ENERGY
AN ENVIRONMENTAL AND ECONOMIC DILEMMA

1. RUNNING OUT OF ENERGY[1]

Extension Bulletin E-1173 November 1977

The days of cheap energy are gone forever. Scientists, engineers and industrial leaders agree energy costs will increase rapidly in coming years. Already, rising prices have forced lifestyles to change throughout the country.

It is essential that we begin to conserve more than we now do. The United States currently has 6 percent of the world's population and uses about 35 percent of the world's resources. Our reign as the world's energy glutton will soon come to an abrupt end as a result of dwindling resources and rising prices.

We must find new values and a way of life that will allow us to live comfortably, yet within our means in the world energy picture. Though our current lifestyle depletes our limited quantities of resources, we can counter rising costs and impending shortages by using resources more efficiently and effectively than we now do.

It is conceivable that we could live on much less energy and be just as well fed and sheltered and probably socially and culturally happier. Sweden achieves an average per person Gross National Product (GNP) equivalent to that in the United States but uses about two-thirds as much energy per person as we use.

HOW DO WE KNOW WE ARE RUNNING OUT?

Just like any kind of production, energy production begins slowly and rises with demand. Easily obtainable resources are developed first.

As production increases, cost decreases due to economies of scale which develop larger machines that dig out more at lower costs. But as wells or mines go deeper or more remote, recovery costs rise.

Production slows and may eventually cease when recovery costs exceed those of a substitute resource. Today's rising energy prices are evidence that this time has come.

Production curves published by the Energy Research and Development Administration show that production of natural gas and petroleum in the United States peaked in the early 1970s (Figures 1 and 2).

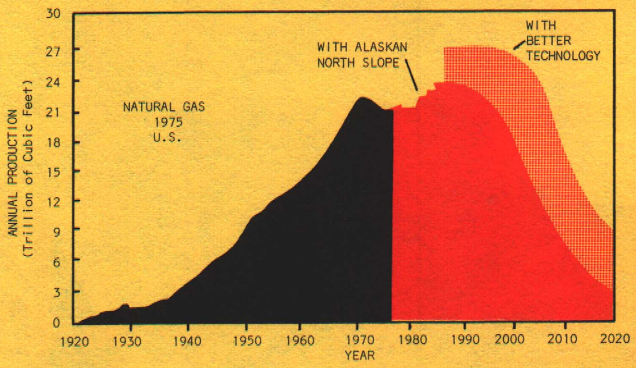

Figure 1—United States natural gas supply (4).

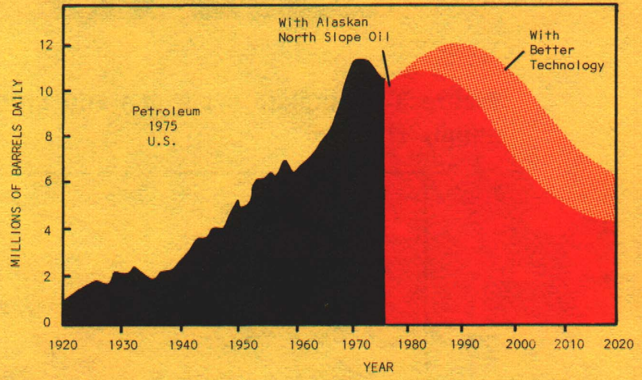

Figure 2—United States production of petroleum liquids (4).

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[1]*From a presentation by Herman Koenig, Director, Center for Environmental Quality, MSU, at a seminar for community leaders of Genesee and Lapeer Counties on March 28, 1977, in Flint, MI. The series of four seminars was sponsored by Michigan State University's Cooperative Extension Service. Adapted by Bill Stout and Paul Parker, Department of Agricultural Engineering, MSU.*

Other titles in the series are: No. 2, Energy and Ecosystems (Extension Bulletin E-1174); No. 3, Energy and World Food Production (Extension Bulletin E-1175); and No. 4, Developing an Energy Policy (Extension Bulletin E-1176).

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In about 60 years, nearly 80 percent of the world's crude oil supply will be gone (Figure 3). The production cycle peak for coal will occur sometime between 2100 and 2200 A.D. if we expand production at anticipated rates as a partial replacement for oil and natural gas (Figure 4). But regardless of how coal or fluid fossil fuels are used, the entire fossil fuel era appears only as a blip in human history (Figure 5).

