Low Carbon Growth
Our ethical responsibility

BY JAMES L. SWEENEY

WE, AS HUMANS, must face the implications of growing pressures on our natural resource base. Income per person is growing sharply in the most populous nations, particularly China, and India may not be far behind. More income implies more consumption; more consumption implies more production; and more production leads to increased use of natural resources.

The supply of some natural-resource-intensive products has increased sustainably, especially through technological advances such as the use of fertilizers and irrigation for agricultural crops. However, for others, the increase in supply needed to meet increased use is not sustainable, such as with deep sea fish, because we exploit the resource faster than it is being renewed.

Other resources, such as oil and gas, are depletable and finite. Technological advances have allowed us to tap progressively lower qualities of such resources and to find resources that were previously undetectable. Advances have also allowed us to use the resources we extract more efficiently. However, since technological advances do not actually increase the resource base, these supply increases are unsustainable over the long term.

Fortunately, most of the key natural resources are governed by market forces, so rising prices can be expected to keep supply and demand roughly in balance. Consumers may not like

A green Santa Claus distributes 2008 free Greenlite energy efficient light bulbs in December 2007, in New York's Times Square.

the rising prices, but markets can effectively allocate these scarce resources to maintain balance. However, if no market exists for a specific resource, market forces cannot work effectively to create supply and demand balances. For these resources, systematic overuse will occur unless appropriate interventions are implemented. Most of these resources are what are called the global commons.

The combination of two issues—a) technological advances that have allowed us to use a resource more rapidly, but have not increased the natural system's ability to renew the resource stocks and b) lack of normal markets to balance supply and demand—can lead to intractable problems when the appropriate interventions are absent. If we add a third issue—a global resource stock—then the problems become even more intractable.

Growing pressures on the atmosphere

PERHAPS THE MOST IMPORTANT natural resource that suffers from this trio of issues is the capacity of the upper atmosphere to absorb greenhouse gases without destroying ecosystem services essential for human health and welfare. Technology has allowed us to "harvest" this resource very rapidly, through our greenhouse gas emissions into the atmosphere. But technology has not altered the rate at which these gases are cleaned out of the atmosphere. Thus, use of this atmospheric resource is also unsustainable, and because no one has property rights on the upper atmosphere, no natural market exists to efficiently allocate this scarce resource. Finally, use of this scarce natural resource is a global problem, with all nations drawing upon this global resource. The increasing concentration of greenhouse gases has already adversely impacted many ecosystems and endangers human health and welfare. The problem is both long-term and severe. Fortunately, public attention and understanding of the problem have increased and we now realize that urgent action within a global framework and agreement is needed.

Energy production, use and transportation account for 85 percent of greenhouse gas releases measured on a carbon equivalent basis, and 98 percent of the US carbon dioxide net releases. While figures vary by country, these three are the most fundamental underlying sources of greenhouse gases. Thus, changes to these sectors are essential for reducing greenhouse gas emissions.

Much attention has been paid to the creation of "clean energy," energy that can be produced with minimal carbon dioxide releases. Wind, solar, hydro, nuclear and biomass are all potential clean energy sources. But the cleanest energy is that which is not used in the first place. There is now a growing realization that efficient energy use must be a fundamental component of any solution to the problem of global climate change. Hence, an important goal is to use less energy per capita while continuing to strive for economically, socially and environmentally sustainable and equitable growth.

Some options for reducing greenhouse gas emissions, focusing on low carbon growth, are explored in this article. However, without the appropriate international agreements, implementation will be inadequate.

Major options for reducing greenhouse gas emissions

A NUMBER OF LOW CARBON growth options exist for reducing our net greenhouse gas emissions, particularly carbon dioxide, which could be implemented over different time horizons. These include: 1) improved efficiency in energy use, especially over the short to medium term, through technological and behavioral changes; 2) producing energy which minimizes carbon dioxide emitted, especially for new power plants, and realistically over the medium to long term; and 3) reducing carbon dioxide produced in non-energy sectors, such as agriculture and forestry, and industries, such as cement production. In addition to these, technologies are being developed to capture and permanently store greenhouse gases, especially carbon dioxide.

