that relate directly to workplace application. Of course, the line between education and workforce development is not always clear as the two often go hand in hand. However, most four year+ college degrees and nearly all two year associate degrees in science, technology, engineering and math, require knowledge and experience that are directly applicable to various technical professions and occupations. Workforce development is also concerned with ensuring that workers are able to upgrade their knowledge and skills after formal education to remain competitive in the job market. In addition to training workers in Hawaii, labor shortages can also be addressed by encouraging the in-migration of workers in high-skilled occupations, especially former residents looking for opportunities to return to their home state.

Degrees in Science and Technology



Source: Degrees Earned by Level, Gender, Field of Study; University of Hawaii at Manoa.

*:Including majors in Natural Sciences, School of Ocean, Earth Science & Tech, College of Engineering, School of Medicine, College of Tropical Agriculture and Human Resources (exculding Family and Consumer Science).

What is this? This is the percent of total UH Manoa graduates (bachelors and above) earning degrees in science and technology fields. Comparable data has yet to be collected for the U.S. as a whole.

Why is it important? Trained workers in scientific and technology specialties represent the backbone of an emerging Hawaii's technology workforce. This measure tracks how well the University of Hawaii at Manoa, the major source of highly skilled graduates for the state, is doing at turning out such graduates.

How has Hawaii performed? Highly trained graduates in scientific and technology specialties have remained a relatively constant proportion of all UH Manoa graduates over the past seven years. While it is not clear how this compares with other states, the percent has shown no increase in recent years. With the introduction of STEM academies and other programs into secondary schools over the next several years, we would hope to see an accelerating interest by post-secondary students in science and technology majors.

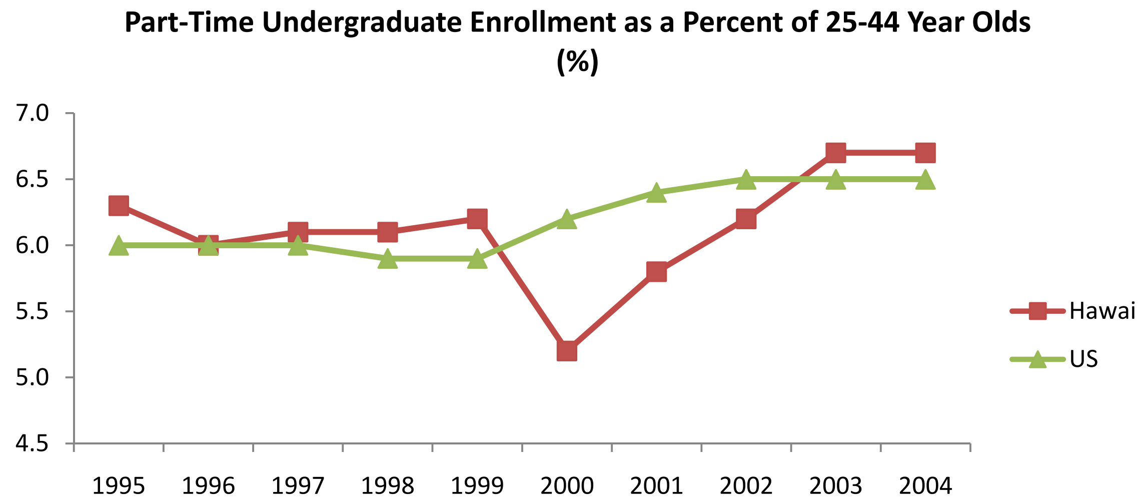
Rapid Response, Custom Training

What is this? Rapid response custom training is the delivery of short term, skill-specific training, usually by community colleges, for which there is no established curriculum in place. These programs are usually designed for individual firms or industries which have an opportunity to expand if the critical skill sets can be marshaled in a short period of time.

Why is it important? Technology and many other businesses are experiencing rapid changes in the types of skill sets they need to stay competitive. Also, many times decisions to invest in increased capacity or start a business depend on how fast the needed workforce can be assembled. Rapid response custom training is used in many states to ensure companies have access to advanced skills training customized to their specific needs. Otherwise these companies will look elsewhere or not expand at all.

How has Hawaii performed? Currently, Hawaii has only rudimentary capability to deliver such custom training. The University of Hawaii Community College System is developing such a capability, but it has yet to become a full fledged program. For that reason there is no metric or data available for this indicator. As the UH effort evolves data on that effort and similar efforts elsewhere will be compiled and compared.

Life-long learning



Source: National Center for Higher Education Management Systems, 1992-2004.

What is this? This measures the percentage of prime working age adults taking some college courses. It is an indicator of the rate at which adult workers are increasing their knowledge and skill levels beyond their earlier participation in formal educational programs.

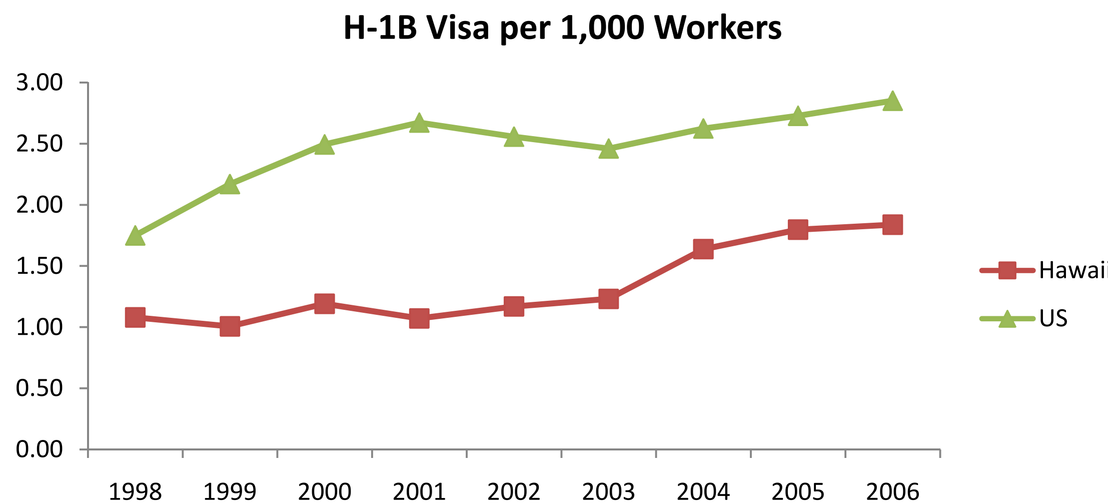
Why is it important? New workers entering the labor market with new skills represent only a small percentage of the total workforce. For the workforce as a whole to increase its skill level and thus the competitiveness and innovation capacity of the economy, people already in the workforce (incumbent workers) must periodically upgrade their skills or be retrained. Further, as the rate of baby-boom retirements increases, middle and lower level workers will be promoted into more responsible positions without the luxury of having years of experience and mentorship. Economies that recognize that gap and provide means and motivation to prepare lower and middle level workers with more training now, will be more competitive and provide a better quality of life.

How has Hawaii performed? Hawaii has recently exceeded the national average for this metric after a few years of sub-par performance. The bigger picture may be that these are poor rates for both the nation and Hawaii. As technology and markets change and labor shortages increase, it is essential that workers have access to and take advantage of upgrading their skills and education to maintain a productive, competitive economy. Regions that can boost incumbent worker training substantially will be at a significant advantage.

Worker Recruitment

Two major sources of additional skilled workers for Hawaii's innovation sector are in-migrants from the mainland and skilled workers from foreign countries.

H-1B Visas:



What is this? This is the rate at which Hawaii companies are able to secure skilled workers from abroad under an immigration program called the H-1B Visa. The U.S. Immigration & Nationality Act, allows U.S. companies to employ foreign 'guest' workers in specialty occupations where there are no qualified U.S. citizens or residents available. The program is limited to 65,000 workers per year nationally and applications to bring workers in greatly exceed that.

Why is it important? Research points to a looming shortage of labor in the coming years as the large, baby boom generation retires and the numbers of people entering the labor force remain modest in comparison. A prime source of skilled workers to fill this gap is the growing number of foreign college graduates being turned out in both foreign and U.S. universities.

How has Hawaii performed? Hawaii is behind the nation as a whole in attracting highly skilled labor to augment limited local supply. Certainly, Hawaii companies are competing with many large corporations that feed from this source of skilled labor. But Hawaii has advantages in this competition including a high quality environment and lifestyle, a multi-cultural population and major educational institutions such as the University of Hawaii System, East West Center and numerous private colleges that already attract and graduate significant numbers of foreign students.

Kama`aina Repatriation:

What is this? This measures the number and change in former residents returning to work and live in Hawaii after working or receiving and education on the U.S. mainland or abroad.

Why is it important? This is another important way Hawaii can supplement a tightening workforce that if not addressed could stall competitiveness and our standard of living. Former residents of the state are prime prospects for augmenting Hawaii's workforce in shortage areas. Many would like to return to Hawaii under the right circumstances and once here, have support networks to ensure that they will remain part of the labor force much longer than in-migrants with few or no ties to the islands.

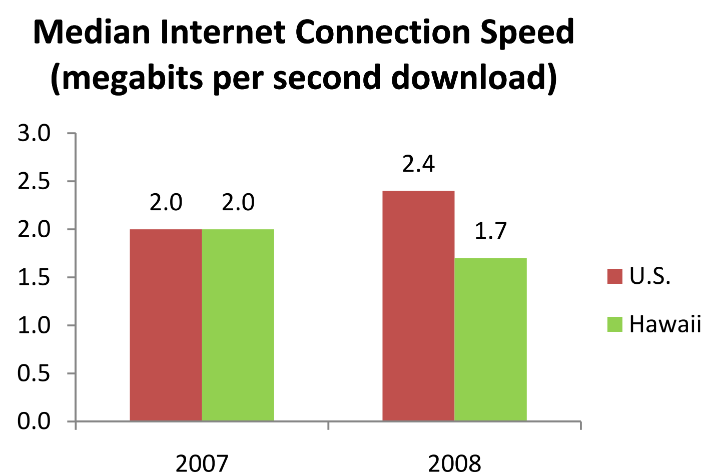
How has Hawaii performed? As yet there is no comprehensive source of data for this metric. Evidence to date is anecdotal. However, given its importance as a source of labor for Hawaii's economy it is noted here.

5. Infrastructure

Infrastructure refers to the basic support assets, usually tangible, that allow commerce to be conducted. Roads, power lines, communications, water, waste disposal systems, and transportation systems are just a few examples of the economy's infrastructure. For the innovation sector more specialized infrastructure such as broadband connectivity,

conferencing and teleconferencing centers, technology incubator facilities, and specialized processing and testing facilities usually found in universities are a few examples. No single indicator can represent the scope of infrastructure capacities needed to support the innovation economy. However, a universally essential element in the digital age is broadband connectivity.

Broadband Connectivity



Source: Communication Workers of America, Speed Matters Project,www.speedmaters.com. August 2008.

What is this? This is the median download speed in megabits per second (mbps) for computer users who voluntarily participated in the speed matters tests for 2007 and 2008. Approximately 229,000 tests were done at the national level and 700 in Hawaii in 2008. The tests represent an unknown mix of high and medium speed connections (fiber optic, cable and DSL). The Speedmatters researchers think that few dial-up users participate in the tests.

Why is it important? In the digital age, and especially for such a geographically remote place as Hawaii, electronic connectivity with the world at large is a key requisite for competitiveness. Increasingly more commerce and information delivery is through the Internet. An innovation economy requires the development of new markets and new supply chains. Connectivity is the key 'highway' for commerce in the twenty-first century.

How has Hawaii performed? The median Hawaii download speed actually declined somewhat from 2007 to 2008, while the U.S. as a whole increased speed slightly. The mix of connections involved in the tests can impact the results. The mix itself can be impacted by the price of higher speed connections. Among the states, median download speeds ranged from a high of 6.8 mbps in Rhode Island, to 0.8 mbps in Alaska. Hawaii's speed ranked it 23 in the nation. However, even Rode Island's speed pales next to a number of foreign countries according the Speedmatters project. The fastest internet connections are reported for Japan with a median 65.1 mbps in 2008. Others included South Korea, 50.7 mbps, Finland, 22.2 mbps, France 18.0 mbps, and Canada, 7.8 mbps. Hawaii is certainly capable of higher speeds. For instance a DBEDT computer using the State internet system registered average download speeds of 8.1 mbps in late August 2008 on the Speedmatters test site.

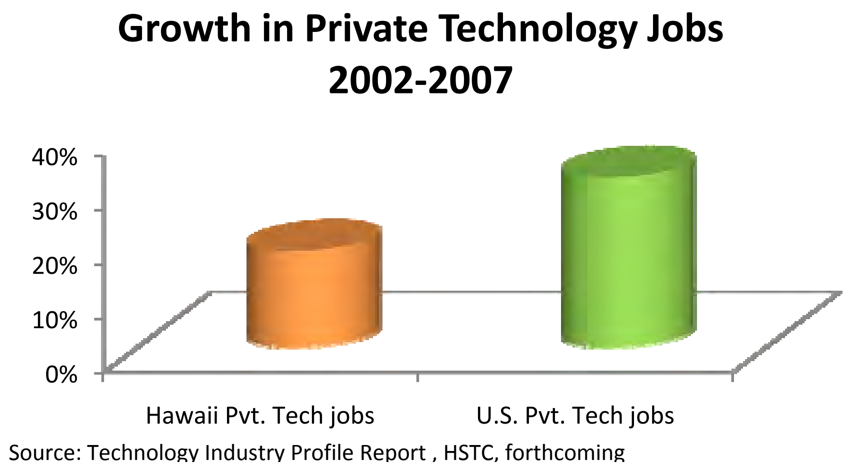
However, speeds assessed by different organizations can vary. For instance, the Information Technology and Innovation Foundation pegs average (as opposed to median) U.S. download speeds at 4.8 mbps in 2006 compared with the 2.0 CWA rate in 2007.

