# Beating the Btu Tax
## The 6 Percent Solution

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May 1993

INSTITUTE FOR LOCAL SELF-RELIANCE
Environmentally Sound Economic Development

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# Beating the Btu Tax

## The 6 Percent Solution

*The Btu tax will raise fuel prices, on average, by 6 percent. Experience indicates that farmers, manufacturers, homeowners and building managers can reduce energy consumption by 6 percent with investments that quickly repay themselves. The Btu tax is not a threat to the economy. It is a challenge to our ingenuity and our willingness to adopt proven energy saving techniques.*

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On February 17, 1993, President Clinton proposed a domestic energy tax. This proposal has been dubbed the Btu tax.[1] When fully implemented in 1997, this tax will generate about $20 billion annually. The Administration contends that this broad based tax will impose only a small burden on any individual consumer and exemplifies the President's belief that shared sacrifice is needed to reduce the deficit.

The Administration notes that an energy tax promotes several beneficial objectives, in addition to its revenue-raising potential. Raising the cost of energy encourages energy efficiency. By exempting renewable fuels and imposing a higher tax on oil, the Btu tax encourages business and households to switch to domestically produced fuels and those that are more environmentally benign, such as natural gas and solar energy.

Opposition to the energy tax has been led by energy providers and energy intensive industries. Major segments of the business community have also mounted an unusually coordinated and aggressive attack including the newly formed Affordable Energy Alliance, which boasts more than 900 companies and associations, among which are the Farm Bureau, the National Association of Manufacturers, the American Petroleum Institute, the National Federation of Independent Businesses.

Opponents insist that an energy tax will reduce employment by 600,000 nationally, damage the competitiveness of many key exporting industries and seriously burden already hard pressed household budgets.[2]

Mobil has attacked the Btu tax with paid advertisements in the New York Times. Minnesota's largest electric and gas utility and former employer of Secretary of Energy Hazel O'Leary, Northern States Power (NSP), provides a toll free number with a taped announcement informing customers that "the more they learn about the tax the less they like it". At the end of an accompanying pamphlet NSP urges its 1.3 million customers, "If you are concerned about the well-being of your family and this region's quality of life, contact community leaders or your Congressional representatives right away."[3]

This avalanche of criticism may cause Americans to lose sight of a simple and central fact. *The energy tax will raise energy prices by about 6 percent. Almost all farmers, manufacturers, retail stores and households can reduce energy consumption by six percent with investments that repay themselves within the three year phase-in period of the proposed Btu tax.*[4]

The most overlooked, yet attractive aspect of the Btu tax is that it is easily offset. An income tax can be reduced only by lowering one's income. A payroll tax can be diminished only by lowering wages or employing fewer workers. An energy tax, however, can be offset by reducing energy consumption, a strategy which not only saves the customer money but generates important economic and environmental benefits to the nation. If every sector achieves a 6 percent energy usage reduction by 1997, when the Btu tax will be fully phased in, everyone would win. The customer would pay no more for energy with the tax than without it, and the federal government would receive virtually all the expected revenue.

To illustrate, let us assume a household pays $1,000 for energy per year and the Btu tax is 6 percent. In 1997 this household will pay $1,000 for energy plus $60 to the federal government for the Btu tax. Its total energy related bill will come to $1060. Now consider what happens if that family reduces its energy consumption by 5 percent. In 1997 it will be pay $940 for energy and an additional energy tax of $57(6 percent of $940) for a total bill of $997. The family actually pays less than before, while the federal government receives 94 percent($47/$50) of what it had expected to receive.

By 1997, this translates into an annual savings of about $25 billion over the national energy bill of $500 billion[5] Is this possible? A huge body of experience suggests it is. Every sector can reduce energy usage by 6 percent with investments that repay themselves very quickly.

This paper examines the potential for improving energy efficiency in three sectors: agriculture, manufacturing, and building management. These sectors consume more than 50 percent of domestic energy. This is an illustrative rather than an exhaustive analysis, based on actual operating experience and focussing on a few well-documented areas for energy savings.

