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An Energy Policy Perspective on Solar Hot Water Equipment Mandates

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I.
INTRODUCTION

Four hundred years ago the English Parliament addressed and tried to solve the then prevailing energy crisis. It found that "the necessary provision of wood . . . doth daily decay and become scant, and will in time to come become much more scarce, by reason whereof the prices are grown to be very great and unreasonable, and in time to come will become much more, if some remedy be not provided." Its remedy was to prohibit (in a region around London) any use of wood to make coke to be used for ironmaking.[1] The more things change, the more they remain the same.

The intellectual process is simple and in many ways appealing. A resource is suddenly perceived as far more scarce than formerly (the "target resource"). Alert observers identify a cluster of uses that seem as a group to be less worthwhile than some others (timber for ironmaking, gas and electricity for hot water heating). They prohibit this cluster of uses; or, what is the same thing, they mandate an alternative.

The focal articles in this issue of the *UCLA Journal of Environmental Law and Policy* take adversary stances on the wisdom of local ordinances mandating the installation of solar hot water heating devices in new houses. Neither champion articulates a general analytical framework by which to resolve the dispute. This article will attempt to fill the gap.

The approach I suggest—a perfectly ordinary one, for which I claim no patents—consists of three stages: (1) To identify relevant existing market and government failures, (2) to identify the corrective measures best designed to offset the failures, and (3) to determine whether any policy change, by correcting market or

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1. 23 ELIZ. I, ch. 5 (1581); *see also* J. BURKE, CONNECTIONS 164 (1978).

government failures, generates benefits that exceed its costs. The bulk of this article will treat the first stage; the last two will be telescoped together in a brief overview of solutions.

The search for market and government failures rests on the premise that when relative prices are "correct," firms will produce, and consumers will consume, the "correct" amount of every good or service. Market and government failures, within this analysis, include any circumstance which makes prices deviate from the correct relationships. Proponents of a solar hot water mandate implicitly assert that, without the mandate, production and consumption of solar hot water equipment is below the correct level. Thus they implicitly assert the existence of incorrect price relationships between solar hot water equipment and substitutes for that equipment, *i.e.*, they assert market or government failures. If we can identify those failures, then we are likely to be able to devise the right cures for the underconsumption of solar hot water equipment. Although even the right cures may well not operate with surgical precision, they are far more likely to do so than cures devised without an identification of the relevant failures.

For purposes of this analysis, what do "correct" prices and production/consumption levels mean? Correct prices, loosely speaking, must be ones that accurately reflect cost; we will further refine that concept later in this article. Correct production/consumption levels are such that it is impossible to change them in any way that would make one person better off without making someone else worse off.

Suppose, for example, that natural gas is the only close substitute for solar hot water equipment; that both are priced exactly at cost; and that the cost (and therefore price) of natural gas is so high that for all consumers, under all circumstances, it is cheaper to heat water with solar equipment. Under these assumptions all consumers would rely exclusively on solar equipment. There would be no possible change, as between natural gas and solar water heating, that could make any person better off without making someone else worse off. Any switch to natural gas would increase costs without generating any offsetting benefit.

If we go further, and make the heroic assumption that all prices in the society are correct, then it would follow that precisely the correct amount of solar hot water equipment was being consumed. Each consumer would invest in solar equipment precisely that portion of his or her budget that was justified in terms of the benefit that it afforded. No more than that amount; for if the last dollar spent on solar equipment gave him less satisfaction than it would if spent on something else, he surely would spend it on the alternative. And no less than that amount; for if an additional dollar spent on solar equipment would yield more satisfaction than the same dollar spent in the next most gratifying purchase, he would switch it to solar equipment. And since we have assumed that all prices perfectly reflect costs, it appears that we can make no change that would make one person better off without making another worse off. The last dollar that he may spend upon solar equipment reflects exactly the same burden on society's resources as it would if he spent it on a dollar's worth of some other good; a switch would release no net resources and thus would not permit any additional benefit to others. As it is for solar equipment, so it would be for all other goods and services; as for this consumer, so for all others.

Of course this utopia does not exist. Market and government failures abound. But from their almost infinite variety some stand out as ones most likely to contribute seriously to an underconsumption of solar hot water equipment. Of these, all but one are failures that tend to reduce the prices of substitutes for solar equipment below cost. The exception (transaction costs for acquisition of solar easements) might raise the price of installing solar equipment above its true cost.

II.
MARKET AND GOVERNMENT FAILURES

The problems most likely to cause price/cost divergences that would materially affect the market for solar equipment seem to be: (1) National risks from the vulnerability of foreign supplies; (2) discounts of the future; (3) distortions in the mortgage lending market; (4) ceilings on the price of natural gas; (5) public utility pricing; (6) transaction costs for the acquisition of solar easements; (7) pollution; (8) information externalities; and (9) common pool problems in energy resource ownership.

1. National Risks from the Vulnerability of Foreign Supplies

In 1980 the United States imported 5.2 million barrels of oil per day.[2] That represented 40% of its oil consumption and about 13% of its total energy consumption (which in 1979 was the equivalent

2. Wall St. J., Jan. 16, 1981, at 6.

of 39 million barrels of oil per day).[3] Although lower than the levels in the immediately prior years, these import rates entail startling vulnerability. In journalese, the vulnerability derives from energy's being "essential." One can express the point more precisely: In the short run, it is very costly for producers to find petroleum or similar alternative fuels to replace foreign supplies, and for consumers to find and use non-fuel substitutes for the tasks now performed by foreign fuels. On the supply side, all substitutes (coal, natural gas, nuclear energy and solar) entail large capital investment that cannot be made overnight (except at astronomic cost). On the consumption side, much of the capital now in place—factories, thinly-insulated dwellings, our fleet of cars and trucks, and our highway network—is well adapted to energy at low prices and in large amounts. It too cannot be quickly adapted to high prices and small quantities, except, again, at astronomic cost. In economic terms, the short-run price elasticities of supply and demand for petroleum are very low.

As a result, a dramatic price increase would be necessary to clear the oil market if foreign supplies were curtailed. One estimate is that if the flow of Persian Gulf oil stopped, the world market price would rise to about $200 per barrel (compared with a current price of about $35 per barrel).[4] Even with the most competent government management, such a shock would inflict dramatic losses on society. Foreign governments will clearly anticipate that the United States will sacrifice major interests to avoid any such development. This expectation shrinks our freedom of maneuver, and may enlarge theirs, to our pain.

But the current price of oil does not fully reflect these risks.[5] This divergence between price and cost distorts the price relationship between solar equipment and a major substitute (electricity generated by oil-fired plants). Some might argue for a solar man-

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3. *Id.* See U.S. DEPARTMENT OF ENERGY, REDUCING U.S. OIL VULNERABILITY: ENERGY POLICY FOR THE 1980's, DOE/PE-0021, at 5 (1980) [hereinafter cited as REDUCING U.S. OIL VULNERABILITY].

