Environmental Innovation and Societal Transitions 9 (2013) 38–42

Contents lists available at ScienceDirect

Environmental Innovation and Societal Transitions

journal homepage: www.elsevier.com/locate/eist

An overview of the energy efficiency potential

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ARTICLE INFO

Article history:
Received 6 September 2013
Accepted 12 September 2013
Available online 21 October 2013

Keywords:
Energy efficiency
Energy policy
Investment

ABSTRACT

The global economy is not particularly energy-efficient. At current levels of consumption the U.S. economy, for example, is an anemic 14% efficient – which means that the United States wastes about 86% of the energy now burned to maintain its economy. Most recently, Laitner et al. (2012) documented an array of untapped cost-effective energy efficiency resources roughly equivalent to 250 billion barrels of oil. That is a sufficient scale that would enable the U.S. to cut total energy needs in half compared to business-as-usual projections for the year 2050, and still maintain a robust economy.

1. Introduction

All interactions of matter involve flows of energy. This is true whether they have to do with earthquakes, the movement of the planets, or the various biological and industrial processes at work almost anywhere in the world. Within the context of a regional or national economy, the assumption is that energy should be used as efficiently as possible. An industrial plant working two shifts a day 6 days a week for 50 weeks per year, for example, may require more than one million dollars per year in purchased energy if it is to maintain operation. An average American household may spend $2000 or more per year for electricity and natural gas to heat, cool, and light the home as well as to power all of the appliances and gadgets within the house. And an over-the-road trucker may spend $60,000 or more per year on fuel to haul freight an average of 100,000 miles. Regardless of either the scale or the kind of activity, a more energy-efficient operation can lower overall costs for the manufacturing

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2210-4224/$ – see front matter
http://dx.doi.org/10.1016/j.eist.2013.09.005

plant, for the household, and for the trucker. The question is whether the annual energy bill savings are worth either the cost or the effort that might be necessary to become more energy-efficient?[1]

In one sense of the word, the global economy is not especially energy-efficient. At current levels of consumption the U.S. economy, for example, is only 14% energy-efficient – which means that the United States wastes about 86% of the energy now burned to maintain its economy (Laitner, 2013) building on (Ayres and Warr, 2009). Because of that very significant level of inefficiency, many in the business and the policy community increasingly look to energy efficiency improvements as cost-effective investments to reduce waste and cut costs. One current example of this win–win opportunity is the advent of energy service companies (ESCo's) that save energy for clients at no cost to them, while making a profit for themselves.

The current system of generating and delivering electricity to homes and businesses in the United States is just 32% efficient. That is, for every three lumps of coal or other fuel used to generate power, only one lump in the form of electricity is actually delivered to homes and businesses. What America wastes in the generation of electricity is more than Japan needs to power its entire economy. The technologies that power the fossil–fuel economy, for example the internal combustion engine and steam turbines, are no more efficient today than they were in 1960, when President Eisenhower was in office. Laitner (2013) suggests that this level of inefficiency may actually constrain the greater productivity of the economy. And yet, any number of technologies can greatly improve energy performance. Combined heat and power (CHP) systems, for example, can deliver efficiencies of 65–80% or more in generating power and usable heat or steam, at a substantial economic savings (Chittum and Sullivan, 2012). And an incredible array of waste-to-energy and recycled energy technologies can further increase overall efficiency and save money (Worrell et al., 2003).

2. Historical impact of energy efficiency

As one of the richest and more technologically advanced regions of the world, the United States has expanded its economic output by more than 3-fold since 1970. Per capita incomes are also twice as large today compared to incomes in 1970. Notably, however, the demand for energy and power resources grew by only 40% during the same period.[2] This decoupling of economic growth and energy consumption is a function of increased energy productivity: in effect, the ability to generate greater economic output (that is, to produce more goods and services), but to do so with less energy. Having achieved these past gains with an often ad hoc approach to energy efficiency improvements, there is compelling evidence to suggest that even greater energy productivity benefits can be achieved. Indeed, the evidence suggests that since 1970, energy efficiency, in its many different forms has met three-fourths of the new U.S. demands for energy services to maintain the production of goods and services. And this has happened, despite the lack of efficiency gains in the electric power sector, as pointed out by Casten (this volume).

Energy efficiency has been an invisible resource. Unlike a new power plant or a new oil well, we do not see energy efficiency at work. A new car that gets 20 miles per gallon, for example, may not seem all that much different than a car that gets 40 miles or more per gallon. And yet, the first car may consume 500 gallons of gasoline to go 10,000 miles in a single year while the second car my need to only 250 gallons per year. In effect, energy efficiency in this example is the energy we do not use to travel 10,000 miles per year. More broadly, energy efficiency may be thought of as the cost-effective investments in the energy we do not use either to produce a certain amount of goods and services within the economy.

3. The cost-effective potential for exploiting the energy efficiency resource

Can the substantial investments that might be required in the more energy-efficient technologies save money for businesses and consumers? Lazard Asset Management (2012) provides a detailed

[1] The mentioned energy expenditures are derived from several calculations by the author.

[2] These and other economic and energy-related data cited are the author's calculations based on data drawn from various resources available from the Energy Information Administration (EIA annual-a, 2012; annual-b for 2013).