INSTITUTE FOR 21ST CENTURY ENERGY
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METRIC OF THE MONTH: DECEMBER 2011

A DEEPER LOOK INTO INTERESTING TRENDS IN ENERGY SECURITY DATA

INDUSTRIAL ENERGY EFFICIENCY

Industrial Energy Efficiency is the topic of this edition on Metric of the Month. It is one of the six energy use and efficiency metrics used to compile the Index of U.S. Energy Security Risk.

Of the four sectors identified by the Energy Information Administration (EIA)—residential, commercial, industry, and transportation—industry accounts for the biggest share of energy use. EIA estimates that in 2010 industry used about 30.1 trillion Btus, or 31%, of all the energy consumed in the United States.[1] Large energy users include the petroleum, coal, paper, chemicals, metals, mining, cement, glass, and food industries. This makes industrial energy efficiency an important metric of energy security.

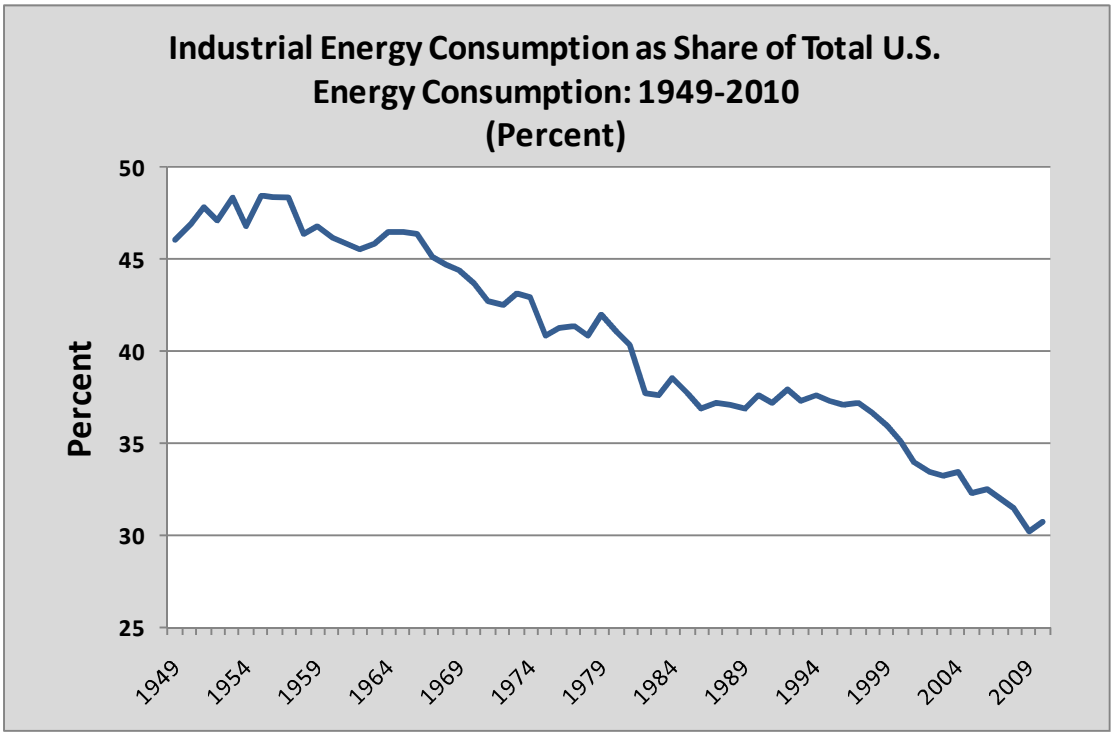
As Figure 1 shows, however, energy use by industry is shrinking relative to energy use in other sectors. Since the mid-1950s to the present, industry's share of energy use has fallen steadily, from over 45% to just over 30%. This reflects not only improvement in the efficiencies of most industries and processes, but also the broader shift in our economy towards services and less energy-intensive goods.

The mix of energy sources in the industrial sector has changed, also. In 1950, coal was the dominant fuel (36%), followed by oil (24%), natural gas (22%), electricity (15%), and renewables (4%). Primary coal use in the sector has declined dramatically while electricity use has increased just as dramatically. Today, electricity is the largest energy source (34%) used by industry, followed by natural gas and oil (both at 27%), renewables (8%), and coal (5%).[2] While it may seem like coal is being phased out of the sector, it is important to note that the relative rise in electricity consumption means that industrial users are offsetting reductions in *direct* coal use by using increasing amounts of *indirect* coal use through the purchase of electric power, nearly half of which is on average generated using coal.

[1] These figures include the consumption of primary energy and the primary energy used to produce the electricity consumed in the sector, including electrical system energy losses. See: EIA, *Annual Energy Review*, Table 2.1a, Energy Consumption Estimates by Sector, 1949-2010. Available at: http://www.eia.gov/totalenergy/data/annual/.