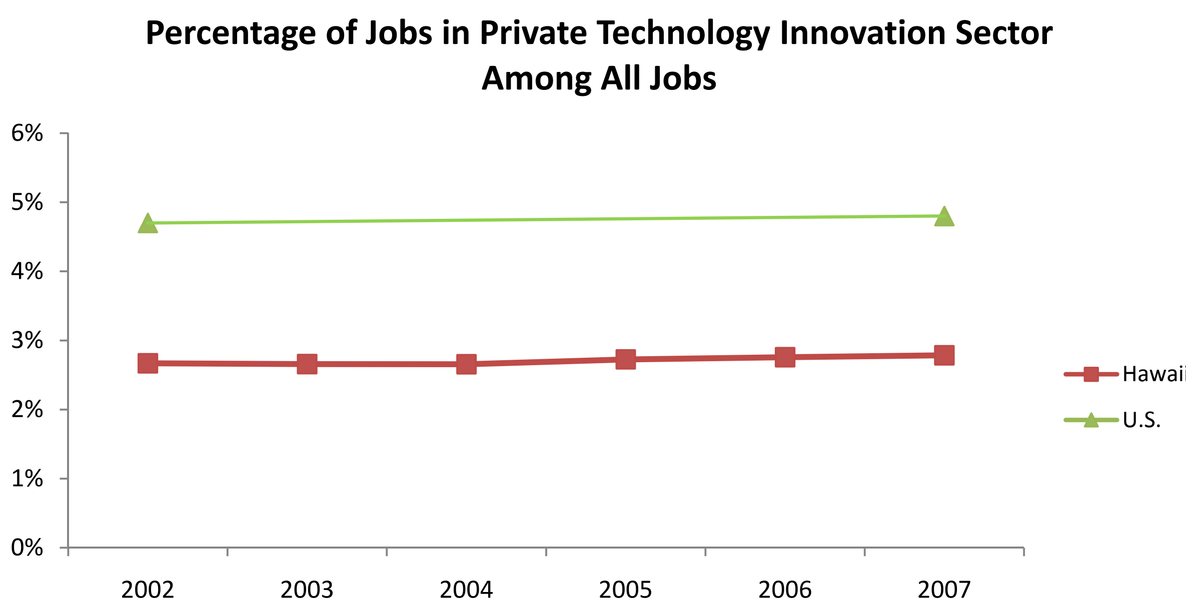
B. INNOVATION SECTOR AND SUPPORT ASSETS

Strong innovation capacity should translate into an innovation sector and support assets that can help transform the economy. This includes competitive enterprises in the technology and creative sectors and such assets a high a proportion of skilled occupations, diffusion of technology to other sectors of the economy and strong entrepreneurial activity.

1. Size and Growth of the Technology Sector

Technology Sector Growth and Proportion of Jobs





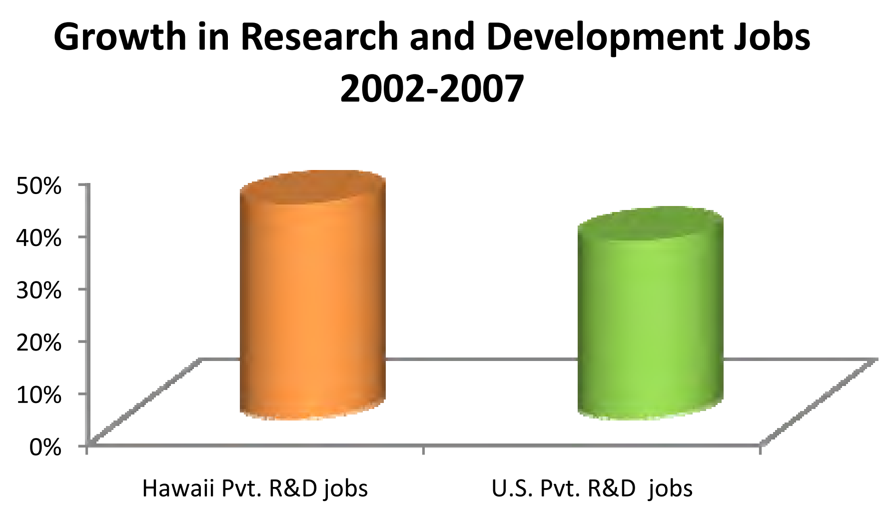
Source: Innovation and Technology In Hawaii, HiSciTech Institute, October 2008

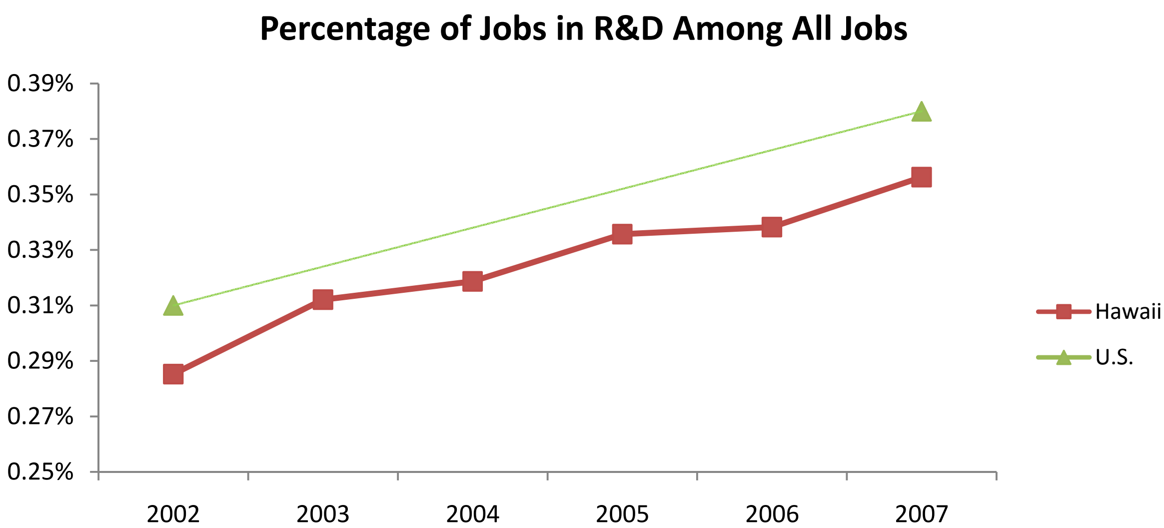
What is this? This is the growth and percentage of all jobs (salaried workers, sole proprietors and self-employed) in the technology sector of the economy. Results of a study conducted by the Hawaii Science and Technology Council in collaboration with DBEDT has refined the identification of the State's Technology and Innovation sector based on definitions established by U.S. Department of Labor researchers. That definition shows Hawaii has a private technology sector encompassing more than 23,000 workers and entrepreneurs, representing about 3% of the state's total workforce in 2007.

Why is it important? Innovation is a product of creativity and technology. Thus, the technology sector represents a major basis for an innovation-led economy. While Hawaii's most competitive and vital economic sector will continue to be the visitor industry in the foreseeable future, technology offers an opportunity to broaden the base of growth and provide a source of skilled job demand and high wages.

How has Hawaii performed? Hawaii's technology sector has outpaced the 2.5% annual economic growth rate over the last five years, with a 3.3% annual rate. This is despite the heavy emphasis on manufacturing in the U.S. Department of Labor definition of the tech sector. However, that difference was not enough to move the overall proportion of technology in the economy much. It will take much more vigorous growth in key sub-sectors of technology over a number of years to approach the national average.

Research and Development Growth and Proportion of Jobs





Source: Innovation and Technology In Hawaii, HiSciTech Institute, October 2008

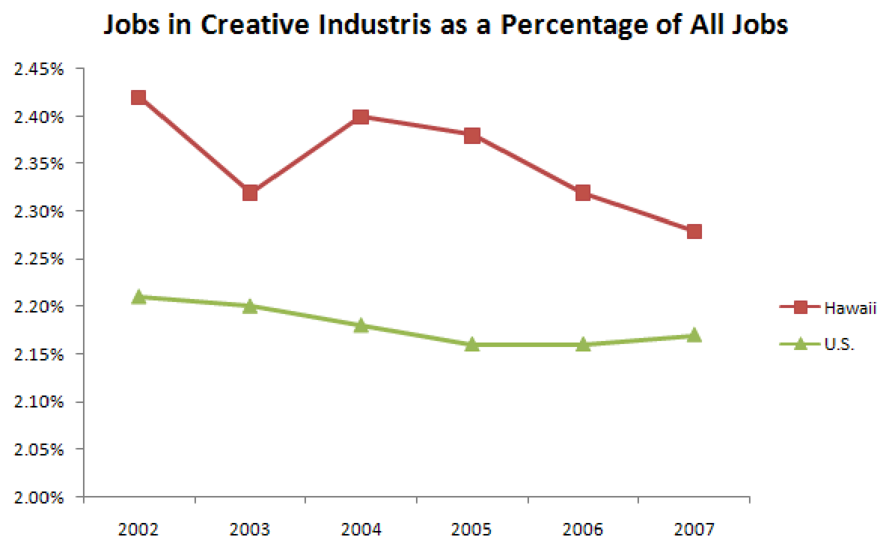
What is this? This includes the growth and percentage of all jobs (salaried workers, proprietors and self-employed) in the specific sub-sector of *scientific research and development*.

Why is it important? Research and development activity is a core sub-sector of technology because it generates the knowledge and breakthroughs that drive innovation in technology products and eventually the economy as a whole.

How has Hawaii performed? Research and development at both the state and national levels has shown exceptional growth relative to the rest of the economy. While still very small, R&D is becoming a bigger share of the technology sector. Hawaii is much closer to the national proportion of this sub sector and has more than kept pace with the strong U.S. growth over the last 5 years.

2. Size and Growth of the Creative Sector

The creative sector includes artistic and related technical activity resulting in artistic and entertainment products and services. These include not only live performances, but also digital products such as music, film, computer animation and computer gaming. Preliminary estimates of the creative sector have been developed by DBEDT.



Source: DBEDT.

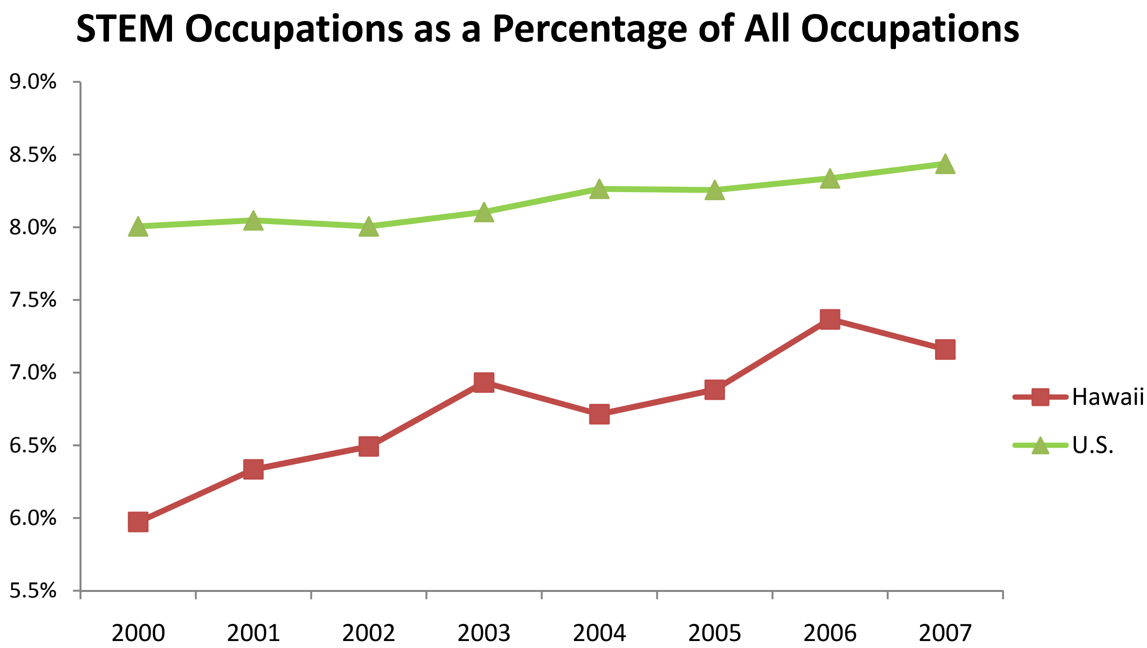
What is this? This measures the percentage of jobs in the creative sector. The creative sector encompasses arts, music, film, dance and numerous other creative activities that produce entertainment and cultural products.

Why is it important? If technology provides the tools for innovation, creativity shapes the blueprint. Creative activities in the economy have significant influence on the way technology is translated into commercial goods and services. From advertising to literature, and film to music, creative activity stimulates innovative thinking. As an important byproduct, a vibrant creative and cultural sector is a magnet for highly skilled and educated workers that can add to Hawaii's appeal as a place to live and work.

How has Hawaii performed? Hawaii has a higher proportion of jobs in creative industries than the U.S. as a whole, although the difference has narrowed in recent years. Jobs in the sector have not kept pace with the growth in the economy as a whole since 2004.

3. Highly Trained Technical Workforce

Percentage of Stem Occupations in the Economy:



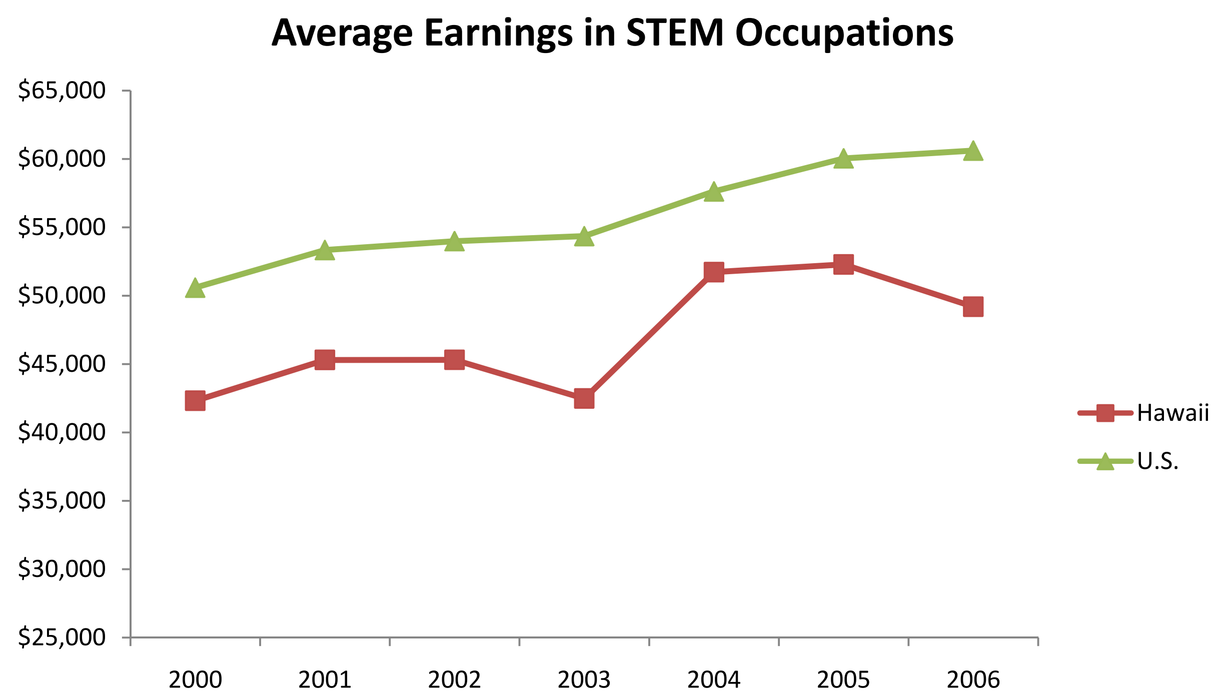
Source: Bureau of Labor Statistics, May Occupational Employment and Wage Estimates. For occupations included, see Appendix B.