4. REDUCING U.S. OIL VULNERABILITY, *supra* note 2, at 11.

5. Some readers might ask why the market fails to adjust for the national vulnerability risk, assuming that resource owners really do take into account the user cost of current production; such user cost will, after all, reflect anticipated risks of future scarcities and the resulting possible price rises. A short and politically realistic answer is that no resource owner could comfortably expect government to allow him or her to enjoy the value increments that would result if the world price of oil suddenly rose to $200 per barrel. Moreover, under almost any imaginable circumstances such a price increase would have dramatic second-order effects on the economy. Finally, the national vulnerability risk imposes a present restraint on American foreign policy.

date to restore the balance. But one can only evaluate the mandate remedy in comparison with others; this I defer to Part III.

2. Discounts of the Future

It is often argued that "the market," meaning individuals and firms making decisions in a market, disregard or unduly discount future benefits and costs, and that this disregard or discount skews decisions, to the injury of the future. If indeed prices failed to reflect costs imposed upon society in the future, that failure would tend to cause underconsumption of solar equipment, and might justify a mandate. The concern is particularly poignant when one considers generations not yet born.

The concern bears upon two aspects of the web of economic relations that may culminate in a consumer's decision about solar equipment. First, if producers of substitutes for solar energy disregard the cost of exhausting those substitutes (mainly fossil fuels), the current supplies of those fuels will be too great and the price too low. Consumers would thus receive a false signal. Second, if consumers in some sense undervalue future gains (conventional energy costs saved), as against current burdens (the price of solar equipment), they would use less than the correct amount of solar energy.[6]

Exhaustion of nonrenewable resources. The anxiety here rests largely on the quite sound perception that the owners of nonrenewable resources may well have no concern for the welfare of future consumers. But the observation, while correct, ignores the fact that (except in a special case discussed below)[7] an owner extracting a resource today incurs an opportunity cost: the loss of future sales. Anticipated future scarcities, therefore, give the owner a pecuniary motive to defer extraction to the degree that deferral is efficient.

There are a number of possible vulnerabilities in this analysis, and I have endeavored to deal elsewhere with as many as seemed significant.[8] The one that seemed most vital was that the current

6. *See, e.g.*, Hamrin, *In Support of local Sales Mandates*, 1 UCLA J. ENV. L. & POL'Y 107, 115-16 (1981), contending that "Human nature causes people to be more likely to discount savings in the future and place a greater emphasis on first-cost savings."

7. *See* text accompanying notes 32-36 *infra*.

8. *See* Williams, *Running Out: The Problem of Exhaustible Resources*, 7 J. LEGAL STUD. 165 (1978) [hereinafter cited as *Running Out*].

real rate of interest might be inefficiently high.[9] The real rate of interest is a critical element of the process since a resource owner who is ascertaining the cost of foregoing a sale in 1991 at $100 (in constant 1981 dollars) will determine the *present value* of the cost by discounting it to the present at the real rate of interest. One hundred dollars discounted from 1991 to 1981 at 3% is $74; discounted at 1% it is $91. If the real rate of interest is high, obviously there will be far fewer circumstances in which it will pay a resource owner to defer extraction. A high real rate of interest reduces the opportunity cost of present extraction. Thus if the interest rate is inefficiently high non-renewable resources will be undervalued.

Undue consumer discount of future benefits. At the consumer level a distorted real rate of interest would have comparable effects. If solar hot water equipment would save $200 per year (in 1981 dollars) for twenty years, the consumer must discount future costs saved to their present value to compare them with the cost of the solar equipment. At a real rate of interest of 3%, the present value of the savings is $2980; but at a real rate of interest of 5% it is only $2500. Thus an inefficiently high real rate of interest tends to bias the decision against solar energy.

Part III addresses the issue of whether a solar mandate is an appropriate remedy for distortions in the real rate of interest.

3. Distortions in the Mortgage Lending Market

Apart from the interest rate, there might be defects in the mortgage lending market that prevent a purchaser from investing in solar hot water equipment even when doing so was sound. Some suggest that a house buyer might decide against solar hot water or be unable to buy it, even where it is efficient, because of the effect on his mortgage payments.[10] There appear to be two reasons why that might be so; (1) mortgage lenders' disregard of the fuel savings generated by the solar equipment, and (2) inflation-generated distortions in the burden of conventional amortization programs.

To examine this argument, we must first consider how a prospective solar hot water equipment buyer would go about making his decision. The first step is relatively easy. As we are confining ourselves to new houses, he need only ascertain the difference be-

9. *Id*. at 185-98.

10. *See* Langston, *Mandates: Good Intentions Misplaced*, 1 UCLA J. ENV. L. & POL'Y 121, 130 (1981) [hereinafter cited as Langston].

tween a new house with solar hot water equipment and an equivalent new house without such equipment. Let us suppose that to be $2500.

The second is a good deal more iffy. It is to evaluate the fuel savings in the years they are expected to occur. He can put aside general price inflation because, as we shall see, it will wash out.[11] But he must anticipate escalation in the price of fuel measured in constant 1981 dollars. Here the calculation will depend upon the realistic alternatives to solar hot water heating. Natural gas, now sold at prices that are small fractions of the world price of equivalent energy in oil,[12] will probably escalate most sharply as deregulation under the Natural Gas Policy Act inches its way to completion in the late 1980s and the 1990s.[13] Lesser real price increases can be expected for electricity, depending in part on whether the generators producing it are driven by gas, oil, coal or nuclear power, and on the pace of utility rate regulation reform.[14] To simplify the process, let us consider annual fuel cost savings amounting to (i) $150 and (ii) $200 (in 1981 dollars) for a period of twenty years.[15]

At that point the prospective buyer must compare an immediate outlay of $2500 with a stream of future savings. If he need not borrow for the purchase, he will presumably discount the stream of future savings at the after-tax real rate of return on his own marginal alternative investment. (It is the *after-tax* rate of return because the expenses saved by the solar device would have been met with after-tax dollars. It is his own *marginal* investment, because he would give up only his *least* attractive alternative investment of $2500 to make the investment in solar energy.) Naturally the rates of return must be adjusted for risk and liquidity differentials.[16] If that rate of return is 3%, $150 a year for twenty years discounts to a present value of $2235; $200 a year for twenty years discounts to $2980.[17]

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11. *See* note 19 & accompanying text *infra*.

12. *See* notes 21-25 & accompanying text *infra*.

13. Natural Gas Policy Act of 1978, Pub. L. No. 95-621, 92 Stat. 3351 (1978).

14. *See* text at 146-47, 153-55 *infra*.

