How To Spend $100 Billion For Energy

The U.S. Labor Party, Senator Abraham Ribicoff (D-Conn.), and Nelson Rockefeller are spokesmen for three different energy programs carrying a $100 billion price tag. Those programs differ on *what* the money is to be spent on. The U.S. Labor Party insists on 'hard' energy technology — fission, oil, coal, natural gas; Ribicoff on "soft" technologies — solar, wind, shale oil, etc.; Rockefeller wants to mix them.

The results would be enormously different.

When the criterion of *energy density* is used — the relative energy equivalents of labor, material and capital inputs required to produce a given energy output — the U.S. Labor Party's program would realize a net energy production increase of 20 percent, cutting energy prices in half, creating 3 million new construction and manufacturing jobs and realizing a 36 percent profit on the $100 billion spent. The same criterion applied to the Ribicoff "soft" programs shows disastrous results: a net energy *loss*, a quadrupling of prices, reduced real wages, and elimination of a massive number of industrial jobs. Were the Rockefeller "compromise" adopted, the disastrous ratio of energy consumed to energy produced for the "soft" technologies would wipe out the benefits accrued from the "hard" technologies. No decisive break with the current mess of steady energy price inflation will be possible, and economic stagnation, unemployment, and erosion of real wages will result.

This is hardly a choice. The fact is, energy-dense technologies are *low-cost* — however much capital is initially required. They have a high rate of *social profit.* For every dollar invested, "hard" technologies make available a much larger amount of wealth for the growth of the whole economy. For every job absorbed by such technologies' expansion, that translates into four or five additional jobs created elsewhere through new-output energy availability. Thus, only these technologies permit economic growth, at higher and higher *rates* of growth.

Conversely, with low-energy-dense, "soft" technologies the opposite is the case. Energy must then cost more, because more labor, capital, and material is required for its production. As labor productivity declines (production per capita), so does consumption per capita, that is, real wages. Soft energy technologies have a *negative* rate of social profit, because they require more of society's total wealth than they produce. Therefore their implementation does not create growth, but promotes the overall collapse of the economy.

Table 1 shows clearly exactly which technologies fall into each of these two categories. The low-cost, energy-dense technologies are fission, gas, coal, and oil — the presently used power technologies. They are used precisely because they are the cheapest available for the period before thermonuclear fusion power comes on line. In electric generation, fission and coal are closely comparable and, on a national average, produce energy at a real (uninflated) price of only about 60 percent the present market price for electricity. This gives some indication of the amount the economy already pays for the overpricing of fuels. The real rate of profit on these sources is very high, above 40 percent per year, currently shared out among the mining companies, the utilities and, above all, the banks which finance both. This rate of profit indicates how rapidly new wealth can be plowed back into the economy through the expanded use of these energy sources.

For non-electric fuel sources, it is clear that coal and gas are by far the cheapest sources. This is directly related both to the inherent high energy density of these fuels and their relative availability in highly concentrated deposits. Natural gas in particular, despite all the propaganda to the contrary, has been barely exploited in this country. Vast amounts of "dry" gas — gas not associated with oil — have barely been tapped, and all competent experts agree that natural gas production could be doubled or for every billion dollars invested, a third of a million barrels of oil per day equivalent energy will be produced, or 2/3 of a trillion cubic feet of gas per year. From the vast majority of the known reserves, gas can be produced profitably for far below the current ceiling price of $1.75 per 1,000 cu. ft. (the equivalent of oil at about $7 a barrel). The only reason independent gas producers are vehemently demanding much higher prices through deregulation is that they expect to continue to be frozen out of the credit markets, and thus reliant on self-generated profits of 30 percent per year and more to finance expanded drilling. With cheap federal credits, such self-defeating policies will be totally unnecessary, and abundant cheap gas production will be completely feasible.

Notably, oil, while still among the cheap energy sources is currently considerably more expensive than gas or coal when produced in the U.S. Easily available oil supplies have in fact been fairly thoroughly exploited in the U.S. and remaining supplies require greater amounts of investment, such as for deep wells, the Alaska pipeline and off-shore operations. Nonetheless, oil supplies remain available for considerable expansion in use of this fuel, as wellhead prices close to the current dollar ceiling (or refined product prices of $9 a barrel).

The contrast between these cheap energy sources and the high-cost variety is striking.

First, there are the marginal resources such a shale oil and tar sands. Such resources, blasted out of the ground or extracted by various *in situ* methods, require the setting up of large factories, built by hundreds of thousands of construction workers in presently uninhabited regions such as central Wyoming and northern Canada. They are expensive because they are inherently far more diffuse than the concentrated deposits of oil and gas now being exploited. To be profitable they would require energy prices of nearly triple the current domestic one, and nearly double the OPEC price. In simple capitalistic terms, such investments would be losing propositions *unless* there was either a 200 percent increase in domestic oil prices *or* a 60 percent reduction in construction workers' wages, thus reducing the major capital cost of the projects.

A second variety of high-cost technology is the coal conversion schemes which again use very large industrial plants, involving very heavy capital investment to convert coal into gas or oil, wasting half of the original energy in the process. As Table I indicates, about one-tenth as much energy is produced from coal gasification as from an equal investment in simple coal-mining, and even less than that out of coal liquifaction.

