

The Knowledge Economy Has Arrived: Now What Do We Do?
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Thank you for the opportunity to be part of your meeting today. I was a member of SCUP early in my career before I took a wrong turn, and it is good to be back among you. Before I took that wrong turn I was employed by the Illinois Board of Higher Education. One day at the IBHE Joan Racki walked in off the street looking for a job. Her master's degree in international studies (and obvious intelligence and work ethic) seemed perfect preparation for a job in facilities planning and budgeting. It is a great pleasure to be here today with her and with Jay Kahn, another Board of Higher Education alumnus.

My current job is connected to my experience at the Illinois Board of Higher Education. SHEEO is the national association of the CEOs of statewide governing or coordinating boards. These men and women work at the interface of public policy and higher education. The role of the SHEEO association is to help them and the states successfully advance the public's interest in higher education. We focus primarily on public needs and public policy, and we find ourselves speaking both to policy makers and institutional leaders about their responsibilities in meeting public needs.

I have been asked to talk today about current issues and emerging trends in higher education. Before getting into the meat of the presentation, I'd like to make a distinction between being a planner and a "futurist." I've never had much use for "futurists." The ratio between their self-confidence and knowledge seems too high to me. It is an honor to be among planners.

So without claiming prophetic powers, let me share some information about trends which I believe have important implications for the future of higher education.

I want to begin with a quick review of Tom Friedman's best selling book, *The World is Flat*. Friedman's title, of course, is a play on words. He means to say the "playing field" of the world economy has become more "flat," rather than being tilted so much in favor of more developed economies like the United States, Japan, and Western Europe. Friedman identifies ten forces that are "flattening" the world. They are:

- 1. Fall of Berlin Wall 11/9/89**
- 2. First Mainstream Web Browser – Netscape goes public, 8/9/95**
- 3. Work Flow Software – Standardized applications, Pay-pal (e-Bay), et al**
- 4. Open Sourcing – Apache Adobe readers, LINEX**
- 5. Outsourcing – Y2K, spin off functions to India**
- 6. Offshoring – China in the WTO, capital flows to find cheap labor**
- 7. Supply-chaining – Wal-Mart retailer to manufacturers**
- 8. Insourcing – UPS services linked to shipping**
- 9. In-forming – "Google-like" intelligent searches and data mining**
- 10. "The Steroids" Wireless Mobile Digital Communication**

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Some think Friedman downplays the negative aspects of globalization and undervalues the important and essential roles of governments in the world economy. These are legitimate reservations, but they do not diminish his achievements. Friedman has grasped and masterfully articulated powerful forces that are dramatically changing the world.

The “world flattening forces” Friedman writes about are based in the global transformation from a manufacturing economy concentrated in a few countries to a knowledge economy which, empowered by information technology and the internet, has the potential to spread throughout the world. The forces driving this transformation have been with us for decades. The late Peter Drucker apparently first used the phrase, the “knowledge economy” in his 1968 book, *The Age of Discontinuity*. Thirty three years later, in November 2001, Drucker wrote a special survey in *The Economist* entitled “The Next Society,” which includes these words:

“The next society will be a knowledge society. Knowledge will be its key resource, and knowledge workers will be the dominant group in its workforce. Its three main characteristics will be:

- *Borderlessness, because knowledge travels even more effortlessly than money.*
- *Upward mobility, available to everyone through easily acquired formal education.*
- *The potential for failure as well as success. Anyone can acquire the “means of production,” i.e. the knowledge required for the job, but not everyone can win.”*

I have the greatest respect for Peter Drucker, but I take exception to one of his predictions, which would have dire consequences for people in your line of work. In 1997 Drucker predicted in *Forbes Magazine* that technology would make large universities of brick and mortar obsolete within 30 years.

Steve Portch, a friend of mine, has suggested that Drucker must never have lived with a teenager. By the time they reach the age of 18 teenagers desperately want to leave home, and their parents desperately want them out of the house. Sending them to a college with bricks and mortar is an attractive option.

But without question the “knowledge economy” and Friedman’s “flat world” have profound implications for every country, for the sustainability and quality of human life on the planet, and for higher education.

Let me summarize a few of the broader implications as they appear to me.