The analysis concludes that each sector can offset the Btu tax by using a different strategy. Farmers can adopt reduced or no tillage methods of cultivation to cut diesel fuel consumption; better soil monitoring and crop rotation techniques will reduce energy intensive nitrogen fertilizer use. Primary manufacturing industries can cut energy use by raising the amount of scrap materials they use. Residential, commercial and institutional sectors can reduce building energy consumption by improving lighting and heating efficiency.

In all three sectors, strategies that reduce energy consumption sufficiently to offset the Btu tax can either provide immediate economic benefits or can generate a return on investment greater than 20 percent a year.

In fact, one might characterize the President's proposed tax a levy on apathy rather than on energy use, since savings sufficient to offset its costs can be so easily achieved. Only those who refuse to become more efficient will suffer. Benjamin Franklin offered counsel relevant to the current situation. When people complained about government taxes two hundred years ago , he responded with sympathy but added, "We are taxed twice as much by our idleness, three times as much by our folly, and from these taxes the commissioners' cannot deliver us."

Contrary to the hysteria promoted by the Affordable Energy Coalition, the Btu tax doesn't undermine our competitiveness. It challenges our ingenuity and initiative. In short, it taxes our imagination.

## Beating the Tax: A Sectoral Analysis

Table 1 presents the impact of the Btu tax on various fuels.[6] As we can see, the relative increases vary. Electricity rates will go up the least, while coal costs will rise the most. The relative increases will also vary depending on the cost of energy. This is because the tax is a fixed fee per million Btus of energy used while the price of energy varies around the country and by sector. For example, the tax on electricity is equivalent to about .27 cents per kWh. Residential

## Table 1
### The Impact of the Btu Tax

| Fuel | Price ($/unit)[8] | Tax/MBtus | Btus/unit[9] | Tax/unit | Percent increase |
|---|---|---|---|---|---|
| Oil(#2 Fuel) gallon[10] | $0.934 | $0.599 | 138,690 | $0.083 | 8.89% |
| Natural Gas-ccf | $0.571 | $0.257 | 100,000 | $0.026 | 4.50% |
| Coal-short ton[11] | $32.820 | $0.257 | 18,800,000 | $4.85 | 14.72% |
| Electricity(Coal fired)-kWh | $0.077 | $0.257 | 10,500 | $0.003 | 3.50% |
| Gasoline-gallon | $1.117 | $0.599 | 125,000 | $0.075 | 6.70% |
| Diesel Fuel(ag use) gallon | $0.591 | $0.257 | 138,690 | $0.036 | 6.03% |
| Diesel Fuel(non ag use) gallon | $1.087 | $0.599 | 138,690 | $0.083 | 7.64% |

electric prices vary from 4.4 cents per kWh in the state of Washington to 11.4 cents in New York. Thus the Btu tax would raise residential electric prices by about 6 percent in Washington and 2.4 percent in New York.[7] Similarly, since industry tends to pay a lower price for coal, natural gas or electricity than residences, the Btu tax would represent a higher percent increase in the private sector.

## Building Energy: Residential and Commercial

The operating experience of thousands of buildings around the country shows that energy reductions of 6 percent or greater can be achieved with paybacks of 3 years or less.

## Table 2
### Residential Sector Energy Use, 1988[12]

| Use | Percentage |
|---|---|
| Space heating | 46 |
| Water Heating | 15 |
| Food Storage | 13 |
| Space Cooling | 9 |
| Lighting | 7 |
| Other | 13 |

Table 2 presents energy usage on a national level in the residential sector. Table 3 contains similar information regarding the commercial sector. Table 2 reveals that a 10 percent savings in residential space heating would save almost 6 percent of total residential energy consumption. Similarly, slashing commercial lighting energy consumption by 20 percent would reduce overall commercial energy consumption by over 5 percent.

These goals are achievable. The EPA's Green Lights program, for example, is converting lighting in over 3 percent of the nation's office space. EPA findings show 47-83 percent reductions in lighting energy consumption in buildings that have already gone through the program, with paybacks of 3 years or less.[14]

In the residential sector, replacing standing pilot lights in furnaces with electronic ignitions has allowed homeowners in six Illinois cities to reduce energy consumption by about 5 percent, with a payback of under 4 years.[15]

Lowering the thermostat by 5 degrees at night reduces space heating consumption by about 5 percent.[16] If the homeowner already owns a set back thermostat this is a no cost efficiency measure. A new electronic thermostat will pay for itself in one year or less.