15. Transmuting the stream of fuel cost savings, which will obviously grow in real terms over the 20-year period considered, into a stream of *equal*, annual, $150 or $200 amounts, obviously requires the use of an interest rate, selection of which I have deferred. This is theoretically improper, but has no effect on the substance of the analysis for our purposes.

16. The condition that liquidity must be held constant may be critical. *See* text accompanying notes 51-53 *infra*.

17. The prospective buyer for whom the fuel costs savings were a stream of $150

For the buyer who will borrow, the calculation should not be radically different. For him, not only his fuel savings but also his costs are spread over several periods, and he must make them comparable. The nonborrower used a discount rate derived from the *opportunity* cost of investing in solar equipment, and the borrower may be expected to use a discount rate derived from out-of-pocket cost (the after-tax real interest rate on his loan). Again, at a 3% real rate (say a 15% nominal rate, of which 9% is an adjustment for expected inflation and 3% is offset by tax savings), the $150 and $200 annual fuel savings will have present values of $2235 and $2980, compared with a present value cost of $2500.

We must then inquire if there is any reason why the prospective buyer anticipating a $200 annual fuel cost saving would not proceed with the solar investment. For the nonborrower, it is hard to see why not. The $2500 investment in solar equipment generates benefits with a present value of $2980, at the discount rate implicit in the alternative investment that he would have to forego; the latter investment generates benefits with a present value (at that rate) just equal to $2500. As the rates have been adjusted for both risk and liquidity differentials, it is hard to see why he would reject the solar investment.

What of the borrower? Might banker disregard of fuel savings, or the impact of inflation upon mortgage amortization cause a buyer to inefficiently reject solar equipment?

Lenders' possible disregard of fuel savings. In the past it has been conventional for mortgage lenders to evaluate a prospective borrower by comparing his annual income with the expenses generated by the purchase, summarized in the acronym PITI (principal, interest, taxes, and insurance). Obviously, if lenders persist in applying such a formula, solar devices may drive the PITI/income ratio too high for some borrowers. They increase principal and interest costs, and change no other element in the formula.

While such a formula made sense in the era of cheap conven-

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per year will therefore, presumably, not proceed. Since the $150 multiplied by 20 years equals $3000, and the system cost only $2500, some might object that that decision is socially unwise and unfair to future generations. But recall that our prospective buyer desists because he has an investment with a *better* rate of return. Assuming no change in his net consumption pattern, therefore, he will leave a *more* valuable legacy for the future, as of the year 2001, than the unconsumed energy that would have been spared if he had proceeded with purchase of the solar hot water equipment. The point is made in some detail in D. NICHOLS, THE ECONOMICAL USE OF EXHAUSTIBLE RESOURCES 13-14 (1974).

tional energy, clearly revision of the formula is now suitable. And indeed, not surprisingly, the emerging concept among mortgage lenders is to change the numerator to PITIE (principal, interest, taxes, insurance and *energy*).[18] Accordingly, for a solar device that is a sound investment, the reduction in E (energy) will presumably more than offset increases in P and I (principal and interest).

Inflation-generated distortions in the burden of amortization payments. In periods of no (or trivial) inflation, level-payment mortgage repayment arrangements mean that the borrower's repayment burden is the same in all periods. Thus a duty to repay $500 a month for twenty years is the same burden in every month. If the borrower's real income rises, of course the payment's relative burden falls, but its absolute character is constant.

Under conditions of chronic inflation, two things change. First, the interest rate must rise because the lender will be repaid with dollars of lower value. Merely to assure the repayment of the real value of the principal, the interest rate must include a component for expected inflation. Consequently, if the market-clearing interest rate under stable monetary conditions would be 3%, and inflation is expected to be 12% over the period of the loan, the nominal interest rate will be about 15%.[19]

So far so good. The lender is repaid the real value of his principal, plus interest; the borrower pays no more. (Of course unexpected shifts in the rate of inflation throw all this off. If inflation rises *above* its expected level, the lender suffers a capital loss and

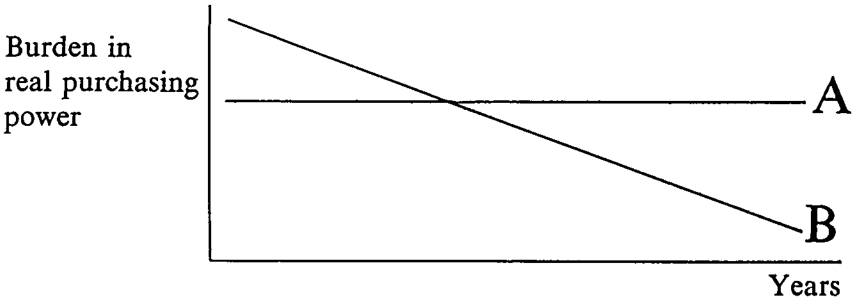
18. Telephone conversation with loan officer at a Boulder, Colorado bank (Jan. 21, 1981).

19. This makes it appear that the relationship is additive. In fact it is multiplicative, but the results are close enough for our purposes. Suppose market conditions are such that the interest rate without inflation would be 3% and that inflation is expected to be 12%. The loan is of $100, to be repaid in full, with interest, in exactly one year. For the lender to receive the real value of his principal at the end of one year, he must be repaid $112. For him to receive real interest on that, he must receive $112 multiplied by one plus the real interest rate, *i.e.*, $112 multiplied by 1.03. In this example, then, the necessary repayment would be $112 x 1.03, or $115.36, and the nominal interest rate would be 15.36%. The general equation is $r = (1 + i)(1 + \mathrm{r}) - 1$, where r = the nominal rate of interest, i = the expected rate of inflation, and r = the real rate of interest.

For any individual, the "expected inflation rate" is the average of the various possible inflation rates anticipated for the relevant period, each such estimated rate weighted by its probability (in his estimate). The market expected inflation rate, which can only be indirectly known, *see, e.g.*, Ranson, *Taxes and "Real" Interest Rates*, Wall St. J., Mar. 16, 1981, at 22 col. 3, reflects the various expected inflation rates of participants in all markets in which interest rates are relevant.

the borrower enjoys a capital gain. If the inflation rate falls *below* its expected level, the opposite effects occur.)

Enter the level payment amortization. If the mortgage is to be repaid in level payments, their real burden is far heavier at the outset, before inflation has eroded their value, than in the last periods, when it has done its work. At an expected inflation rate of 10%, the real value, in April 1981 dollars, of an obligation to repay $1000 in May 1981 is nearly $1000. The real (*undiscounted*) value (in April 1981 dollars) of an obligation to pay $1000 in April 2001 is about $148. The problem is depicted graphically below:



A=annual burden, in real purchasing power, of a level-payment amortization obligation under conditions of monetary stability.

B=annual burden, in real purchasing power, of a level payment amortization obligation under conditions of substantial expected (but stable) inflation.