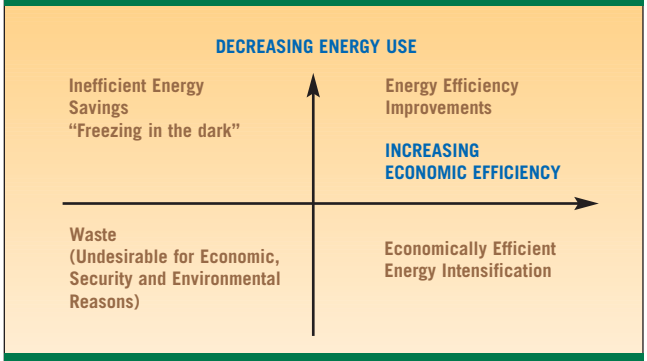
Improved energy efficiency

THE DESIRE TO REDUCE greenhouse gas emissions and fossil fuel economics—prices and price volatility—provide incentives for developed countries to reduce energy intensity, the amount of energy used to produce a unit of GDP or to perform some desirable service. In the US, a 10 percent reduction in overall energy intensity would lead to a reduction in fossil fuel use by 8.6 quadrillion Btu. This would have the same impact on carbon dioxide emissions as would doubling the entire US nuclear power output or by increasing, 25-fold, wind and solar-based energy production, with these increased energy outputs replacing equivalent amounts of fossil fuels.

However, reducing energy intensity is a very different concept than increasing energy efficiency. "Energy efficiency" means economically efficient reductions in energy intensity. We can explore this relationship by representing energy use on one axis and economic efficiency on another (Figure 1).

In a perfect market, economic efficiency increases—the right side of the diagram—would not be possible, since perfect markets would be economically efficient. Any increases or decreases in energy intensity would decrease economic effi-

FIGURE 1: CONCEPTUAL RELATIONSHIP BETWEEN ENERGY USE AND ECONOMIC EFFICIENCY



Source: Analysis by the author

ciency. However, markets are imperfect and energy markets riddled with failures. Thus opportunities exist for increases in economic efficiency along with opportunities for decreases in energy intensity.

Many possibilities exist for energy efficiency improvements and economically efficient energy intensification through a mixture of technological, regulatory and behavioral/institutional changes. Thus, market mechanisms, regulatory frameworks and information availability could play critical roles. Figure 2 shows some of these possible changes. Some would increase energy efficiency, some would economically efficiently increase energy intensity, and some would reduce economic efficiency. For policy purposes, it is essential to determine which is which.