What is this? This is the percentage of workers in the economy in occupational fields requiring science, technology, engineering and math (STEM) skills. The complete list of these occupations is shown in Appendix B.

Why is it important? High skilled technical workers in the economy represent a basic asset for the development of innovation activity. The proportion of STEM-intensive occupations in the state's workforce provides a metric for that asset. This proportion is a direct result of successful educational and workforce development efforts.

How has Hawaii performed? Hawaii has shown a fairly consistent increase in the proportion of STEM occupations since the beginning of the decade. This compares to a somewhat marginal increase at the national level. It is not clear if this increase is due entirely to the education of residents or also includes the result of Hawaii attracting skilled workers from elsewhere.

Average Earnings in STEM Occupations:

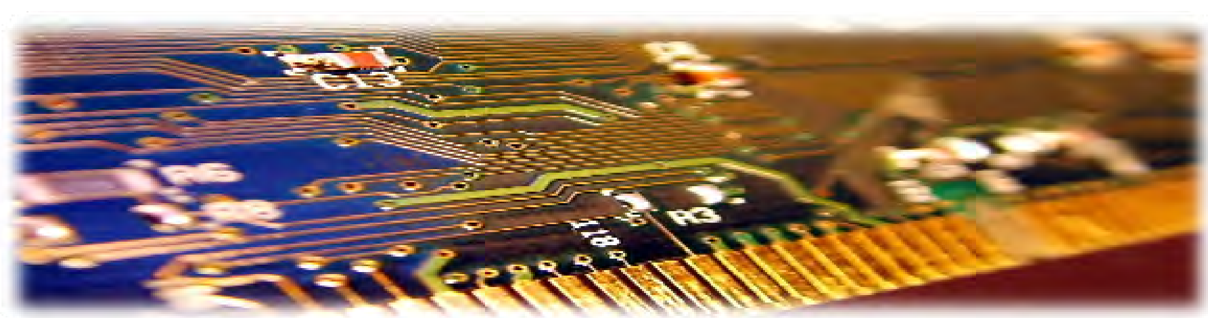


Source: U.S. Census Bureau, American Community Survey, 2000-2006. For occupations included, see Appendix B.

What is this? This measures average yearly earnings by Hawaii and U.S. workers in STEM occupations. The data are not corrected for effects of inflation.

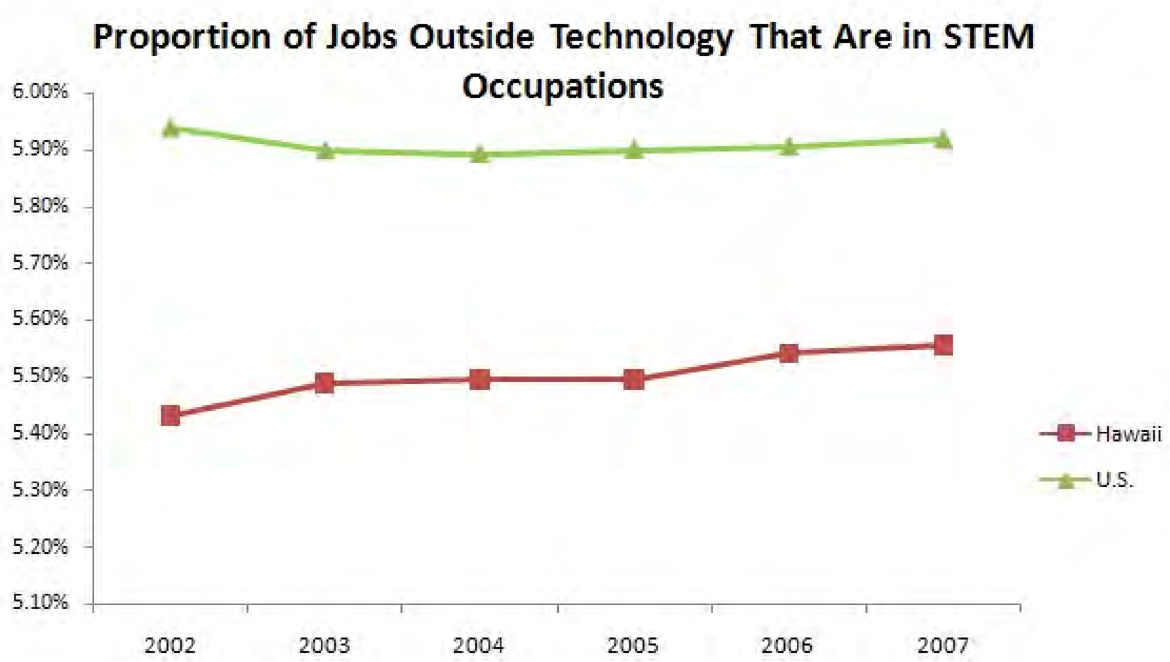
Why is it important? In order to attract and keep workers into STEM occupations in Hawaii, those jobs must pay well above the average and be high enough to discourage outmigration to similar but higher paying jobs elsewhere.

How has Hawaii performed? While STEM occupations pay much better than the average job in the economy, that pay level continues to be well below pay at the national level. The gap appears to have widened in the last two years for which data are available.



4. Technology Diffusion Beyond the Technology Sector

Proportion of STEM Occupations Outside the Technology Industry:



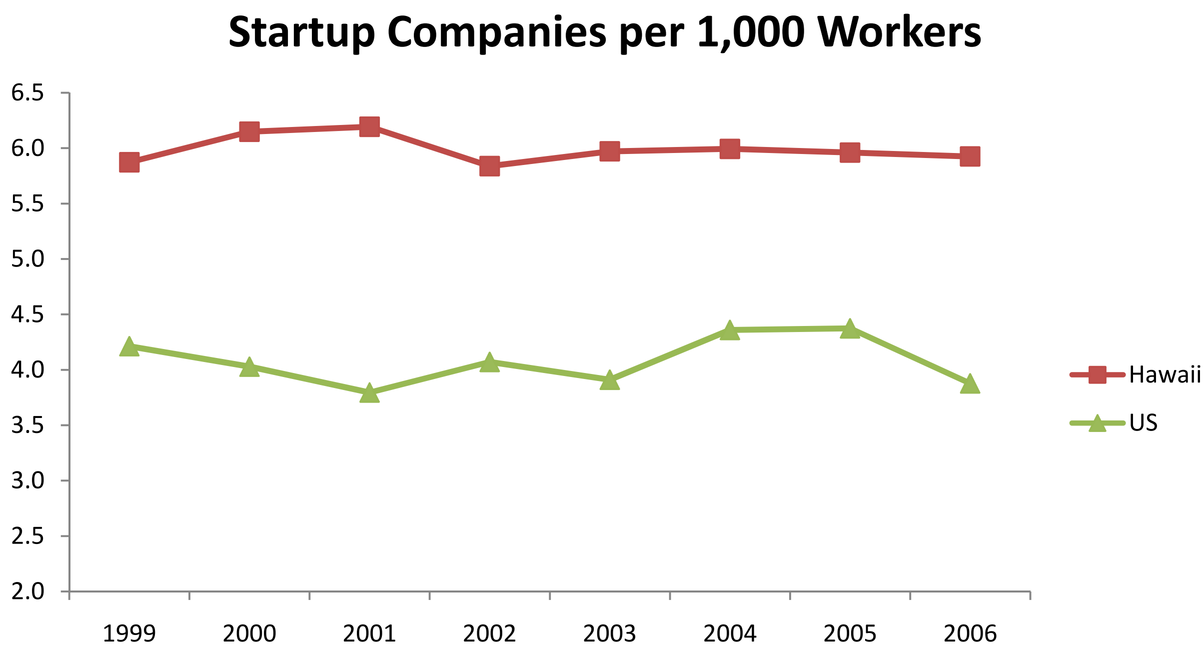
Source: EMSI, Economic Modeling Specialist, Inc. For STEM occupations and technology industries included, see Appendix B.

What is this? This is the proportion of jobs in STEM occupations that are not in the defined technology sector. (The list of STEM occupations is in Appendix B)

Why is it important? It is difficult to measure the diffusion of technology into the economy as a whole. However, an indication of that is the proportion of jobs in STEM occupations that are generated outside of technology. All sectors of the economy benefit from workers with strong STEM skills, not just technology industries. Expansion of STEM occupations outside of technology industries indicates that other industries are using the benefits of technology and innovation to increase competitiveness and provide better paying jobs.

How has Hawaii performed? Hawaii is somewhat below the level of national performance for this metric. This may be due to the relatively smaller manufacturing sector in Hawaii which would be expected to demand a higher proportion of STEM occupations. Hawaii's proportion of these occupations outside the technology sector has been increasing modestly over the last few years and has begun to narrow the gap with the nation.

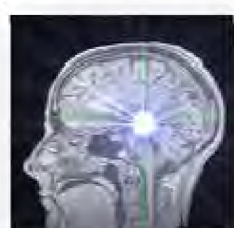
5. Entrepreneurial Activity



Source: U.S. Small Business Administration, The Small Business Economy, 1999-2006.

What is this? This measures the number of new companies entering the economy, scaled by the relative size of the Hawaii and U.S. economies.

Why is it important? Entrepreneurial risk taking and potential rewards have been the driving force behind much of the digital revolution. However, like technology infusion, entrepreneurism is a difficult quality to measure. The best measure at this time is the rate of new company formation.



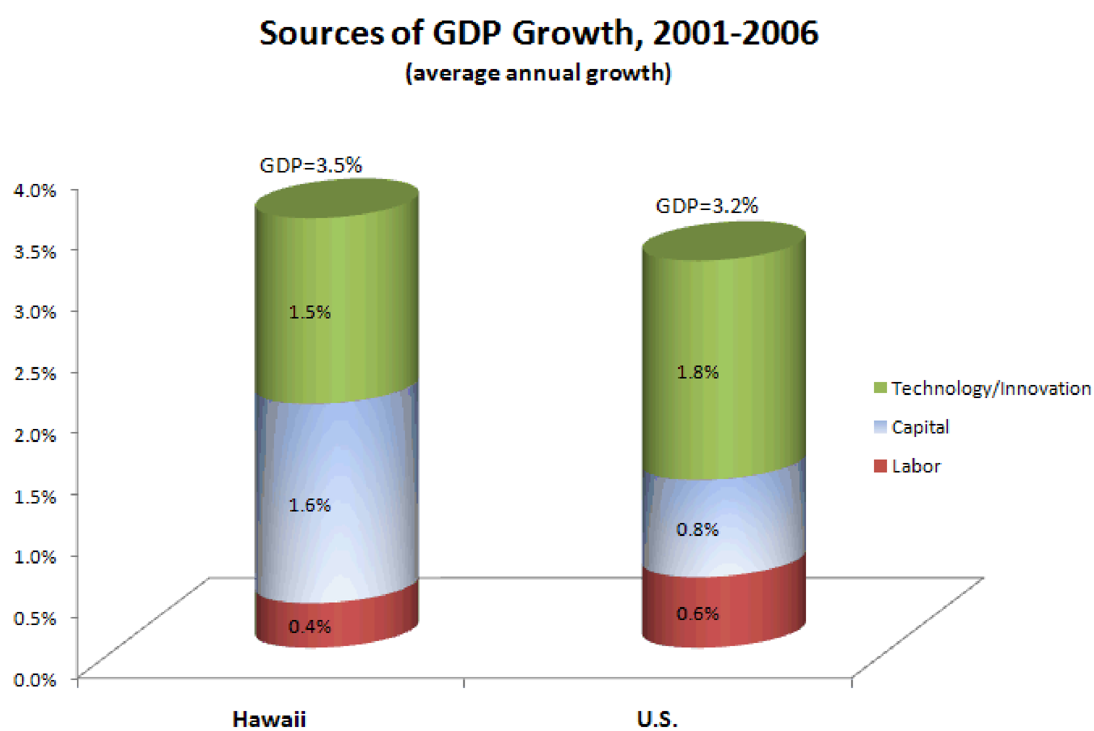
How has Hawaii performed? Hawaii appears to have outperformed the nation in business startups in recent years, possibly due to the relatively stronger economy in the state. However, neither Hawaii nor the U.S. has shown much of an upward or downward trend in this metric. This is a limited measure of entrepreneurial activity. It includes many more types of firms than those in the innovation sector. Efforts are underway to narrow the scope of this indicator to firms in innovation sectors.

C. ECONOMIC TRANSFORMATION

(Innovation Outcomes)

The ultimate purpose of fostering innovation capacity and assets is the overall prosperity and competitiveness it generates in Hawaii's economy. A strong innovation sector and innovation assets should result in more sustainable growth by ensuring that growth in the economy is driven by technology and productivity rather than just more people and more physical development. The economy will tend to become naturally more diversified and reach out to global markets. Median incomes should reflect the impact of more knowledge-intensive activity as the number of jobs that pay sustainable wages increase as a share of the total. Importantly to Hawaii, innovation in energy production and use should make the State increasingly more energy efficient.