The most expensive energy sources are the so called soft technologies, or the Amory Lovins Specials (named after that very soft young man who advocates such nonsense.) These sources, admired by ecological freaks and their friends, are expensive because they use energy sources which are inherently highly diffuse. In the case of geothermal and wind power, the diffuseness leads to very small-scale energy production and thus very low labor productivity in the construction of small and scattered facilities. The application of these soft technologies would be very hard on peoples wallets, since it would require the quadrupling or quintupling of everyone's electric bills. And of course, for a given investment, only one-seventh to one-fifth of the energy would be produced as compared to a similar investment in fission or coal electric generation.

Within these soft technologies, the much-touted scalar technologies — solar-electric and biomass fuel generation (better known as firewood) — are in a class by themselves. These methods of utilizing "free solar energy," the most diffuse type of all, are naturally enough the most expensive of all. In fact, it would take 500,000 workers and cost $80 billion at current prices to construct a biomass conversion complex capable of producing energy equivalent to one million barrels of oil per

Table I — Costs of Energy Production

Fuel Production

Energy Source	Capital Costs ($billion per MBDE)	Labor (jobs/MBDE)	Cost ($/BBL)	Price ($/BBL)	Rate of Profit (% per annum)
Coal	3	10,000	1.10	2.75	70
Gas	5	15,000	1.40	3.50	40
Oil	13	35,000	3.60	9.00	10
Oil Shale	20	100,000	7.50	19.00	—1 (loss)
Tar Sands	27	140,000	8.50	21.00	—2 (loss)
Coal Gasification	27	170,000	9.00	22.00	—3 (loss)
Coal Liquifaction	40	250,000	13.50	34.00	—6 (loss)
Biomass Conversion	80	500,000	27.00	68.00	—9 (loss)

Electric Generation

Energy Source	Capital Costs ($billion per MBDE)	Labor (jobs/GWE)	Cost (cents/KWH)	Price (cents/KWH)	Rate of Profit (% per annum)
Fission	.8	4,000	.9	2.7	40
Coal	.8	5,000	.9	2.7	40
Wind	4	20,000	4.5	13.5	—1 (loss)
Geothermal	6	30,000	6.7	20.0	—5 (loss)
Solar	10	100,000	11.0	33.0	—7 (loss)

Key

MBDE — million barrels per day equivalent
GWE — gigawatts electricity (million kilowatts). One MBDE energy is sufficient to produce 20 GWE at normal efficiency.
KWH — kilowatt hours
BBL — barrels

COST is the true cost of production of the finished fuel at point of consumption (i.e. refined petroleum). In all energy production technologies, the vast majority of costs is absorbed by capital construction and capitalization (drilling the wells and building the refineries, etc.).

PRICE is the fuel or electric price which will return a profit of 15 percent a year.

PROFIT is the annual gain or loss on capital assuming fuel is sold at current prices ($7 per barrel of oil or energy equivalent; 4 cents per kilowatt of electricity). Note that for the case of petroleum, the price is calculated after refining; for crude oil, the price would be very close to the actual current price of $7 per barrel. Also note that the apparently small losses of the high cost fuels are not small at all. A loss of 3 percent per annum would lead to a loss of a third of initial capital in a decade, the loss of 9 percent per annum would lead to a virtually total write-off of capital in the same period.

JOBS means mainly jobs involving construction of energy-producing complexes, except in the case of coal-mining where ongoing labor costs are substantial.

day. Even more absurd is the case of solar energy. To build a solar generating system capable of supplying New York City's 10 gigawatt per day electricity requirement alone, fully one million workers would have to be mobilized for a construction effort costing $100 billion — nearly 10 times the city's annual budget.

The application of these low-energy-dense technologies would lead to increases in fuel prices by more than 1000 percent and in electric prices by more than 800 percent. Conversely, these soft technologies could be applied and energy could be produced at current prices if the construction and steel workers constructing the gigantic solar generators and massive biomass converters would merely agree to have their wages reduced by a factor of ten — to about $30 a week.

The Alternative Programs

Given the above analysis of the cost of various energy technologies, it is not hard to design an appropriate way to spend $100 billion to develop energy and to estimate the impact a program will have. Obviously we propose to invest only in cheap energy sources. Electric generation is to come from a combination of 30 fission and 50 coal plants, for a total investment of $57 billion. Fuel will come predominantly from expansion of gas production.

An expansion of gas production by 40 percent, or 8 trillion cu. ft. per year (4 million barrels a day equivalent) can be financed by $20 billion in government loans, enough to send every independent gas producer in the country scrambling for his drilling rig. Major regions of expansion will be in Appalachia, Mississippi, Louisiana, Texas, Oklahoma, the northern Rockies, and New Mexico. Coal production, mainly for new electric capacity, will be expanded considerably as well, with $6 billion allocated for an expansion of coal production by 30 percent or 180 million tons per year. Oil production should also be expanded, to fully exploit existing relatively cheap reserves, with $17 billion going to expand production by about 10 percent.