- First, geography and natural resources are likely to become even less important as a source of wealth and economic advantage – not irrelevant, but less important. Being in a community of talented people may be more important than being located close to natural resources or easy transportation.
- Second, the availability of cheaper labor will continue to be advantageous, but only temporarily. Jobs are likely to move across borders faster than ever before. Many manufacturing jobs have moved from the U.S. “rust belt,” to the U.S. south, then to Mexico, and then to China. Eventually

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manufacturing jobs are likely to move from China to other less-developed countries.

- Third, the national economies that now lead the world are likely to become relatively less significant. Brazil, Russia, India, and China are growing much more rapidly than the U.S., England, France, Germany, Italy, and Japan.
- Fourth, higher education *should* become less of an elite enterprise; a much larger fraction of the world population will need higher education. Furthermore, “mass” higher education with lower standards of quality will not work. Everybody will not need or achieve a four-year degree, but many more people must be educated to a higher standard than previously required. Achieving this goal will require both more effective education of disadvantaged groups and social policies to enable them to pay the costs of higher learning.
- Fifth, people are likely to obtain higher education throughout life, both as an economic necessity and as “consumer good.” Many young are likely to make the transition from adolescence to adulthood in “brick and mortar” colleges and universities, but this will not be the end of their higher education.
- Sixth, the “means of production” in higher education and the providers of higher education will continue to become more diverse. More and more we are likely to employ technology to reduce costs and increase effectiveness, new providers will spring up to serve emerging markets, and established providers will diversify their services. (This is, of course, the continuation of a long trend. In my office library I found a book entitled, *Presidents Confront Reality: From Edifice Complex to University Without Walls*. It was published 30 years ago, in 1976.)
- Seventh, the diversity of knowledge providers and delivery systems is putting more pressure on postsecondary systems to assure quality and promote improvement. Qualifications frameworks and new approaches to accreditation and the assessment and certification of learning seem likely.
- Eighth, the growing importance of educational attainment will require much stronger relationships between elementary, secondary, and postsecondary education. We must develop, stronger, more meaningful P-20 relationships in standards, professional development, and data systems.
- Ninth, higher education in the United States will continue to be a high social and political priority, but the economic stress of an aging population, health care costs, growing deficits, and resistance to tax increases will require colleges and universities to increase productivity substantially in order to meet national goals.
- Tenth, economic growth, population growth, and rising living standards will severely challenge world ecosystems, and those challenges will, in turn, challenge social and political systems. We must increase the scope and effectiveness of education so people and our political systems can deal more effectively with such challenges, and we will become even more desperately dependent on innovative research to advance technology, increase energy efficiency, and ameliorate disease.

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While I must necessarily be brief, I want to focus the rest of my comments on six of these observations: the re-alignment of national economies, the imperative for mass higher education, the need for enhanced quality assurance and improvement mechanisms, the need for stronger P-20 relationship, the need for increased educational productivity, and challenges to the world ecosystem.

The growth and projected re-alignment of national economies

Most of us remember when world economic and monetary policy was “set” by the group of five. Then it became the G-7 and the G-8, and last month the G-20 met in Pittsburgh and announced that it would henceforth be the body setting world economic policy.

A couple of years ago Goldman Sachs projected that by 2050 China will have a Gross Domestic Product of \$44 trillion and India’s GDP will be \$28 trillion. China’s economy is projected to be larger than the projected size of the U.S. economy (\$35 trillion), and India is projected to be not far behind. As you can see from the slide, phenomenal growth rates are projected for China and India, actually faster for India than China, where GDP is projected to increase 46 times over the current level in the next 44 years.

GDP per capita in the U.S. is projected still to be substantially higher than in China or India, but the relative advantage of the U.S. will shrink substantially. Today GDP per capita in the U.S. is 30 times larger than GDP/capita in China and 70 times larger than GDP/capita in India. By 2050 Goldman Sachs projects the U.S. advantage will shrink to 2.7 : 1 over China and 4.8 : 1 over India.

Together, by 2040 the aggregated economies of Brazil, Russia, India, and China (BRIC) are projected to be larger than the aggregated economies of the G-6, the U.S., U.K. France, Germany, Japan, and Italy. Of course, the economies of many countries not on this list will also be growing rapidly during the next 45 years.

In essence, the rest of the world has embraced the recipe for social and economic progress used by the United States in the last half of the 20th century: A well-educated workforce, research and development, and a competitive, market economy governed by fair laws.

(Source: Goldman Sachs, cited in a presentation by Anthony Carnevale, American Association of Colleges and Universities, January 26, 2006.)