1. Innovation's Contribution to Growth

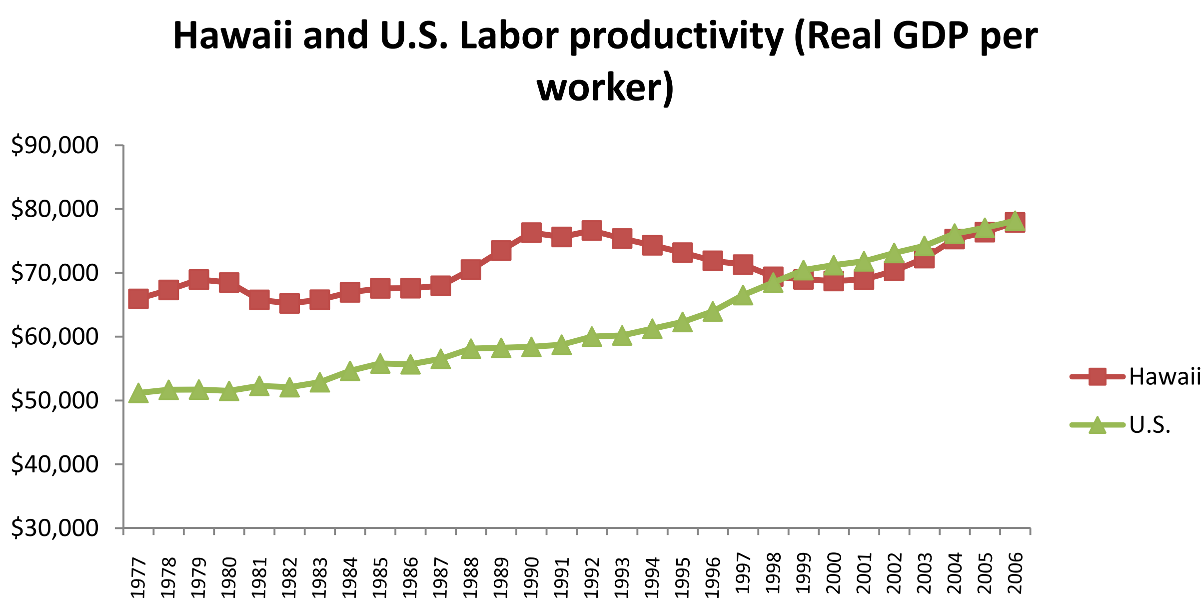


What is this? This is the estimated proportion of economic growth generated by technical change and innovation. It is arrived at by accounting for the contribution of capital investment and labor input. In other words, if the only contribution to growth is the addition of capital and labor, economic growth should have been an average of only 2.0% for Hawaii and 1.4% for the U.S. between 2001 and 2006. The excess growth is attributed to technology and innovation as they are embodied in better equipment, more skilled and educated workers, better organization and management of production, and improvements in the business environment.

Why is it important? About half of all US growth since World War II has been attributed to technical change; that is, the application of innovation and technology to the production of goods and services. Technology and innovation boosts the overall productivity of the economy allowing labor and owners to share in the gains. This results in higher wages and a higher standard of living without necessarily raising costs and prices.

How has Hawaii performed? In Hawaii, the portion of growth from technology and innovation has been considerably less than the nation, especially in the 1990s. Most recent estimates indicate that more than about 57% of U.S. economic growth between 2001 and 2006 was generated by innovation and technical change. For Hawaii that proportion is a somewhat lower, 43% over the same period. Still, this is an improvement from the 1990s. As Hawaii and the U.S. transition through business cycles, these proportions tend to fluctuate. Time will tell if Hawaii's improvement is a long-term trend.

2. Labor Productivity



Source: State of Hawaii Databook; Statistical Abstract of the United States.

What is this? This measure is total gross domestic state and national product divided by the number of workers and is the amount of GDP generated on average by each worker in the economy. Several factors contribute to GDP per worker. The quantity and quality of capital equipment is a major factor. Workers skills and education levels are another important factor.

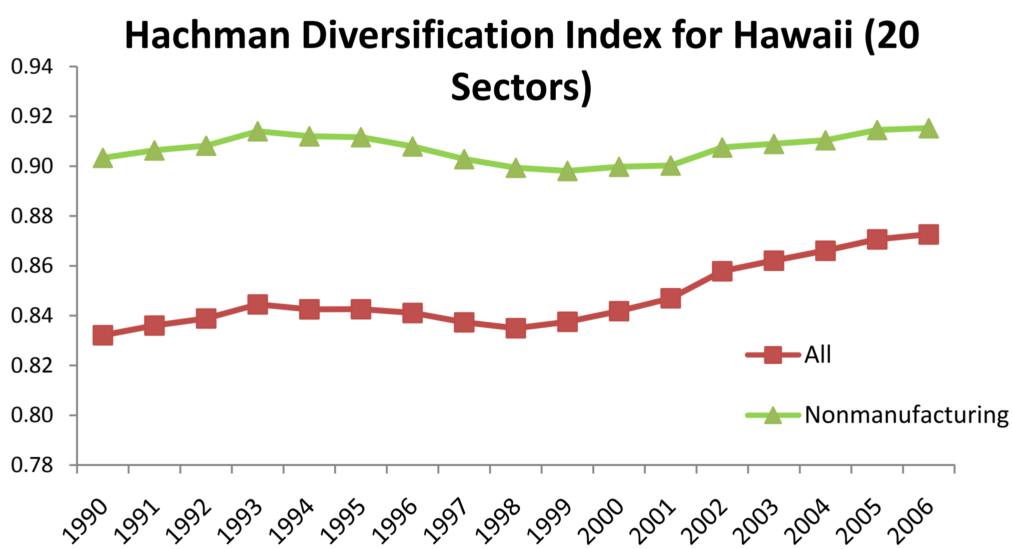
Why is it important? Worker productivity is the basis for a company's ability to compete, attract investment and pay higher wages. We would expect labor productivity to increase as innovation improves a firm's competitiveness. Increases in labor productivity are essential to support increased wages and labor income.

How has Hawaii performed? After out-performing the nation for at least two decades, Hawaii's output per worker now about equals the national rate. Hawaii worker productivity fell during the 1990s but has shown steady improvement since the beginning of this decade.

3. Diversification

Innovation, technology, creative activities and a skilled workforce, should help Hawaii develop a more diversified economic structure. Nearly everyone agrees that more diversification would be desirable in the economy. But the term can mean different things to different people. Some see diversification as creating more economic activity outside of tourism related businesses. Others see it as developing a broader overall balance of industry activity throughout the economy. The value of diversification in a stock portfolio is standard wisdom.

Diversification reduces risk by keeping any one firm or industry's stock to a limited proportion of the total investment portfolio. However, the industries in an economy's portfolio usually represent activities in which the region is competitive. The level of diversification will tend to reflect the range of activities in which the economy is competitive. For this reason most regions will tend to be less diverse than the national economy, since most regions specialize to some extent.



Source: DBEDT, Measuring Economic Diversification in Hawaii, 2008

What is this? The Hachman diversification index compares the relative diversification of industries at the state level with the national economy. A value approaching 1.0 for the index means the state's economy is nearly as diverse as the national economy. A state's degree of industry diversification declines as the index values drop closer to zero. The index can be calculated for all industries or a selected set of industries. In the chart above the diversification for all industries is represented by the solid line, while diversification of industries outside of manufacturing is represented by the dashed line.

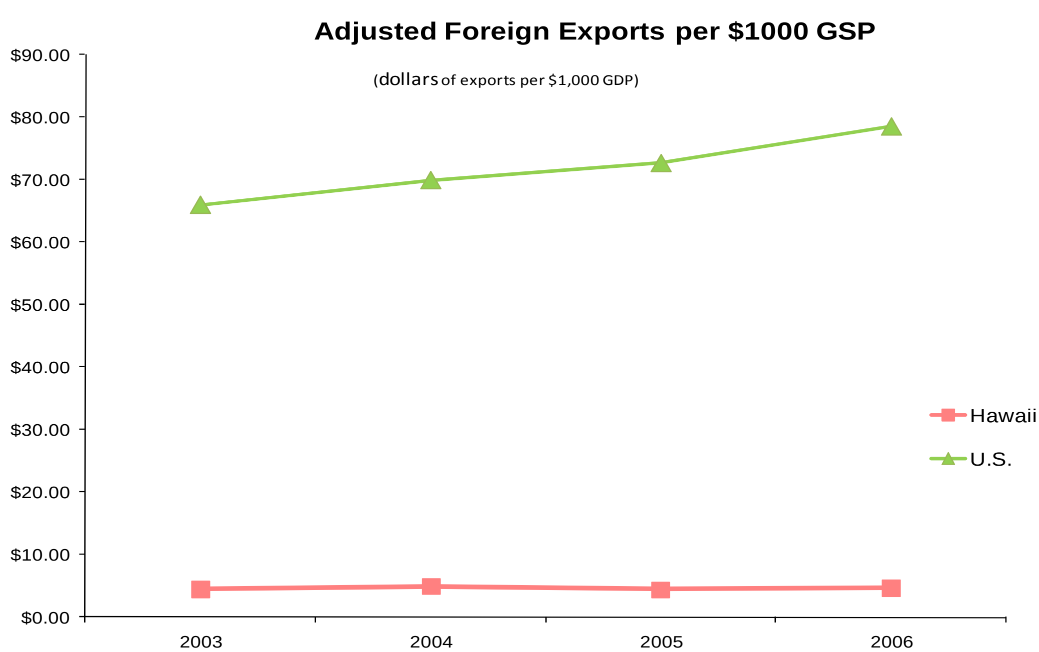
Why is it important? Hawaii has recognized for years that over-dependence on a small group of large industries like tourism, plantation agriculture and military expenditures limits occupational opportunities and leaves the economy vulnerable to dislocations resulting from problems in any one of those industries. The development or expansion of economic activity outside the current major sources of economic activity could help counter dislocations in the major industries and provide a wider range of high quality jobs for Hawaii's residents.

How has Hawaii performed? Since the late 1990s, Hawaii's economy does appear to have moved slightly closer to the nation in terms of industry diversification. However this may be due to the national economy relying less of manufacturing during this period.

Diversification outside manufacturing is in the low 90 percent relative to the nation, which suggests that the state's service-sector mix is contains a diverse range of activity. This measure has not changed much over the last 16 years, however.

4. Global Integration

Merchandise Exports:



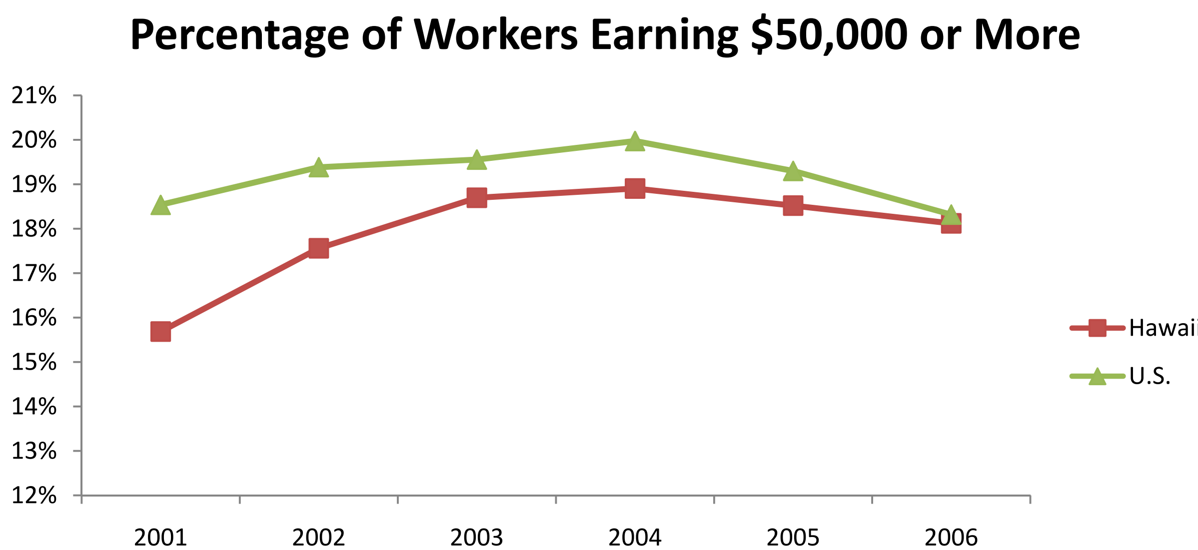
What is this? This is the value of merchandise exports to foreign countries by Hawaii. It is adjusted to the extent possible to subtract out most goods made elsewhere but transshipped through Hawaii.

Why is it important? In addition to trade in general, innovation should result in more exports of goods and services to world markets. While exports of services are difficult to identify, the export of goods is measurable and serves as a partial substitute for the overall measure.

How has Hawaii performed? When adjustments are made for exports originating elsewhere but passing through Hawaii customs district, Hawaii's export of goods, while growing, has shown little increase in recent years as a proportion of the economy.

5. High Wage Jobs

Workers Earning $50,000 or More: (Constant 2006 Dollars)



Source: U.S. Census Bureau, American Community Survey, 2000-2006.

What is this? This measures the proportion of workers in the economy who earn $50,000 or more in constant 2006 dollars. There is no common standard for the term "high wage." Some states use a rule of thumb that it should be pegged at about 50% higher than the average wage. Most efforts have resulted in a wage around the $50,000 level. Therefore using $50,000 as a base for high wage jobs is comparable to other analyses. This measure of "high wage" should not be mistaken as a "self-sufficiency" income. Self-sufficiency is a measure of

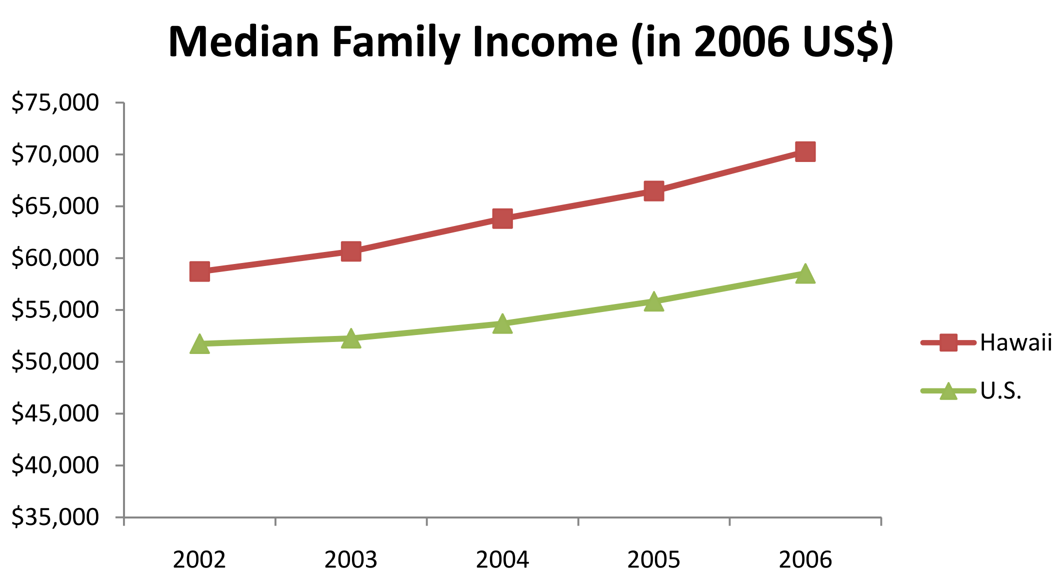
income needed to achieve a particular standard of living for a given household composition. There are actually several different self-sufficiency income levels depending on the number of different household sizes and compositions that may be priced. By contrast, the measure of high wage jobs here, is meant to measure how well the economy is able to increase the proportion of jobs over a certain wage level. (The self-sufficiency wage will be the subject of a report to be released by DBEDT later in 2008.)