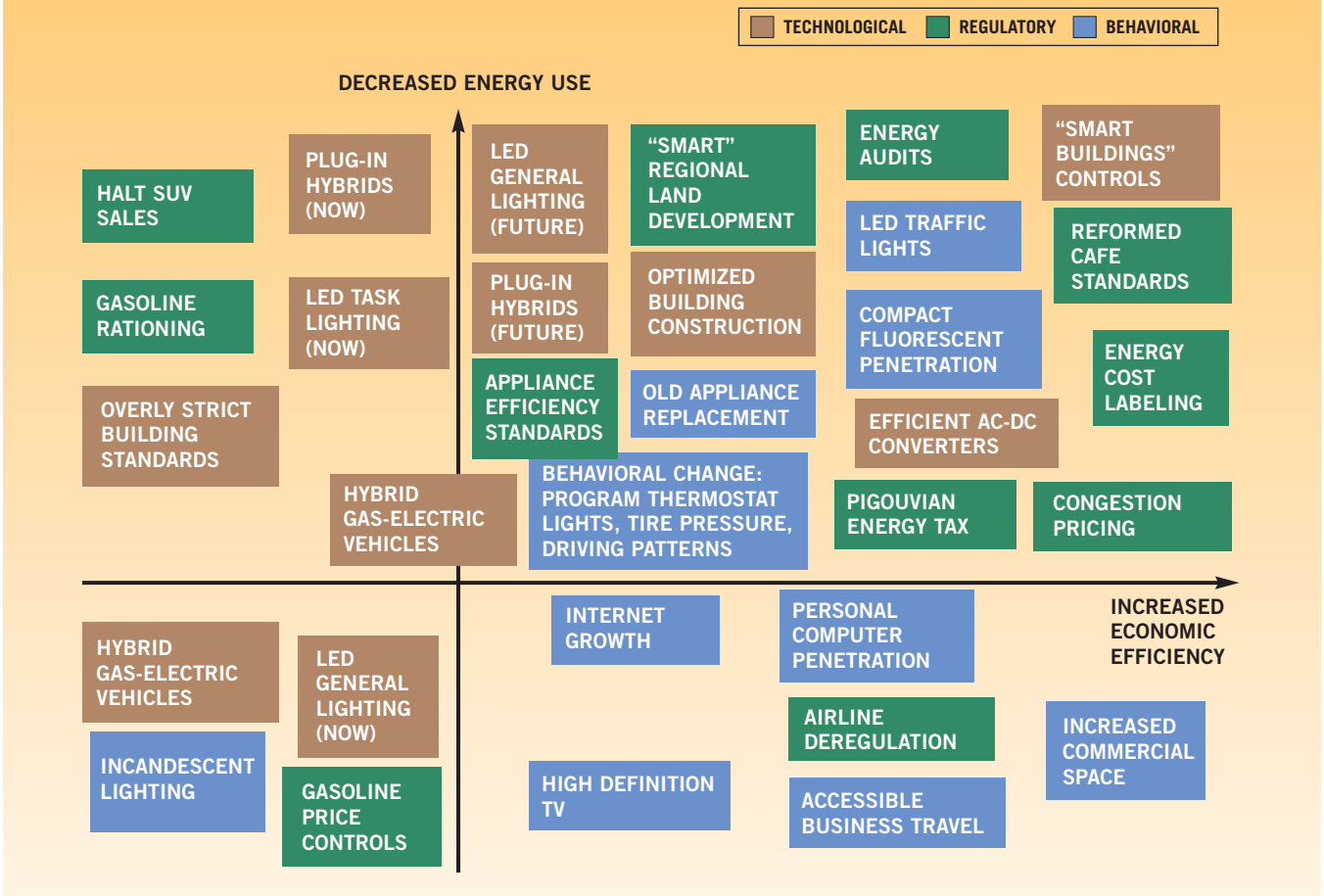
Regulatory mechanisms include halting sales of sport utility vehicles (SUVs), deregulating airlines, congestion charges and increased energy taxes. The first would be economically inefficient, the second is economically efficient, but has probably increased energy intensity, and the last two would economically efficiently decrease energy intensity.

Many technological changes, such as LED lighting, optimized building design and construction, improved gasoline mileage, and efficient AC-DC converters, would improve energy efficiency.

Provision of information and incentives to encourage changes in consumer behavior, such as using compact fluorescent lights and replacing old energy inefficient appliances, are possible and options are being pursued in many developed and developing countries. Regional or local land planning can be a short- to long-term option and can help with energy efficiency in multiple sectors.

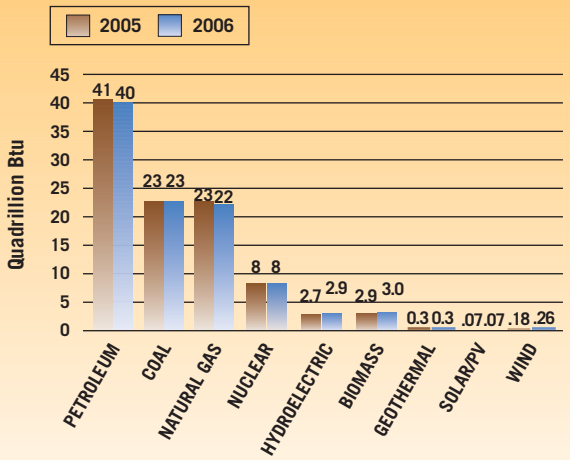
Identifying options for improving energy efficiency does not imply changes come easily. Various barriers and market failures inhibit changes that would increase energy efficiency. These include: pricing below marginal cost; non-time-differentiated electricity pricing; limited information availability; and suboptimal incentives for technology development. Efforts to recognize and overcome these barriers could lead to quicker adoption of energy efficiency measures. Accelerating market development, increasing funding of energy research

