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Introduction

Concepts of Appropriate Technology

For his different purposes man needs many different structures, both small ones and large ones, some exclusive and some comprehensive . . .

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What scale is appropriate? It depends on what we are trying to do.

–E. F. Schumacher, Small is Beautiful[1]

Appropriate technology (AT) involves an attempt to tailor the scale and complexity of a technology to the job that needs to be done on the basis of human as well as purely economic values; it tries to be sensitive to the needs, desires, and resources of the people who will use the technology; and it is sometimes offered as an alternative or supplement to the centralized technology of the industrialized West. Any attempt to define AT precisely is likely to end in frustration, however: the proponents of AT cannot always agree among themselves on exactly what the concept entails, and its emphasis has changed several times in the last 10 years, depending on where and when it was applied. What follows, then, is a sample of the positions held by various AT advocates and groups at different times. It is not a definitive treatment, but rather a summary illustration of the many threads that have come together in the AT movement. This movement's beliefs are distinctive but not always strictly coherent—this to some degree may be inevitable, since AT embodies the principles of diversity and selectivity in its response to varying local conditions and priorities.

In one of its earliest forms, AT was proposed as an alternative approach to economic development in the Third World. Observers like British economist E. F. Schumacher noted that, when advanced technology (particularly the capital-intensive kind employed by industrialized societies) was introduced into a developing nation, it sometimes created as many social and economic problems as it solved. What is needed, Schumacher suggested, is an "intermediate technology" that is far more productive than traditional methods, but still more labor intensive and less capital intensive than the sophisticated technologies of the industrialized nations. In the agricultural sector this might be a metal plow, for instance, as opposed to a hoe at one extreme and an air-conditioned tractor at the other. In the Third World, then, AT is usually associated with small-scale, decentralized industries that make extensive use of an abundant resource—unskilled labor-and are more sparing of resources that are less abundant-energy, investment capital, and skilled labor. An example in the manufacturing sector might be a village foundry that produces and repairs the metal plows: such a project would provide training and jobs in the countryside; its product would improve the yields and lives of local farmers; and multiplied by hundreds of villages, it would lay the foundation for an advanced but decentralized iron and steel industry. An "intermediate" technology, in short, is often more appropriate than an advanced technology to the needs and the resources of a developing nation. AT proponents claim that, if it does the job better, it represents the economically sensible choice both for the Third World and for the industrialized nations who are aiding its development.

In the United States, by contrast, AT was originally associated with the environmentalist and "back to the land" movements of the late 1960's and early 1970's. Its early proponents were influenced by Rachel Carson's *Silent Spring (1962)* with its prophecy of an ecological catastrophe,[2] by the

[1] E. F. Schumacher, *Small is Beautiful*: Economics as *if People Mattered (New* York: Harper and Row, 1973), pp. 61-62.

[2] Rachel Carson, *Silent Spring* (New York: Houghton-Mifflin, 1962).

publication of The *Limits to Growth* (1972) with its prediction of the "overshoot and collapse" of world industrial growth,[3] and by a spreading disenchantment with an advanced technology that, despite its material benefits, was felt to be an overbearing and sometimes destructive presence. Some of these early advocates concentrated on reviving traditional techniques like organic farming and log houses, but for others the emphasis on smallness and simplicity became what Witold Rybczynski has called "a cheerless reaction against the excessive optimism that had been prevalent in the industrial nations.'" For a few of them AT represented a negation of the values of advanced technology and other large-scale social institutions, and their attacks became so extreme that E. F. Schumacher came to regret the title of his influential *Small is Beautiful*, which he feared was becoming a simplistic dogma. Others dismissed the AT movement at that time as "antitechnology" and a retreat to more primitive standards of living.

Over the last decade a broader and more pragmatic concept of AT has emerged side by side with the first. A growing number of observers have pointed out that, while small may be "beautiful" in many ways, it is not always sensible. For some jobs it is possible to scale down or decentralize a large technology, but impossible or undesirable to do away with it entirely. In this view, AT embodies the principle of selectivity in assigning (or developing) a "mix" of large and small technologies to meet specific tasks and conditions:

> In the ideological view, AT is an antidote to the past trends in Western technology, particularly those of the last twenty-five years . . . .
>
> The alternative view stems from a more pragmatic definition of AT and leads to the conclusion that the whole AT movement is simply a manifestation of an increasing tendency toward diversity' and pluralism in today's world. Thus, it is argued, AT will occupy an increasing number of ecological niches in the global technology but only in places where it is adapted to its environment . . . . [The] special characteristics of smallness of scale and susceptibility to community control are less important than the overall measure of adaptation to the social and natural environment, which may imply large scale and centralized control in some instances, small scale and decentralized control in others, or some symbiotic combination of the twos

