Enhancing American Productivity

The rise of China, India and other emerging economies is straining global energy supplies and raising U.S. energy prices. Using energy resources more efficiently will strengthen the U.S. economy and make American businesses and workers more competitive internationally. Investing in building efficiency today helps ensure future economic prosperity.

United Technologies Corporation
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If you have questions or would like to provide feedback, please contact us at ourapproach@utc.com

The Role of Energy in the U.S. Economy

Energy, along with labor, land and capital, is a basic ingredient in any country's economic growth formula. Known as a "factor of production" to economists, energy illuminates buildings, heats homes and offices, powers factories, and moves goods and people. For advanced economies like the U.S., prosperity comes from finding ways to use these factors of production more efficiently, thereby increasing economic productivity. Productivity gains are responsible for roughly 60 percent of U.S. economic growth since 1960 and more than 75 percent over the past decade.

Energy efficiency has played an important role in past American productivity improvements. Technical innovations, new design techniques, better management practices, and smart policies have enabled businesses and households to improve energy services (e.g. lighting, heating and cooling, powering appliances and machinery) while cutting the amount of coal, oil, natural gas and electricity required to deliver those services. Each dollar of additional U.S. economic activity today requires only half as much energy as it did 1960.

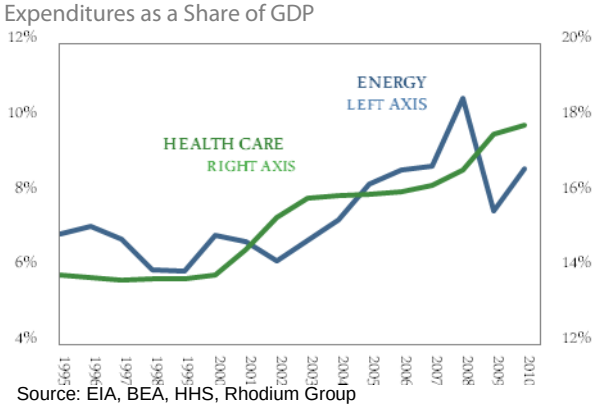
Yet unlike land, labor and capital – the other inputs into the U.S. economy – the price of energy is highly volatile and determined by international events as much as domestic market conditions. And over the past decade, energy prices have nearly doubled thanks to growing demand in emerging economies and political turmoil in energy-rich parts of the world. So while the U.S. economy continues to become more energy efficient, the share of national income Americans spend on energy is actually increasing (Figure 1).

The impact of this trend on U.S. economic growth and international competitiveness is similar to the growing cost of American healthcare. Between 1998 and 2008, U.S. healthcare expenditures increased by $1.2 trillion and U.S. energy expenditures increased by $1 trillion, eroding household income and raising business operating costs. Yet unlike healthcare expenditures, 37 percent of the increase in energy expenditures was sent out of the U.S. to energy-exporting countries. Rising energy prices have contributed more to the U.S. trade deficit over the past decade than America's total trade with China.[i]

Rising energy prices create business uncertainty and reduce overall investment. Indeed, four of the last five recessions in the U.S. have been preceded by a spike in energy costs (Figure 2), and today's high energy prices are threatening an already fragile economic recovery.

Figure 1: Rising Energy and Health Costs

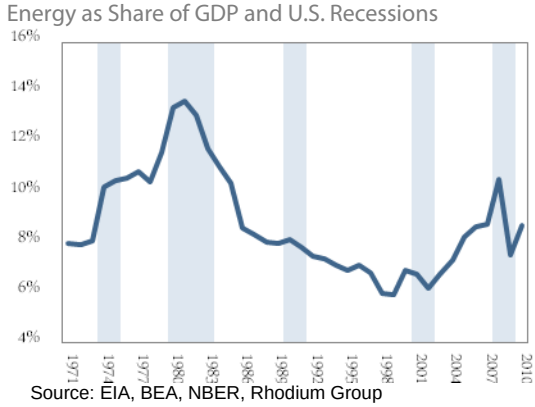
Expenditures as a Share of GDP



Source: EIA, BEA, HHS, Rhodium Group

Figure 2: Energy Costs and Recessions

Energy as Share of GDP and U.S. Recessions



Source: EIA, BEA, NBER, Rhodium Group

America's Future Energy Challenge

The past few years offer a preview of the energy challenges that lie ahead. In the face of the worst American recession in more than a generation, U.S. energy prices dipped only briefly before returning to pre-crisis levels. That's because while energy demand dropped sharply in developed countries, developing countries have more than picked up the slack.

The developed world accounts for less than 45 percent of global energy demand today, down from 51 percent in 1990. And over the next two decades, the U.S. will account for only 2 percent of global energy demand growth, while China, India and the Middle East will account for 38, 14 and 9 percent respectively (Figure 3). With developing countries adding two Americas worth of additional demand between now and 2030 and global energy supply increasingly concentrated in politically unstable parts of the world, high energy prices are here to stay.