The imperative for “mass” higher education

Geoffrey Colvin, a writer for Fortune, recently observed that workers in the United States and Western Europe are now the most expensive in the world. Because business can now meet many needs by outsourcing and offshoring, expensive workers must find a way to be worth what they cost. For the U.S. this challenge is clear; to maintain its standard of living, the people of the United States must be among the best educated workers in the world.

Why is this essential? Capital is speeding around the globe looking for cheaper labor, and lower-cost workers around the world are acquiring more knowledge and skill. Manufacturing now accounts for

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about 15% of jobs in the United States, and its share of employment has shrunk more or less continuously for decades. While some components of the rapidly growing services sector (nursing, for example) are place bound, entrepreneurs have ingeniously discovered ways of providing a surprising range of services remotely. Using the telephone, technicians in India have helped me repair the wireless card on my computer. Other Indian professionals provide legal services and interpret X-rays for clients in the U.S.

The rest of the world has learned the recipe the U.S. used for economic prosperity in the last half of the 20th century: 1) Combine a well-educated workforce with investment in R&D; 2) Marinate in a competitive market economy governed by fair laws; and 3) Stir gently and continuously.

The first ingredient in this “recipe” is a “well-educated workforce.” U.S. educators have frequently claimed to lead the world’s finest system of higher education. Until recently most indicators supported the claim. The leading U.S. research universities were (and still are) global leaders, and the U.S. *has* had the world’s most educated workforce and the world’s highest participation rate in higher education.

The danger for the United States in the 21st century is complacency. Other nations have “gone to school” and observed what the United States achieved in the past 50 years. Since 1990 they have dramatically improved educational attainment, while we have not. They are working vigorously to develop the scientific and technological prowess they need to compete with the United States. If we don’t change what we do, their momentum and our stagnation will eventually relegate the American people and the American economy to second tier status. A good many nations in Europe and Asia have approached or surpassed the U.S. in educational attainment for young people under the age of 35.

And while the rate of participation in India and China is far below that in the U.S., the numbers of college-educated workers (and engineers) in those countries far exceeds the U.S. total.

A few years ago I heard a talk by Yang Jin, Deputy-Director General in the Department of Basic Education in the Ministry of Education for the People’s Republic of China. I was struck by both the ambition of China’s education plans and the sophistication of his thinking about what is required for achieving their goals.

His data show China has nearly achieved a 20% participation rate of young adults in higher education. China’s ambition is to achieve 100% education through the high school level by 2020. To achieve more widespread educational attainment, he said China is:

- Making instruction more student centered rather than teacher centered;
- Focusing on creative thinking, individual differences, students with learning difficulties, and value-added instruction; and
- Making teacher professional development a high priority.

In the United States the decreasing value of a high school education has motivated youth to increase their educational aspirations. Of high school sophomores 72% say they plan to obtain a baccalaureate degree and 36% aspire to a graduate or professional degree. These aspirations are directly related to changes in the U.S. and the world economy.

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In 1973 we had a labor force of 91 million employees. High school dropouts held 32% of those jobs and high school graduates held 40%, for a total of 72%. This was 66.4 million jobs in the 91 million workforce.

The other 24.6 million jobs (26% of the total) were held by college graduates (16%) and people with some college (12%.)

Thirty-four years later, in 2007 we had a labor force of 154 million employees. Only 11% of those jobs were held by high school dropouts, and 30% were held by high school graduates. Their share of the workforce dropped from 72% to 41% in 34 years. Their share happens to be 64 million jobs in 2007, slightly fewer than existed in 1973.

By comparison, the number of jobs held by people with college degrees or some college jumped from 24.6 million in 1973 to 91 million in 2007. These people now account for 51% of employees. All the job growth in the past 37 years has been in jobs filled by people with some postsecondary education. (Source: Anthony Carnevale.)

It would be fair to ask whether the economy really needed all that education. An economist would say the best test of need is what businesses are willing to pay. Since 1975 the average earnings of high school dropouts and high school graduates have dropped in real terms (by 15% for dropouts and by 1% for graduates.) Real earnings have increased by 19% for college graduates.

Before the 2008 presidential election the State Higher Education Executive Officers sent a letter to both candidates calling for Presidential leadership to make regaining world leadership in higher education a national priority. Both candidates responded favorably to that call, and President Obama has followed through with initiatives to implement many of our recommendations. Some of these have already been enacted, and others are likely to be considered in the near future.

