INSTITUTE FOR 21ST CENTURY ENERGY

AN AFFILIATE OF THE U.S. CHAMBER OF COMMERCE

METRIC OF THE MONTH: APRIL 2012

A DEEPER LOOK INTO INTERESTING TRENDS IN ENERGY SECURITY DATA

SCIENCE AND ENGINEERING DEGREES INTENSITY

Given the importance of the energy sector to the well being of the U.S. economy, ensuring an adequate and adequately skilled workforce is a matter of national security. Our energy industry employs well over one million people today, yet nearly half of this workforce is expected to retire in the next 10 years. As the country's energy sector expands to meet expected demand, thousands of additional workers will be needed to design, build, operate, and service tomorrow's energy infrastructure.

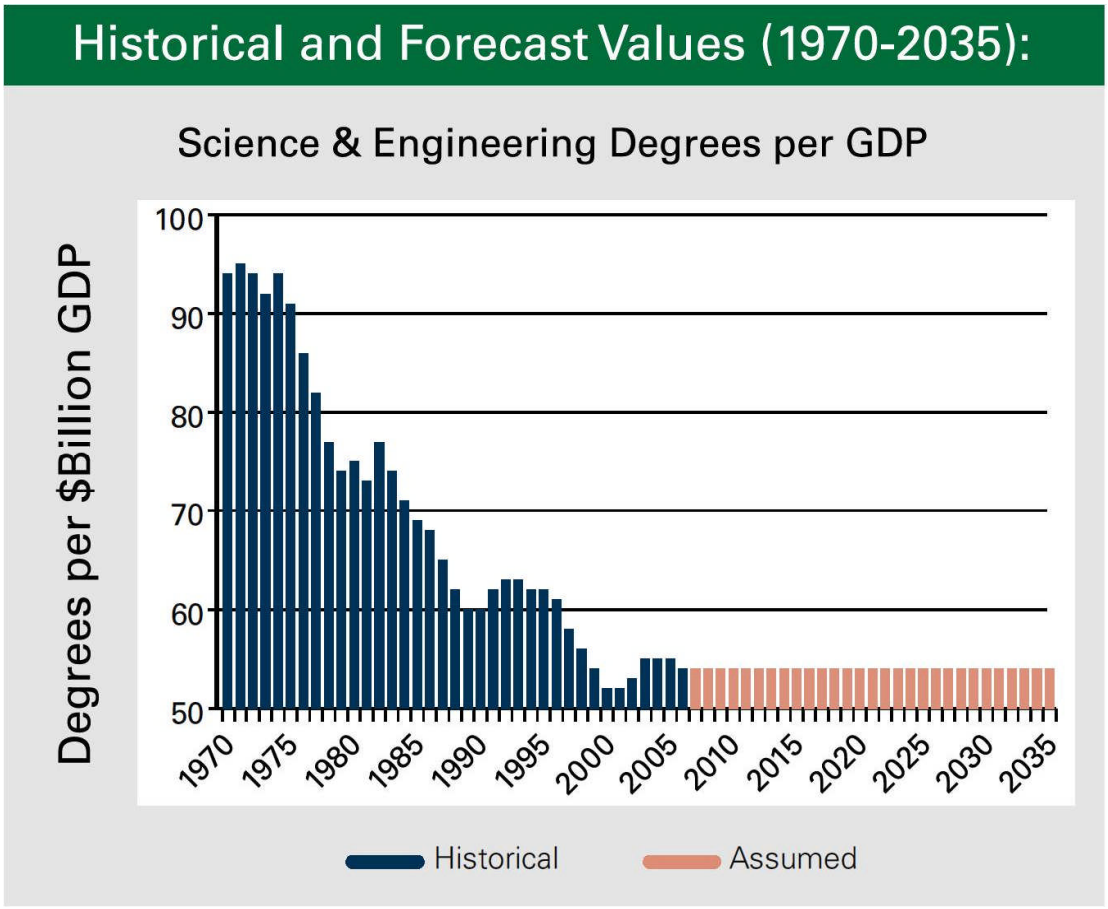
This edition of Metric of the Month focuses on Science and Engineering Degrees Intensity, defined as the number of science and engineering (S&E) degrees, per billion real (2000) dollars of Gross Domestic Product (GDP). This metric indicates the degree to which human capital in science and engineering fields will be available to the economy, and it is one of three Research & Development metrics used in the Index of U.S. Energy Security Risk.