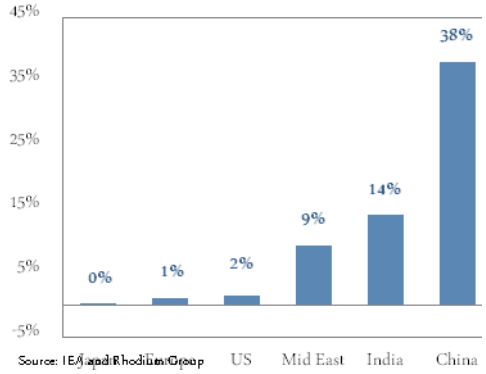
And it's not just oil where Americans are paying more as a result of growing developing country demand. China became a net importer of oil in 1993 and, in the years that followed, raised the price Americans paid for gasoline at the pump. In 2009 China became a net importer of coal and is in the process of raising the price U.S. power plants pay for coal. Thanks to strong Chinese demand, U.S. coal prices held up through the financial crisis and are now 40 percent higher than they were just five years ago (Figure 4).

Less exposed to developing country demand, U.S. natural gas prices have declined significantly in recent years as new unconventional gas resources have come online. But continued American access to cheap natural gas is far from guaranteed. Global gas markets have not experienced the same price decline and the resulting price gap could lead to domestic price spikes if U.S. supply starts feeding international markets (Figure 5).

For American businesses and consumers, the bottom line is clear – the days of reliably low cost energy are over and future economic growth and competitiveness will depend on making our energy resources go farther.

Figure 3: Developing World Drives Demand

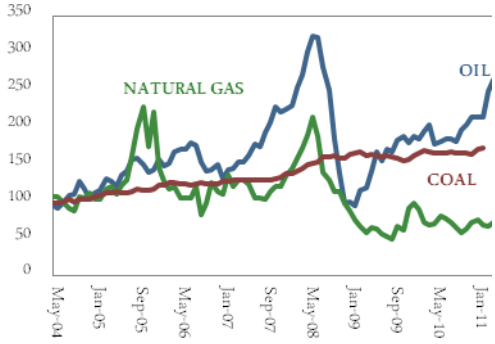
Share of Global Demand Growth 2008-2030



Source: IEA and Rhodium Group

Figure 4: U.S. Energy Prices

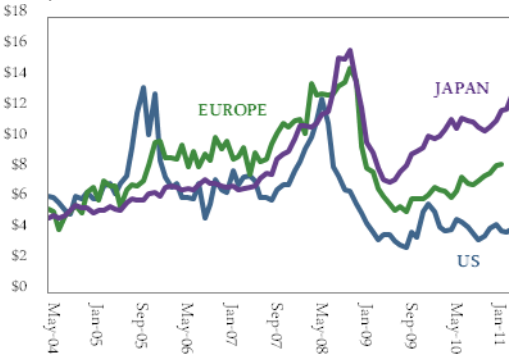
Index, 2003-2004 = 100



Source: EIA and Rhodium Group

Figure 5: Natural Gas Price Gap

USD per Million BTU



Source: EIA, EuroStat, CEIC and Rhodium Group

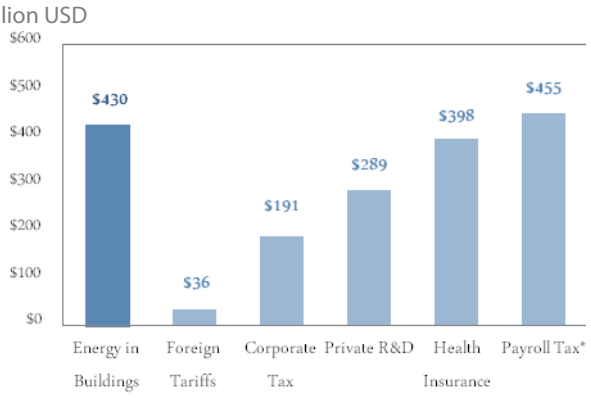
Powering Growth through Building Efficiency

The most effective strategy for improving American energy productivity is investing in energy efficient buildings. Residential and commercial buildings account for 40 percent of all energy consumed in the U.S., with Americans spending $430 billion to power their homes, stores and offices in 2010. That's more than U.S. businesses spend on employee health insurance and nearly as much as they pay in payroll taxes (Figure 6). Reducing energy expenditures makes business more competitive, frees up resources to invest in new production or hire new employees, lowers prices for consumers, and leaves households with more money in the bank after paying their energy bills to either save for the future or spend on other goods and services. In short, improving energy efficiency improves America's economic growth prospects.