## Table 3

### Commercial Sector Energy Use, 1988[13]

| Use | Percentage |
|---|---|
| Space heating | 32 |
| Lighting | 28 |
| Space cooling | 16 |
| Food storage | 5 |
| Water heating | 4 |
| Other | 15 |

Installing low flow shower heads can save about 2 percent of heating energy with less than a three year payback.

With regard to lighting, residences can save money and energy by upgrading to high efficiency compact fluorescent light bulbs. One recent study in the Pacific Northwest concluded that installing efficient bulbs in two most frequently used fixtures resulted in a savings of 319 kWh a year with a payback of less than 5 years.[17] This is about 4 percent of the average electric consumption in a household without electric heating.[18]

The Environment and Energy Resource Center in Saint Paul reports average savings of 22.2 percent with the installation of a steam control package in older steam heated apartment buildings. The average payback is 2.6 years.[19] Based on data from apartment buildings with newer multi-zone hot water heating systems, the average savings are 10.3 percent with a 2.6 year payback.

Schools and universities also can save modest amounts of energy with quick paybacks. One of the most extensively monitored efforts has taken place at the sprawling Minneapolis and Saint Paul campuses of the University of Minnesota. The University Building Energy Efficiency Program, begun in January 1990 is now saving the University $1.3 million a year with investments of $4.5 million.[20] UBEEP has reduced space heating consumption by 7 percent by repairing or replacing all defective steam trap radiator valves. It has reduced lighting by 40 percent and overall electrical consumption by 14.7 percent by installing more efficient lamps and lighting controls.

Both the electrical and heating savings had paybacks of less than 5 years and in many cases less than 3 years despite very low energy costs.[21]

## Agriculture

In 1990, grains accounted for about $33 billion of the $80 billion in farm income from crops.[22] Our largest agricultural crop, by weight, is corn, which may also be the nation's most energy intensive crop. One of the frequently heard claims from those opposed the Btu tax is that it would wreak havoc on corn farmers.[23] Therefor, corn is a good example for the potential of energy reduction.

Corn farmers can completely offset the Btu tax by adopting more efficient cultivation and harvesting techniques. Table 4 compares the amount of energy used by the average corn farmer, the most efficient corn farmers on a state basis and the most efficient individual corn farmer.

To offset the proposed Btu tax, corn farmers must reduce energy consumption by about 450,000 Btus per acre. As Table 4 shows, farmers could reduce energy consumption by about 1.5 million Btus if the average corn farmer adopted the best existing techniques, an additional 2 million Btus if the state of the art energy were matched.[24]

In the short term farmers can offset the Btu tax by reducing their use of the plow by adopting low till or no till farming practices. Spurred by federal farm legislation to prevent soil erosion, thousands of farmers have already done this. In several Indiana counties as

## Table 4

### Agricultural Energy Use for Corn Production[25]

| | Average | | Best Existing State | | State-of-the-Art Farmer | |
|---|---|---|---|---|---|---|
| | lbs/acre | BTU/acre | lbs/acre | BTU/acre | lbs/acre | BTU/acre |
| Nitrogen | 127 | 4,023,900 | 71 | 2,130,000 | 38 | 1,178,000 |
| Phosphorus | 48 | 263,160 | 36 | 198,000 | 15 | 83,400 |
| Potash | 57 | 241,740 | 22 | 93,500 | 17 | 72,760 |
| Pesticide | 1.58 | 218,790 | 1.82 | 252,025 | 2.37 | 328,186 |
| Fuel | 6.55 | 903,900 | 1.80 | 248,400 | 1.00 | 138,000 |
| Other | — | 3,280,320 | — | 3,116,300 | — | 3,010,800 |
| Total Energy | — | 8,931,810 | — | 6,038,225 | — | 4,811,146 |