This ecological metaphor is apt, since environmental compatibility remains a major criterion in this selection process. In the past few years, however, a growing number of appropriate technologists have come to view themselves as pioneers operating "at the frontier" in several areas of applied science. They argue that much of what is called AT is in fact a particular kind of advanced technology designed for changing resource conditions. In adapting to the current economic environment, for instance, AT has led to a number of relatively sophisticated technologies that are efficient users of energy and material resources. In this view, the main technical challenge is to integrate AT applications in community systems that incorporate resource-efficient architecture, integrated aquiculture-agriculture systems, water conservation and wastewater reclamation, new domestic applications of computers and communication technologies, and the like,

There appear to be four major areas of concern in which AT can make a specific, productive contribution:

- problems of economic growth;
- problems of international equity;
- problems of domestic equity; and
- problems of regulation and participation.

[3] D. H. Meadows, et al., *The* Limits to Growth: A Report/or the *Club of* Rome's Project on the Predicament *of* Mankind (New York: Potomac Associates/Universe Books, 1972).

[4] Witold Rybczynski, "After Appropriate Technology," paper presented to the American Academy for the Advancement of Science annual meeting, Washington, D. C., Feb. 15, 1980, See also his Paper Heroes: A Review *of* Appropriate Technology (New York: Anchor, 1980),

[5] Harvey Brooks, "A Critique of the Concept of Appropriate Technology, " in Appropriate *Technology* and Social Values—A Critical Ap*praisal,* edited by F. A. Long and A. Oleson (Cambridge, Mass.: Ballinger, 1980), pp. 55-56.

Problems Addressed by Appropriate Technology

Problems of Economic Growth

AT proponents may not be able to agree on just how much economic growth the world and Nation can sustain, but most of them conclude that there has to be some middle path between headlong expansion and no growth at all. Continued indiscriminate growth would contribute to further pollution of the environment, depletion of energy resources and other raw materials, inflation and supply shortages so severe as to threaten the economic system, and increasing social and political tensions. No growth at all—a position attributed to the AT movement by some people—would have catastrophic effects on the international and domestic economies and, by betraying the hopes and expectations of the less fortunate, might lead to widespread social unrest.

There are a number of positions in the AT dialog over growth: some proponents feel that the United States is "misdeveloped" and that there must be a change to more frugal lifestyles and an end to the ever-increasing consumption of materials; many feel that some growth is possible, but only in selected sectors or at a slower pace; still others believe that the wise application of technology (e.g., the careful use of energy, particularly through conservation measures and the development of renewable sources) could make growth possible and sustainable, although perhaps not at the rate of the past 25 years. Most observers, however, see the search for solutions to the problems of growth as a monumental challenge to human ingenuity, as well as an opportunity to redress some of the perceived errors and wrongs of the past.

Five major themes emerge from this dialog:

1. A *human definition of growth* .–The quality of life is as important as the quantity of material outputs; increased consumption of raw materials is not a satisfactory measure of human progress.
2. *Sustainable growth.* —Mature industrial economies must make the transition from production processes that exhaust resources and produce undesirable wastes to processes that use renewable or recyclable resources and, where possible, use the wastes of one process as raw material for another.
3. *Environmentally sound growth.*—Attempts to put "filter tips" on existing industries should be only a transitional stage in the development of technologies that procure and process materials with fewer and less harmful wastes.
4. *Decentralized growth.*–More care should be taken *to* adjust the scale and geographical distribution of technology to the actual distribution of needs; this can also cut costs (e.g., transportation) by taking advantage of the human and material resources available in the local community or region.
5. *Diversified growth.—There* is a need for a diverse "mix" of technologies from which to pick those that are (or can be) best tailored to the job and the location.