Why is it important? Regardless of the exact dollar criteria, a key goal of the innovation initiative is to increase the proportion of workers in the economy making relatively higher incomes. We would expect this to happen as companies focusing on higher valued output begin to demand more high skilled workers and as training programs deliver such skills to new and incumbent workers. A higher proportion of high wage jobs means greater financial stability, standard of living and occupational opportunities for Hawaii's people.

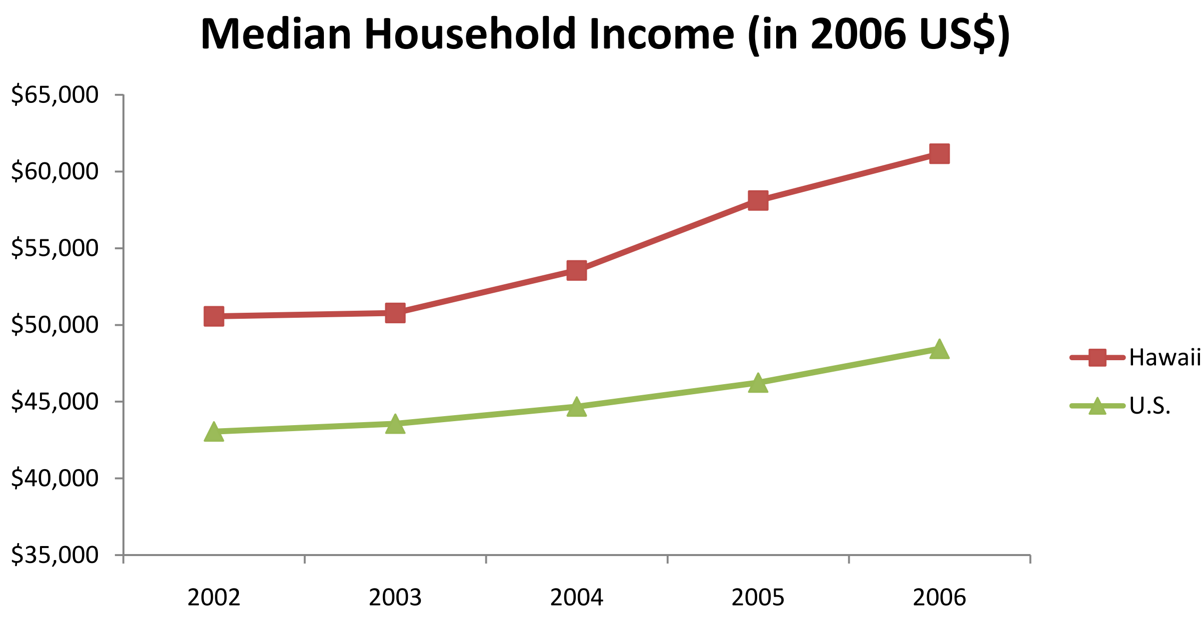
How has Hawaii performed? In 2006 the number of $50,000-and-up earners in Hawaii as a percent of the workforce was about the same as the U.S. Hawaii has shown some improvement in the proportion of workers making $50,000 or more since 2001. The trend peaked in about 2004 at both the Hawaii and U.S. Levels. It is not completely clear what has caused the recent slide in this statistic but it has affected both Hawaii and the U.S. Inflation has increased over the last couple of years and may have outpaced wage increases.

6. Median Income

Median Family Income:



Source: U.S. Census Bureau, American Community Survey, 2000-2006.



Source: U.S. Census Bureau, American Community Survey, 2000-2006.

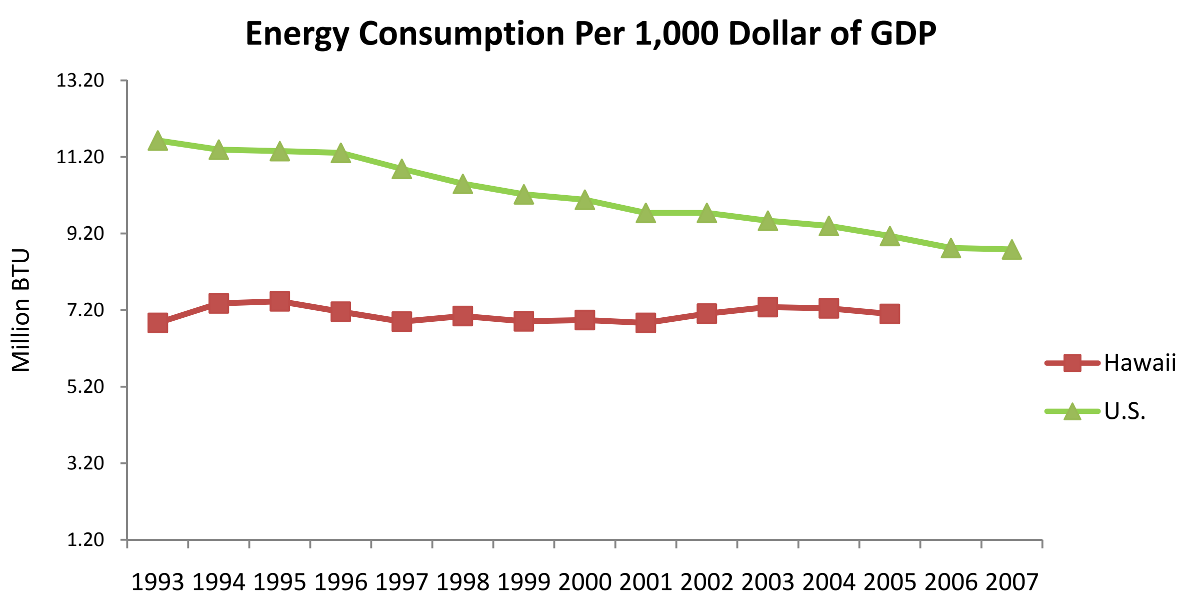
What is this? These two metrics represent the income of the median (middle) household and family in the Hawaii and U.S. economies. In other words there are as many families or households earning above this level as there are earning below this level.

Why is it important? Beyond the self-sufficiency wage it is important to monitor trends for the total income resources at the family and household levels. Median family and household income should also increase as the innovation economy creates better job opportunities.

How has Hawaii performed? Both family and household income in Hawaii has been higher than for the nation in recent years. Hawaii's incomes have also grown somewhat faster.

7. Energy Efficiency

Energy consumption – Million BTUs per $1,000 of real GDP



Source: U.S. EIA and BEA., 1993-2007

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What is this? This is an estimate of the total energy used in Hawaii for a year measured in British Thermal Units (BTUs) divided by real Gross Domestic Product in thousands of dollars.

Why is it important? A particularly important measure to Hawaii is the extent to which innovation activity may be improving the efficient use of energy. Beyond moving to indigenous sources of energy, the only other major way Hawaii can save on rising energy costs is to use less of it, through conservation and better technology.

How has Hawaii performed? Energy use is generally more efficient in Hawaii that nationally. However, Hawaii has shown little improvement in this metric over time. By contrast, the U.S. is becoming increasingly more efficient over time.

IV. Conclusions

In terms of C**apacity for Innovation and Technology**, Hawaii is not yet meeting national standards for most indicators. In education, an important challenge is better preparation of graduates for two and four year college. Hawaii also trails the nation in getting high school graduates into college and keeping them there long enough to get their degrees or certificates. This lack of preparation may be a factor in the lower college-going rate of high school graduates and the lower rate of college freshmen returning for the second year of college.

Research and development efforts exceed national level in the public sector but trail far behind in the private sector. Capital availability is also a challenge. Venture capital investments appear to be miniscule in Hawaii compared to investments nationally. However, with State help, very small firms in Hawaii are doing a better job of securing capital in the SBIR and STTR grant programs. In workforce development, Hawaii is behind in turning out graduates in science and math. While Hawaii is doing a little better than the nation in getting working adults back into post secondary training, it is not likely at a rate that will keep incumbent worker skills at a high, competitive level. Hawaii is behind in attracting skilled workers from abroad, and there is no accounting at this time for efforts to attract skilled, former residents (Kama`aina) back to Hawaii.

Regarding Hawaii's **Innovation Sector and Support Assets**, Hawaii is mostly behind national measures. The technology sector in Hawaii is understandably smaller relative to the nation since Hawaii is not a competitive place for mass manufacturing. Still, there has been little if any increase in the proportion of this sector in the economy over the last five years. However, within the technology sector, there has been relative growth in research and development activity over the last five years, tracking similar increases in proportion at the national level. Creative industry employment is a bright spot in the innovation sector, with a proportion of total jobs well over the national level. However, Hawaii's lead in this area has been slipping in the last three years. Hawaii is also behind the nation in the proportion of high wage jobs as measured by STEM occupations and the pay levels for those jobs, although there are indications that theses gaps are narrowing. Small business startups continue to exceed the national rate, probably driven by Hawaii's stronger economy in recent years.

In terms of the Impact of Innovation and Technology on **Economic Transformation**, the picture is mixed in terms of performance but most current trends are positive. The estimated contribution to economic growth through technology and innovation has been about 43 percent so far this decade, somewhat below the national average of 56 percent. Some of this performance may be reflecting cyclical improvements in efficiency, so the metric needs to be monitored over a longer period of time to see if these gains are from an improved economic structure. Labor productivity has slipped from well above national levels to about the national average in 2006. Some investigation is needed to determine what sectors are contributing or impeding overall productivity growth in Hawaii.

Diversification of the economy has shown improvement over the last several years. Global integration measured by exports is low compared to the nation and has shown little long term growth during the current business cycle as a proportion of the economy. Of course, globalization is more than exports of goods, and efforts are underway to develop both qualitative and other quantitative measures of this concept.

The proportion of workers earning over $50,000 in the state has slowed recently from above the national level to about matching that level. This is possibly the result of a higher inflation rate in Hawaii over the last three years, which drags down the real or constant dollar value. Median household and family income are clearly higher than the respective U.S. medians. Recent inflation has not dampened that differential. However, this metric must be interpreted carefully because of the structural cost-of-living difference between Hawaii and the national average. This tends to make the difference less reliable as an indicator of standard of living.

Finally, Hawaii is more energy efficient than the nation as a whole, but the nation is clearly catching up, while Hawaii has shown little improvement over the last 15 years.

APPENDIX A: Indicator Data Sources and Detailed Tables

Education Attainment & Progress through the Educational Pipeline

Indicator: Public high school graduation rate.

Year	Hawaii	U.S.
1991	75.90	73.70
1992	77.70	74.20
1993	74.90	73.80
1994	75.70	73.10
1995	74.80	71.80
1996	74.50	71.00
1997	69.10	71.30
1998	68.80	71.30
1999	67.50	71.10
2000	70.90	71.70
2001	68.30	71.70
2002	72.10	72.60
2003	71.30	73.90
2004	72.60	74.30
2005	75.10	74.70

Source: U.S. Dept of Education, National Center for Education Statistics, 1998-2005.

Indicator: High school dropout rate.

Year	Hawaii	U.S.
1998	5.20	5.00
1999	5.30	4.80
2000	5.30	5.00
2001	4.50	4.04
2002	5.10	3.60
2003	4.70	3.90
2004	4.80	4.10
2005	4.70	3.90

Source: U.S. Dept of Education, National Center for Education Statistics, 1998-2005.

The following equation is used by the National Center for Education Statistics (NCES) to compute the event dropout rate: $Rg = Dg/Eg$, where Rg = the grade 9–12 dropout rate (rounded to a single decimal place), Dg = the number of grade 9–12 dropouts, and Eg = the grade 9–12 enrollment. Event dropout rates provide a measure of the percentage of students who drop out of school in a single year.

Indicator: SAT Scores of College-Bound Seniors.

Year	Hawaii	U.S.
1999	995	1016
2000	1007	1019
2001	1001	1020
2002	1008	1020
2003	1002	1026
2004	1001	1026
2005	1006	1028
2006	996	1021
2007	990	1017

Source: The College Board, College-Bound Seniors, 1999-2007.

The State Education Data Center (SEDC) of the Council of Chief State School Officers reports a 61% participation rate among Hawaii high school senior test takers compared with 49% nationally. Refer to: http://www.schooldatadirect.org/app/data/q/stid=12/llid=111/stllid=235/locid=12/catid=1024/secid=4610/compid=854/site=pes

Indicator: Percent of high school graduates going directly to college.

Year	Hawaii	U.S.
1992	56.1	54.3
1994	61.7	57.1
1996	62.0	58.5
1998	59.6	57.2
2000	59.8	56.7
2002	49.8	56.6
2004	51.6	55.7
2006	59.8	61.6

Source: National Center for Higher Education Management Systems, 1992-2006.

Indicator: Freshman Retention Rates - First-Time 4-year College Freshmen Returning Their Second Year

Year	Hawaii	U.S.
1995	76.9	74.2
1999	76.4	74.1
2001	72.6	74.1
2002	66.4	73.6
2004	72.2	76.5

Source: National Center for Higher Education Management Systems, 1992-2004.

Indicator: Freshman Retention Rates - First-Time 2-year College Freshmen Returning Their Second Year

Year	Hawaii	U.S.
1995	42.0	55.6
1999	40.2	55.1
2001	43.9	54.1
2002	45.0	54.8

Source: National Center for Higher Education Management Systems, 1992-2004.

Indicator: Bachelor's Degrees Awarded Per 100 HS Graduates 6 Years Earlier

Year	Hawaii	U.S.
1997	40.0	47.5
1998	38.9	47.9
1999	41.5	46.5
2000	41.3	50.2
2001	39.6	48.9
2002	39.4	50.8
2003	44.1	51.8
2004	45.4	51.8
2005	43.1	52.1

Source: National Center for Higher Education Management Systems, 1992-2004.