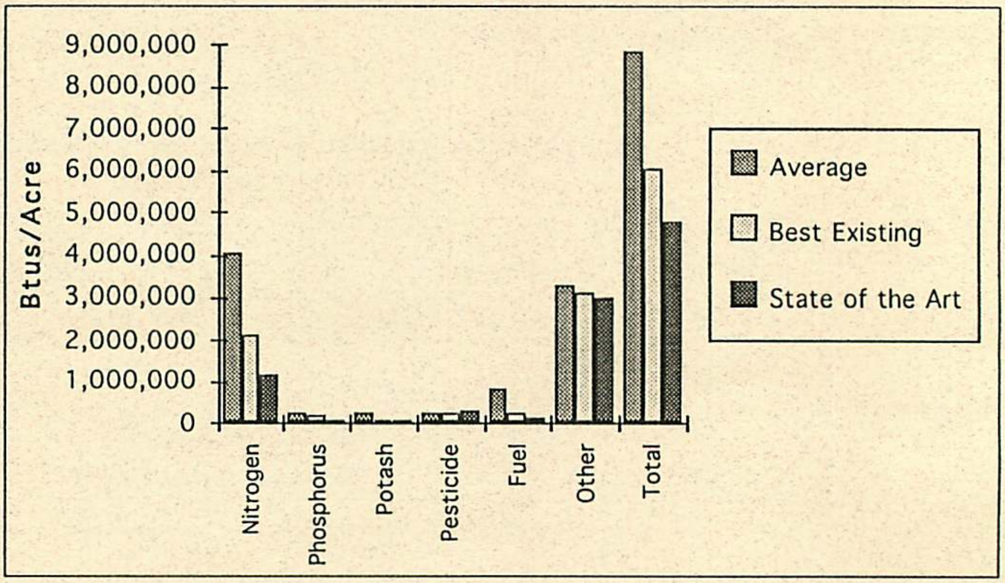
much as 40 percent of the soybean acreage and 25 percent of the corn acreage use no till techniques. Indeed, the economics of this have become so clear that a large part of the growth of conservation tillage, especially no till, is occurring on flat, non highly erodible fields that are not included in conservation compliance regulations.[26]

In recent years farmers have begun to closely monitor the impacts of various farming practices. Beginning in 1989 and 1990 with Indiana's Profit Through Efficient Production Systems(PEP$) program and after 1991, with Successful Farming magazine's MAX program, comprehensive data has been available on the actual inputs used and the economic impact on thousands of farms. In 1992 growers from 14 states provided economic and yield information for 1,337 corn and soybean fields.

As Table 5 shows, no-till farming can save 3.2 gallons of diesel fuel per acre, or about 465,000 Btus.[27] This alone would offset the Btu tax. Shifting to reduced or no tillage practices saves farmers money from the

## Figure 1

### Energy Used in Corn Farming



## Table 5

### Energy to Produce Corn with Various Tillage Systems

| Input | Diesel fuel equivalent (gal/acre) Conventional | Chisel | No-till |
|---|---|---|---|
| On-farm fuel | 5.00 | 3.95 | 1.80 |
| Machinery(mfg&maint.) | 2.57 | 2.48 | 1.05 |
| Herbicides | 1.75 | 2.01 | 2.88 |
| Nitrogen[28] | 26.55 | 26.55 | 26.55 |
| **Total** | **35.87** | **34.99** | **32.28** |

start. The payback is immediate. Table 6 is based on actual operating data from Indiana corn farmers.

The bottom line is that switching to no-till practices reduced Indiana corn farmers' gross income per acre by about $8.20. However, it also reduced their costs by $14.55, resulting in a boost to net income of $6.35 per acre. A 700 acre corn farmer would thus have an increase in income of $4,445.

A similar dynamic may hold for soybeans. *Successful Farming* notes, "Looking at 371 Iowa soybean fields in fields where soil losses were held under 5 tons an acre, profits were about $15 per acre higher than fields with 5-8 tons of soil loss and nearly $30 greater than fields losing more than 8 tons of soil."[31]

## Primary Manufacturing

One of the best strategies for energy intensive industries to reduce energy consumption is to increase their use of scrap. Because they require less processing, secondary feedstocks reduce energy requirements. Almost all industries already use some amount of scrap in their manufacturing process. If the typical manufacturer were to raise the percentage of recycled content in the product to levels already reached by many competitors, this would completely offset the Btu tax.

