Efficiency Electricity for the Environment and the Economy

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環境と経済のための電気効率

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Abstract

This paper presents the case for increased energy efficiency not only as a way to reduce global warming but also as a way to achieve economic benefits. The case for energy efficiency is illustrated with examples of lighting, appliances, efficiency gains in businesses, and efficiency in the production of electricity. Electricity can be produced at up to 90% efficiency through cogeneration systems compared to the 33% efficiency of standard power plant produced electricity by the time it is delivered to the user. Efficiency is economical and suitable for both the developed and developing world. Rather than being an expensive way to respond to global warming, efficiency is a money saving way to protect the earth. Finally, in order to increase the use of efficiency three steps are necessary. First, information and education about efficiency is needed. Secondly, governments should reduce subsidies that encourage wasteful energy use. Third, consumers need to choose efficiency when making decisions related to energy.

Key words: energy, efficiency, environment, global warming

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抄　　録

この論文では、地球温暖化を緩和するだけではなく、経済利益をも得るために電気効率を伸ばす例を発表する。その電気効率の例は、電光、電気器具、ビジネスの上での効率の有益性、そして、熱電併給（コジェネレーション）システムを通しての電気生産効率の例と共に説明される。効率は、経済的で先進国、発展途上国ともに必要とされているものである。地球温暖化対応への不経済なやり方よりも、効率を考慮した経済的で地球を守る方法の方がより望ましいと考える。最後に、効率を高めるための３つのステップが必要である。第一に、効率についての情報、教育が必要である。第二に、政府は必要以上のエネルギー使用を促すようなものへの補助金を減らすべきである。第三に、そのような情報を得た消費者がエネルギーに関する決断をする時に効率の高いものを選ぶことである。

キーワード：エネルギー、効率性、環境、地球温暖化

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Efficient Electricity for the Environment and the Economy

Electricity has become essential for the daily life and work of billions of people. Providing electricity is a major industry itself. Over $800 billion is spent each year for the electricity used throughout the world (Flavin and Lenssen 5). Meanwhile, producing electricity also contributed to the 6,000 million tons of CO2 emitted each year by the burning of fossil fuels (Flavin and Dunn 11). This is a cause of global warming with related extremes in weather. Japan, and other countries have seen rising energy use by both industrial and household consumers during the recent past. This rising use of energy has led to calls by the power companies and by governments for increasing the production of electricity, particularly by using nuclear power. However, these governments and electric power companies are overlooking a wonderful possibility, energy efficiency. Efficiency is the effective use of something with little or no waste. By increasing efficiency in the use and production of electricity, nations could eliminate the need for more nuclear power plants. Efficiency would also enable countries to meet or exceed their commitments to reducing greenhouse gas emissions. Furthermore, increasing efficiency would have economic and financial benefits. Thus, countries should develop strong policies for the efficient use and production of electricity for both environmental and economic benefits.

Several examples of efficiency can help in the understanding of its usefulness in saving energy. The first example is that of electric light. If we compare two sources of electric light, we can see a great difference. The first type of electric light is the light bulb that has not changed very much since Thomas Edison invented it almost 100 years ago. Electricity sent through a special type of wire heats up and gives off light. However, newer compact fluorescent lights can produce the same illumination while using 1/4 of the energy, so a traditional 60 watt light bulb can be replaced with a 15 watt light bulb. Most of the electrical energy going into the traditional light bulb produces heat with only about 10% of the energy producing light. The newer lights use electricity more efficiently to produce more illumination and less heat.

