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SHOULD THE GOVERNMENT SUBSIDIZE NON-CONVENTIONAL ENERGY SUPPLIES?*

by

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The Department of Energy has been gradually announcing the pieces of a program to subsidize the industrial development and commercialization of a number of "non-conventional" energy supplies. Although the size of this program is yet to be determined, it could easily become enormous in scope, costing some 10 to 20 billion dollars over the next five years. Increasingly, this program is being viewed by some as the major instrument of U.S. energy policy, as the Administration relies on it to bridge the growing gap between our consumption and production of energy.

The particular sources of energy likely to be most heavily subsidized by this program include oil from shale rock, gas and liquid fuel from coal, and perhaps breeder reactor technology, although significant subsidies will also be allocated to solar energy, wind power, and other technologies. The production of many of these energy sources does not require or represent fundamental new scientific or technological advances. On the contrary, shale oil was first produced in Britain in the 1850s, and gaseous and liquid hydrocarbons were produced from coal in Germany during World War II and are being produced today in South Africa.

These energy sources are called "non-conventional" because they are presently not being produced or consumed in significant quantities in the United States, or, for that matter, almost anyplace else. The reason that these sources are not utilized extensively or being rapidly developed is quite simple -- they are extremely expensive. It is difficult to pinpoint just how much more expensive they are than conventional energy supplies, but estimates that we have examined put them at two or more times the cost, on a thermal-equivalent basis.

Of course, as conventional energy supplies become increasingly scarce, and as energy prices rise, shale oil, gasified coal, solar energy and a variety of other non-conventional sources may someday become commercially viable, and in fact may eventually displace conventional oil and natural gas as major fuels. Exactly when that day will come is difficult to predict, but if, as the Administration has argued, it is likely to be upon us in the next decade, why do we not observe the private sector already rapidly gearing up to produce these sources of energy in the absence of federal subsidies? And more importantly, is it desirable for the government to spend billions of tax dollars to subsidize these supplies sufficiently to make them economically attractive to producers and consumers? At a time when there is growing pressure to limit government expenditures in other important areas such as health, education, and environment, we must ask whether these subsidies to specific energy supply technologies are really in the public interest.

1. The Plan for Government Involvement

Proposals for government subsidies of non-conventional energy supplies have taken a variety of forms. First, direct subsidies have been suggested to reduce the cost and increase the profitability of new energy technologies. The most common form of direct subsidization is through the use of government revenues to finance some fraction (usually greater than 50%) of the construction of "demonstration plants" for the production of various non-conventional energy supplies.

A demonstration plant is basically a production facility at or close to commercial scale, and its construction provides a means of obtaining hard numbers for the actual cost of each technology and better knowledge about the operating characteristics of the technology. The information gained from these plants is primarily useful for evaluating the "commercial" possibilities for the specific technology rather than for obtaining basic and applied scientific knowledge. Outside of the military and space programs, where commercial viability is not an issue, the government has traditionally focused its R&D expenditures on the financing of basic and applied scientific research, leaving industrial development and commercialization efforts to the private sector where both the benefits and costs of expenditures can be most effectively balanced in the context of commercial realities.

However, the Department of Energy now argues that without direct government subsidies to finance the construction of demonstration plants, private firms will face too much uncertainty to allow them to make the "correct" investments in these technologies. Of course any new technology involves uncertainty and requires an investment in learning -- the risks associated with the development of new products and processes have been recognized in our patent system. Private investors are normally willing to undertake such projects when the expected rewards from success are greater than the losses from failure. Yet we are now being told that in the case of non-conventional energy sources the government should bear much of the cost and the risk because the private sector is unwilling to do so. We have not, however, been told why it should be necessary for the taxpayer to bear these costs if these technologies are indeed such "good bets."

Tax credits are another form of proposed subsidy, though one that is somewhat less direct. If the production of a particular form of energy is at all profitable in the long run, tax credits will increase the after-tax profitability. But even if a particular project is never profitable, tax credits may have the effect of reducing the <u>overall</u> tax burden to companies involved in the production of a wide range of energy sources, and thus make the new technology more attractive.

