Scientific discovery and technological innovation are indispensable for promoting economic growth and an affordable energy future that safeguards our national security in the technologically-driven 21st century.

The United States spends more on R&D than any the country in the world, but as a share of economic output, the amount spent has been falling as other countries increase their investments in research. Business finances and carries out the majority of R&D activities in the United States, with the federal government the second largest source of funding. Often, business works in partnership with government agencies and laboratories on research projects covering the range of energy technologies, including renewables and other alternatives, fossil fuels, carbon capture and storage, nuclear, electricity transmission and distribution, and others.

While the United States spends a large and rising amount of money on R&D, most of that money is spend on things other than energy, as the chart in Figure 1 shows. In fact, energy accounts for a relative small portion of total R&D spending. Nevertheless, the impact of energy R&D can be significant. Look no further than the development and application of new horizontal drilling, hydraulic fracturing, and geological imaging technologies, which have unlocked huge new reserves of domestic oil and gas. These developments promise to revitalize manufacturing, chemical, iron and steel, and other industries, create new jobs, and enhance energy security.

Technological advances like hydraulic fracturing do not occur absent investment in energy research and development (R&D). This edition of Metric of the Month features Industrial Energy R&D Expenditures, defined as dollars spent by industry on energy-related R&D per $1,000 of GDP. This metric indicates private industry engagement in improving performance and enabling new technological breakthroughs. (Federal government energy-related R&D expenditures will be the topic of a future Metric of the Month.)
Two data series are required to develop historical and forecast data for this metric: (1) industrial energy R&D; and (2) total U.S. GDP. Historical industrial energy R&D data used in the 2012 edition of the Index of U.S. Energy Security Risk run only through 2007.\(^1\) For 1973-2007 historical expenditures on industrial energy R&D, “company” data from the National Science Foundation’s (NSF) Industrial Research & Development Information System were used.\(^2\) The NSF data for industrial energy R&D do not extend further back than 1973, so it was assumed that expenditures per unit of GDP for 1970 to 1972 were the same as for 1973. The historical data, expressed in nominal dollars, were converted into 2000 dollars using each year’s GDP deflator. Historical data for U.S. GDP was developed using the Energy Information Administration’s Annual Energy Review. Data were converted to from 2005 dollars to 2000 dollars.\(^3\)

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\(^1\) Most of the other historical data in the 2012 edition of the U.S. Index run through 2011, but there is a much larger lag collecting and publishing R&D expenditure data compared to energy data.


For data beyond 2007, the ratio of expenditures to GDP equal was held constant at the 2007 value. Potentially, industrial surveys could be used to improve the near-term outlook.

Figure 2 charts the historical and forecasted Industrial Energy R&D Expenditures per $1000 of GDP over the 1970-2035 timeframe. The historical trend shows a dramatic swing. Beginning in the late 1970s, industry R&D on energy increased substantially, more than doubling earlier levels, largely as a response to the oil crises of the 1970s and early 1980s. By the mid-1980s, a time when oil prices were plunging, the pattern has generally been one of decreasing investment, such that in recent years, the relative investment has only been 10% to 20% of the amounts seen in 1980. Since 1999, however, private sector energy R&D as a share of GDP has begun to turn higher, though it still remains far below earlier levels.

Whereas fossil fuel-related R&D dominated earlier industry efforts, an increasing amount of R&D over recent years has been focused on alternative and renewable sources of energy. With the oil and gas shale revolution, however, there has been an increasing focus on R&D related to making hydraulic fracturing safer, cheaper, and more effective.
To use this metric as a component of the U.S. Index, the data series had to be inverted because the risks described by this metric move in the opposite direction to the value of the metric. That is, the higher the amount of R&D expenditures, the lower the risk, and vice versa. The metric was inverted by taking the reciprocals and then normalizing the time series to an indexed value, where the year 1980 is set at 100. Because there was a very wide spread—roughly tenfold—between the highest and lowest annual values, a more compressed range of values was sought to make the data more comparable with the data for other metrics. This was achieved by dividing each year’s measure into the 1980 measure, and then taking the square root of that inversion. This produces the values graphed in Figure 3, which shows increasing risks from about 1980 to 2000 and lowering risks from 2000 to the present.

With about two thirds of all R&D conducted in America being done by the private sector, it is important that we ensure a climate conducive to R&D investment by private sector companies. The R&D tax credit, which allows businesses to deduct part of those investments from their taxes, has been a very effective policy at doing this.

Figure 3.
The R&D tax credit was initiated through the Economic Recovery Tax Act of 1981. Originally set to expire at the end of 1985, it has been extended—with modifications along the way—almost continually through to the present. Through the years, extension of the credit by Congress often has come down the 11th hour, and in some cases has had to be applied retroactively. It was most recently renewed for one year as part of the “Fiscal Cliff” legislation in January 2013.

The on-again, off-again nature of the R&D tax credit has made R&D planning for businesses more difficult. The Energy Institute advocates making it permanent so that companies have greater certainty as they plan and conduct R&D.