While improving higher education requires the moral and material support of the federal government, this is not primarily a job for the federal government. A lot of the work, in fact most of the work, must be done at the state, local, and institutional levels. We must step up to the challenge.

The key issues are straightforward. Over the next 16 years we must generate an average of one million more degrees per year in order to have 55% of our workforce with a postsecondary credential – a reasonable projection for what will be required to be second to none, since three nations are already above 50%. (The U.S. is now at 40%.)

We also must continue to attract and retain well-educated people from other countries. In the recent past we have imported 350,000 postsecondary degree holders every year. We must continue to let talented people come to the United States, and we must make it easy for them to participate in our educational system, our economy, and our culture.

Some SHEEO members asked how we could conceivably generate 16 million more postsecondary degrees by 2025. That is a reasonable question, so we developed one scenario, which produced some interesting insights. We can get 30% of the way by gradually, but steadily increasing the rates of high school graduation, college participation, and college graduation by ten percentage points. This is

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ambitious, but it is feasible. While strengthening success rates in high school and college is essential for building a durable educational foundation, it is sobering to realize that in sixteen years we can get *only* 30% of the way to a 55% attainment rate by improving the pipeline.

The remaining degrees (over 10 million) must come by providing more postsecondary education to the 17 million adults from the age of 25 to 44 who have some college, but no credential, and the 22.7 million high school graduates 44 or younger, who have not gone to college. About a quarter of this population can and should get a postsecondary credential.

It goes without saying, but let me say it anyway – we need more degrees with no compromise on quality. We have to be deadly serious about student learning, and we need to improve the knowledge and skills of *all* students, the gifted, the average, and the academically challenged.

So **who** must become better educated? This is obvious: those who currently are less-well educated – the poor, the children of the less-well educated, those who for any reason (poverty, race, ethnicity, or recent immigration to the United States) tend not to participate and thrive in postsecondary education.

The college participation rate is high for students from high socio-economic status families, regardless of academic ability and preparation. The college participation rate is substantially lower for students from low socio-economic status families, even when they are high in academic ability and preparation. *Source: Access Denied*, Department of Education, February 2001 (see Figure 1).

The college graduation rate is even more dramatically influenced by socio-economic status. This chart from Tony Carnevale's recent article in *Liberal Education* analyses data from the National Education Longitudinal Study to examine the graduation rate at a BA or higher by SES and SAT score. Low SES students at every level of academic ability obtain the baccalaureate degree at a substantially lower rate than students with higher SES and comparable SAT scores. ("A Real Analysis of *Real Education*," Anthony P. Carnevale, *Liberal Education*, Fall, 2008, pp. 54-61.)

The most dramatic and worrisome differences are for average students, those with an SAT score between 800 and 1200, roughly plus or minus one standard deviation from the average of 1000. Roughly 60% of high SES students in the average ability group obtain a BA or higher degree. About 40% of students in the second quartile of SES with average academic ability obtain a BA or higher, and fewer than 20% of average ability students in the lowest quartile of SES obtain a BA or better.

More attainment, no compromise on quality, *higher* quality

Some people seem to assume that the current level of educational attainment is the best we can do. The data I've just shared, and all the rest of my life experience, convince me we have a long way to go before we exhaust the learning capacity of the human race. But grade inflation, or degree inflation won't substitute for authentic knowledge and skill. Quality assurance is a concern.

This issue has been around for a long time. We used to solve it by looking at inputs, faculty quality, library books, facilities, etc. That doesn't work so well for on-line instruction. And people have noticed accredited institutions sometimes have poor graduation rates, and even graduating students sometimes seem inadequately educated. Others have argued that we over-emphasize seat-time over learning; we

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should measure student competencies, not institutional prestige. I don't know who first said it, but you've probably heard the sound bite: Time is the constant, learning the variable.

The Bologna Process in Europe is an effort to achieve common definitions of degrees and ease transferability among countries. Qualifications frameworks – definitions of what level of skill and knowledge must be required for different degrees – are being established around the world. And faculty from different institutions, even in the United States, are working to “tune” their courses and requirements to harmonize with the standards they share.

LEAP, Liberal Education and America's Promise, an initiative of the Association of American Colleges and Universities, has broadly outlined the learning outcomes people need to thrive and be productive, responsible citizens in the 21st century, and is challenging institutions and students to pursue them. The Voluntary System of Accountability (APLU and ASSCU), the Voluntary Framework of Accountability (the community college version under development), and NAICU's U-CAN framework are all efforts to focus on learning and student success.