It is impossible to develop alternative energy sources rapidly enough to compensate for dwindling natural gas and petroleum supplies. No alternative energy sources are as cheap and easy to use as fluid fossil fuels.

WHAT ABOUT NUCLEAR POWER?

If we were to convert to nuclear energy, uranium production in the United States would peak before the end of the century (Figure 6). For nuclear energy to be economically feasible, breeder reactors that produce and reuse plutonium—a reactor fuel—are necessary. Plutonium, however, is a potentially dangerous, radioactive element used to produce nuclear weapons. It is dangerously radioactive for 250,000 years after it is produced in the fission process.

Persons living in a system dependent on nuclear energy must decide if they want to live with the danger of nuclear terrorism and possible mishaps caused by human error. Thus, the decision to develop breeder reactors is not so much a technical one as a social one.

Social costs of nuclear energy are difficult to estimate as are the real economic costs of nuclear power. Standard economic accounting does not always identify the break-even point of energy recovery. In the past, the only costs associated with resources were what it took to recover them.

NET ENERGY

The crucial measure of economic viability is really the cost to produce the energy available after recovery, processing and delivery. This is referred to as the

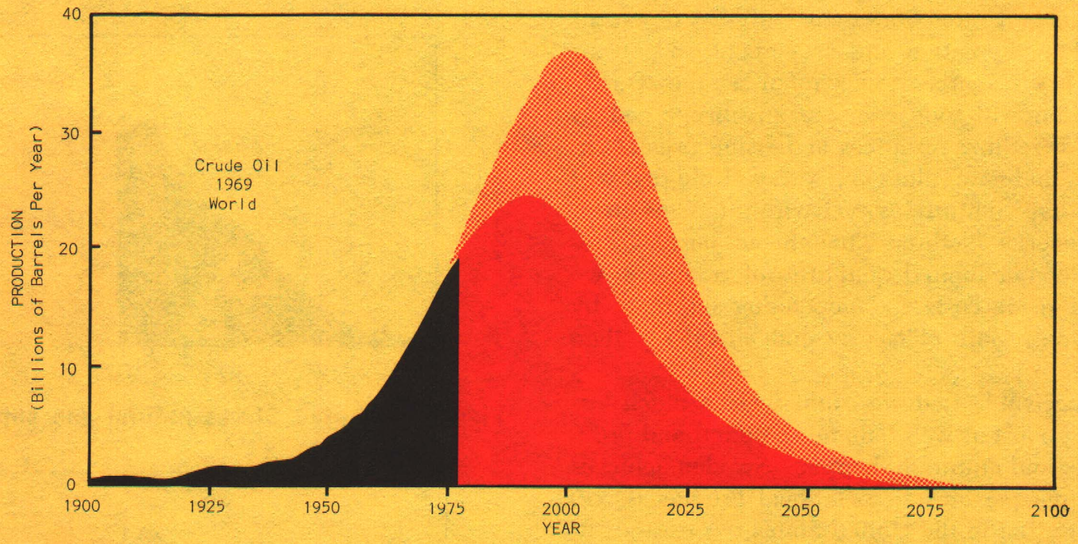

Figure 3—Complete cycle of world crude-oil production for two estimates of total supply (1).