Problems of International Equity

The poorest nations, by and large, are staying poor. The Third World, where 90 percent of new babies are born, is less able than the industrialized West to cope with inflation and rising energy costs, and less able to accumulate needed capital. Schumacher and others have argued that the indiscriminate development of capital- and energy-intensive technology is bound to run into trouble under these conditions. It can lead to higher unemployment, the social and economic destruction of rural areas, and mass migrations to the urban slums. As Congressman Clarence D. Long, a proponent of AT in U.S. aid programs, has noted:

> As I think back on the role of professional economists in foreign aid, as an economist, I simply have to blush. Economists were ignoring the principles of economics that they taught in their own classrooms, namely that the factors of production could be combined in proportions appropriate to their relative abundance and scarcity . . . .
>
> Anyone who looks at the sidewalks of Bombay or at the countryside outside the cities in any poor country can see that heavy capital development strategies have, if anything, created extreme concentrations of wealth in poor nations while at the same time disemploying, or failing to employ, thousands and millions. Our foreign aid, originally

thought of as a way of heading off communism, may well have been a boost to communism by increasing the already glaring disparities between the rich and the poor.[6]

Schumacher argued that AT would allow a "bottom up" form of development. It would establish more work places for a smaller capital investment, and by creating more jobs it would benefit more people. These ideas were not universally popular. For years, many economists had held that developing countries would move up through the "stages of economic growth" by adopting the capital-intensive technology of the West. When the nation would reach a "take off' point, it would evolve toward modern mass production and consumption patterns, and the benefits would "trickle down" to the vast poorer population.[7] This economic program, however, seldom came to pass, and the benefits of development have been further delayed or diverted by recent rises in energy costs and by the mounting costs of caring for rapidly growing populations.

Appropriate technology has also been criticized as a "second rate" technology, not as "good" as the technology used by the developed countries. This attitude is based in part on the notion that AT is antitechnology and antiprogress. AT advocates counter that an intermediate technology is a "first step" technology, one that improves upon traditional methods and lays the foundation for an equitable form of development by promoting the skills and expertise that will be required by the advanced technologies that can, if desired, be developed later.

More recently, AT proponents have introduced ideas and techniques which might properly be called "advanced appropriate technologies. " They are relatively sophisticated but easy to use, and they fit into the traditional village way of life. Examples include several renewable energy technologies, small-scale industries, and the use of solid-state communication technologies for education and village health care. Advocates of these new technologies think they would help some nations leapfrog the Industrial Revolution and avoid the problems that currently face the industrialized West.

Problems of Domestic Equity

The thrust of industrial and technological growth over the past century has been to substitute energy and capital for labor, thereby increasing worker productivity. Most nations, however, are now beginning to encounter scarcities of both capital and cheap energy, making this approach less satisfactory. AT advocates point to a number of inequities that seem to be created or exacerbated by highly centralized advanced technology:

- the increasing concentration of wealth in a few national and multinational corporations;
- unemployment, underemployment, and worker unrest from stultifying or nerve-wracking jobs;
- lack of satisfying social roles for the elderly, the young, women, and minorities;
- disproportionate hardships for low- and fixed-income people coping with rising energy costs and other effects of inflation; and
- undermining of self-respect produced by the "welfare orientation" toward the unemployed and the poor.

AT advocates fear that failure to deal decisively with the problems of growth will make these problems worse, and they offer three basic approaches to solving the problems of domestic equity:

1. Replace highly capital- and energy-intensive technologies with small-scale, decentralized technologies that will create new jobs in more numerous locations.
2. Combine the factors of production in a proportion that responds to changing patterns of abundance and scarcity: when both unemployment and energy prices are rising, it might make better sense to substitute labor for energy–not wheelbarrows instead of trucks, but better maintenance (and improved efficiency) of existing trucks.
3. Emphasize a "community development" approach to the problems of poverty by using appropriate technologies as a basis for public projects and local enterprises that will develop local skills, provide jobs for the young and

[6]Hon. Clarence D. Long, *Congressional Record*, Feb. 8,1977.

[7]See W. W. Rostow, *The Stages of Economic Growth: A Non-Communist Manifesto*, 2d ed. (Cambridge, England: Cambridge University Press, 1971).

productive activities for the elderly, and create opportunities for small local businesses.

Problems of Participation and Regulation

Most AT advocates believe that increases in Government regulation have occurred in response to the increasing size and impact of advanced technology. They point out that this "Government explosion" has occurred in every industrialized nation, regardless of ideology:

> We seem unwilling to come to terms with the fact that each increase in the order of technological mastery and managerial control leads to a concomitant order of magnitude of government coordination and control. . . . [Advanced] industrialized societies . . . generate a bewildering increase in unanticipated social costs: in human maladjustment, community disruption, and environmental depletion. . . . The cost of cleaning up the mess and caring for the human casualties of unplanned technology . . . mounts ever higher.[8]

By contrast, the social philosophy of the AT movement tends to favor a shrinking of Government. The investors and small businessmen who are attracted to AT complain that Government regulation inhibits technological innovation and diversity; social activists complain that growing technical, organizational, and regulatory complexity leaves the ordinary citizen powerless to understand or influence the choices that will affect him. AT proponents therefore offer three approaches to the problems of regulation and participation:

1. Develop new ways to foster active citizen participation in evaluating the technological choices that affect their communities.
2. Develop technologies that allow individuals and communities to reduce their dependence on large, remote institutions, no community can be totally self-reliant, but a reduction of scale could result in a reduction in the level of Federal involvement and regulation.
3. Develop inherently low-impact technologies, which will not only ease the problems of growth but will also require less regulatory control; a truly advanced technology should have few unintended side effects.