The initial year's payment is indeed a hurdle. Proponents of a solar hot water mandate might, therefore, advance this problem as a reason why intelligent house buyers might reject solar hot water equipment even when it was a sound investment; further, they might urge a mandate as a solution.

There are two other possible solutions, one (perhaps) difficult, the other fairly simple and in fact *emerging in the market*. The first solution is to eliminate inflation. The second is to abandon the level-payment amortization system in favor of one with payments that *rise* in nominal dollars and are *constant* in real value at the expected rate of inflation. Alert mortgage bankers are in fact adopting such schemes.[20] In view of the suddenness with which

20. Telephone conversation with loan officer at a Boulder, Colorado bank (Feb. 4,

chronic inflation has appeared, it is hardly surprising that the development did not get under way earlier.

4. Ceilings on the Price of Natural Gas

The Natural Gas Policy Act of 1978 (NPGA) imposes ceilings on the prices at which virtually all natural gas may be sold. Although journalists often describe the NGPA as removing such controls in January 1985, that is true only of certain categories of gas.[21] A recent DOE study estimates these at 55-65% of production.[22] For some other categories the NGPA specifies deregulation in 1987,[23] and for the remainder (gas which is in some sense "old") it makes no provision at all for deregulation. In the late 1980s and 1990s, however, the proportion of natural gas under price controls would gradually shrink. Although each category of gas involves different price rules, the current ceiling price for most of the categories of "new" gas is about $2 per thousand cubic feet (mcf).[24] As a barrel of oil has about six times the energy equivalent of one mcf, this means that the ceiling price for "new" natural gas corresponds to about a $12 per barrel price for oil, or about *one-third* of the current average world price of about $35.[25] The prices charged consumers are well below the prices for "new" gas, as the consumer's price is averaged down to reflect "old" gas priced at about $1 per mcf.

The impact of the price controls upon our energy consumption is dramatic. The real economic cost of our marginal energy (*i.e.*, the energy supplies that we would refrain from using if our energy

1981). At inflation rates such as those currently prevailing, it may be necessary, if one is to obtain a repayment schedule whose real burden is level over the course of the loan, to have the loan *increase* in nominal dollars in the early year or years (*i.e.*, the initial payments would not even cover the nominal interest, which would accrue). This is not so startling as it seems, once one recognizes that much of the nominal interest payment is in fact return of principal.

21. *See* Natural Gas Policy Act, § 121. There is, moreover, a possibility of recontrol. *See id.* § 122.

22. REDUCING U.S. OIL VULNERABILITY, *supra* note 2, at II-B-8.

23. *See* Natural Gas Policy Act § 121(c).

24. *Id.* §§ 102, 103, 105, 108.

25. The problem is exacerbated by the NGPA's requirement of "incremental pricing," a term used by the Act to refer to rules requiring that the bulk of the burden of higher-priced vintages of fuel be assigned to industrial consumers, and by the failure of state utility rate commissions to apply principles of marginal cost pricing. *See* text at 146-47 *infra*.

On the other hand, since transportation and distribution costs must be added to the wellhead price before the gas reaches the customer, the final regulated price to the customer may not be as small a proportion of the market price as indicated above.

consumption fell) is either the world market price for oil (about $35 per barrel) or a domestic equivalent produced at prices equivalent to the imports.[26] We pay for this either in the real resources used to produce the energy domestically or in the goods and services that we must export to pay for foreign energy. Meanwhile, however, Americans buy natural gas at a price equivalent to less than $12 per barrel equivalent. As a result they neglect a vast range of substitutes that are *cheaper* than the $35 per barrel costs that the nation incurs as a result. Among these substitutes are: (1) Simply heating or cooling their homes less; (2) using thermostats that fit heating and cooling patterns more aptly to the life patterns of the users; (3) buying appliances that are more economical, or operating existing appliances more economically; (4) installing more insulation; and (5) installing passive and active solar energy systems.[27]

This distortion clearly tilts consumer decisions against the use of solar equipment that would be efficient under correct prices. Thus it might provide a basis for a solar mandate. But I will defer that issue to Part III's discussion of possible solutions.

5. Public Utility Pricing

The closest substitutes for solar hot water equipment, gas and electricity, are provided by public utilities. Their distribution networks have the character of natural monopolies; competition would occur only at the cost of wasteful duplication of such networks. Accordingly, their prices and service are regulated by state public utility commissions. The regulatory schemes, aimed at providing the utilities a "fair" rate of return on investment, typically fall far short of matching prices with marginal costs.

Two aspects of this divergence are important for our purposes.

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26. Where the domestic product may be produced free of ceiling prices, as is now the case for domestic oil, investors will be willing to incur costs as high as the world price to produce a barrel of oil. Thus, the critical increments to United States supplies derive either from imports, for which we give up $35 in goods and services, or from additional American production, which requires $35 to *produce* in goods, services, and user costs (future consumption foregone).

27. *See* Ben-David, Schultze, Balcomb, Katson, Noll, Roach & Thayer, *Near Term Prospects for Solar Energy: An Economic Analysis*, 17 NAT. RESOURCES J. 169 (1977), for a study of the extent to which removal of controls would expand the market for solar devices.

Average consumption of natural gas by gas-consuming households fell from 107,000 cubic feet in 1974 to 95,000 cubic feet in 1978. Wall St. J., Mar. 17, 1981, at 1, col. 6.

First, increases in the *relative prices* of the inputs to power plant construction, plus general price inflation, have sharply driven up the costs of current power plant construction. Yet regulatory commissions base the rate of return on historic rather than replacement costs; current costs are merely averaged into the rate base. Thus consumers make decisions—how long a shower to take, how frequently to run a dishwasher, whether to purchase solar equipment—on the basis of low *average* costs, such as 5 cents per kilowatt (the delivered price). Yet those decisions, cumulatively, sooner or later will force the construction of a plant that will produce electricity at a cost of, say, 10 cents per kilowatt. When it is built, the new plant's 10 cent per kilowatt costs will only be passed on to consumers in average form, perhaps raising the price to them by only a fraction of a cent.

Secondly, peak-hour use is more costly than off-peak use. It requires the utility to own and maintain plant capacity that lies idle during the off-peak, and the sources drawn on for the peak (older, less efficient plants, and gas turbine generators) have higher operating costs. Even for gas, peak demand imposes higher costs, either for additional storage space or for manufacture of gas from petroleum products. Yet the consumer who chooses to draw on hot water during a peak (late afternoon, for example), is charged no more than one who does so at an off-peak hour.[28]

Again there is a clear discrepancy between true cost and the price signal received by the consumer. Again I will defer evaluation of a solar mandate as a solution.