This metric is developed as the ratio of two data series: S&E degrees awarded and total U.S. GDP. For historical data on S&E degrees awarded in the U.S., we used data on bachelors, masters, and PhD degrees collected by the National Science Foundation's National Center for Science and Engineering Statistics. (For the years 2007 and beyond, we assume no change in the number of degrees.) Historical GDP data were taken from Energy Information Administration's *Annual Energy Review* 2009, which are based on Department of Commerce data, and converted the values to 2000 dollars. Over the forecast period through 2035, we assume a constant level of degrees. Projections for GDP were taken from EIA's *Annual Energy Outlook*.

Figure 1. charts the historical and forecasted number of S&E degrees per billion constant dollars of GDP over the 1970-2035 time frame. The historical data show a steadily worsening trend relative to the economy since the mid-1970s.

Although the total number of college degrees more than doubled since 1970, and even rose relative to overall population increase, the share of S&E degrees as a percent of all degrees fell from over 34% of all degrees in 1970 to 30% in 2006. As a result, the number of S&E degrees awarded has not kept pace relative to the growth in GDP.

Figure 1.



Projections suggest that the demand for craftsmen—electricians, plumbers, welders, and machinists, for example—laborers, engineers, hydrologists, and other professionals will grow rapidly. As the data in Figure 1 indicate, the existing pipeline of new workers may not be big enough to offset the expected retirement of existing workers, which could result in the loss of critical institutional knowledge and experience.

It is also the case that the majority of graduate students in some engineering and science fields at U.S. universities are not U.S. citizens. According to NSF's National Science Board, foreign student make up about one-third of S&E doctorates, and in some fields, such as engineering, physics, and computer sciences, foreign students earned more than half.

In the coming decades, the United States must be prepared to compete for talent. Restrictions on visa and immigration policies have deterred international graduate students, postdoctoral researchers, and visiting scholars, who were otherwise likely to study and work in science and engineering fields in the United States. The NSB also notes that the number of S&E degrees by foreign universities, especially in Asia, is growing rapidly.

It is clear we need to do a better job of attracting U.S. students to scientific fields, especially as more and more foreign students, who historically stayed in the U.S. after school, are increasingly attracted to opportunities in their home countries. Until we do, we need to ensure that immigration policies allow U.S. trained foreign-born scientists to remain and immigrants with needed skills to work in the U.S.

As we look to expand the number of graduates with science, engineering, and math degrees, we must also tap under-represented demographic groups. We should draw on the talents of all U.S. students, from every background, to produce the number of engineers, scientists, and skilled workers we will need in the future.