A second example is that of electric appliances. For example, many of the refrigerators that were sold 10 or 15 years ago used much more electricity than refrigerators that are made today. Looking at the number of figures listed inside the doors of refrigerators, it used to be common to see use of over 50 kilowatts of electricity each month. Even larger refrigerators today require only 22 kilowatts of electricity each month. That is a saving of more than 50%. Electric motors and other parts of the refrigerators have been improved to use energy more efficiently. Sharp's 400 liter refrigerators have improved in annual energy use "from 864 kilowatt -hours in 1995 to 312 kilowatt-hours in 1998, thereby reducing the annual electricity charge from ¥19,870 to ¥4,340" (Asaba). These saving are considerable. In the United States, there are

about 150 million refrigerators and freezers. By setting standards for the energy efficiency of refrigerators, by 2001 the U.S. will have avoided the need for 40 one gigawatt power plants which will save consumers throughout the nation $10–$13 billion a year (Rosenfeld 46–48). An official of Sharp Corporation estimates that if all Japanese households were to use the company's energy saving refrigerators, air conditioners, microwave ovens, and washing machines it ". . . would achieve an annual evergy cost saving of more than ¥1 Trillion. Put simply, energy-saving technology could have the same economic benefits as ¥1 trillion worth of tax cuts" (Asaba). Flavin and Tunali report studies showing that the efficiency of appliances can be doubled or tripled (Flavin and Tunali 47–48). Companies now compete to produce more efficient appliances and consumers have begun to notice.

A third example of efficiency is its use in companies and businesses. Joseph J.Romm has written of numerous cases where companies have saved money by becoming more energy efficient. One case is that of the Southwire Company which saved over $40 million in the cost of energy between 1981 and 1988. Much of the savings came from buying and using more efficient electric motors. Without the savings in the cost of energy, the company might have failed with the loss of 4,000 jobs (152–154). Another case is that of the Pennsylvania Power & Lighting Company. By spending $8,362 to change the lighting in its engineering room, they were able to save $2,035 each year in lighting costs. However, with improved lighting, the engineers were able to work faster and more accurately for a gain in productivity of $42,240 a year (90–92). Similarly, the Reno Nevada post office spent $300,000 to improve the lighting in its mail sorting room. Energy savings were about $22,400 a year. With better lighting the mail sorters were able to reduce the number of mistakes and save $400,000 a year in labor (xv – xvii). Among other companies mentioned which found similar benefits are Control Data, the NMB Bank of Holland, Lockheed, and the Compaq Computer Corporation. These examples illustrate that using energy more efficiently is clearly good for business. All of the savings in energy are also clearly good for the environment because when less energy is used, less pollution is produced.

A fourth example of efficiency is in the production of electricity. Usually, electricity is produced at large central power plants located away from cities. About 2/3 of the energy from the fuel is lost in this system. The most efficient turbines can only transform about 40% of the steam coming out of a nuclear reactor or a thermal power plant into electricity. The rest of the primary energy becomes waste heat. Sending the electricity across a power grid results in the loss of another 5% of the electrical energy after it has been produced (Sukue!). On the other hand, cogeneration is the simultaneous production of electricity and use of the heat at the same site. Small power plants using natural gas turbines can produce electricity inside buildings. The heat that is not converted into electricity can be used to warm the buildings in the winter and can also drive compressors to cool buildings in the summer. There is little loss

of electricity in sending the electricity through the building. Compared to traditional power plants that effectively use about 33% of their energy, cogeneration can use up to 90% of the energy (Cogen Europe). One local example is the use of co-generation in Osaka at Bentencho. The Hotel, office building, and swimming pool complex gets electricity, heat, and cooling from a cogeneration system.