6. Transaction Costs for Acquisition of Solar Easements

Under present law, a property owner normally has no right inherent in his property ownership protecting him from his southern neighbor's erecting obstructions that would impair the value of his solar devices. He can, of course, buy an easement from his southern neighbor. The amount of the purchase price that is necessary to compensate the southern neighbor for damages inflicted and opportunities curtailed by the easement is a real cost of using the

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28. *See* FORD FOUNDATION STUDY GROUP, ENERGY: THE NEXT TWENTY YEARS 142-53 (1979), on which the above analysis is largely based. *See also* REDUCING U.S. OIL VULNERABILITY, *supra* note 2, at II-B-19-22; and *see* H. MOHRING, TRANSPORTATION ECONOMICS 59-67 (1976), for an unusually lucid description of the relation between marginal cost peak-load pricing and return on investment under conditions of constant returns to scale.

solar device. The solar user's obligation to pay for it can hardly be deemed a market failure.

If the would-be solar user's gain from being able to install the device exceeds the losses of the southern neighbor, they may strike a deal from which both would gain. The solar user can obtain rights at a cost less than that of the net savings that he anticipates. The southern neighbor can receive a payment higher than the value (to him) of the rights he yields. But the prospective solar user and his southern neighbor can make such a deal only with each other. In this bilateral monopoly situation, there is a range of possible prices at which the easement might be sold (the northern owner's gain being the ceiling, the southern owner's losses being the floor). Haggling and bluff are likely. Those transaction costs, coupled with the inevitable ones of drafting a suitable agreement, may prevent otherwise useful agreements from coming into existence.

It is, however, hard to see any real relevance of this problem to a proposed mandate for solar hot water equipment in *new* housing. The overwhelming bulk of new housing comes into being as a result of the development, or redevelopment, of substantial tracts of land. The developer will in most instances be able to establish adequate solar access rights by means of restrictions in his deeds. However great the transaction cost problem may be in the retrofit context,[29] it seems trivial in the present one.

7. Pollution

All forms of energy production entail a degree of pollution. (Since one must manufacture and transport the component parts of solar collectors, etc., solar energy is no exception,[30] although it appears to be a very minor offender.) The litany is long and depressing; oil spills, sulfur dioxide, greenhouse effects from oxidization of fossil fuels, atmospheric cooling from particulate matter, thermal pollution, radiation from coal and nuclear energy, visual pollution from strip mining, etc. But the problems are specific to each energy form, and highly variable. Reliance on solar power

29. *See* Williams, *Solar Access and Property Rights: A Maverick Analysis*, 11 CONN. L. REV. 430, 436-40 (1979), for a consideration of these transaction cost issues.

30. For a treatment of the pollution from the production of photovoltaic cells, *see, e.g.*, D. COSTELLO, D. POSNER, J. DOANNE, D. SCHIFFEL, & K. LAWRENCE, PHOTOVOLTAIC VENTURE ANALYSIS: PROGRESS REPORT, APP. IV, ENVIRONMENTAL IMPACTS OF PHOTOVOLTAIC CELL DEVELOPMENT (1978) (Dep't of Energy Contract No. EG-77-C-01-4042, Solar Energy Research Inst.).

may well, as an *average* matter, displace reliance on some more polluting form of energy; it may even do so in every case. But the extent to which is does so depends very sharply on the form of energy it in fact displaces; consequently it is very hard to assign a value to that displacement that is appropriate for all cases, or even very many.

The alternative, of course, is to attack the pollution of alternative forms more directly, as in fact our clean air legislation does. Despite the restrictions imposed by that legislation, of course, there may well be considerable pollution from alternate energy forms for which the producers incur no cost. Consequently, they may well be producing more pollution than can be justified by its benefits; and the resulting products may sell at lower prices, and in higher quantities, than would be the case without this externality. One answer, however, would seem to lie in imposing charges on polluters, either as a supplement to, or substitute for, the present regulatory system. Such charges could be attuned to the amount of damage done by the particulate pollutant. It would therefore operate as a more precise cure for such wasteful pollution than a solar mandate.

8. Information Externalities

Because individuals and firms cannot obtain full property rights in information that they produce, it is likely that they do not invest as much in the production of information as would be justified by the potential benefits of such investment.[31] This may well justify government research subsidies; energy—including solar energy—is an obvious area for such subsidies. Since a solar mandate is not a research enterprise, it is hard to rest the case for it on this basis.

One might argue that a solar hot water equipment mandate serves research purposes because it will increase our experience with such devices. The argument seems very weak. A mandate requires standards, for otherwise the enforcement agency cannot determine whether there has been compliance. If the standard is in the form of specifications, then they divert individual effort

31. *But see* Hirshleifer, *Where are We in the Theory of Information?* 63 AM. ECON. REV. 31, 33-34 (1973), for suggestions that the effect of weak property rights in information may be offset by: (1) information's being a sort of common-pool problem, with the new data subject to accelerated exploitation like oil or gas under the Rule of Capture, and (2) the opportunity that information affords its possessors to make investments that will rise in value when the information is disclosed.

from experiment with alternatives into mere repetition of the type mandated. If all markets were covered by the standards, the mandate would extinguish most or all such experimentation. Even if the standards take the form of performance criteria (*e.g.*, requirements that the system be able to provide a specific amount of hot water, or a specific proportion of the user's hot water needs), it freezes the area of experimentation. This is at the expense of other innovation that might prove more valuable; for example, production of systems that fell below the performance limits but were so dramatically cheaper that they consituted, overall, an advance.

9. Common Pool Problems in Energy Resource Ownership

The Rule of Capture allows the owner of a tract of land to extract oil or gas from a well that is wholly within his territory, even though some of the mineral may originate in a neighbor's land, without liability to the neighbor. Under the Rule, an owner will make his decisions on drilling and production strategy without regard to costs inflicted on other owners of interests in the oil or gas reservoir. A variety of distortions result. The most significant, for our present purposes, is that each owner has a skewed vision of the opportunity costs of current extraction. In deciding the amount to extract in the current period, an owner ought to consider, among the costs of present extraction, the loss of the opportunity to sell the oil or gas at a future date (the "user" cost of present extraction).[32] If other owners in the pool may extract any oil that he tries to "save" for future extraction, however, he will tend to disregard that cost.

The result, of course, is a risk of unduly rapid extraction. Two boys with a single milk shake, but each with his own straw, present the same problem. Unless they can work out an agreement, the milk shake is likely to disappear rapidly. If either drank slowly, in the hopes of spreading the pleasure over several minutes, he would probably find himself facing an empty glass.

If the common pool problem in fact accelerates the rate at which producers extract oil and gas, it would depress the price below true cost. (Price would reflect extraction cost, but not user cost.) Thus one might advocate a solar mandate in order to offset this price distortion.