For example, energy costs represent roughly 18 percent of total production costs for glass containers.[32] Experience indicates that for each 10 percent increase in cullet or scrap glass use, energy consumption goes down by about 2.5 percent.[33] The average glass container is comprised of 30 percent cullet. Many glass smelters use over 50 percent cullet. As Figure 1 shows, if the average glass smelter were to raise its scrap content to the levels already reached by several operating facilities, it would offset the Btu tax.[34]

A similar dynamic can be seen in the aluminum industry. Although producing aluminum from scrap requires just 5 percent of the energy needed to

## Table 6

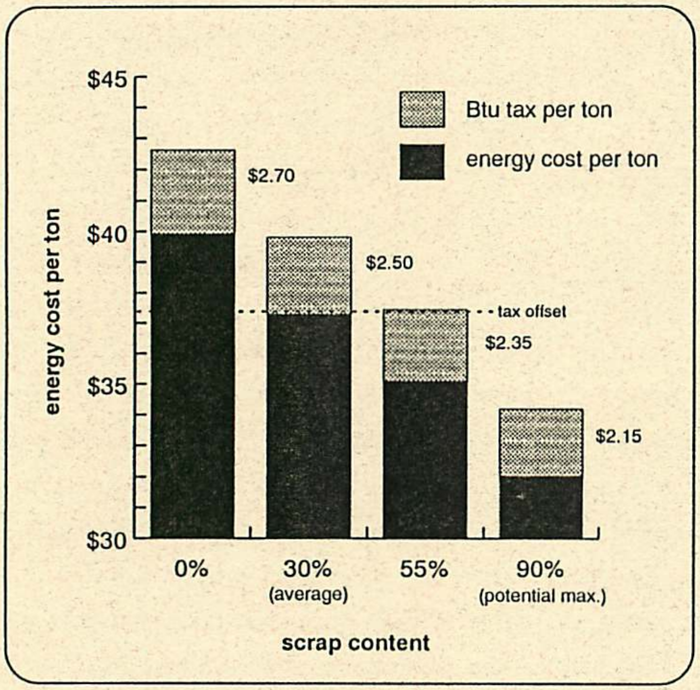
### Corn Costs with Various Tillage Systems

(four year average-Indiana)[29]

| Tillage | Fields | Pesticides | Field Operations | Both Inputs | Yields | Income/Acre[30] |
|---|---|---|---|---|---|---|
| No-till | 285 | $24.31 | $48.43 | $72.74 | 148.5 | $289.58 |
| Ridge Till | 46 | $19.54 | $58.99 | $78.53 | 148.5 | $289.58 |
| Reduced Till | 161 | $23.55 | $59.97 | $83.52 | 174.3 | $339.89 |
| Plow | 52 | $19.51 | $67.88 | $87.39 | 152.7 | $297.77 |

## Figure 2

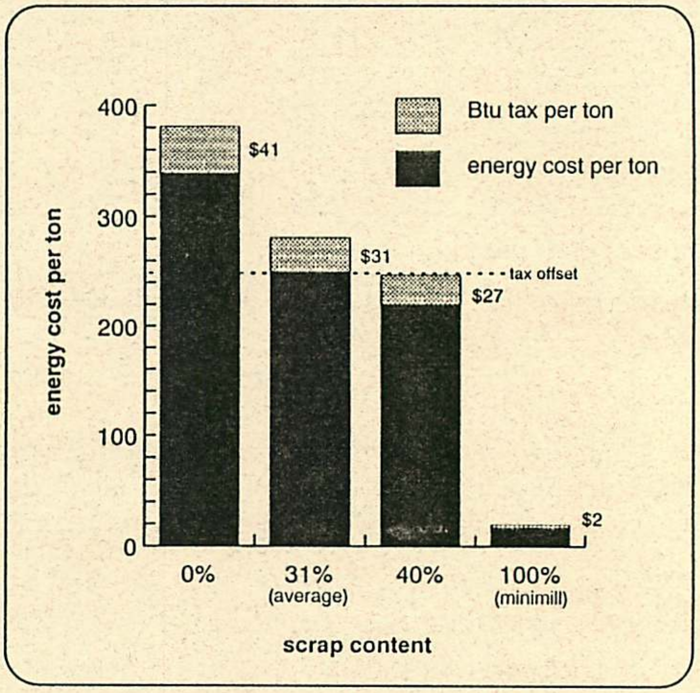
### Energy Costs for Glass Container Production for Four Scrap Content Levels




Source: Institute for Local Self-Reliance, 1993.