Indicator: Associate Degrees Awarded as a Percent of High School Graduates Three Years Earlier

Year	Hawaii	U.S.
1996	23.2	21.9
1997	24.9	22.7
1998	28.0	22.1
1999	24.9	21.6
2000	26.9	21.5
2001	24.9	21.1
2002	23.5	21.1
2003	28.9	22.4
2004	28.9	23.4
2005	26.3	24.1

Source: National Center for Higher Education Management Systems, 1992-2004.

Entrepreneurship training

Registrations for Mgt 320 Fundamentals of Entrepreneurship, UH Manoa

Year	Manoa Under Grad Regis-trations (fall)	Registrations for Mgt 320 (fall spring & summer	%
2003-04	13,102	24	0.18%
2004-05	13,693	40	0.29%
2005-06	13,826	79	0.57%
2006-07	13,542	78	0.58%
2007-08	13,417	115	0.86%

Source: UH Shidler College of Business; UH course registration reports.

Indicator: Enrollment in entrepreneurship certificate courses, Kapiolani Community College

Year	Total Student Registration	Entrepreneurship Courses Registration	%
2000	20,300	54	0.27%
2001	21,004	54	0.26%
2002	20,967	42	0.20%
2003	21,783	61	0.28%
2004	20,544	58	0.28%
2005	20,577	68	0.33%
2006	21,000	70	0.33%
2007	21,297	75	0.35%

Source: UH course registration reports.

Indicator: Percent of adults, 25 years and older, with Associate degree & above

Year	Hawaii	U.S.
2000	35.93%	31.45%
2001	35.11%	32.12%
2002	36.27%	32.69%
2003	36.81%	33.52%
2004	37.99%	34.12%
2005	37.68%	34.57%
2006	39.20%	34.38%

Source: U.S. Census Bureau, American Community Survey, PUMS data, 2000-2006.

Research & Development Effort

Indicator: Government, university & nonprofit R&D per $1,000 of GDP

Year	Hawaii	U.S.
1999	6.00	6.56
2000	5.83	6.55
2001	6.06	7.47
2002	8.02	7.04
2003	6.54	7.26
2004	7.14	7.06

Source: National Science Foundation, National Patterns of R&D Resources.

Indicator: Private industry investment in R&D per $1,000 of GDP

Year	Hawaii	U.S.
1999	0.67	19.69
2000	1.04	20.07
2001	2.13	19.58
2002	2.34	17.53
2003	2.85	18.15
2004	2.61	17.26

Source: National Science Foundation, National Patterns of R&D Resources.

Indicator: Patents issued to companies per 1,000 workers

Year	Hawaii	U.S.
1995	0.14	0.49
1996	0.17	0.52
1997	0.15	0.51
1998	0.15	0.66
1999	0.16	0.68
2000	0.15	0.68
2001	0.17	0.69
2002	0.15	0.67
2003	0.16	0.67
2004	0.14	0.64
2005	0.09	0.55
2006	0.16	0.68
2007	0.13	0.61

Source: U.S. Patent Office, Patent Counts by State and Tear, 1977-2007.

Capital Availability

Indicator: Venture capital invested per $1,000 GDP

Year	Hawaii	U.S.
2002	$0.10	2.12
2003	$0.28	1.81
2004	$0.27	1.93
2005	$0.22	1.86
2006	$0.55	2.02
2007	$0.08	2.18

Source: Price Waterhouse Coopers, Moneytree Venture Capital Profiles, 1996-2007.

Indicator: Small Business Innovation Research (SBIR) grant dollars per $1,000 of GDP

Year	Hawaii	U.S.
1997	0.06	0.14
1998	0.07	0.12
1999	0.09	0.11
2000	0.12	0.11
2001	0.08	0.12
2002	0.08	0.14
2003	0.09	0.16
2004	0.29	0.17

Source: U.S. Small Business Administration, *The Small Business Economy, 1997-2004*.

Indicator: Small Business Innovation Research (SBIR) grant dollars per $10,000 of GDP

Year	Hawaii	U.S.
2000	0.02	0.07
2001	0.02	0.06
2002	0.14	0.09
2003	0.17	0.09
2004	0.24	0.18

Source: U.S. Small Business Administration, *The Small Business Economy, 2000-2004*.

Workforce Development

Degrees earned per year in science and technology fields.

Year	%	Total Degrees Earned	Degrees Earned in Science & Tech	Natural Sciences	Sch of Ocean, Earth Science & Tech	College of Engineer -ing	College of Trop Ag & Human Res	School of Medicine
1999	18.44%	3942	727	347	40	148	69	123
2000	18.10%	3603	652	286	42	132	91	101
2001	19.08%	3454	659	283	41	115	87	133
2002	18.46%	4127	762	307	45	150	59	201
2003	19.41%	3859	749	348	54	130	66	151
2004	18.49%	4175	772	358	64	144	75	131
2005	18.27%	4401	804	360	57	161	82	144
2006	18.43%	4313	795	375	56	133	106	125

Source: Degrees Earned by Level, Gender, Field of Study; University of Hawaii at Manoa.

Lifelong Learning

Indicator: Part-Time Undergraduate Enrollment as a Percent of 25-44 Year Olds

Year	Hawaii	U.S.
1990	5.3	6.1
1995	6.3	6.0
1996	6.0	6.0
1997	6.1	6.0
1998	6.1	5.9
1999	6.2	5.9
2000	5.2	6.2
2001	5.8	6.4
2002	6.2	6.5
2003	6.7	6.5
2004	6.7	6.5

Source: National Center for Higher Education Management Systems, 1992-2004.

Indicator: H-1B visa per 1,000 workers

Year	Hawaii	U.S.
1998	1.08	1.75
1999	1.01	2.17
2000	1.19	2.49
2001	1.07	2.67
2002	1.17	2.56
2003	1.23	2.46
2004	1.64	2.62
2005	1.80	2.73
2006	1.84	2.85

Source: U.S. Dept of Homeland Security, Yearbook of Immigration Statistics.

Technology Infrastructure

Indicator: Average internet download speed

Average Internet Download Speed (Mega bits per second)				
	2007	2008		
U.S.	2.0	2.4		
Hawaii	2.0	1.7		

Source: Communication Workers of America, Speed Matters project, www.speedmatters.com

Size and Growth of the Private Technology Innovation Sector

Indicator: Percentage of Jobs in Private Technology Innovation Sector among All Jobs

Year	Hawaii	U.S.
2002	2.7%	4.7%
2003	2.7%	
2004	2.7%	
2005	2.7%	
2006	2.8%	
2007	2.8%	4.8%

Source: Economic Profile of the Technology Industry, Hawaii Science & Technology Council (forthcoming).

Indicator: Growth of Jobs in Private Technology Innovation Sector

Growth in Private Technology Jobs 2002-2007	
Hawaii Pvt. Tech jobs	17.9%
U.S. Pvt. Tech jobs	31.5%

Source: Same as previous table.

Indicator: Percentage of Jobs in R&D among All Jobs

Year	Hawaii	U.S.
2002	0.29%	0.31%
2003	0.31%	
2004	0.32%	
2005	0.34%	
2006	0.34%	
2007	0.36%	0.38%

Source: Same as above.

Indicator: Growth of Jobs in R&D.

Growth in Research and Development Jobs 2002-2007	
Hawaii Pvt. R&D jobs	41.1%
U.S. Pvt. R&D jobs	34.0%

Source: Same as above.

Size and Growth of the Creative Sector

Indicator: Total Employment in Creative Industries as percent of civilian employment

Year	Hawaii	U.S.
2002	2.42%	2.21%
2003	2.32%	2.20%
2004	2.40%	2.18%
2005	2.38%	2.16%
2006	2.32%	2.16%
2007	2.28%	2.17%

(Includes NAICS industries 511,512,515,516,711 and 712)

Source: DBEDT

Highly Trained Technical Workforce

Indicator: STEM Occupation as a percentage of all occupation

YEAR	Hawaii	U.S.
2000	5.97%	8.01%
2001	6.33%	8.05%
2002	6.49%	8.01%
2003	6.93%	8.10%
2004	6.71%	8.26%
2005	6.88%	8.26%
2006	7.37%	8.34%
2007	7.16%	8.44%

Source: Bureau of Labor Statistics, May Occupational Employment and Wage Estimates.

Indicator: Average Earnings in STEM Occupations

Year	Hawaii	U.S.
2000	$42,314	$50,589
2001	$45,305	$53,339
2002	$45,312	$53,990
2003	$42,478	$54,356
2004	$51,726	$57,626
2005	$52,288	$60,045
2006	$49,195	$60,614

Source: U.S. Census Bureau, American Community Survey, PUMS data, 2000-2006.

Technology Diffusion beyond the Technology Sector

Indicator. Proportion of Jobs Outside Technology That Are in STEM Occupations

Year	Hawaii	U.S.
2002	5.43%	5.94%
2003	5.49%	5.90%
2004	5.50%	5.89%
2005	5.50%	5.90%
2006	5.54%	5.91%
2007	5.56%	5.92%

Source: EMSI, Economic Modeling Specialist, Inc. For STEM occupations and technology industries included, see Appendix B.

Entrepreneurial Activity

Indicator: New startup companies per 1,000 workers

Year	Hawaii	U.S.
1999	5.87	4.21
2000	6.15	4.03
2001	6.19	3.79
2002	5.84	4.07
2003	5.97	3.91
2004	5.99	4.36
2005	5.96	4.37
2006	5.93	3.88

Source: U.S. Small Business Administration, *The Small Business Economy, 1999-2006*.

Innovation's Contribution to Growth

Indicator: Estimated proportion of economic growth due to innovation & technical change.

Contributions to Economic Growth				
2001-2006	**Labor**	**Capital**	**Technology/ Innovation**	**GDP**
Hawaii	0.4%	1.6%	1.5%	3.52%
U.S.	0.6%	0.8%	1.8%	3.17%
Source: DBEDT				

Labor Productivity

Indicator: Hawaii and U.S. Labor productivity (Real GDP per worker, in chained 2000 US$).

Year	Hawaii	U.S.
1995	$73,186	$62,324
1996	$71,901	$63,980
1997	$71,305	$66,541
1998	$69,399	$68,496
1999	$68,969	$70,450
2000	$68,739	$71,218
2001	$68,951	$71,835
2002	$70,323	$73,135
2003	$72,304	$74,241
2004	$75,303	$76,185
2005	$76,376	$77,076
2006	$77,917	$78,180

Source: State of Hawaii, Dept of Business, Economic Development and Tourism, Measuring Economic Diversification in Hawaii, February 2008.

Diversification

Indicator: Hachman Diversification Index for Hawaii

Year	All	Nonmanufacturing
1990	0.832	0.903
1991	0.836	0.906
1992	0.839	0.908
1993	0.844	0.914
1994	0.843	0.912
1995	0.843	0.912
1996	0.841	0.908
1997	0.837	0.903
1998	0.835	0.899
1999	0.838	0.898
2000	0.842	0.900
2001	0.847	0.900
2002	0.858	0.907
2003	0.862	0.909
2004	0.866	0.910
2005	0.871	0.915
2006	0.873	0.915

Source: Calculated by DBEDT, based on data from State of Hawaii Data Book; Statistical Abstract of the United States.

Global Integration

Indicator: Merchandise Exports per $1000 of GDP

Merchandise Exports per $1000 of GDP		
	Hawaii	U.S.
2003	$4.52	$66.03
2004	$4.92	$69.99
2005	$4.45	$72.74
2006	$4.68	$78.60

Source: U.S. Department of Commerce, DBEDT adjustments.

High Wage Jobs

Indicator: Percentage of Workers Earned $50,000 or More (in 2006 US$)

Year	Hawaii	U.S.
2001	15.68%	18.54%
2002	17.56%	19.39%
2003	18.70%	19.56%
2004	18.91%	19.98%
2005	18.52%	19.30%
2006	18.12%	18.32%

Source: U.S. Census Bureau, American Community Survey, PUMS data, 2001-2006.

Median Income

Indicator: Median Family Income (in 2006 US$)

Year	Hawaii	U.S.
2002	58,703	51,742
2003	60,647	52,273
2004	63,813	53,692
2005	66,472	55,832
2006	70,277	58,526

Source: U.S. Census Bureau, American Community Survey, 2000-2006.

Indicator: Median Household Income (in 2006 US$)

Year	Hawaii	U.S.
2002	50,565	43,057
2003	50,787	43,564
2004	53,554	44,684
2005	58,112	46,242
2006	61,160	48,451

Source: U.S. Census Bureau, American Community Survey, 2000-2006.

Energy Efficiency

Indicator. Energy Consumption per $1,000 of GDP

Year	Hawaii	U.S.
1993	6.87	11.63
1994	7.38	11.39
1995	7.43	11.35
1996	7.16	11.31
1997	6.90	10.89
1998	7.04	10.50
1999	6.91	10.22
2000	6.94	10.08
2001	6.87	9.74
2002	7.11	9.74
2003	7.28	9.53
2004	7.25	9.40
2005	7.10	9.13
2006		8.82
2007		8.78

Source: U.S. Energy Information Administration (EIA) and U.S. Bureau of Economic Analysis (BEA).