These are not easy problems, but the urgency of addressing them is growing. Accreditation shopping is a hot issue, and the federal government has proposed rules to tighten “institutional integrity” controls for Title IV eligibility. The accrediting associations are being pressed to come up with some new ideas. The student credit hour has been the coin of the realm; I don't know how much longer that will work.

Stronger relationships between elementary, secondary, and postsecondary education

It is difficult, no it is impossible to increase authentic postsecondary educational attainment on a weak foundation of elementary and secondary education. A lot of us in higher education have blamed K-12 education for our problems, and guess what, K-12 educators have been known to blame higher education for teachers who don't know their subject matter and principals who can't lead.

We are completely, utterly interdependent with K-12 education. Its success is essential for our success, and K-12 cannot succeed if we don't do our part.

The Chief State School Officers and National Governors association have launched an initiative to create internationally benchmarked, common academic standards in math and English, and encourage states to adopt them voluntarily. This coming year several groups will be working to create common assessments for these standards. Higher education leaders have been involved in this process, and we need to stay involved in order to build the consensus needed for this initiative to succeed.

Another initiative underway will develop a model of common data standards for K-12 and higher education in order to improve the consistency and comparability of information about students as they move through our educational system and enable schools and colleges to give each other feedback about student success. Both these efforts are seeking to develop more useful “language” for communicating about important educational issues, without creating excessive standardization of things where there should be freedom for innovation and creativity.

Finally, let me say a word about teacher and school leader education and continuing professional development. I believe we have a working consensus about what needs to be done in this area, but we

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are finding it difficult to overcome the inertia of the status quo. If we make this a priority in postsecondary education, we will improve the quality of our students in the future and gain enormous public good will and credibility.

Why must higher education in the U.S. become more productive?

The short answer is: We need more educated people and better educated people, and we are short of extra money. First let me share some information on state support for higher education, enrollment trends, per student state support, and net tuition per student.

In another context Samuel Johnson wrote, “Depend on it sir, when a man knows he will hang in a fortnight, it concentrates his mind wonderfully.” The current recession seems to be concentrating minds in higher education, and that is a good thing. We are a quite a ways from the gallows, however. I’d like to describe some serious challenges while arguing that perspective on the long term trends provides room for optimism.

First, let’s take a look at state funding in the simplest terms. From 1961 to 2008 state funding grew from \$1.4 billion to \$85.2 billion. The rate of increase has been pretty dramatic every decade. Even over the past eight years, arguably one of the toughest periods for higher education in the U.S., state funding grew from \$61 to \$85 billion.

Of course, one should consider enrollment growth and inflation in looking at state funding. This chart shows constant dollar, per student funding for 25 years, 1983 to 2008. Enrollments grew from about 7.4 million to 10.4 million, state support per student varied from a low of about \$6500 to a high of about \$7800 in 2008 dollars, and constant dollar net tuition grew steadily from about \$2000 in 1983 to \$4000 in 2008. Total educational revenues from states and tuition hovered around \$10,000 per student this entire period.

Recessions have had a predictable and pernicious effect on higher education funding in the U.S. over the past forty years. In recessions enrollments grow, state funding doesn’t grow (or declines slightly), and tuition goes up. After the recession state funding usually recovers, but tuition stays up. The long term trend has been a shifting of the cost burden to students. These factors, and others worth some discussion, seem to be eroding public engagement and the nation’s commitment to public higher education.

You may be wondering about 2009 and budgets for 2010. In a few states, these have been particularly brutal years. In others, they’ve been tough, but not quite brutal. The federal stimulus fund provided about 3-4% of the amount of state funding in many states for 2010, and in many cases that amount was sufficient to fill or nearly fill the decline in state funding. The big worry is whether the economy and state funding will recover fast enough to avoid large declines when the stimulus funding is exhausted.

In essence, the state fiscal stabilization fund of the stimulus package worked more like a tourniquet than a transfusion for state budgets. It stopped the immediate bleeding of jobs and services, but it cannot restore the patient to health. State economies must revive to generate their own revenues.

Why are we short of money? One big reason is the only group in our population not expected to grow in the next 15 years are those in the prime working years, 25-55. Retirees needing more health care will

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grow enormously, and students needing education will grow steadily, but more modestly.