Implications for Politics

AT appears to offer no specific prescriptions for action, no hard and fast rules of the road. It does, however, offer a distinctive way of analyzing the needs and resources of a community, as well as a broader context in which to judge the suitability of the various technologies' solutions to the community's problems. It has also drawn greater attention to the issue of how the character of a technology can influence the character of a society. AT advocates warn that, by continuing single-mindedly along the path of centralized technology, society will be led into worse problems that will only become more difficult and more expensive to remedy in the future. They argue that we must instead choose a different path, a technology more appropriate to human values and goals, one that treads more softly on nature and leaves more options (and fewer problems) for future generations.

[8]Hazel Henderson, Creating *Alternative* Futures (New York: Berkeley, 1978), p. 84.

Congressional Interest in Appropriate Technology

Background

Congress has frequently taken the lead in encouraging the development of AT, but although a number of bills relating to small-scale solar technologies and energy conservation were introduced as early as the 1950's, the specific phrase "appropriate technology" is not found in any action of any Congress before the 93d (1973-74). Three of the four major existing Federal programs in appropriate technology were initiated by the 94th Congress (1975-76):

- the National Center for Appropriate Technology (NCAT);
- the appropriate technology program of the National Science Foundation (NSF); and
- A.T. International, Inc. (ATI).

The fourth major program was initiated by the 95th Congress (1977-78):

- the Appropriate Technology Small Grants Program of the Office of Small-Scale Technology (OSST) within the Department of Energy (DOE).

The 95th Congress also passed a number of measures related to AT, including the Energy Extension Service, the Agricultural Solar Energy Research, Development, and Demonstration Act of 1977, and the Food and Agriculture Act of 1977. Federal funding for these AT programs is growing but still small. In 1978, when total Federal R&D funding amounted to approximately $26.3 billion, of which about $2.8 billion was spent on energy R&D, only 1 percent ($30 million) was spent on Federal AT programs. (For a more detailed breakdown of Federal legislation and funding for AT programs see table 1.)

93d Congress

The 93d Congress passed two major pieces of solar legislation that prepared the way for the more extensive work on AT that was to follow. The Solar Heating and Cooling Demonstration Act of 1974 (Public Law 93-409) established a joint program in the National Aeronautics and Space Administration (NASA) and the Department of Housing and Urban Development (HUD) to develop solar heating and cooling devices and to encourage their commercialization. The aim of the program, as implemented, was to promote the development of large-scale, advanced solar systems; it gave little attention to small-scale, dispersed ap-

Table 1 .—Federal Legislation and Appropriations Related to Appropriate Technology