## Figure 3

### Energy Costs of Average Aluminum Products for Four Scrap Content Levels




Source: Institute for Local Self-Reliance, 1993.

make aluminum from virgin resources, only 31 percent of aluminum products consist of scrap. An increase from 31 to 40 percent is needed to offset the proposed Btu tax. For example, The Golden Aluminum Company of Golden, Colorado produces 67,500 tons of can sheet each year in its San Antonio, Texas mill using 70 percent scrap feedstock.

In the steel industry, new mini-mills which rely on 100 percent scrap, have already captured 35 percent of the 90 million ton per year domestic steel market. Traditional, vertically integrated steel mills use, on average, 25 percent scrap. The proposed Btu tax will widen the production cost advantage of 100 percent scrap based steel mills. Assuming both types of steel mills manufacture cold-rolled coil(strip) steel, the Btu tax will increase the costs for traditional mills by $4.50 and minimills by $3.30 per ton of production.[35]

A similar dynamic affects the paper industry. In each industry, if a company that currently uses the industrial average recycled content raised its scrap levels to those already achieved by state-of-the-art competitors it would completely offset the Btu tax. Table 8 breaks out by material the average scrap content for products, the State of the Art levels and the average needed to offset the Btu tax. In each case companies can offset the proposed Btu tax without having to boost their scrap content to the highest levels achieved by at least one of their competitors.

## Table 7

### Scrap Content Needed to Offset Tax

| Material | Average (%) | SOTA (%) | Average needed to offset Btu tax (%) |
|---|---|---|---|
| glass | 30 | 42-78 | 55 |
| steel | 25 | 50 | 35 |
| aluminum | 31 | 70 | 40 |
| paper | 20 | 100 | 30 |

SOTA: State of the art.
Source: Institute for Local Self-Reliance, Glass Packaging Institute, American Iron & Steel Institute, The Aluminum Association, American Forest Products Association.

## Conclusion

Industry, agriculture and the commercial, institutional and residential sectors can offset the proposed Btu tax with investments that repay themselves in fewer than five years. In many cases the economic payoff is dramatic and immediate.

This paper has not examined the economic benefits that often result as byproducts from higher energy efficiencies. For example, low flow showerheads also reduce water and sewer bills, thereby shortening payback periods even further. Electronic ignitions reduce safety problems that might result from using pilot lights. The University of Minnesota found that its energy efficiency program reduced maintenance budgets for its steam system and also improved campus lighting. Farmers that use no tillage techniques can reduce soil erosion by up to 70 percent and cut labor requirements by about one hour per acre. In late-season stress situations, conservation tillage, which leaves more surface cover, can mean higher yields. Glass smelters that use high levels of cullet reduce wear and tear on their furnaces. Paper mills using high levels of scrap can avoid expensive environmental control measures.[36]

We have not, for example, examined the transportation sector nor the issue of new construction and equipment. This does not imply that these two sectors cannot also achieve energy savings with economical measures.

Simple maintenance techniques can easily raise the efficiency of one's automobile by 5 percent or more. For example, a clogged air filter can cause the engine to run "dirty". Instead of the typical fuel ratio of 15 parts air to 1 part fuel the ratio can drop to 10 to 1 or even 7 to 1, resulting in higher fuel consumption.[37] The Ford Motor Company estimates that after the car reaches 45 miles per hour, each additional 5 miles per hour speed increase subtracts 2 miles per gallon from the car's fuel economy.[38] An overall average fuel efficiency of 17 miles per gallon at 65 miles per hour can mean a 25 percent reduction in fuel efficiency from a speed of 55 miles per hour. A four pound underinflation of tires knocks off about half a mile per gallon in fuel mileage, reducing fuel efficiency by about 3 percent.[39]

The data is clear that the incremental costs of raising the efficiency of new buildings or buying higher efficiency products are very low compared with the energy savings. For example, a recent study found that advanced heat pumps, already in the marketplace, can cut electricity consumption in all-electric homes in half or more with paybacks based on the incremental cost above traditional electric resistance heating/air conditioning, that pay back in about 3.4 years.[40] A recent Illinois study found that high efficiency rehabbing of multifamily buildings raises the overall rehab investment by 5 percent while reducing energy costs by 31-75 percent, with a 4-8 year payback.[41]

In the last 15 years we have learned how to achieve the same level of comfort, speed, productivity and yield with less and less energy. Farmers have learned to control soil erosion and reduce fertilizer and diesel fuel consumption while maintaining yields and raising net income levels. Manufacturers have learned to make their industrial processes more efficient, in part by increasing their use of scrap. Building managers have learned that upgrading the efficiency of lighting, heating and air conditioning systems can save significant amounts of money.