A number of tax credits of this type have already been proposed. For example, the Senate version of the Energy Tax Act of 1978 included a $3 per barrel credit for shale oil and oil from tar sands, a 50¢ per mcf credit for geopressurized methane and for any gas from a non-conventional source, and residential credits for home insulation and expenditures on solar and wind energy.[1]

Shale oil and coal gasification and liquefaction projects typically have large capital requirements, so that the cost of debt capital is a major component of total cost. Loan guarantees are currently being discussed as another indirect form of subsidy. They have been proposed for the financing of a high BTU-coal gasification demonstration plant, for example. Such guarantees reduce the riskiness of loans, and thereby reduce the interest rates that companies must offer to attract capital. The cost to the public of this form of subsidy is difficult to measure, since it depends on the number and sizes of loans that become subject to default. An extensive program combined with a high default rate could be very costly.

We have gathered and evaluated cost data for several non-conventional energy sources, and found that they have only limited prospects of being profitable. To put it simply, at least for the next several years, conventional sources are likely to be cheaper.[2] It is therefore not surprising that the private sector has not been particularly interested in these supply technologies without the infusion of government subsidies; indeed, their development is probably not an efficient use of society's scarce resources. It would not make sense to invest large sums of money in projects that do not appear to be economical, unless it can be shown that there are good reasons why the decisions generated by the private sector are inconsistent with the

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1. Only the residential credits, however, were included in the Conference version of this bill. (Source: Energy Tax Act of 1978, 95th Congress, 2nd Session, Senate Reprint No. 95-1325.)

2. Under our direction, Saman Majd, a graduate student at MIT, has conducted financial analyses of several non-conventional energy technologies. The results are described in S. Majd, "Financial Analysis of Non-Conventional Energy Technologies."

public interest. In short, if the producers and consumers of energy who are in the best position to evaluate the commercial value of alternative energy supplies are not interested, why should the taxpayer be forced to overrule these decisions with subsidy incentives?

2. The Rationale for Subsidies

The arguments raised in favor of government participation in non-conventional energy supplies fall into two categories. The first is based on the view that the United States is becoming more and more dependent on imported energy from sources that are increasingly insecure, and the government can reduce this dependence by accelerating the production of new domestic energy supplies. The second type of argument says that projects to produce these energy sources are of a special nature that makes it difficult or impossible for them to be undertaken by the private sector without government assistance.

There is no question that the United States is becoming increasingly dependent on imported energy as the gap between our energy consumption and our domestic energy production continues to grow. In fact, for some fuels, such as natural gas, we have experienced outright shortages. The Department of Energy recognizes that at current energy prices these new technologies are simply not economically viable, and therefore they can be relied upon to help bridge the gap between our energy consumption and production only if they are given massive subsidies. The issue, however, is whether there are more efficient means of bridging the consumption-production gap that would end up costing the American public less.

The Department of Energy has also claimed that the special nature of these technologies is such that government participation in their commercialization would be needed even if energy prices were higher. Proponents of this view usually point to the fact that commercialization of these technologies typically involves large capital expenditures, and in some cases considerable risk, so that private firms would be unwilling or unable to raise the necessary capital and make the necessary investments. In effect, it is argued that there are significant market imperfections which make the technology look unprofitable to private firms, even though its social value is considerable, and it is these market imperfections that justify government intervention.

We will examine these two types of arguments in some detail to determine whether they should indeed be used to justify the kinds of programs that the Department of Energy is now proposing. After doing this, we will present what we see to be the proper role of the government in the commercialization of non-conventional energy supplies, first in the context of an ideal, or "first-best" energy policy, and then in the context of "second-best" energy policy, operating under the kinds of political constraints that are likely to exist in the near future.

3. New Energy Technologies as a Substitute for Imports

Before considering whether the subsidization of non-conventional energy supplies is a desirable means of reducing the growing gap between domestic energy consumption and production, we should be clear on just why that gap exists. U.S. energy policy has for the last several years pursued the goal of keeping the domestic price of energy well below the world level. Maintaining an artificially low price for consumers -- and domestic producers -- has the effect of stimulating energy demand, and at the same time reducing domestic production. Some five or six million barrels per day of our current eight or nine million barrels per day of oil imports is directly attributable to these low price policies.[3]

Two principle policies have been used to maintain a low domestic price of energy. The first of these is the crude oil price controls-entitlement program, which basically works by taxing the domestic production of oil (by holding its price below the refiner's price) and using the proceeds of the tax to subsidize imports (thereby reducing the cost of high-priced imported oil to the refiner). This policy has the effect of keeping the average price of crude oil to U.S. producers at about fifty percent below the world price, and has the interesting side effect of putting the United States government in the business of subsidizing oil imports from OPEC.