APPENDIX B: STEM Occupations

Code	Occupation	STEM Disciplines
11-3021.00	Computer and Information Systems Managers	Computer Science
11-9011.01	Nursery and Greenhouse Managers	Life Sciences
11-9011.02	Crop and Livestock Managers	Life Sciences
11-9012.00	Farmers and Ranchers	Life Sciences
11-9021.00	Construction Managers	Engineering
11-9041.00	Engineering Managers	Chemistry, Computer Science, Engineering, Geosciences, Life Sciences, Physics/Astronomy
11-9121.00	Natural Sciences Managers	Chemistry, Computer Science, Engineering, Geosciences, Life Sciences, Mathematics, Physics/Astronomy
13-1041.01	Environmental Compliance Inspectors	Life Sciences
13-1051.00	Cost Estimators	Engineering
13-2011.01	Accountants	Computer Science
13-2011.02	Auditors	Computer Science
15-1011.00	Computer and Information Scientists, Research	Computer Science
15-1021.00	Computer Programmers	Computer Science
15-1031.00	Computer Software Engineers, Applications	Computer Science, Engineering
15-1032.00	Computer Software Engineers, Systems Software	Computer Science, Engineering
15-1041.00	Computer Support Specialists	Computer Science
15-1051.00	Computer Systems Analysts	Computer Science
15-1061.00	Database Administrators	Computer Science
15-1071.01	Computer Security Specialists	Computer Science
15-1081.00	Network Systems and Data Communications Analysts	Computer Science
15-1099.99	Computer Specialists, All Other	Computer Science
15-2011.00	Actuaries	Mathematics
15-2021.00	Mathematicians	Mathematics
15-2031.00	Operations Research Analysts	Computer Science, Mathematics
15-2041.00	Statisticians	Life Sciences, Mathematics
15-2091.00	Mathematical Technicians	Mathematics
15-2099.99	Mathematical Science Occupations, All Other	Mathematics
17-1011.00	Architects, Except Landscape and Naval	Engineering
17-2011.00	Aerospace Engineers	Engineering
17-2021.00	Agricultural Engineers	Engineering, Life Sciences
17-2031.00	Biomedical Engineers	Engineering
17-2041.00	Chemical Engineers	Chemistry, Engineering
17-2051.00	Civil Engineers	Engineering
17-2061.00	Computer Hardware Engineers	Computer Science, Engineering
17-2071.00	Electrical Engineers	Engineering
17-2072.00	Electronics Engineers, Except Computer	Engineering
17-2081.00	Environmental Engineers	Engineering
17-2111.01	Industrial Safety and Health Engineers	Engineering
17-2111.02	Fire-Prevention and Protection Engineers	Engineering
17-2111.03	Product Safety Engineers	Engineering
17-2112.00	Industrial Engineers	Engineering
17-2121.01	Marine Engineers	Engineering
17-2121.02	Marine Architects	Engineering

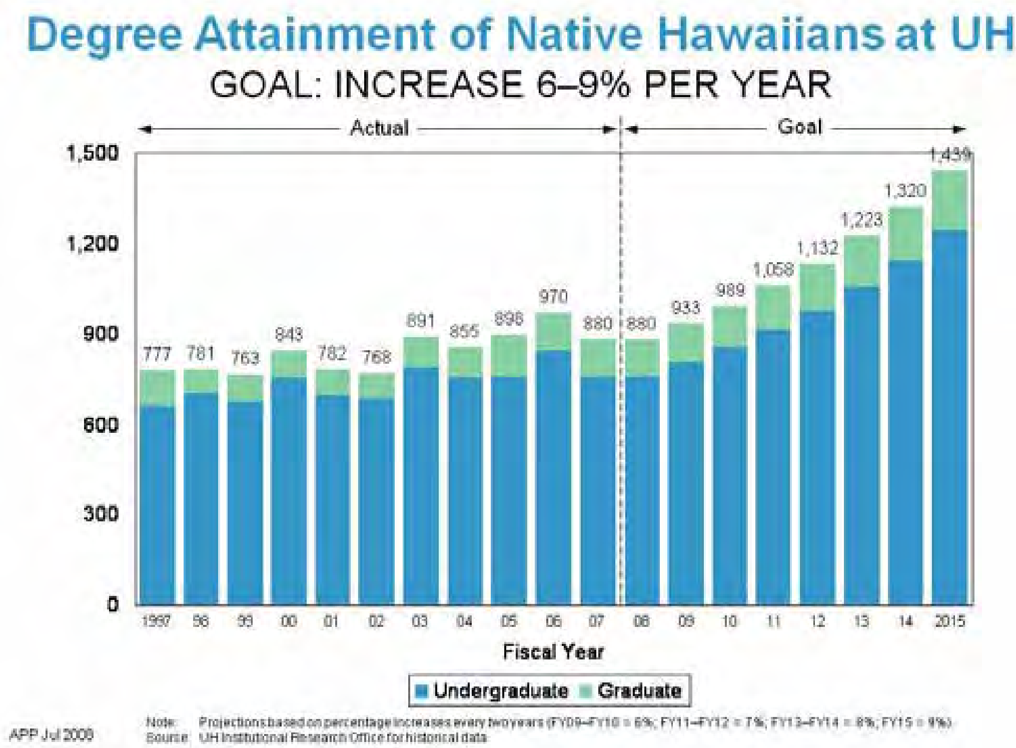
17-2131.00	Materials Engineers	Engineering
17-2141.00	Mechanical Engineers	Engineering
17-2151.00	Mining and Geological Engineers, Including Mining Safety Engineers	Engineering
17-2161.00	Nuclear Engineers	Engineering
17-2171.00	Petroleum Engineers	Engineering
17-2199.99	Engineers, All Other	Engineering, Geosciences
17-3011.01	Architectural Drafters	Engineering
17-3011.02	Civil Drafters	Engineering
17-3021.00	Aerospace Engineering and Operations Technicians	Engineering
17-3022.00	Civil Engineering Technicians	Engineering
17-3023.01	Electronics Engineering Technicians	Computer Science, Engineering
17-3023.03	Electrical Engineering Technicians	Computer Science, Engineering
17-3025.00	Environmental Engineering Technicians	Engineering
17-3026.00	Industrial Engineering Technicians	Engineering
17-3027.00	Mechanical Engineering Technicians	Engineering
17-3029.99	Engineering Technicians, Except Drafters, All Other	Engineering
19-1011.00	Animal Scientists	Life Sciences
19-1012.00	Food Scientists and Technologists	Life Sciences
19-1013.00	Soil and Plant Scientists	Chemistry, Life Sciences, Physics/Astronomy
19-1020.01	Biologists	Life Sciences
19-1021.00	Biochemists and Biophysicists	Chemistry, Life Sciences, Physics/Astronomy
19-1022.00	Microbiologists	Life Sciences
19-1023.00	Zoologists and Wildlife Biologists	Life Sciences
19-1029.99	Biological Scientists, All Other	Life Sciences
19-1031.01	Soil and Water Conservationists	Life Sciences
19-1031.02	Range Managers	Life Sciences
19-1031.03	Park Naturalists	Life Sciences
19-1032.00	Foresters	Engineering, Life Sciences
19-1041.00	Epidemiologists	Life Sciences
19-1042.00	Medical Scientists, Except Epidemiologists	Life Sciences
19-1099.99	Life Scientists, All Other	Life Sciences
19-2011.00	Astronomers	Physics/Astronomy
19-2012.00	Physicists	Mathematics, Physics/Astronomy
19-2021.00	Atmospheric and Space Scientists	Physics/Astronomy
19-2031.00	Chemists	Chemistry, Physics/Astronomy
19-2032.00	Materials Scientists	Engineering
19-2041.00	Environmental Scientists and Specialists, Including Health	Environmental Science
19-2042.00	Geoscientists, Except Hydrologists and Geographers	Geosciences
19-2043.00	Hydrologists	Geosciences
19-2099.99	Physical Scientists, All Other	Engineering, Life Sciences
19-4011.01	Agricultural Technicians	Life Sciences
19-4011.02	Food Science Technicians	Life Sciences
19-4021.00	Biological Technicians	Life Sciences
19-4031.00	Chemical Technicians	Chemistry, Life Sciences
19-4051.01	Nuclear Equipment Operation Technicians	Engineering, Physics/Astronomy
19-4051.02	Nuclear Monitoring Technicians	Engineering, Physics/Astronomy
19-4091.00	Environmental Science and Protection Technicians, Including Health	Environmental Science

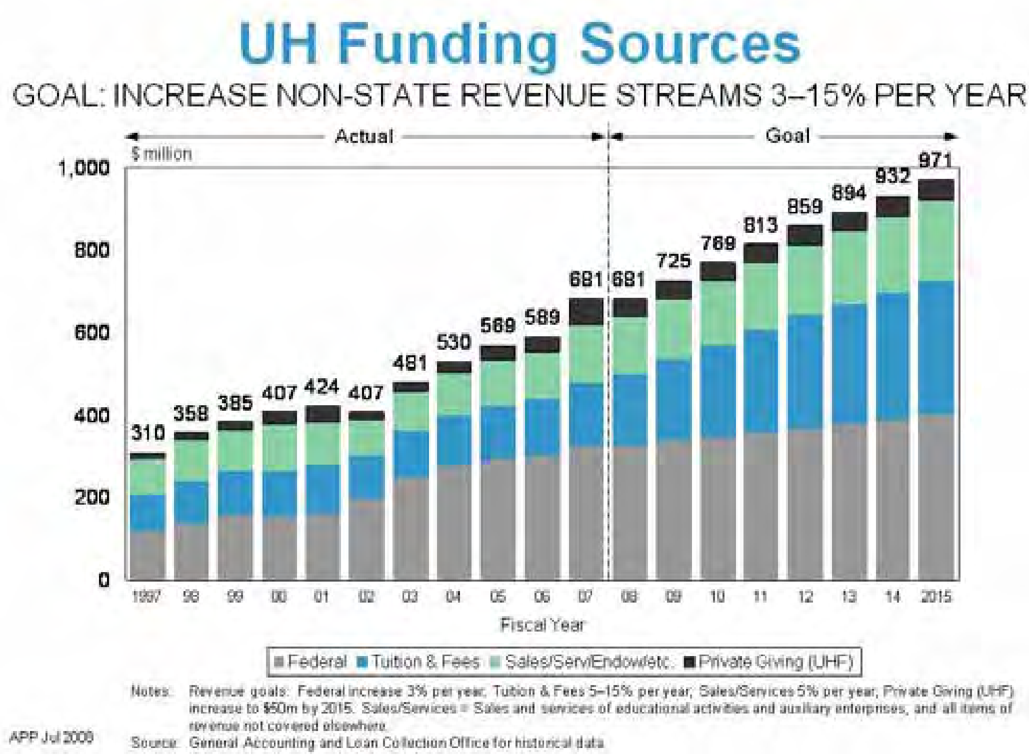
19-4093.00	Forest and Conservation Technicians	Life Sciences
19-4099.99	Life, Physical, and Social Science Technicians, All Other	Environmental Science
25-1011.00	Business Teachers, Postsecondary	Computer Science, Mathematics
25-1021.00	Computer Science Teachers, Postsecondary	Computer Science
25-1022.00	Mathematical Science Teachers, Postsecondary	Mathematics
25-1031.00	Architecture Teachers, Postsecondary	Engineering
25-1032.00	Engineering Teachers, Postsecondary	Chemistry, Computer Science, Engineering, Geosciences, Life Sciences, Physics/Astronomy
25-1041.00	Agricultural Sciences Teachers, Postsecondary	Life Sciences
25-1042.00	Biological Science Teachers, Postsecondary	Life Sciences
25-1051.00	Atmospheric, Earth, Marine, and Space Sciences Teachers, Postsecondary	Geosciences, Mathematics, Physics/Astronomy
25-1052.00	Chemistry Teachers, Postsecondary	Chemistry, Geosciences
25-1053.00	Environmental Science Teachers, Postsecondary	Environmental Science
25-1054.00	Physics Teachers, Postsecondary	Mathematics, Physics/Astronomy
25-1071.00	Health Specialties Teachers, Postsecondary	Life Sciences, Physics/Astronomy
25-1192.00	Home Economics Teachers, Postsecondary	Life Sciences
25-9021.00	Farm and Home Management Advisors	Life Sciences
27-1024.00	Graphic Designers	Computer Science
29-1031.00	Dietitians and Nutritionists	Life Sciences
29-2033.00	Nuclear Medicine Technologists	Physics/Astronomy
29-2051.00	Dietetic Technicians	Life Sciences
33-3031.00	Fish and Game Wardens	Life Sciences
35-1012.00	First-Line Supervisors/Managers of Food Preparation and Serving Workers	Life Sciences
35-2012.00	Cooks, Institution and Cafeteria	Life Sciences
45-1011.06	First-Line Supervisors/Managers of Aquacultural Workers	Life Sciences
45-1011.07	First-Line Supervisors/Managers of Agricultural Crop and Horticultural Workers	Life Sciences
45-1011.08	First-Line Supervisors/Managers of Animal Husbandry and Animal Care Workers	Life Sciences
45-2021.00	Animal Breeders	Life Sciences
45-3011.00	Fishers and Related Fishing Workers	Life Sciences
45-4011.00	Forest and Conservation Workers	Engineering, Life Sciences
45-4021.00	Fallers	Life Sciences
45-4022.00	Logging Equipment Operators	Life Sciences
45-4023.00	Log Graders and Scalers	Life Sciences
49-3023.01	Automotive Master Mechanics	Engineering
49-3023.02	Automotive Specialty Technicians	Engineering
51-2023.00	Electromechanical Equipment Assemblers	Engineering
51-3092.00	Food Batchmakers	Life Sciences
51-4012.00	Numerical Tool and Process Control Programmers	Computer Science
51-8091.00	Chemical Plant and System Operators	Chemistry
51-9011.00	Chemical Equipment Operators and Tenders	Chemistry
53-6051.07	Transportation Vehicle, Equipment and Systems Inspectors, Except Aviation	Engineering

Source: Bureau of Labor Statistics, 2008.