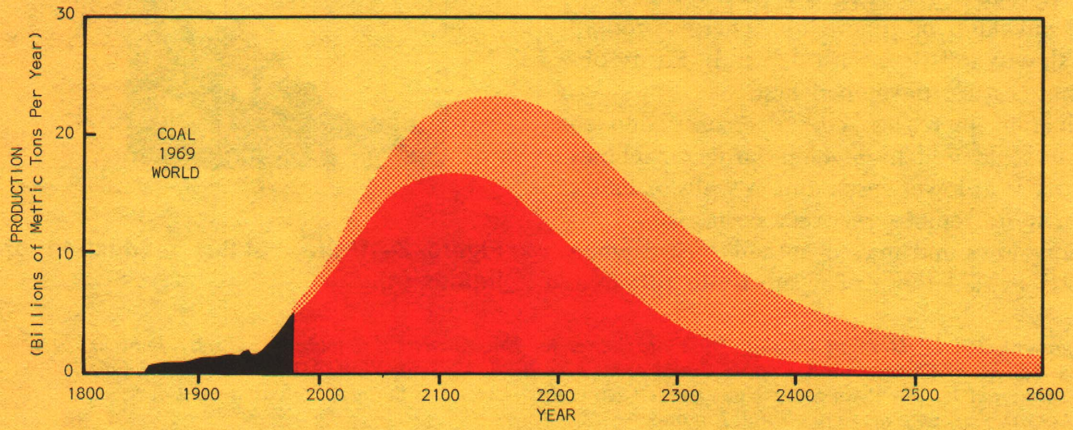

Figure 4—Complete cycle of United States coal production for two estimates of total supply (1).

net energy gain. Net energy returns from nuclear power or the gasification of coal, therefore, will approach zero sooner than the recovery cycle indicates.

It is unclear whether a net energy gain will result from development of natural gas and petroleum in the Alaskan North Slope, because we do not know how much energy was expended in building and maintaining the pipeline and developing the cities required to support the construction crews. Nor do we know how much of these energy costs should be charged against the pipeline.

WHAT IS GOING TO HAPPEN?

Since passing the production peak for natural gas and petroleum, the option of holding the price down no longer exists. Capital stocks—the products we produce with—use energy, materials and labor. If each of us insists that our salaries be tied to the rising cost of living, then all three factors will go up. The cost of producing energy is going up—we can't stop that; the cost of producing the materials is going up—we can't stop that. Then if we tie our salaries to that rising cost of living, the third factor also goes up, and what will happen to the value of the dollar? Ultimately, the cost of energy relative to labor must go up, but we can counter shortages and rising costs by using our resources more efficiently and effectively.

Conservation is not just a matter of saving; it is a method of maintaining a way of life. Systems of production and consumption are linked with institutional and cultural mechanisms. As decreasing supplies of energy demand increasing inputs of labor in the production-consumption system, American culture and institutions will change.

Earlier cultures spent generations trying to maintain harmony with their environment and resource supply. Many failed.

HOW WILL WE CHANGE?

Changes in energy use can be made through a combination of "technological fixes," increased product durability and revised land use patterns.

—Technological Fixes

Energy can be saved by matching the quality of

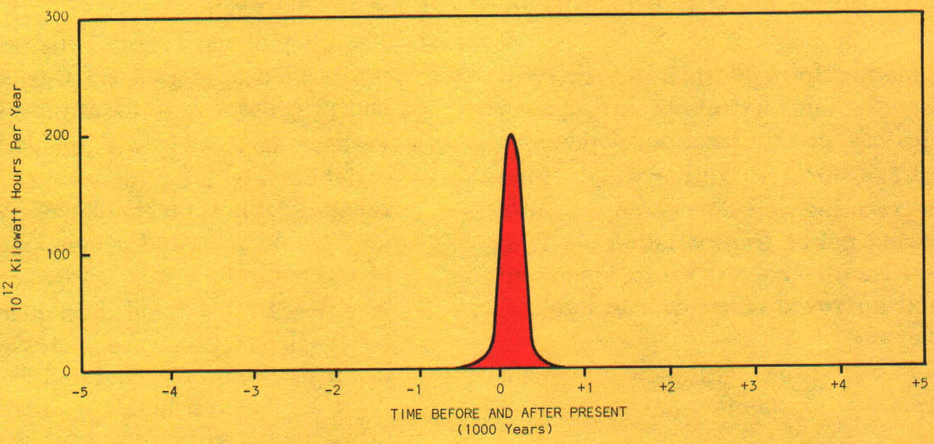

Figure 5—Epoch of fossil-fuel exploitation in perspective of human history from 5,000 years in the past to 5,000 years in the future: a blip on the scale of time (2).