The second major policy is the regulation of the wellhead price of natural gas, which for many years has been held far below the world market level, and which resulted in domestic shortages of natural well gas before the 1973 oil embargo. The Natural Gas Act of 1978 represents a major step in correcting this policy, although gas prices will reach free market levels only after several more years pass.

Through its commercialization program, the Department of Energy is in effect now asking taxpayers to finance the difference between the high cost of producing non-conventional energy supplies in the United States and the low price that consumers are asked to pay. But Americans are in fact much worse off with higher taxes than with higher energy prices. Individuals can choose to avoid paying higher energy prices by limiting their consumption, but they have no choice regarding the taxes they must pay. A commercialization program forces consumers to pay a good portion of the high cost of energy in-

3. See R.E. Hall and R.S. Pindyck, "The Conflicting Goals of National Energy Policy," The Public Interest, Spring 1977.

directly, through their taxes. As a result, there is little incentive to conserve, and consumption will grow, as production falls. A growing tax burden will then be required to finance a growing share of subsidized production.

Rather than subsidize higher cost non-conventional energy supplies, it is preferable to purchase oil and natural gas at home and from abroad at world market prices. Offering government subsidies of one form or another to developers of new energy forms means requiring the nation to pay much more for energy than is necessary. This is exactly what government policy should avoid.

A counter-argument that is sometimes raised is that the development of more expensive non-conventional energy supplies should be accelerated today so that lower cost conventional energy supplies can be saved for future generations. But this argument is specious because it ignores the time value of money (reflected in the market interest rate), which makes it cheaper to consume low cost supplies now and higher cost supplies in the future. As conventional oil and natural gas reserves are gradually depleted, the market prices of these resources will rise over time, so that eventually their use will be replaced by higher cost resources such as shale oil, gasified coal, and solar energy, which the DOE is essentially trying to "force" the country to utilize now through government subsidization. To reverse this order of use by accelerating the commercialization of non-conventional supplies would only impose an unnecessary cost on the American public.

4. New Energy Technologies and Market Imperfections

We have argued that if a new energy technology does not appear profitable to the private sector, its development is probably not an efficient use of society's scarce resources. However, in some situations there may be significant market imperfections which make the technology appear unprofitable to private firms, while in fact its social value is quite high. It is only in such a case that some type of government intervention might be desirable.

Let us therefore try to identify potential market imperfections and evaluate the likelihood that they will bias decisions to invest in new energy technologies. Those who advocate government intervention often point directly or indirectly to one or more alleged failures of the market. Here we examine those alleged failures that have attracted the most attention.

A. Energy Price Imperfections

As a result of past government regulation, most energy prices are presently below their true marginal social cost. For example, electricity is priced on the basis of average historical cost which is generally below marginal or replacement cost, natural gas regulation has kept interstate prices below the competitive market level, and domestic crude oil regulations have kept the prices of petroleum products below the world market prices which represent the true costs to the U.S. economy. It is prevailing or expected market prices, however, on which private firms base their decisions about the profitability of new energy technologies.

Government price regulation has therefore created an important <u>disincentive</u> to investments in new energy technologies. The perception that such investments are "justified" from a complete analysis of the costs and benefits to the U.S. economy may be correct, even though private firms do not find such investments attractive in the face of regulated energy prices that do not reflect the true social costs of additional consumption to the U.S. economy. Since energy prices have been kept "too low" we cannot expect the private market to provide the proper signals vis à vis new sources of supply.

While government price regulation clearly leads to an important market imperfection, it is an artificial one created by the government's own actions. To set things right the government can either eliminate the source of the problem by allowing energy prices to rise to replacement cost, or it can try to "balance" the disincentives created by regulation with additional incentives to new technologies in the form of subsidies. We will explore this choice further below.