The impact of such a program on the economy would be immense. Electric generation capacity would be increased by 80 gigawatts (a million kilowatts) or 25 percent. Total energy production would be increased by 8.8 million barrels a day equivalent, or 22 percent. This would be sufficient energy, developed over a relatively short period (as little as two years for the fuel expansion) to set off a tremendous rate of growth in the economy as a whole. Sufficient energy would be provided for a total of 3 million new jobs in manufacturing, construction and related industries, of which only about 500,000 would be used for the energy expansion program itself. This high ratio of jobs needed by the program to jobs produced by the resulting energy implies a high rate of social profit — in fact a rate in monetary value of 36 percent a year at current prices. Such rapid growth of energy supply using sources inherently cheaper than the current price will lead over a period of time to the end of energy shortages in the U.S. and the reduction of energy prices, ultimately by as much as 60 percent — implying a comparable increase in real wages.

For contrast, let us assume that about half the the low-cost program.

Prices of electricity would quintuple, and the price of fuel quadruple. Real wages would decline by 70 percent, either through such price increases, through massive wage-slashing and union-busting, or a combination of both. Industry would be gutted: the program would require more labor and materials than could be produced by the energy generated by the project. The investment program in energy-dense technologies would generate 3 million new jobs on the basis of the energy produced by the project workforce of 500,000. By contrast, the application of soft energy technologies would initially employ 650,000 in a $100 billion investment program, but would produce only enough energy to support 500,000 jobs, a net overall loss to the economy as a whole. If prices and wages were actually held constant, the project would lose enough money to squander the entire $100 billion

Table II — $100 Billion for Energy Development: The Alternatives

Low-Cost Energy Plan

Fission	$24B for 30 GW
Coal Electricity	$33B for 50 GW
Coal	$ 6B for 2 MBDE
Gas	$20B for 4 MBDE
Oil	$17B for 1.3 MBDE
Total: 80 GW 7.3 MBDE	**$100B for 8.8 MBDE**

B—billion
GW—gigawatts (million kilowatts)
MBDE—million barrels of oil per day equivalent

Rotten Compromise

Fission	$19B for 24 GW
Coal Electricity	$ 4B for 6 GW
Wind	$ 4B for 1 GW
Geothermal	$12B for 2 GW
Solar	$10B for 1 GW
Coal	$ 5B for 1.8 MBDE
Gas	$ 4B for 0.8 MBDE
Oil	$19B for 1.5 MBDE
Shale	$ 4B for 0.20 MBDE
Tar sands	$ 4B for 0.15 MBDE
Coal Gas	$ 5B for 0.20 MBDE
Coal Oil	$ 5B for 0.10 MBDE
Biomass	$ 5B for 0.06MBDE
Total: 35 GW 4.8 MBDE	**$100B for 5.8 MBDE**

High-Cost Energy Plan

Wind	$12B for 3 GW
Geothermal	$18B for 3 GW
Solar	$20B for 2 GW
Shale	$13B for .65 MBDE
Tar Sands	$ 7B for .25 MBDE
Coal Gas	$10B for .40 MBDE
Coal Oil	$10B for .25 MBDE
Biomass	$10B for .12 MBDE
Total: 8 GW 1.7 MBDE	**$100B for 2.1 MBDE**

Table III — The Results

	Low-Cost Energy Plan	Rotten Compromise	High-Cost Energy Plan
Price of electricity	$.027/kwh	$.047/kwh	$.20/kwh
Price of fuel	$4.30/bbl	$8.40/bbl	$25.00/bbl
Net reinvestable profit	$36 billion/year	$14 billion/year	$4.5 billion (loss)
Project labor	500,000 jobs	550,000 jobs	650,000 jobs
Total jobs created in economy	3 million	2 million	500,000
Real wages	+60 percent	—20 percent	—70 percent

kwh—kilowatt hours
bbl— barrels

very rapidly.

Finally let us look at the compromise plan: a little hard and a little soft. Such is the program proposed in the Rockefeller Critical Choices plan of 1974, recently revived by the former Vice President and endorsed by Sen. Long. It includes a lot of fission, just small "pilot" projects for wind, geothermal, solar, shale, tar sands, coal conversion, and biomass, in addition to oil and some gas and coal. However, although the amounts of energy produced by the high-cost methods are small, nearly *half the total capital* is invested in them and thereby wasted. The net effect of this "compromise" is to increase the prices of both electricity and fuel by about 20 percent, thus continuing the present steady escalation of energy costs that is crippling U.S. industry.

Only 45 percent of the electricity of the low cost program and only 60 percent of the overall energy production is produced by the compromise — naturally enough, since half the capital is wasted on oil shale, and so on. This means that the profit level is less than half as much and far fewer jobs are created — a net gain in jobs of 1.5 million as against 2.5 million and at the expense of a 20 percent fall in real wages. Although there does remain an apparent small net gain in energy production (less than 10 percent of current production), this is barely enough to keep even. Thus overall, the real net return on investment is negligible and the program as a whole in essence perpetuates the existing situation.

— *Eric Lerner*

Figure I — Results of $100 Billion Investment in Energy