These demographics have serious implications for state revenues and expenditures. The National Center for Higher Education Management Systems (NCHEMS) and the Rockefeller Institute have projected that every state will have a revenue shortfall by 2013; the average will be 5.7%.

David M. Walker, Comptroller General of the United States has projected future federal deficits and spending, assuming we meet obligations for Social Security and health care, sustain current domestic, international, and military spending at the rate of GDP growth, and extend all the Bush administration tax reductions now scheduled to expire. (This is the path of least political resistance.) By 2040 interest payments on the federal debt will nearly equal all federal revenues, spending will equal 40% of GDP, and revenues will equal less than 20% of GDP. The annual deficit will equal or exceed federal revenues.

I don't believe these projections will come true; they are far too devastating to be tolerated. But those aspiring to leadership in public life and education should know they will face tough challenges. Our fiscal house is in disarray; and we need to put it in order.

I am not a pessimist concerning public support for higher education, but I am convinced we will need to increase productivity both to meet the demand for higher education and to secure the public support needed to meet that demand.

The public perception is that higher education is generously funded in the U.S. What the public doesn't recognize is the huge disparities in funding among institutions of higher education, and the strain of competitive pressures, which in some respects, drives up costs.

Public debate about education and money is usually dominated by three wrong ideas:

- A. *There is a "right amount;" we can create the perfect formula.*
- B. *The only way to get improved performance is to spend more money.*
- C. *We can get the results we need without spending more money.*

The first "wrong idea" has generated endless debate and complex analyses of data, much like those I've just presented. The debates are endless and pointless because financial policy is fundamentally about priorities, investment, management, and politics, not formulas. Analysis has its place, but it can't make decisions. Higher education is not entitled to a fixed share of public resources; the "right amount" is a question for judgment and negotiation.

The second "wrong idea" especially angers policymakers and hard-headed business leaders who are forced to increase productivity in their day jobs. They argue in higher education results don't change when we spend more money, only the cost increases.

The third "wrong idea," of course, is a reaction to the second. Some in the "accountability" movement argue that more investment is completely unnecessary; all that is required for better performance is more discipline. This might be true if the world economy were not requiring a quantum leap in educational attainment. Marginal change will not yield the necessary results.

In contrast to these “wrong ideas,” I propose focusing on three “right” questions:

- A. *What does the public need from higher education?*
- B. *What can higher education do better with the money we have now?*
- C. *Where can strategic investments help us get the results we need?*

The first “right question” is the place to start a conversation. The states dramatically increased their investment in higher education in order to educate the baby boom. It was easy to get consensus in the 1960s; the number of 18-24 year olds was increasing rapidly, and Sputnik had recently been launched into space. Consensus is harder now because we need to educate a larger *proportion* of our population (a more difficult task) to cope with a less clear threat -- the loss of competitiveness in the global economy. Compared to the 1960s, average people must now be educated to a higher standard. The basic dynamics are the same, however – when there is a consensus about goals and priorities, investment will follow.

The second “right question” is the key to progress. The public has deep faith in the value of education, persistently expressed in public polls, political rhetoric, and the recurring pattern of recovery in funding for higher education. But too many in the public lack confidence that additional investment will generate the results we need. And even with greater confidence in higher education, the public will never be able to provide enough “new” money to make our work easy.

The money we have now is greater and far more important and than any “new money” we might obtain. Additional spending is unlikely to produce better outcomes in higher education, *without changes* in how we allocate resources and how we approach teaching and learning. The most important financial issue in higher education is not how incremental dollars are used, but the use of existing base funding. Our priorities and the incentives of the budget process will determine the effectiveness of higher education far more than any amount of incremental funding.

That said – marginal dollars still matter. Through strategic investments to address the third “right question,” public policymakers and higher education leaders can resolve the tension between the second and third “wrong ideas.” Money motivates action, and people with shared objectives are willing to make strategic investments to achieve them.

I know of cases where higher education has embraced these three key questions and demonstrated more effective use of existing resources. The public has responded with the investments necessary to meet ambitious goals. Actions, not just words are needed to overcome the skeptical view that inertia, not public priorities, rules in higher education.

Growing stress on world ecosystems

Higher education is important, of course, not just because of its inherent value, but because higher education is relevant to virtually every important issue facing the human race. I’d like to conclude by venturing tentatively into a field where I have no professional expertise, and many of you have quite a bit.