B. Discount Rates Used by Private Firms

It is sometimes argued that private firms, when making investment and planning decisions, use discount rates that are "too high" and that bias their decisions away from the kinds of highly capital-intensive projects that are involved in the commercialization of non-conventional energy supplies. There are essentially three reasons that are cited to explain why private discount rates tend to be higher than the "social" discount rates that should be used to properly evaluate the benefit of a project to society.

First, it is argued that social discount rates are lower than private discount rates because private agents do not value the well-being of future generations sufficiently. Using a lower social discount rate would lead us to shift expenditures towards more investment (and less consumption) today and more consumption tomorrow than would be achieved from purely private decisions.[4]

Second, it is argued that market interest rates ordinarily include some premium for the uncertainty, or risk associated with the investment. This risk is reflected in (real and nominal) differences in the interest

4. Alternatively, some have argued that we should impute a lower social discount rate in cost-benefit calculations as a shortcut for accounting for external economies or public goods characteristics that are not properly accounted for by private decisions makers.

rates of risky and safe assets. Proponents of subsidies argue that such risk premiums would be unnecessary with government investment projects, since the government is so large and has so many projects over which it can diversify risk that its investments could be treated as being riskless. Government investments would therefore be evaluated at lower interest rates than those private firms use, reducing their apparent costs and making them more profitable from a "social" point of view.

Finally, it is argued that corporate taxes distort discount rates, since the rate of return on private projects must include a provision for the payment of income and other taxes. According to this argument, because the government does not have to pay taxes to itself, the social rate of discount would be lower than the private discount rate, making projects "socially profitable" even though they are unprofitable in the private market.

As far as most new energy technologies are concerned, all three of these arguments are largely specious. Most of the historical discussion of social discounting has been conducted in the context of very large capital-intensive projects (such as dams), with very long lifetimes, with public goods characteristics and external economies, and which will be owned and operated by the government. While it is reasonable to assume that these projects are less risky (and therefore should carry a risk-free interest rate), these are not the characteristics of most new energy technologies.

There is also little evidence that private firms "overdiscount" the future by not utilizing the appropriate discount rate, although this is a question that is really not subject to any kind of objective analysis. In any case, there is no reason to believe that such an effect would appear only in energy supply and demand decisions.

While it is true that government bonds will carry a lower interest rate than other bonds because the government is always expected to pay up, this is a reduction in risk from the viewpoint of investors rather than from the viewpoint of society. If there are inherent risks associated with the economic viability of new energy technologies, there is little reason to believe that the government can diversify these risks any better than can the private capital market. Government debt does not eliminate risk, but only shifts it from investors to taxpayers.

The only situation in which the government might be in a better position to diversify risks than the private capital market is when such extremely large capital investments are involved that the default risks cannot be adequately absorbed by a single firm or a consortium of firms. However, such situations are rare. The investments contemplated for most new energy technologies are not outside the range of investment projects that the energy industry has been able to mobilize in the past. For example, private firms have had little or no trouble in raising the capital necessary for such projects as the Alaskan pipeline, LNG tankers, oil refineries and large chemical plants -- projects whose capital requirements were of roughly the same magnitude as a shale oil or coal gasification plant. If there is a problem here it is not the result of the size of the individual plant investments required.

The tax argument is also specious. The capital that might be used by the government to finance a project has an opportunity cost. That capital is withdrawn from the private sector, at a cost represented by both the lost returns from private investments and any lost taxes that such investments might have generated. From the perspective of opportunity cost we see that the cost of obtaining funds for public investment projects is equal to the gross rate of return, including taxes, that are foregone by diverting this capital from the private sector to the public sector.

Thus, it is difficult to be impressed by arguments that private decision makers use a discount rate that is "too high." Let us therefore turn to the other arguments raised regarding market imperfections.

C. Consumer Perception Imperfections

It has also been argued that consumers use discount rates that are too high, and therefore pay too much attention to short-run costs of alternatives (such as initial acquisition cost) and too little attention to the "life-cycle" costs. If this is true, consumers would be less inclined to purchase such technologies as solar heating, which have high capital costs but low operating costs.