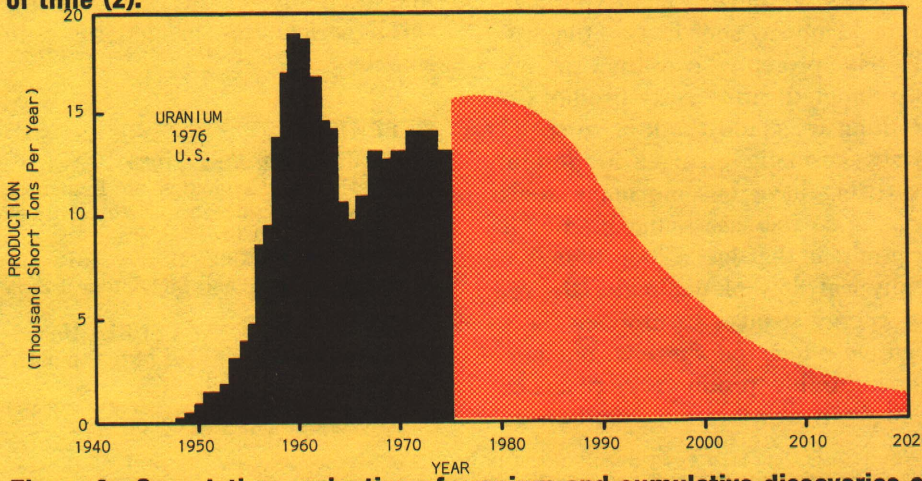

Figure 6—Cumulative production of uranium and cumulative discoveries of uranium as a function of time (3).

energy to the job performed. Heating buildings with electrical resistance wastes energy. When converting from a coal pile or a nuclear process to electricity, two units are lost for each one used. But in many cases this waste heat could be utilized. On the Michigan State University campus, for example, the power plant uses the residual heat from electricity generation to heat campus buildings and thereby achieves a 75 percent overall efficiency level in heat and electrical production.

Direct solar energy has been developed for space and water heating. But because the sun shines a limited number of hours each day, there is an enormously complicated energy storage problem. And there is no cheap method for concentrating and converting it into a mobile energy form that can do work. Solar cells, like those found in a spacecraft, currently take more energy to build than they produce in a lifetime. Research is underway to develop less expensive and less energy-intensive methods for manufacturing solar cells.

Wind—a form of solar energy—can do mechanical work, but it, too, cannot be stored economically for use when needed.

Hydropower, another form of solar energy, performs work consistently, but most of the hydropower in the United States has already been developed.

Other technical fixes include shifting freight from highways to rail, decreasing dependence on the automobile by transferring public transportation needs to rail and other mass transit systems, better home and office insulation and improved efficiencies in lighting, heating and appliances.

However, technological changes alone will not solve the energy shortage or maintain our standard of living.

—Product Durability

Over the last 50 years we have tried to stabilize our economy and provide jobs by speeding up the production process. We have promoted consumerism, expanded production, promoted throw-away products—in short, done everything we could think of to speed up production. Minor cosmetic changes in design, packaging and advertising have become major tools of the marketers aiming to increase demand. But if we start producing products that last a long time, we can cut down the physical flow of our materials, reduce the amount of energy it takes to produce them and reduce the negative effects on the environment.

By producing more durable products in place of throw-away goods, we can increase our standard of living. Though the GNP may shrink, we will reduce the adverse effects on the environment and conserve resources. If we produce more durable products, like cars that last twice as long as present automobiles, or refrigerators that last the lifetime of the owner, we may reduce employment in production, but increase employment opportunities for the maintenance of those goods.

It is tragic to think that the primary measure of economic performance is productivity per person. Somehow productivity in terms of the yield per unit of energy resources expended must be given more attention.

—Land Use

Changes in land use are the most complicated types of adjustments that may occur, but they can provide the most energy savings. Over 60 percent of all gasoline is consumed in transportation. Transportation needs from one area of the country to another can be reduced as regions become economically self-sufficient. That goal can be brought about through three related strategies:

1—Recycling of wastes and partly used resources within a region ensures even distribution of residuals and provides a resource supply for future use.

2—Perhaps increased crop yields per acre can be maintained by adopting smaller scale, more diversified agricultural technologies. Where energy and land are precious and people abundant, high levels of mechanization are senseless.

3—In a decentralized and diversified community, material efficiency can be increased because many residuals can be recycled and reused. In such settings, society can better maintain nutrition levels, provide jobs, reduce transportation needs and more efficiently put waste products to use.

Extension efforts to inform the public about issues and alternatives are crucial in bringing about the cultural reorientation needed for redirection of our resources.

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