APPENDIX C: Outcome and Performance Measures, University of Hawaii System, 2008 to 2016

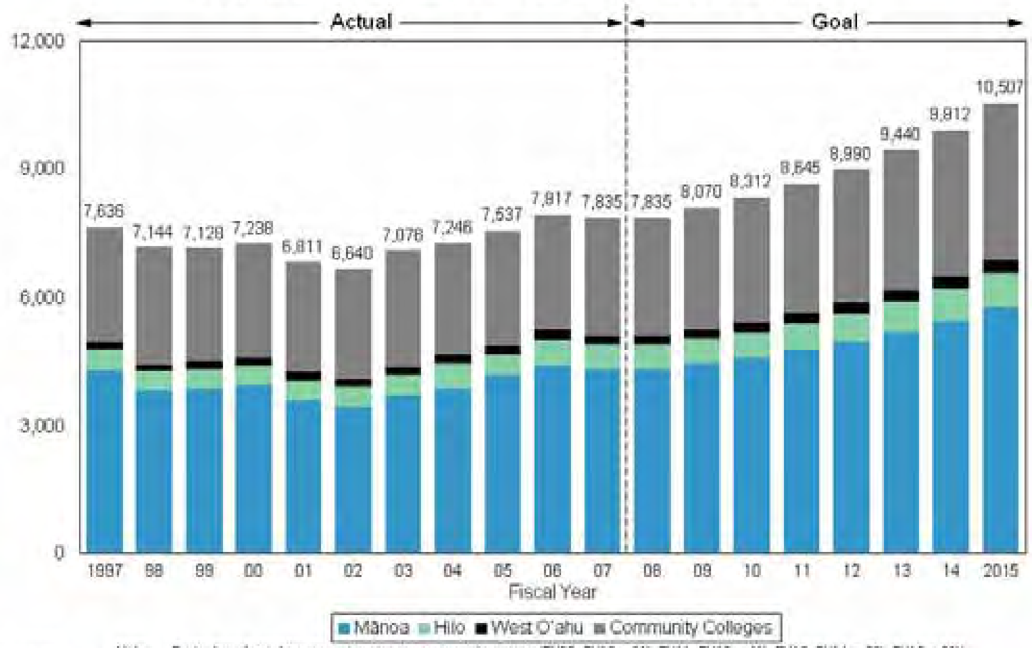
(Provided courtesy of the University of Hawaii System Office of Academic Policy and Planning)





UH Degrees & Certificates of Achievement Earned

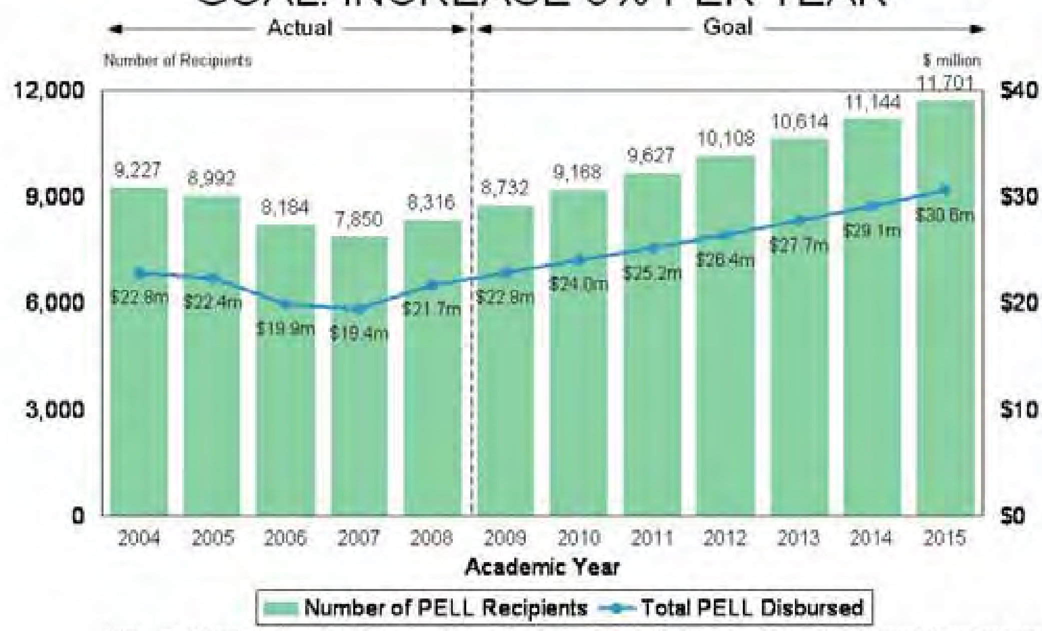
GOAL: INCREASE 3–6% PER YEAR



Note: Projections based on percentage increases every two years (FY09–FY10 = 3%; FY11–FY12 = 4%; FY13–FY14 = 5%; FY15 = 6%).

UH Disbursement of PELL Grants

GOAL: INCREASE 5% PER YEAR



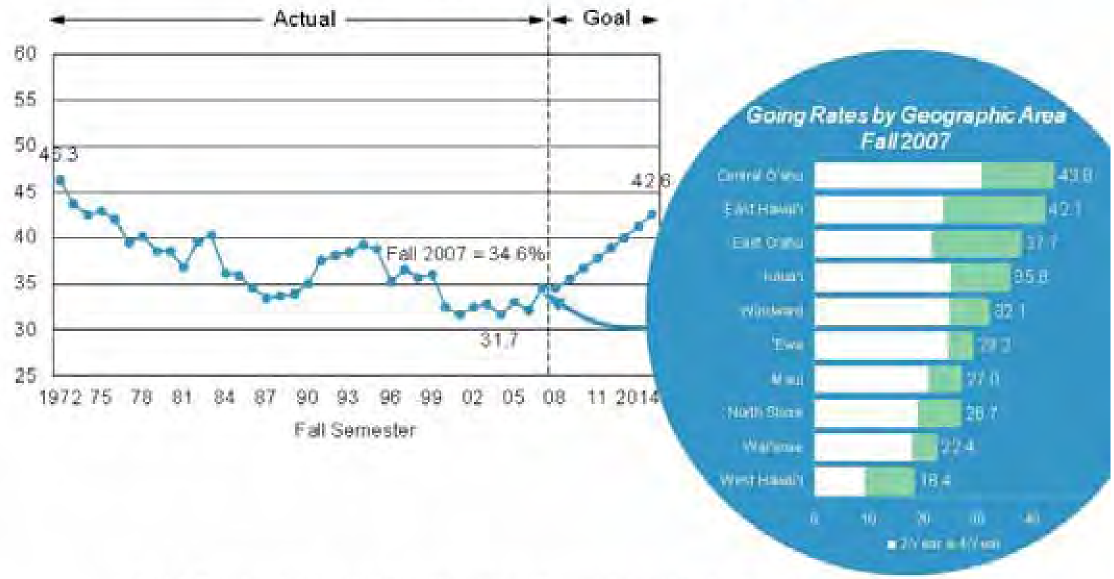
Notes: The Federal Pell Grant program provides need-based grants to low-income, first-time undergraduate students or students enrolled in certain post-baccalaureate programs that lead to teacher certification or licensure. The maximum award for the 2008–09 award year (July 1, 2008 to June 30, 2009) is $4,731.
AY08 figures are estimated. Average amount awarded: AY04, $2,471; AY05, $2,490; AY06, $2,437; AY07, $2,477; AY08, $2,613.

APP Jul 2008

Source: UH Office of Student Affairs for historical data

Going Rates of Public and Private High Schools, UH System

GOAL: INCREASE 3% PER YEAR

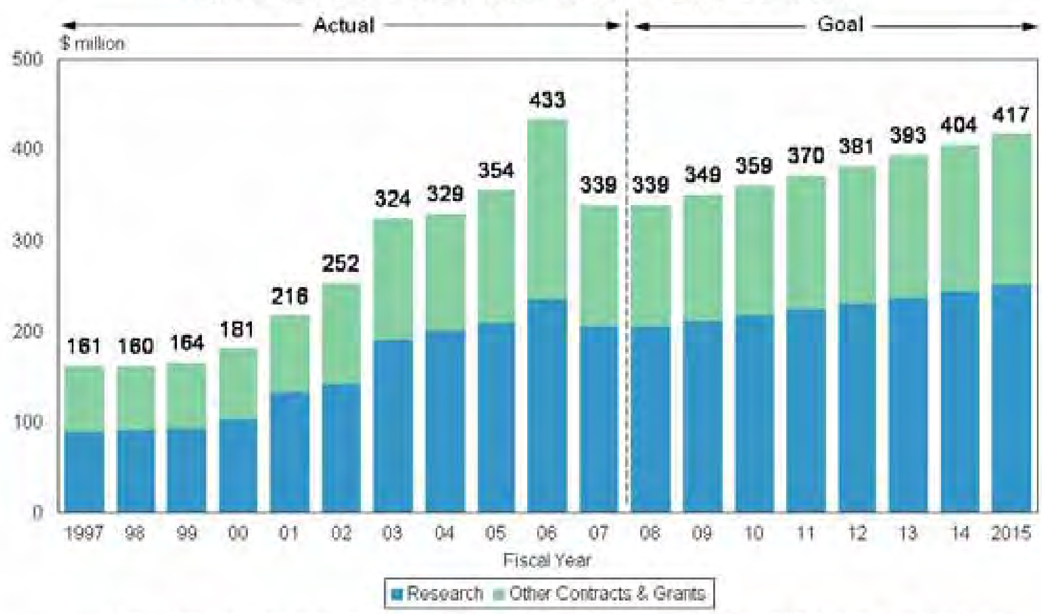


Notes: The going rate is the percentage of Hawai'i high school graduates entering the University of Hawai'i without delay upon graduation from high school.

APP Jul 2008 Source: UH Institutional Research Office for historical data

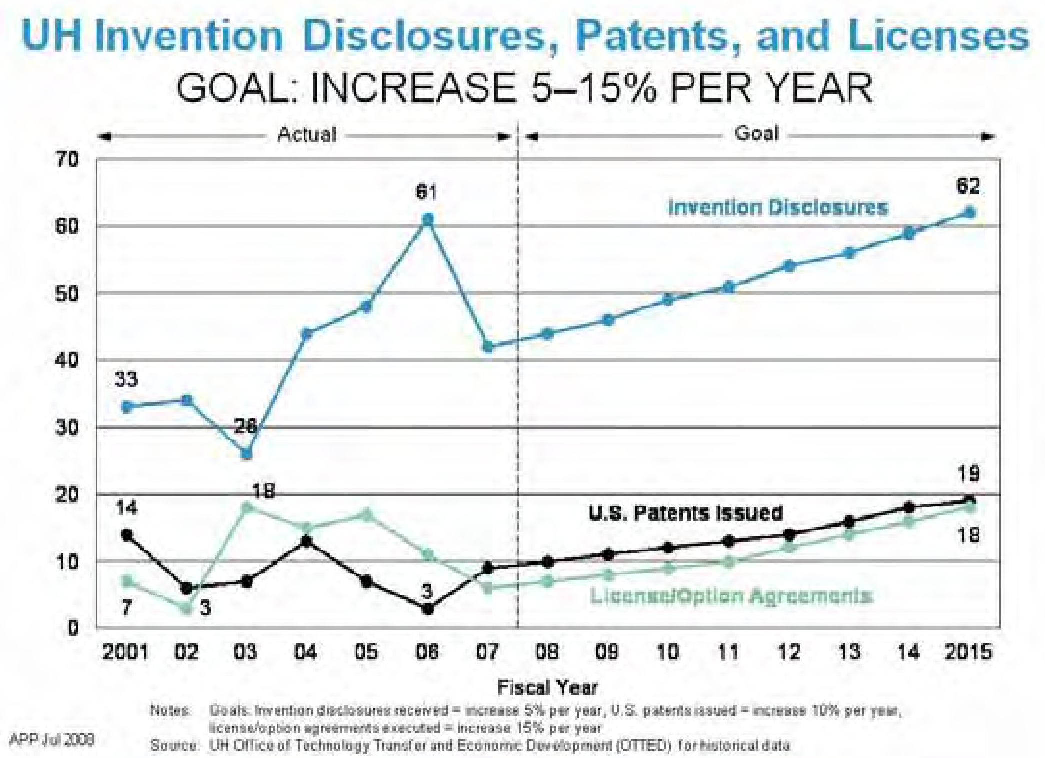
UH Extramural Fund Support

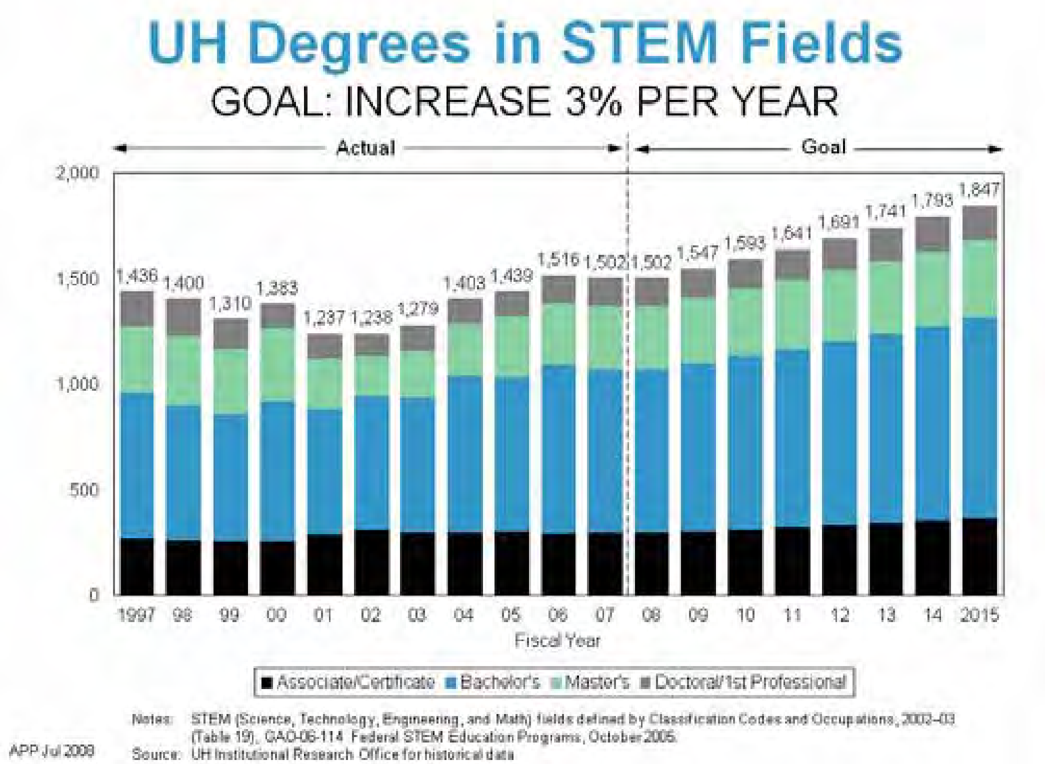
GOAL: INCREASE 3% PER YEAR



Note: Other contracts and grants includes training, instrumentation, building improvements, conferences, centers, boat operations, art and dance performances, etc.

APP Jul 2008 Source: UH Office of Research Services for historical data


UH Invention Disclosures, Patents, and Licenses
GOAL: INCREASE 5–15% PER YEAR
Actual
Goal
Invention Disclosures
U.S. Patents Issued
License/Option Agreements
Fiscal Year
Notes: Goals: Invention disclosures received = increase 5% per year, U.S. patents issued = increase 10% per year, license/option agreements executed = increase 15% per year
Source: UH Office of Technology Transfer and Economic Development (OTTED) for historical data
APP Jul 2008


UH Degrees in STEM Fields
GOAL: INCREASE 3% PER YEAR
Actual
Goal
Fiscal Year
Associate/Certificate
Bachelor's
Master's
Doctoral/1st Professional
Notes: STEM (Science, Technology, Engineering, and Math) fields defined by Classification Codes and Occupations, 2002–03 (Table 19), GAO-06-114 Federal STEM Education Programs, October 2005.
Source: UH Institutional Research Office for historical data
APP Jul 2008