The Btu tax encourages us to build on this experience. Those who are already efficient can learn to be even more efficient. Those who are only average can quickly adopt the proven techniques of their neighbors, competitors and colleagues.

The Btu tax is not a threat to the economy. It is a challenge to our ingenuity. Let's stop the naysaying and get to work.

## NOTES

1 *A Vision for Change in America.* Executive Office of the President of the United States. February 1993. A British Thermal Unit, the amount of heat needed to raise the temperature of one pound of water, about one eight of a gallon, one degree Fahrenheit. This is about the amount of heat in a match head.

2 *The BTU Tax: Bad for America, Bad for Jobs!* The Affordable Energy Alliance. Washington, D.C., April 1993.

3 *How the Proposed Btu Tax Would Affect You.* Northern States Power. Minneapolis, Minnesota. April 1993.

4 The Btu tax will actually raise energy costs by 3-15 percent, depending on which fuel is used and the customer's current cost of energy. The average will be about 6 percent. See Table 1.

5 This is an approximate figure, taking into account the exemption for home heating oil and the fact that electricity, which has the smallest percentage increases, accounts for a disproportionate share of the nation's energy bill.

6 As of May 17, 1993.

7 See, C.C. Conner, R.G. Lucas, *Technical Support Document for Proposed Revision of the Model Energy Code Thermal Envelope Requirements,* Pacific Northwest Laboratory. Richland, WA. February 1993.

8 Coal prices are average price of 1992, from the Department of Energy, Energy Information Administration, National Energy Information Center. Fuel oil, gasoline, diesel(ag use) natural gas are nationwide averages from January 1993, *Monthly Energy Review,* US DOE/EIA, April 1993. Diesel Fuel(non ag) prices are January 1993 nationwide averages as reported by Computer Petroleum Corporation, April 1993. Diesel fuel(ag uses) price includes a rebate for fuel use for off road purposes.

9 Coal Btu content comes from Department of Energy, Energy Information Administration,National Energy Information Center. All other come from *Energy Content of Fuels,* Minnesota Department of Public Service, October 1992.

10 Heating oil is exempt

11 This is the price for coal used for manufacturing. Coal used to produce coke for steelmaking is exempt.

12 *Building Energy Efficiency.* Office of Technology Assessment. May 1992.

13 *Building Energy Efficiency.* May 1992. Office of Technology Assessment.

14 *Space Conditioning: The Next Frontier.* United States Environmental Protection Agency. April 1993. Page 1-6.

15 *Home Energy,* November/December 1992.

16 The Center for Energy and the Urban Environment in Minneapolis calculates an energy savings of 4.7 million Btus per year from a 5 degree setback for 8 hours a day. Honeywell claims that a 5 degree setback(or increased setting at night for homes with high air conditioning demand) will save 7-12 percent depending on location. See also Tom Wilson "Good News on the Setback Front", *Home Energy.* January/February 1991. Higher amounts of energy can be saved with dual setbacks, that is, setting back the temperature during the winter months during the day when family members are out of the house and then again during the night when they are in bed.

17 *The Grays Harbor PUD Compact Fluorescent Maximization Study. Lighting Use and Economic Supplement.* September 1992.

18 In Minneapolis, the average residential customer uses about 119 million Btus for space heating and 7,281 kWh for electricity. 1988-1992 averages from *Annual Report, Northern States Power.* Minneapolis, MN. 1992.