However, state law endeavors to solve the difficulty by two

32. *See* text at 139-40 *supra*.

quite separate strategies. The first is "conservation regulation," under which, for example, state authorities set (1) well-spacing regulations, which restrict the number of wells that may be drilled per area of land (*e.g.*, only one well per eighty acres), and (2) "allowables," or maximum rates at which the wells may be operated. These devices are necessarily rather crude. Concerns for fairness and equal treatment require that the authorities operate to a large extent by rule. Thus reservoir-by-reservoir evaluation of all relevant factors is sacrificed to some degree.[33] Further, as the state authorities do not enjoy the increases in value that would follow from choice of the most efficient strategy, there is no *a priori* reason to suppose that they will select it.

The second device is unitization, under which owners in the reservoir agree upon a common plan of action. If all owners agree, there is no difficulty. But often some will be tempted to hold out in the hopes of obtaining a disproportionate share of the gains that a unified strategy would generate. The legal solution is "compulsory unitization," under which some majority of the owner interests may compel a reluctant minority to accept their plan. Thus unitization replaces disparate ownership with a single management that, because of its being able to enjoy the gains from the most efficient extraction strategy, is most likely to adopt it.

People concerned with the "common pool" distortions in oil and gas ownership are likely to detect a number of flaws in state law provision for unitization. Statutory preconditions to compulsory unitization—high percentages necessary to force the minority in,[34] limitation to secondary or tertiary recovery programs,[35] and rules for the treatment of dissenters[36]—may all seem unduly inhibitory. Although the stately pace toward solution may be frustrating, the states have been experimenting cautiously in the direction of apt solutions. A solar hot water mandate, if it were offered as a solution (or as part of a solution), might only confuse issues and tend to derail the evolution of these remedies.

33. These techniques are summarized and analysed in S. MACDONALD, PETROLEUM CONSERVATION IN THE UNITED STATES: AN ECONOMIC ANALYSIS (1971).

34. In Colorado, for example, owners of 80 percent of the interests must approve. *See* COLO. REV. STAT. § 34-60-118(5) (1973).

35. *See, e.g.*, ALASKA STAT. § 31.05.110(b)(1) (1979); LA. REV. STAT. ANN. tit. 30, § 5(c) (1975).

36. *See, e.g.*, O'Neill v. American Quasar Petroleum Co., 617 P.2d 181 (Okla. 1980).

III.
REMEDIES

To the extent that solar easements and information costs constitute a market failure their effects would not be effectively remedied by mandating solar hot water heating in new construction.[37] Pollution costs, common pool problems in energy resource ownership, and defects in the mortgage lending market may create significant price distortions relative to solar hot water equipment. However, as previously discussed, remedies more closely fitting these problems than a solar mandate already exist.[38]

Four market or government failures have been identified for which no remedies currently exist and which may lead to under utilization of solar hot water equipment. Three of these relate directly to energy policy and therefore shall be discussed together below. The fourth is the problem of the real interest rate. Distortions tending to raise it, if they exist, would reduce the opportunity cost for present extraction of non-renewable resources thus lowering prices for non-renewable fuels. They would also induce consumers to undervalue the future cost savings that solar hot water heating would generate.[39] However, an inefficient interest rate affects all intertemporal calculations. It not merely accelerates the depletion of natural resource capital, but it also retards the growth of all forms of capital that humans can increase; physical capital (equipment, factories, etc.) and human capital (notably education). Thus someone who is serious about the problem of an excessively high real interest rate must contemplate attack on a relatively broad front. However, to the extent that interest rate distortions exist and cannot be dealt with on an overall basis, a solar hot water mandate might be helpful to remedy price distortions in the energy context.

With respect to the market and government failures identified, the most striking relationship is the way in which the price controls (on the wellhead price of natural gas and public utility sales of electricity and gas) exacerbate the national vulnerability risks. Because dependence on foreign oil (particularly Persian Gulf oil) imposes such risks, every barrel of oil imported entails a true cost to the United States well in excess of the $35 a barrel or so that we pay. The values at stake—possible inability to support foreign al-

37. *See* text at 147-50 *supra*.

38. *See* text at 139-45, 148-51 *supra*.

39. Distortions raising the real rate of interest lead consumers to use an inefficiently high discount rate when calculating the present value of future savings.

lies, particularly in the Middle East; a perceived dependence and powerlessness; risks of serious macroeconomic shock—are so amorphous that any quantification is a bit arbitrary. A recent DOE study suggests that a premium of between $4 and $10 per barrel over the normal import price is a fair stab at the extra cost.[40] Since consumers are not charged any premium for this national security cost, they neglect substitutes for oil that cost more than its $35 per barrel price but less than its real cost to America, perhaps $45.

The NGPA and local public utility controls twist the knife further into the wound. The NGPA induces natural gas consumers to neglect all substitutes[41] that cost more than the $12 per barrel-equivalent that they are charged. Because oil and natural gas are fairly close substitutes, removal of the NGPA could reduce oil imports by about 400,000 barrels a day in the last half of the 1980s.[42] Current public utility regulation policies aggravate matters further.

With regard to national vulnerability risk and price controls at the wellhead and on public utilities, three types of solutions can be suggested: (1) To adjust the price of imported oil *upward* to reflect the vulnerability costs that the market neglects, and allow prices of domestic substitutes (natural gas and electricity) to reflect true cost; (2) to offer affirmative pecuniary rewards to consumers to use substitutes for imported oil; and (3) to require consumers to use certain substitutes for imported oil. The solar hot water equipment mandate is clearly an example of the third type of solution; we can evaluate it only in comparison with the other two.

1. An Oil Import Fee, Removal of NGPA Controls, and Utility Rate Regulation Reform

This solution has the elegant advantage that it would give consumers the correct signals as to *all* substitutes for imported oil. At present, as we have seen, consumers are led to disregard substitutes that cost *more* than the about $12/barrel-equivalent wellhead price of natural gas, or *more* than the artificially low price of electricity, or *more* than the $35 per barrel price of oil, even though these substitutes cost *less* than the true cost of the barrels

40. *See* REDUCING U.S. OIL VULNERABILITY, *supra* note 2, at 7.

41. As always, the concept of substitute is used in the widest possible sense. A consumer heating his or her house to a lower temperature than he would regard as ideal if energy were free is using a substitute.