Public Law (bill)	Title	Date enacted	Committees	AT sections	Total authorized or appropriated (millions)	AT authorized or appropriated (millions)
Public Law 94-1611 (H.R. 9005)	International Development and Food Assistance Act of 1975	Dec. 20, 1975	Senate Foreign Relations House International Relations	306	$1,363	$20 (total for fiscal years 1976, 1977, and 1978
Public Law 94-187 (H.R. 3474)	Authorized & appropriated—ERDA (FY 76)	Dec. 31, 1975	Senate Interior & Insular Affairs House Science & Technology	101(a)(2)	$3,658.7	$97.1 (for solar energy development; not all AT
Public Law 94-439 (H.R. 14232)	Depts. of Labor, HEW Appropriations Act, 1977	Sept. 30,1976	Senate Appropriations House Appropriations	None; in report language	$511.2 (for CSA)	$0.4 (for NCAT)
Public Law 95-39 (s. 36)	Authorized & appropriated ERDA	for June 3, 1977	Senate Interior& Insular Affairs House Science & Technology	101(7)(h) Title V	$1,640	$7.5 (for DOE AT small grants program) $18 (for Energy Extension Service)
Public Law 95-88 (H.R. 6714)	International Development & Food Assistance Act of 1977	Aug. 3, 1977	Senate Foreign Relations House International Relations	Title I 114	$2,502 (title 1)	$18 (for FY 78)
Public Law 95-113 (S. 275)	Food & Agricultural Act of 1977	Sept. 29, 1977	Senate Agriculture House Agriculture	1420 1452	Indeterminate	$60 $20
Public Law 95-205 (H.J.Res. 662)	Continuing Appropriations, 1978	Dec. 9, 1977	Senate Appropriations House Appropriations	—	Indeterminate	$1.5 (for NCAT)
Public Law 95238 (S. 1340)	Department of Energy Act of 1978—Civil Applications	Feb. 25, 1978	Senate Energy & Natural Resources House Science & Technology	Title 1, 101(16) 101(17)	$6,081	$8 (for Energy Extension Service) $8 (for AT small grants)
Public Law 95-424 (H.R. 1920)	Foreign Assistance& Related Programs Appropriations Act, 1979 (title 1)	Oct. 6, 1978	Senate Foreign Relations House International Relations	107, 111	$2,478	Indeterminate
Public Law 95-482 (H.J.Res. 1139)	Appropriations for FY 1979—Continuance	Oct. 18,1978	Senate Appropriations House Appropriations	—	Indeterminate	$1.8 (for NCAT)
Public Law 95-434 (H.R. 11400)	National Science Foundation Authorization Act	Oct. 10,1978	Senate Human Resources House Science & Technology	2 (8)	$930	$0.2
Public Law 96-44 (H.R. 2729)	National Science Foundation Authorization Act for FY 1980	Aug. 2,1979	Senate Labor & Human Resources Senate Science & Technology	2(b)(l), 2(c)(3)	$998	$2.75

SOURCE: Joe Belden of Roger Blobaum & Associates.

placations of solar technology. The Solar Energy Research, Development, and Demonstration Act of 1974 (Public Law *93-473)* had a similar emphasis. The Energy Research and Development Administration (ERDA), created by another Act of the 93d Congress, eventually became the lead agency for the solar program, with HUD remaining responsible for residential applications.

94th Congress

Three of the four major Federal programs in appropriate technology were products of the 94th Congress.

National Center for Appropriate Technology.–Congress urged in report language that the Community Services Administration (CSA) fund NCAT. In September of 1976 CSA approved an initial $400,000 grant to fund the Center, which is headquartered in Butte, Mont., with a staff that now numbers about 60. NCAT was organized to make the benefits of AT developments available to low-income individuals and communities throughout the United States. Its program includes three basic areas:

- a small grants program for low-income groups to fund field demonstrations in energy, housing, agriculture, and recycling;
- technical research and evaluation; and
- national and regional outreach through publications, conferences, field workers, and an information service.

Many NCAT projects are closely associated with CSA's network of community action agencies, but the Center also publishes bibliographies and technical research papers and sponsors regional conferences and technical workshops. It has come under some criticism for poor communications—due, in part, to its location in Butte, Mont.–and some AT proponents believe that NCAT is too narrowly focused to serve as a truly national AT institution, Despite their reservations, however, AT advocates tend to be highly supportive of NCAT's work.

National Science Foundation.–The House Science and Technology Committee, in a report accompanying the NSF budget authorization bill for fiscal year 1977, urged NSF to support work in appropriate technology. NSF's Research Applied to National Needs program commissioned an inquiry into the nature and extent of AT activities in the United States and published three reports in 1977: *Appropriate Technology in the United States–An Exploratory Study, Appropriate Technology-A Directory of Activities and Projects,* and *Appropriate Technology and Agriculture in the United States.* In January 1978, NSF held a national workshop to bring together scientists and innovators in AT, and the recommendations of this conference were also published.

Again at Congress' urging, NSF conducted seven regional public forums in September and October of 1978. The resulting recommendations were incorporated in a program proposal that included the following project areas:

- AT and urban innovation;
- small-scale industrial technology;
- recycling, resource recovery, and conservation;
- AT, rural revitalization, and the small family farm;
- food and nutrition; and
- AT's role and impact on society, the economy, and technological development.

Although NSF sought no funding to implement the plan in its fiscal year 1980 budget request, Congress authorized $2.5 million for the program—$1.8 million for applied research and $700,000 for education and information.

A. T. International, Inc.—ATI was established as a private, nonprofit corporation by the International Development and Food Assistance Act of 1975, which authorized $20 million over a 3-year period for:

> . . . activities in the field of intermediate technology, through grants in support of an expanded and coordinated private effort to promote the development and dissemination of technologies appropriate for developing countries.