In 2006 UTC, in partnership with the World Business Council for Sustainable Development (WBCSD), set out to assess potential energy savings in the global buildings sector and the economics of energy efficient building technology and design.[ii] The project, the most comprehensive undertaking of its kind to-date, analyzed the costs and benefits of energy efficiency improvements in 19 million commercial and residential buildings around the world. The project culminated in a landmark report, published in 2009, on transforming the way buildings use energy. This work has inspired more than 100 companies around the world to launch firm-wide energy efficiency campaigns.[iii]

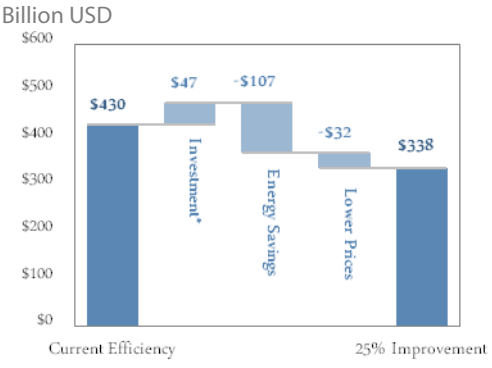
The WBCSD project had a long-term focus – how to achieve a 60 percent global reduction in the amount of energy consumed in buildings by 2050. But with rising energy prices, the American economy needs energy efficiency investments today. So UTC set out to identify what it would take to reduce the amount of energy consumed in both new and existing buildings by 25 percent – a goal that is achievable with existing technology - and the resulting impact on the U.S. economy. To conduct this analysis, UTC drew on the unique buildings technology database developed for the WBCSD project, reviewed the most recent academic, market and government research on building efficiency, and employed a suite of energy system models, including the National Energy Modeling System (NEMS), used by the U.S. Department of Energy for official energy supply and demand forecasting.

Figure 6: Energy Expenditures in Context



Source: WITS, CBO, OMB, BLS, EIA, Rhodium Group * Employer's share

Figure 7: Building Efficiency Savings



* Efficiency investment is amortized over ten years at 6% interest.

Source: WBCSD, EIA and Rhodium Group

Achieving a 25 percent efficiency improvement in today's building stock would require investing roughly $350 billion in energy efficient technology and design. These investments, however, would deliver $139 billion a year in energy savings. American households and businesses would save $107 billion a year by decreasing the amount of energy their buildings consume - a 28.4 percent return on investment. That reduction in demand would lower electricity and natural gas prices for everyone in the country by an average of 10 and 6 percent respectively and deliver an additional $32 billion in energy cost savings.

Amortizing $350 billion in efficiency investments would cost building owners $47 billion per year if amortized over a decade. Subtract this from the $139 billion in annual energy cost savings and the U.S. economy as a whole would save $92 billion per year from a 25 percent improvement in building efficiency (Figure 7). U.S. businesses would save $48 billion per year, greater than the total tariff burden faced by U.S. exporters around the world and equivalent to a 25 percent reduction in the amount of corporate income tax American companies pay (Figure 6). Redirecting that $48 billion towards R&D would increase U.S. private sector investment in innovation by 17 percent. And U.S. households would save an additional $44 billion per year that they would be free to save for the future, invest in education, or spend on consumer goods or personal services.

And the economic benefits of energy efficiency in buildings go beyond the direct energy cost savings. Based on National Academies of Science estimates of the economic cost of current U.S. energy production, a 25 percent improvement in building efficiency would save Americans an additional $11 billion per year through improved public health and better agricultural yields.[iv] Researchers have found that improved lighting, ventilation and temperature control in energy efficient buildings results in significant improvements in worker productivity. [v] And energy efficient schools often see higher test scores and lower absenteeism than their conventional counterparts. [vi] Finally, breakthroughs in energy efficient building technologies help spur innovation in other industries, further improving economic productivity (Box 1).

Box 1: Driving Innovation from HVAC to Power Generation: The PureCycle® Example

At UTC, innovation in building efficiency technology has spill-over benefits for other business units, improving the competitiveness of the company as a whole. A prime example is the PureCycle® power system solution.

Chillers are a key piece of equipment for larger scale Heating, Ventilation, and Air Conditioning (HVAC) systems in commercial buildings that have been continuously improved since their invention by Willis Carrier over 100 years ago. UTC's Carrier group has significantly increased the energy efficiency and environmental performance of chiller technology through a concerted program of research and development on compression, refrigerant, and variable speed technology.

Recognizing there was potential to apply these innovations in "reverse" for generating power, UTC's Pratt & Whitney Power Systems (PWPS) unit utilized Carrier's centrifugal chiller technology to develop its breakthrough PureCycle® power system solution. Using reengineered heat transfer technology combined with a selected refrigerant, the PureCycle® solution replaces the chiller's compressor with a turbine and uses a generator instead of an electric motor to produce electricity from low grade heat sources, such as geothermal or industrial waste heat. PureCycle® technology converts a chillers energy consuming technology into an energy producing device.

[i] Calculated using data from the U.S. Census Bureau and U.S. Energy Information Administration.

[ii] See http://www.wbcsd.org for more information on the Energy Efficiency in Buildings project.

[iii] For more information, see the WBCSD's Manifesto on Energy Efficiency in Buildings at http://www.wbcsd.org

[iv] National Research Council, 2009, *Hidden Cost of Energy: Unpriced Consequences of Energy Production and Use*, Washington: National Academies of Science.

[v] See for example Amanjeet Singh et al, 2010, "Effects of Green Buildings on Employee Health and Productivity", *American Journal of Public Health*.

[vi] Gregory Katz, 2006, *Greening America's Schools: Costs and Benefits*, A Capital E.