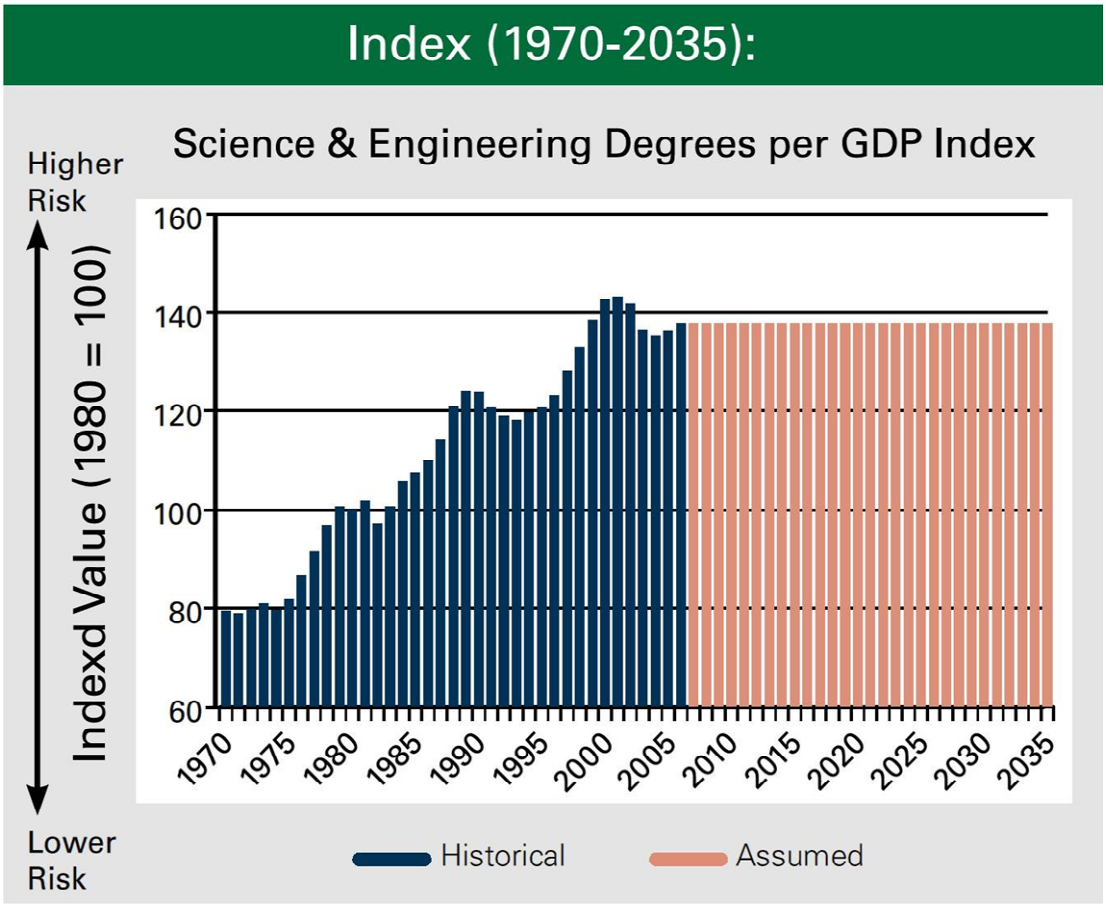
A determined long-term effort is needed to improve the science and math educations of U.S. students, beginning in elementary school right through high school and college. Test results have shown that U.S. elementary students do reasonably well in science and math compared to their peers in other countries, but between elementary school and high school, the performance of U.S. students gets progressively worse. Somewhere along the way, our students are losing their enthusiasm for science and math and the valuable skills that will be needed in a highly technical global marketplace.

Improving the math and science curricula is a must, especially in the middle and high school years to capture and maintain the interest of students. Recruitment of and training for qualified math and science teachers would help and should be pursued with greater vigor.

Effective education and training programs, incentives, and visa policies enabling the American energy sector to attract and retain a new generation of human capital is increasingly important improving America's position in a globally competitive industry and lowering its energy security risks.

As Figure 1 shows, the risks captured by this metric move in the opposite direction of the metric values, that is, a high S&E Degrees Intensity value equates to a low risk and vice versa. For purposes of the Index, then, the values were normalized, with the value for the year 1980 set at 1.00. To convert this into a risk index, the inverse of these normalized values were obtained, and this produces the values graphed in Figure 2.

Figure 2.


Index (1970-2035):
Science & Engineering Degrees per GDP Index
Higher Risk
Indexd Value (1980 = 100)
Lower Risk
160
140
120
100
80
60
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
Historical
Assumed