[2] EIA, *Annual Energy Review*, Table 2.1d, Industrial Sector Energy Consumption Estimates, 1949-2010. Available at: http://www.eia.gov/totalenergy/data/annual/.

Figure 1.



Source: EIA, *Annual Energy Review*.

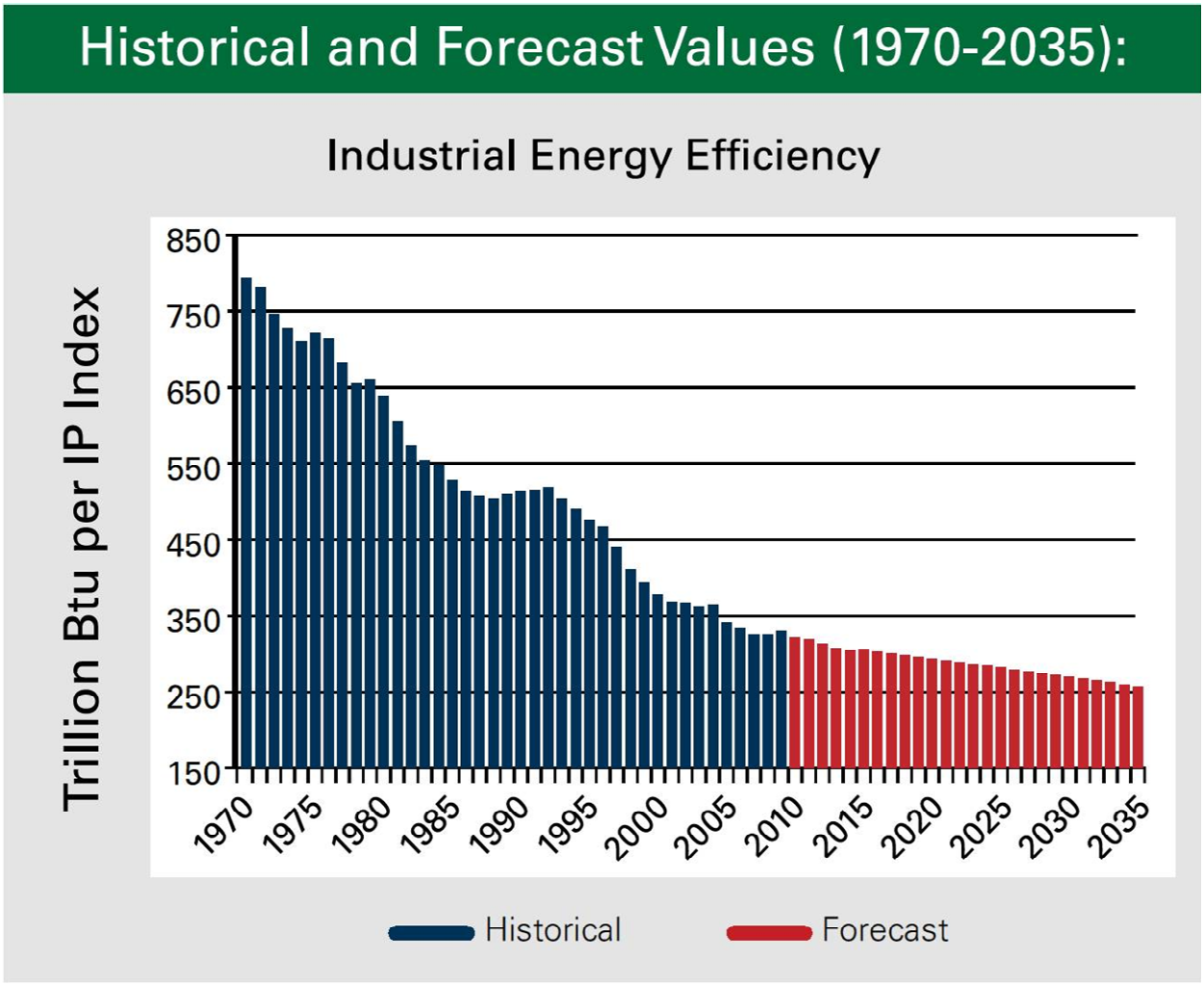
For purposes of the Index, Industrial Energy Efficiency is defined as the total energy used in trillion Btu in the industrial sector divided by the Federal Reserve Board's Index of Industrial Production (IP Index).[3] The resulting metric indicates the degree to which the typical commercial enterprise uses energy efficiently.

Energy consumption, as used here, includes all forms of primary energy, electricity consumption, and associated electricity losses.

The Federal Reserve's monthly IP and the related capacity indexes and capacity utilization rates cover manufacturing, mining, and electric and gas utilities. It does not include agriculture, construction, and some other activities that fall within EIA's definition of "industrial sector," but these tend to be a relatively small portion of overall industrial sector energy consumption. Hence, the industrial scope of the IP index is a reasonably close match to the Industrial Sector defined in the EIA statistics.