FIGURE 2: TECHNOLOGICAL, REGULATORY AND BEHAVIORAL OPTIONS THAT ARE AVAILABLE NOW OR IN THE NEAR FUTURE



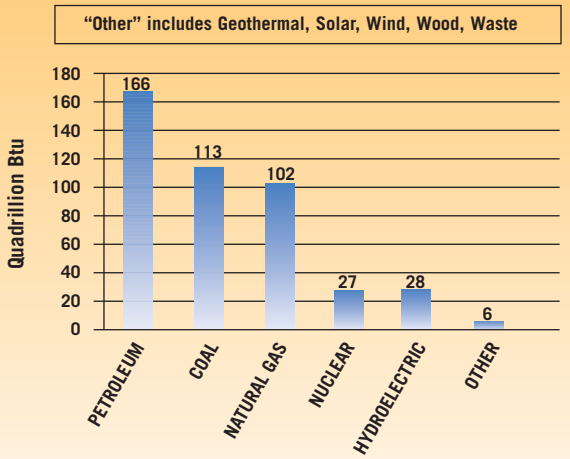
Source: Analysis by the author

FIGURE 3: U.S. ENERGY CONSUMPTION IN 2005 AND 2006



Source: Energy Information Administration, US Department of Energy

FIGURE 4: WORLD ENERGY CONSUMPTION IN 2005



Source: Energy Information Administration, US Department of Energy

and development, risk-sharing to encourage innovation, and policy analysis to improve the enabling and regulatory environments will help in these efforts.

Low carbon energy production

FOR MANY DEVELOPED COUNTRIES, the majority of energy consumed originates from petroleum, coal and gas (see Figures 3 and 4). In the US, all renewable energy, including hydroelectric and biomass, is around 7 percent, with wind and solar being 0.35 percent.

In addition to energy efficiency changes, another option is to move towards low carbon or no-greenhouse-gas-emitting technologies. An increasing proportion of renewable energy along with improved energy efficient and electricity production technologies are options currently available. However, some of these electricity production technologies are characterized by significant economies of scale, so that household or community level solutions are not currently viable in all countries.

The World Bank, in its clean energy investment framework paper in 2004, recognized that meeting energy needs of developing countries is both an urgent need and a challenge. It will require national policies that provide incentives for energy efficiency and incentives for mobilizing public and private investment, nationally, regionally and globally. As many developing countries accelerate their development and thus increase their energy demand, access to affordable, reliable, clean and modern energy services will help decrease poverty, provide other cobenefits—such as decreased exposure to air pollution—and provide many benefits due to energy access that developed countries take for granted, such as lighting, cooking, space heating and cooling, and improved communications. In helping developing countries—especially through technology transfer and investment opportunities—to "leapfrog" to clean and modern energy production, distribution and use solutions will not only help their populations and development goals, but will also help the global atmosphere.

Ethical responsibility for ensuring a healthy future for our grandchildren

A SUITE OF INSTRUMENTS and approaches are needed to limit carbon dioxide emissions in developed countries. These include establishing carbon prices, through a tax or cap-and-trade system, technology development, regulatory frameworks, utility-based programs, local land-use planning, infrastructure design, and corporate, government, NGO and civil society leadership, as well as changes in behavior and ethics. Changes in lifestyles and consumption patterns can be encouraged to increase energy efficiency and significant changes can be implemented for transport and buildings, especially space heating and cooling and lighting.

We need to pursue all these options, and to overcome the barriers associated with their adoption, in order to reduce greenhouse gas emissions, including non-carbon dioxide emissions, such as methane and fluorocarbons. In the short to medium term, we must concentrate on demand side reduction through energy efficiency and supply side, by using a larger proportion of solar, wind and, where possible, thermal energy. We also have the technologies to reduce carbon emissions from non-energy sectors, particularly transport. Incentives for industry and public education can help in encouraging energy efficiency and in moving towards low carbon growth and growth that is equitable for developing countries. It is our choice and our ethical responsibility: we can let the future climate change related crises put our grandchildren in an impossible position or we can anticipate the growing problems and take action now.

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