For decades a public argument has been raging about the impact of human population growth on the world environment. In brief, these are the population numbers:

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- 1800, one billion people
- 1927, two billion people
- 1999, six billion people
- 2050, nine billion people.

By 2050 the human population of the planet will have increased 900% in 250 years. 250 years seems like a lot of time to me, but in the span of geologic time it is a blink of the eye. It is hard to believe this can happen without environmental consequences.

By the way, the U.S. is also projected to grow during this period (a good thing for us economically), but as a society we will become quite a bit older. All age groups will grow, but the fastest rates of growth will be for older Americans. We had about 5 million people over the age of 85 in 2000; we are projected to have about 22 million over 85 in 2050.

What are the consequences of this growth? The opposite poles of pessimism and optimism are epitomized by conservation biologist Paul Ehrlich, and the late business economist Julian Simon.

Thirty-eight years ago, in his book *The Population Bomb*, Ehrlich warned of depletion and damage to finite, fragile natural resources and predicted population growth would soon lead to mass starvation. Julian Simon became famous by disputing Ehrlich's projections, arguing that human ingenuity can and will cope with all natural challenges. On the question of food supply, thus far at least, the optimists seem to have gotten the better of the debate. The "Green Revolution" dramatically increased food production, and Ehrlich's 1968 projections have not come true. The world has experienced starvation, but economic inequality and war have been more important causes than shortages in the food supply.

With all due respect for human ingenuity, in my view unbridled optimism about the future is foolish and irresponsible. Desirable, perhaps inevitable economic growth, combined with the certain increases in the world's population, have serious implications for the quality and sustainability of human life. Let me illustrate with a few slides from the World Resources Institute, based in Washington, D.C.

This slide displays the current carbon emissions per capita in the world, a recognized cause of global warming. In 1999 the U.S. was the world leader with greater than 15 tons of carbon emissions per capita, followed by Canada and Australia with 9-15 tons per capita, and Europe with 3-9 tons per capita. Brazil, India, and China all had less than 1 ton of carbon emissions per capita in 1999. Now recall the projected economic growth rates for Brazil, India, and China, and imagine the effects on world carbon emissions when people in these and other advancing countries model the behavior of more developed countries by driving more automobiles and generating greater amounts of electricity.

The next slide, generated by WRI from an analysis by BP Global, displays the number of years it will take to exhaust current known reserves of oil *at current production rates*. By 2050, only Venezuela and a few African and middle-eastern countries are likely still to be producing oil from known reserves. Only Saudi Arabia has reserves that can endure past 2100. While I have not seen any long-term projections that take into account economic growth, I imagine that, without significant increases in

energy efficiency, current production rates will be inadequate to meet demand, and the reserves will be depleted even faster.

This next slide shows the annual rate of growth in energy consumption from 1987-1996 for a number of countries. Note that the fastest growth rates are in China and India, and the total annual growth *during this period* was 1.1 percent. Reducing the annual growth in energy consumption to 0.8% is necessary to avoid serious consequences, according to Jonathan Lash, President of the World Resources Institute, but *it will take a 40% reduction in projected energy consumption to reach a growth rate of 0.8%.*

Does all this really matter? Let me share a few slides I find persuasive.

This slide shows the average global temperature for the past 1,000 years. After years of stability, the average global temperature has increased about 1%, from 13.5 to 14.4 Celsius from 1860 to 1990. The fifteen warmest years over the past 100 years of direct measurement have occurred since 1980. The Intergovernmental Panel on Climate Change projects further temperature increases ranging from 1.5 C to 5.7 C, depending on human action to reduce emissions.

Accelerating economic growth in developing countries is an important factor in this global problem. Without question, however, *the greatest opportunities and obligations for conservation lie in the United States, Europe, and other prosperous nations who currently have the highest levels of energy consumption on earth.*

These nations consume more, and they have a disproportionate share of the research and technical capacities required to invent more energy efficient technologies and the means of bringing the use of renewable energy resources to scale. Higher education must lead in the research and development necessary to meet these goals. Higher education must lead in informing the public of the problems and issues. We also must lead in incorporating state of the art technologies in our buildings and energy consumption practices.

About fifteen years ago my friend Hal Harvey, then President of the Energy Foundation, introduced me to a fledgling movement to increase the use of “green” techniques in building design and construction. While I know much remains to be done, I have been heartened by the enormous progress since that time. Let me close by applauding those of you who have played important roles in this movement and thanking you for your work.