[3] EIA, *Annual Energy Review*, Table 2.1d; Federal Reserve Board, G.17, Industrial Production and Capacity Utilization. Available at: http://www.federalreserve.gov/releases/g17/Current/default.htm.

Figure 2.



Forecasts of U.S. industrial energy consumption and output ("Total Value of Shipments") were derived from EIA's *Annual Energy Outlook* (*AEO*).[4] The industrial output data represent the sum of manufacturing and non-manufacturing activity. EIA's Value of Shipments data are expressed in terms of billions of year 2000 dollars, and they were linked to the IP Index by taking the ratio of each year's value to the 2008 value, and then applying that ratio to the 2008 IP Index. Using this process, we were able to develop proxy IP Index projections based on EIA's value of industrial shipments projections.

The results covering the period 1970-2035 are shown in Figure 2. The long-term trend shows a dramatic improvement in overall Industrial Energy Efficiency. Between 1970 and 2010, the overall energy intensity was

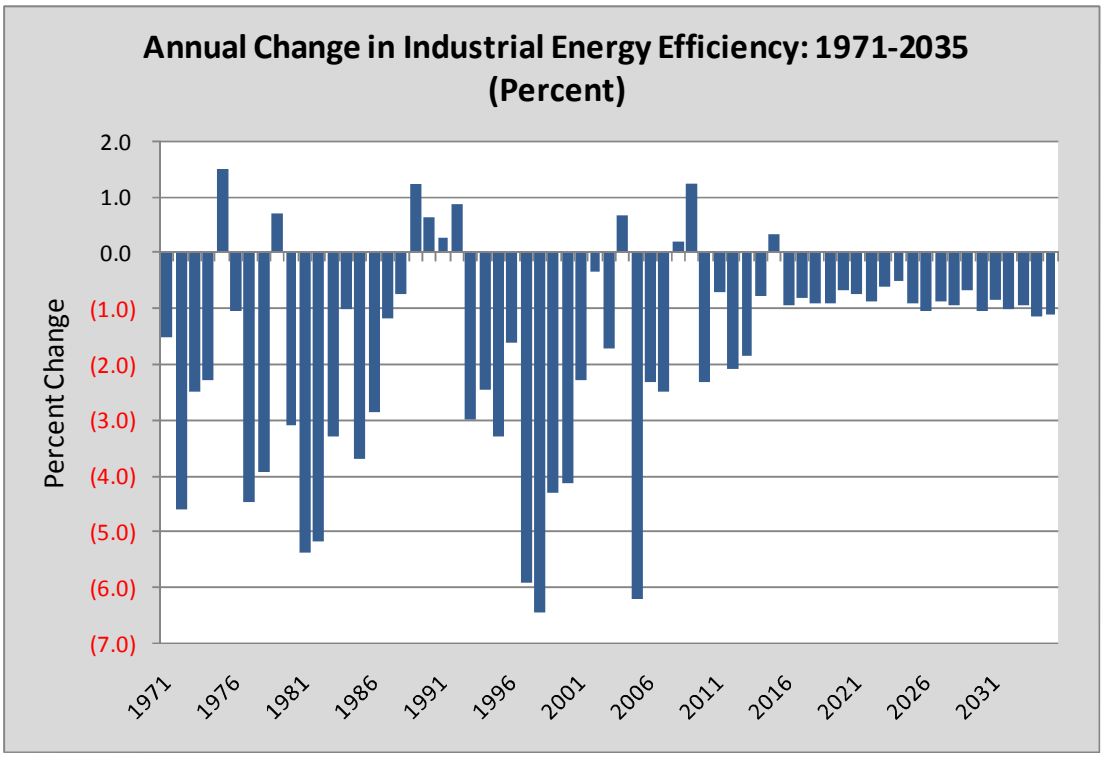
[4] EIA, *Annual Energy Outlook*, Year-by-Year Reference Case Tables, Table 2 ("Total Industrial Consumption") and Table 6 ("Total Value of Shipments"). Available at: http://www.eia.gov/forecasts/aeo/.

more than halved. This reflects not only improvement in the efficiencies of most industries and processes, but also the broader shifts in our economy towards services and less energy-intensive goods.

From 1971 to 2010, industrial efficiency improved at an average rate of about 2.2% a year. As Figure 3 shows, however, the improvement was uneven over the period. From 1971 to the middle of the 1980s, annual efficiency improvements averaged about 2.7%. This trend began to stall and even reverse itself between 1986 and 1992, as rapidly falling energy prices made efficiency less of an imperative, and efficiency improvements average just 0.3% annually. From 1994 to 2010, annual improvements returned to historical levels, averaging 2.6%.

Looking forward, EIA's projections in *AEO2011* indicate a continuing but gradual improvement in this metric, with annual improvements averaging just 0.9, well below the pace form 1971 to 2010. If history is any guide, industry will probably do much better than these projections.

Figure 3.



Sources: EIA, *Annual Energy Review*; EIA, *Annual Energy Outlook*; Federal Reserve Board.