Despite the benefits of efficiency, critics claim that investments in energy saving lights, motors, appliances, etc. costs more than increasing the supply of electricity by building more power plants. However, in reality, saving money is one of the strongest reasons for increasing energy efficiency. In the United States, electric power utilities have established their own think-tank, the Electric Power Research Institute (EPRI). The EPRI says that "Americans can still cost-effectively save half the electricity they use (Rocky Mountain Institute, Energy : Meeting Our Needs). Reducing electricity demand by this much would mean savings in fuel for power plants and further savings because expensive new power plants would not have to be built (Rocky Mountain Institute, Energy : Saving the Utilities). Critics also claim that without increasing electical production, economic growth would come to a standstill. However, 2,500 economists, including six who were awarded the Nobel Prize, stated "that we could cut emissions through conservation and energy-efficiency measures and at the same time increase productivity and economic wealth" (Gelbspan "A Good Climate" 26). This seems to have been validated by recent data showing that between 1996 and 1999 energy use in the United States rose by just 2% while there was a 13% increase in economic output (Reed, Bad News 21). In a report for the European Union, Krause, Koomey, and Olivier contend that lowering CO2 levels through the use of energy efficiency will bring about economic gain. Furthermore, they blame "outdated economic models" and misinformation concerning current technology for the idea that lowering CO2 levels will cause economic loss (vii). A further argument against energy efficiency is that developing countries will need a great increase in energy production to bring their standard of living up from what it is now. However, a study in the Indian state of Karnataka showed that with efficiency improvements, electricity production would need to increase much less than predicted and would cost much less than expected (Hawken, Lovins, and Lovins 250).

Countries face a choice for the future, either to increase the generation of electric power or to increase the efficiency of using electric power. To evaluate these choices, it is necessary to look at what the consequences of each choice might be.

If electric power generation is increased, it will cost a great deal of money and it will cause further environmental problems. Many people have claimed that increasing nuclear power plants will take care of the global warming problem because nuclear power plants do not emit greenhouse gases. Actually though, increasing nuclear power to reduce CO2 will cost seven times as much as using efficiency to reduce CO2 emissions (Magavern 6 and Reed,

Return 25). Thus, increasing nuclear power generation is not an economical way to solve the CO2 problem. Furthermore, the environmental and health dangers of nuclear power plant accidents would increase, so nuclear power is not a good solution either economically nor environmentally. If power generation is increased by using coal, oil, or gas, the dangers of global warming and climate change will increase.

On the other hand, if efficiency is increased, there are many economic and environmental benefits. A good example is the California electric utility, PG & E (Pacific Gas and Electric) which was encouraged by new regulations to save its customers electricity.

> . . . in 1992, PG & E invested over $170 million to help customers save electricity more cheaply than the utility could make it. That investment created $300–400 million worth of savings. Customers got 85 percent of those savings as lower bills, while the utility's shareholders got the rest-over $40 million-as extra profits. Everybody won. (Rocky Mountain Institute, Energy: Saving the Utilities)

Besides being the best economically, such savings reduced the threat of global warming because less fuel was used to provide electricity. If this kind of effort were encouraged throughout the world, there would be great cost savings and reductions in CO2 levels could easily exceed those agreed to at the Climate Conference in Kyoto.

In conclusion, energy efficiency offers the best choice both economically and environmentally. In order to bring about these benefits considerable efforts will have to be made. First, more information about efficiency must be shared. This will have to take place in governments, businesses, schools, and homes. One of the major barriers to efficiency is lack of knowledge or misinformation about it. As Rosenfeld points out,

> It's human nature to be proud of a large visible investment, like a power plant or even an array of photovoltaic (PV) cells, and to ignore many small purchases, usually invisible, like ballasts, lamps, windows, and refrigerators. That makes it hard to convince most people that, for any given year in the foreseeable future, it will be cheaper and cleaner to improve efficiency by a few percent than to increase supply by the same amount. (57–58)

Second, efficiency will need to be encouraged by government policy. Currently, many governments encourage the use of fossil fuels through various subsidies that amount to as much as $300 billion a year (Gelspan "Rx"). That will need to end if progress is to be made through efficiency improvements. Third, consumers at the corporate and individual level will need to choose products that use less energy. Of course, if consumers receive more education about the benefits of efficiency and if governments encourage efficiency, the choice of efficient products will become much easier. The sooner these steps are taken, the sooner and the greater the benefits will be. The other choices will cost more but will benefit the environment less. Thus, energy efficiency should become the policy chosen to save money and to save the environment.

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