There is little clear evidence that consumers indeed tend to overdiscount in this way.[5] In addition, it is difficult to know whether the nature of the imperfection is due to myopic decision making, or simply bad information or an inability to calculate properly the appropriate life-cycle costs of alternative energy systems.

Despite the lack of confirming evidence, this type of consumer imperfection may indeed be of some importance. But this imperfection is relevant primarily to consumer decisions, and not to producer decisions. It may provide an argument for providing tax credits or direct subsidies to consumers for solar energy or home insulation, but this is not at issue with regard to the types of energy supply technologies that have become the primary object of the Department of Energy's commercialization programs.

D. Capturing the Benefits of Technological Information

It is often argued that considerable technological information might be forthcoming from greater research and development efforts, but because this information is difficult to keep private, the benefits will not all

5. Although a recent study by J. Hausman of M.I.T. does give some evidence of consumer over-discounting.

accrue to private investors. As a result, private firms will tend to underinvest in R&D. Alternatively, patent protection might make complete appropriability of important technological information possible, but undesirable because of the distortion caused by resulting monopoly power.

While this argument is generally true for research and development activities that produce basic scientific and technical knowledge, it is not applicable to the commercialization of new energy technologies. Commercialization must be kept distinct from basic scientific research. Most new energy technologies that are candidates for huge subsidies are well understood by potential suppliers, and while there may be some uncertainty as to the ultimate cost of their use, the uncertainty is no greater than that involved in many other ventures commonly undertaken by private firms. Thus, while a good case can be made -- and should be made -- for government funding of basic energy research activities, the argument does not apply to government funding for the industrial development and commercialization of particular technologies.

E. Environmental and Other Regulatory Uncertainties

Finally, it is argued that the technological and economic risks associated with new energy technologies are overshadowed by uncertainties over the environmental regulations that these technologies will encounter when they are developed. Environmental and other public policy controversies surrounding the Clinch River Breeder Reactor and the Barnwell Reprocessing Plant are examples of the kinds of outcomes that potential investors fear.

Uncertainties over the ability to meet current and future environmental standards are faced by many industrial investments, but regulatory uncertainty is probably greater for such energy technologies as shale oil and coal gasification. These technologies raise new and different environmental questions, and to the extent that environmental standards may not be promulgated until they are operational, there may indeed by significantly greater regulatory uncertainty.

The environmental problems associated with shale oil production and coal gasification and liquefaction fall into three main areas: air quality, land, and water. Air quality problems can occur because of plant emissions and fugitive dust. The plants and mines associated with coal technologies and the disposal of spent shale in the production of shale oil may result in serious scarring of the landscape.[6] Finally, the development of these technologies raises concern over the availability of adequate water supplies and the pollution of existing sources.[7]

It has been argued that understanding and solving the environmental problems associated with new energy technologies may require the technology to operate for some period of time. While this would provide the information needed to draw up regulations, without clearly defined regulations the technology may not be developed because of the associated uncertainties. To the extent that this dilemma exists, the construction and operation of first-of-a-kind facilities may have public goods characteristics that would justify

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6. The use of the land for these plants may permanently alter land use in the area, possibly destroying vegetation and wildlife (e.g. in the case of coal based synfuels in the Appalachian regions, agricultural and forest lands would be unavailable for other uses, and reclamation would not totally restore them to their original use). Reclamation and revegetation would be extremely difficult in areas of low precipitation.

7. Synthetic fuels production requires large quantities of water at the sites, and in some regions this would mean a shortage of water for other uses (e.g. for agriculture). Discharge of pollutants into surface streams and leaching into underground sources are dealt with at the planning stage by designing the plants for "zero-discharge," involving recycling of the spent water for use at the plant site. Whether or not the discharge is quite "zero" during full scale operations remains to be seen.

some form of government intervention. On the other hand, regulatory reform, leading to the removal of unnecessary and even counterproductive regulations, and a clarification of the kinds of environmental standards that are likely to be enforced in the future, is likely to be a much more effective way of dealing with this kind of market imperfection.

5. The Proper Role of the Government

The gap between the consumption and production of energy in the United States is indeed growing rapidly, and non-conventional energy supplies may soon be relied on to help close that gap. This would indeed be unfortunate. Most of the gap is due to price controls on crude oil, natural gas and electricity, and it would be much more effective and much less costly to the American public to deal with that gap by eliminating its source, rather than by subsidizing expensive energy substitutes. For this reason, the most important component of a sensible national energy policy is the elimination of domestic energy price controls. Eliminating price controls would enable us to begin utilizing non-conventional energy supplies only as they become economically viable.