42. *See* REDUCING U.S. OIL VULNERABILITY, *supra* note 2, at II-B-20.

of oil whose importation their use would avoid, say, $45. Solar hot water equipment is obviously one such substitute. In many cases it does not "pay" for the consumer now, but in a large subset of those instances, it might pay if he received the correct price signals. But solar water heating is only one of a vast array of such substitutes. When we consider oil as well as natural gas, the possible substitutes include not only the array listed in relation to natural gas pricing, but also gasohol and other energy from "biomass," a vast range of adjustments that may lower automobile fuel consumption (smaller cars, less driving, more carpooling, etc.), and a range of changes in household investment and behavior that would substitute for electricity (roughly parallelling the substitutes for natural gas). One may picture the relationships as follows:

A. Oil, natural gas and electricity at true marginal costs of (say) $45 per barrel or barrel-equivalent; electricity at replacement (and peak-hour) cost.
B. Neglected substitutes, including solar water heating.
C. Oil sold at $35 per barrel; natural gas sold at about $12 per barrel-equivalent; electricity sold at average historical cost.

Distorted price signals lead consumers to rely on oil, gas, and electricity whose cost is high (A), because its price to them is low (C), neglecting all the substitutes at intermediate prices (B). With correct price signals, consumers would buy (and where "production" is necessary entrepreneurs would produce) the amount of *each* of these substitutes that cost less than the true cost of imported oil or its domestic alternatives, and no more. In short, correct prices would achieve that *mix* of consumption, as between oil and all substitutes, that involves the minimum waste of *all* resources.

The objections to such remedies are normally to their supposed distributional consequences: a shift of wealth from consumers to producers. Let us first examine that in the context of removal of the NGPA price controls. The removal would, as already argued, induce consumers to use substitutes for natural gas that are cheaper than the real cost of the natural gas they use. (This means substitutes that are cheaper than the $35 in American resources that must be exported to foreign suppliers for each extra barrel of oil consumed, and cheaper than the $35/barrel-equivalent that must be paid in real extraction resources (well-drilling equipment, labor, etc.) and real user costs (loss of opportunities for future use) to produce the marginal American barrel of oil or its natural gas equivalent.) Thus removal of the control increases real gross national product. (At any rate it would do so in "general equilibrium," when markets have cleared and all resources are employed.)[43] That increment in GNP furnishes enough wealth so that consumers as a class can be left better off than before the change.

Suppose, for example, that the NGPA controls were removed altogether, but that the entire difference between (1) the market price and (2) the NGPA ceiling price were taxed away. This entire amount could be distributed to consumers as a class, leaving them no worse off than before. Since they would then adopt many of the cheaper substitutes (that they now neglect), they would be better off on a net basis. Such a program would, of course, in no way improve incentives to domestic natural gas *production*. Nor can one legitimately assume that such a redistribution is fair. The fact that consumers have enjoyed cheap natural gas for many years hardly establishes a moral claim to receive it cheaply into the indefinite future. But the hypothetical policy suggests the degree to which distributive concerns can be met.

Public utility regulatory reform raises substantially similar issues. Because marginal costs are far higher than historic average costs, a shift to marginal cost pricing would give consumers more correct signals, but also would induce a substantial wealth shift from consumers to owners of public utilities. To the extent appropriate, various devices could offset the wealth shift: Taxes (with the revenues distributed as seemed fit); or a rate structure with very low rates for an initial block (reflecting some consumption level below which no consumer's substitution efforts would ever lead him), followed by marginal cost prices for all additional amounts.

The suggested oil import fee raises some different problems. It would induce even more substitutions—ones that are only justifiable at a price of between $35 and $45 per barrel of oil (assuming a

43. *See* UNITED STATES DEPARTMENT OF ENERGY, ENERGY INFORMATION ADMINISTRATION, ENERGY PROGRAMS/ENERGY MARKETS: OVERVIEW, DOE/EIA-0201/16 at 88-96 (1980). In the pages cited the analyst studies the effects of decontrol of crude oil prices. The argument is essentially the same as that presented in the text: Namely, that removing the distortion gives consumers and producers the correct signals as to what substitutions are most efficient and thus allows the economy to produce a higher-value aggregate product.

The "general equilibrium" assumption is one that may be disputed, but only, I think, as a matter of degree. Whatever one's view of the best way to adjust the economy to the macroeconomic shock of a large rise in natural gas prices, it is a shock that ultimately runs its course, allowing the economy to return to whatever degree of general equilibrium it was capable of before the shock. Paying that price early increases the time period over which the benefits of correct prices can accrue.

$10 import fee). For these additional substitutes consumers would pay more (per barrel saved) than the $35 of goods and services that must be exported to buy a barrel of foreign oil. It would thus depress *gross national product*, a concept that does not measure the hoped-for reduction in national vulnerability. (This is true even though the proceeds of the fee could be distributed to the taxpayers.) As such, it is similar to all the other tax burdens that we shoulder in the interest of national security, with all their distorting effects. A recent DOE study suggests that a $10 oil import fee (indexed to 1980 prices) would reduce imports of foreign oil by 1990 by between 1.2 and 2.0 millions of barrels per day, with the author's best estimate being about 1.6 million barrels per day.[44] These are large savings, and might well seem worth the extra cost (in substitutes for the imported oil).

2. Pecuniary Rewards for Use of Substitutes

Congress and the states have already adopted this solution on a grand scale, with a complex array of tax credits of varying percentages. The drawbacks of such an approach, compared to the alternative of price regulation reform and an import fee on oil, are clear. First, many tactics that consumers would adopt if oil and natural gas were correctly priced are almost impossible to reward through the tax system. Some—such as adjustments of the thermostat or changes in patterns of appliance use—are difficult to monitor without intolerable invasions of privacy. Others cannot be rewarded because of another monitoring problem; they merge imperceptibly with behavior that the consumer might adopt anyway. Federal law, for example, denies solar system components a tax credit if the component serves a structural purpose.[45] Similarly, no credit is given for any passive solar devices because of the difficulty in distinguishing between design features that respond to the incentive and ones a buyer (or builder) selected on quite different bases.[46] Thus large areas of cost effective responses to the true scarcity of energy continue to be neglected.

Second, the various tax benefits granted seem to have an almost random quality about them. Why should solar heating enjoy a federal credit of 40%[47] and insulation one of 15%?[48] One suspects

44. *See* REDUCING U.S. OIL VULNERABILITY, *supra* note 2, at 24-29.
45. Krueger, 1 UCLA J. ENV. L. & POL'Y 161, 164 (1981).
46. *Id.* at 164.
47. *Id.* at 164.
48. 26 U.S.C. § 44C (Supp. 1980).

that these differences are more the function of the lobbying strength of the affected industries, and their success in attaining fad status, than any precise measure of their contribution to reducing consumption of oil or natural gas. As a result, it seems certain that the tax credit approach will induce *more* investment in some substitutions than is justified in terms of their *real* cost in resources relative to that of oil and natural gas. Such excessive expenditures by definition shrink the national welfare. As to other substitutes, the system of pecuniary rewards will induce *less* adoption than is justified in terms of their real cost. The latter failure is most obviously true of the substitute purchases and behavior that receive no tax credit at all.