19 A steam control package includes: steam balancing so that steam gets to all apartments at the same time; a cutout which consists of an outside temperature gauge that turns the boiler off if the temperature outside rises above a certain level; and a reset switch that increases the boiler temperature in linear manner with decreases in outside temperature. The results are based on 22 steam heated and 31 hot water heated buildings

20 *University Building Energy Efficiency Program Evaluation.* Minnesota Building Research Center. Graduate School. University of Minnesota. June 1992.

21 Electric energy costs are 2.9 cents per kwh, with demand charges of $6.04 per kw-month. Steam costs are $4.40 per M lbs.

22 Table No. 1094. *Statistical Abstract of the United States.1992.*

23 The Fertilizer Institute calculates a Illinois corn farmer with 700 acres would lose $5,129 because of the Btu tax. The Fertilizer Institute, April 1993. This figure has been cited widely. However, the estimate is based on the assumption that a farmer will reduce nitrogen fertilizer consumption from 161 to 154 pounds per acre and therefore suffer a 2.9 bushel per acre reduction in yield. This reduction in yield results in $4613 of the $5129 reduction in income. Yet the evidence is overwhelming that farmers can reduce their fertilizer levels substantially without suffering decreased yields. Indeed, while the Fertilizer Institute uses 161 pounds for the average nitrogen application, the national average in 1991 was 127 pounds per acre.

24 Another study, based on low input systems "very similar to those that are currently being adopted by farmers in each of the regions" concluded that total fossil fuel based energy(including energy used in making fertilizers and pesticides), could be reduced by as much as 22 percent. *Potential Energy Impacts of Low Input Sustainable Agriculture.* Donald L. Van Dyne, et. al. Department of Agricultural Economics. University of Missouri. Columbia, MO. April 1992. This is very similar to the reductions shown in Table 4 between average and best existing corn farms.

25 Energy content of nitrogen fertilizer is 31,000 Btus per pound. Phosphorus fertilizers contain 5,560 Btus per pound and potash fertilizers 4,280 Btus per pound. Source: David Morris and Irshad Ahmed, *How Much Energy Does It Take to Make a Gallon of Ethanol?*, Institute for Local Self-Reliance. Washington D.C., December 1992.

26 Jim Lake, "Economics Drive No-till Growth", *Successful Farming.* Mid March 1993.

27 Another study found that conventional systems require 5 gallons per acre while no till requires 1.45 gallons for corn on moderate draft soils. Donald R. Griffth, *Energy Requirements for Various Tillage-Planting Systems.* North Central Regional Extension Publication. No. 202. No date.

28 Application rate of 150 lbs per acre as anhydrous ammonia for all three systems.

29 *Successful Farming.* Mid March 1993

30 Based on corn price of $1.95 per bushel

31 *Successful Farming.* Mid March 1993

32 About 62 percent of all glass is made into containers. See: Michael Lewis, *Saving Btus Through Recycling.* Institute for Local Self-Reliance, Washington D.C. 1993

33 *Glass Container Markets in the New York Region.* New York State Department of Economic Development. May 1992.

34 Owens Brockway plants in Portland Oregon have achieved recycled content levels of 78 percent for brown and green containers, and their Toano, Virginia plant has achieved 60-70 percent scrap content levels. See, Michael Lewis, op. cit.

35 Based on figures from Donald F. Barnett and Robert W. Crandall, *Up from the Ashes: The Rise of the Steel Minimill in the United States.* The Brookings Institution, Washington, D.C. 1986.

36 When Seminole Kraft(Jacksonville, Florida) was faced with having to install new equipment to meet Florida's air pollution standards at a cost of $135 million, the mill instead decided to switch to a 100 percent scrap feedstock. This allowed Seminole to eliminate the problem at a much lower cost—$110 million, a savings of $6 per ton. See "Jumping from Kraft to 100 Percent Recycled", *Resource Recycling.* March 1992.

37 *New York Times.* May 12, 1990.

38 *Saint Paul Pioneer Press Dispatch.* September 15, 1990.

39 See *Minnesota Energy Data Book*, 1992. In 1990 Minnesota vehicles achieved a fuel efficiency of 16.5 miles per gallon. Based on the turnover of new higher efficiency cars and historical trends, we assume this reached 17 miles per gallon by 1992.

40 *Space Conditioning. The Next Frontier.* United States Environmental Protection Agency. April 1993. C-38.

41 *Home Energy.* January/February 1993.