Of the various forms of market imperfections that have been put forth as reasons for government intervention, the most real and most serious is uncertainty over future regulation. Earlier we discussed uncertainty over future environmental constraints and regulations, but of even greater concern to the potential producer of new energy technologies is uncertainty over future government price regulation.

The commercialization of,say, shale oil is indeed a risky venture, but if private firms do undertake such a venture it will only be because they see a potential for profits -- profits large enough to warrant the considerable risk. The fear of private firms, however, is that while they will be permitted to lose almost any amount of money, they will not be permitted to make almost any amount of money. Firms considering shale oil projects rightly fear that should the world price of conventional oil rise considerably over the next decade so that a shale oil facility does turn out to be an economic success, the government would probably regulate the price of the shale oil they produce reducing the profits that could be earned.

Private firms usually have no problem with downside risk as long as there is a commensurate potential for profit on the upside. The problem with non-conventional energy supplies is that firms are unwilling to take downside risk when they perceive a probable government ceiling on their upside potential. It is therefore not surprising that these firms are asking for various forms of government subsidies to limit their downside risk.

Once again, government subsidies are a costly and unnecessary alternative to dealing with the problem directly. The removal of price controls -- and the guarantee that controls will not be imposed on the prices of non-conventional energy supplies produced by the private sector in the future -- would eliminate the one form of market imperfection that is indeed significant and serious.

The removal of controls on the current and future prices of energy supplies is the most important part of a "first-best" energy policy. This, together with a revision of those environmental regulations that are unnecessary and unreasonable, and the clarification of environmental standards and regulations that would apply in the future, would permit private firms to develop new energy technologies at a socially optimal rate. There would then be little or no need for the government to subsidize the commercialization of these technologies. While we would hope to see continued government support for basic energy research, subsidies for the production of non-conventional energy supplies would be no more warranted than subsidies for the production of sugar, peanuts, tobacco, or any other good.

While we do not believe it to be the case, some have argued that the deregulation of domestic energy prices is politically impossible, at least over the next several years. If this is true, would it make government subsidies for new energy technologies desirable? In particular, what role should the government play in the commercialization of these technologies as part of a "second-best" energy policy?

In this case, the government should use its limited resources to reduce the cost (or, equivalently, the risk) of producing non-conventional energy supplies, but should avoid in any way determining the specific technologies that are developed. An especially attractive way to do this would be for the government to provide price guarantees or purchase agreements for broad categories of non-conventional energy supplies, rather than subsidizing specific demonstration plants or technologies directly. For example, the federal government might announce that it is willing to buy a million barrels per day (or equivalent) of liquid or gaseous fuels produced from coal or shale at some fixed price above the current market price. The government would not itself pick a particular process or demonstration plant or get involved in technological decisions or production activities. Rather, it would provide an incentive for the private sector to pursue the development of the most cost effective technologies.

It is private industry, and not the government, that is in the best position to determine which new technologies are most economical and most promising, and to manage the commercialization of those technologies. In addition, private industry is much better able than government bureaucracies to drop the development of a particular project if it later turns out that the technology is not as promising as it once appeared. By choosing a particular plant located in a particular congressional district and creating a government bureaucracy to manage the project, we inevitably create a set of political forces which makes termination of the project very difficult. Nor is there any reason to believe that the personnel in government agencies are in a particularly good position to sensibly evaluate all of the proposals that are always put foward when government subsidies become available. We should never repeat the mistake made in our breeder reactor program by giving the government a primary role in choosing among programs or managing any particular program. By using broad price and purchase guarantees we can avoid finding ourselves in the position of being committed to a technology that appears less and less desirable as time goes on.

To the extent that the government does participate in commercialization, its role should be strictly limited to the most efficient subsidization of alternative energy supplies in general, rather than particular technologies and programs. But we must recognize that this "second-best" policy will still be far more costly to the American public than the "first-best" policy, which largely eliminates the need for government participation in the production of energy in the first place.