My own conclusion is that pecuniary rewards for special types of substitution is markedly inferior to use of market prices and an oil import fee. However, if the latter proved politically unattainable, one might turn in desperation to the former.

3. Mandates for Specific Devices Such as Solar Hot Water Equipment

As the discussion above should make clear, my policy favorites would be: (1) Allowing the prices of domestic energy to reach their market level[49] and (2) imposing a fee on imported oil (and perhaps natural gas) to offset the market's failure to take account of the risks of heavy reliance on imports.[50] But if that strategy is rejected as politically unfeasible or for some other reason, the choice seems to lie between mandates and pecuniary incentives.

A preliminary issue is whether a solar hot water equipment mandate may in some cases foreclose other energy-saving invest-

49. In the case of public utility prices to the consumer, one could obtain marginal cost pricing by: (a) having public utility regulatory authorities adopt reform policies whereby prices of at least the marginal units would approximate marginal cost, as suggested previously, or (b) severing the *generation* aspect of electricity sales from the transmission and distribution aspects, and completely deregulating the former. The argument for the latter, more radical solution, is that under current conditions electricity generation does not exhibit the features of a natural monopoly at all, so that reliance on the market would be sensible. *See* S. SCHURR, J. DARMSTADTER, H. PERRY, W. RAMSAY & M. RUSSELL, ENERGY IN AMERICA'S FUTURE: THE CHOICES BEFORE US 172-73 (1979).

50. An alternative route for arriving at the same result is for the government to impose a quota on imports and auction quota rights to the highest bidders. A further variant, appropriate under some assumptions (possibly, for example, where fear that problems of the common pool and of unduly high real interest rates would cause too rapid a depletion of domestic supplies of oil or natural gas) would be to accompany the fee by an excise tax on domestic oil or natural gas.

ments or reduce the fraction of the population financially able to build new houses.[51] At first glance it may seem that the answer should be negative. Suppose that a prospective house buyer, forced by law to acquire solar hot water devices, is considering whether to install a special extra layer of insulation. One might think that the insulation choice would turn simply on comparison between the present discounted value of its benefits and costs. If the discounted present value of its fuel cost savings exceeds its cost, he will buy it; otherwise not. The fact that the municipal government has forced him to spend money on an unwanted solar device should be irrelevant.

But that argument overlooks the liquidity effect of the mandated solar purchase. The effect of the mandate is to raise his down payment and his legal amortization obligations. On top of those mandated increases, the burden of the extra insulation on his liquidity might simply be too much. And liquidity is no mean concern. Every year Americans invest billions in savings accounts, even though their real rate of return is negative. (Eight percent in interest, when the principal is dwindling 10% through inflation, yields a net real rate of return of -2%. After the 8% is taxed as "income," the net yield will be still lower.) For families stretching their financial resources to the limit, the mandated solar hot water device may well bar investing in the insulation. Yet it is very likely that the insulation would have afforded a far better yield than the solar device in true fuel costs saved per dollar invested.[52]

The liquidity problem also tends to support the suggestion that the mandate may prevent some people from buying a new house at all. As a result they may continue to occupy dwellings far less energy-efficient than a new one, had they been able to afford it.[53]

The mandate versus pecuniary rewards. The core difference, of course, is that the pecuniary reward allows for the circumstance that *in some instances* the rewarded activity may not be desirable. Based on a premise that current relative prices do not give the correct signals, the pecuniary reward alters the relative prices, so that (if it is well calculated) the signals are now correct. But if

51. Langston, *supra* note 16, at 130.

52. S. FELDMAN & R. WIRTSHAFTER, ON THE ECONOMICS OF SOLAR ENERGY *passim*, especially 140, 142 (1980). It should be noted that the dollars invested are not just pieces of paper. They represent the real resources invested in the solar device, insulation, or whatever.

53. Langston, *supra* note 16, at 130.

individual tastes and circumstances vary, there will remain people who, despite the correct signals, still reject the rewarded activity.

The mandate, by contrast, implicitly asserts that the mandate is right for all people in all the circumstances covered by the mandate, or at least in a high enough proportion of them that possible administrative economies justify ignoring the exceptions. It would seem to require a high degree of certainty. In view of studies seriously questioning the efficiency of solar hot water heating devices,[54] I question whether such confidence is warranted. My skepticism is particularly aroused by the liquidity point just mentioned. The trade-off that a house buyer makes between an illiquid investment with a good rate of return, and a liquid investment with a negative rate of return, seems a highly personal one. Solar equipment is a fair-weather item in more ways than one; its value is of little use *for* the proverbial "rainy day." If one wishes not to legislate behavior whose disadvantages exceed its benefits (and who would confess to wanting to do such a thing?), the government's forcing an individual into sharply reduced liquidity is surely a genuine disadvantage.

This leads to an important intangible consideration; the value of economic freedom. If one values economic freedom seriously, either for its own sake or as ancillary to political freedom, then in the political dialogue on a proposed mandate, surely the proponents should have the burden of persuasion.[55] The government is asserting control over the citizen's choice of what kind of house to occupy. Why? He has not crowded the neighborhood, nor emitted objectionable noise or particles; nor has he even offended visually. His fuel use consumes no property that he has not purchased. And if his fuel purchases are at prices deemed lower than the "correct" prices for conventional energy, that is only because the government has failed to make whatever adjustments are necessary to correct them.

Solar hot water equipment mandates in the California tax context. If it is possible to use both the 55% California tax credit and 40% federal credit on a single solar hot water system (so long as the builder claims one and the buyer the other),[56] then house buy-

54. *See* S. FELDMAN & R. WIRTSHAFTER, ON THE ECONOMICS OF SOLAR ENERGY (1980).

55. This contrasts, of course, with the allocation of the burden of persuasion in judicial review of "economic" legislation.

56. *See* Hoffman, 1 UCLA J. ENV. L. & POL'Y 71, 71 n.1 (1981).

ers in California are already being offered a most dramatic pecuniary reward. The federal and state governments collectively reduce the price of solar technology 95%. This is equivalent (if we disregard upkeep costs) to multiplying the relative price of natural gas or electricity twenty times. It seems to me hard to believe that this tilt is not an ample correction of the relative prices.[57] Yet the advocate of a mandate is implicitly saying there are a significant number of house buyers for whom (given all relevant factors, site of house, tastes, liquidity concerns, etc.) solar hot water equipment is desirable, but who nevertheless will not succumb to the tax lures. This could be true only if natural gas and electricity are selling at substantially less than 1/20th their true value, or people are very obtuse about their own welfare.

One might argue that a municipal government normally has no power to adopt the solutions that I have asserted are more appropriate. Might it not be better for the municipality to light a candle than to curse the darkness? The rhetorical Yes is correct only if they are sure it is a candle they are lighting, not a cherry bomb.

57. Under almost any assumption, indeed, it seems exaggerated.