Headquartered in Washington, D. C., ATI's staff includes specialists on Latin America, Asia, Africa, and the South Pacific; its basic objectives emphasize field projects in developing countries rather than conferences or other activities in the United States. ATI has deliberately experimented with new approaches to development assistance,

including support for AT extension, resource centers, and the encouragement of private-sector involvement in AT. Some AT proponents have expressed disappointment that ATI's initial Board of Directors contained few actual practitioners of AT, and an AID review noted a variety of program weaknesses, the most important of which probably is that ATI's approach has been poorly focused. Despite these criticisms, however, ATI remains the principal manifestation of official U.S. support for private-sector AT efforts in the world arena; its creation reflects a significant change in the nature of U.S. development aid.

95th Congress

Interest in AT continued to increase during the 95th Congress, which held the first congressional hearing to deal exclusively with AT. The 95th Congress also created DOE, which continued to work on solar energy and began a very small AT program under OSST.

Office of Small-Scale Technology.–The Appropriate Technology Small Grants Program was initiated in the first year of the new DOE at the urging of several members of Congress. Administered by OSST within DOE, the program began in 1977 as a pilot effort in the Federal Pacific Southwest Region; the success of that demonstration led to an expansion of the program to the national level, although the program's regional basis has been retained.

The Small Grants Program offers awards of up to $50,000 for development and demonstration of ATs and up to $10,000 for concept development. As of June 22, 1979, 12,876 proposals had been received nationwide, asking for a total of $343 million; the OSST staff estimates that about 20 percent of proposals are good to excellent. Projects completed under the program have included efforts in solar thermal, heat recovery, conservation, biomass, wind, geothermal, hydro, aquiculture, integrated systems, and education.

The successes or failures of the DOE Small Grants Program have yet to be measured. Judging by the large number of applicants, the AT Small Grants Program is one of DOE's most popular programs, but enthusiasm at policymaking levels of the executive branch is less apparent.

The Energy Extension Service (EES) was established by the fiscal year 1978 ERDA authorization act to encourage smaller consumers of energy to reduce their energy use and adopt renewable resources. EES began as a 2-year pilot program in 10 States, with projects aimed at homeowners and small businesses. It is now being expanded to include all of the States, on the model of the Agricultural Extension Service of the U.S. Department of Agriculture (USDA).

The Agricultural Solar Energy Research, Development and Demonstration Act of 1977, enacted as a subtitle of the Food and Agriculture Act of 1977 (Public Law 95-1 13), broadened USDA's involvement in AT as well. The Act recognized the present agricultural system's dependence on energy-intensive machinery, fertilizers, pesticides, and herbicides, and called for the development of an "alternative farming technology" that uses solar and renewable energy sources to reduce the farmer's vulnerability to fossil-fuel shortages and price increases.

The Innovative and Alternative Technology Program, established by the Environmental Protection Agency (EPA) in October 1978, provides risk guarantees and an increased Federal share in the funding of wastewater treatment projects. Qualifying projects involve either proven technologies that are not yet in extensive use or developed but unproven technologies that show potential for improved reliability and efficiency or for reduced energy use and lifecycle costs. This program had funded 212 such projects by the midpoint of its initial 3-year authorization and has also established an extensive information and training network.

96th Congress

The major AT-related legislation enacted by the 96th Congress was the Energy Security Act (Public Law 96-294), which created the Solar Energy and Energy Conservation Bank. The Bank is authorized to- provide grants and subsidized loans for the installation of solar and conservation technologies, with particular attention to conservation in existing buildings and solar features in new structures. The funding level of this program is tied to the level of revenues from the windfall oil profits tax. Also passed was the Technology Innovation

Act (Public Law 96-480), which authorizes Federal R&D centers to participate in AT-related activities.

Other AT bills introduced in the 96th Congress include the Energy Productivity Act (an amendment to S. 388), which would authorize $58 billion over 10 years for conservation and alternative energy programs, and the Omnibus Solar Energy Commercialization Act of 1979 (S. 950), which would set a national goal (to be achieved by the year 2000) of at least 20 quadrillion Btu of energy production annually from renewable sources. The latter bill also calls for the establishment of a Solar Energy Development Corp., a lending institution similar to the Solar Bank.

The Scope and Methods of This Report

In June 1978, several Members of Congress asked OTA to conduct an exploratory study of AT, with particular instructions that the study:

- assess "the conceptual base for appropriate technologies;"
- assess "technologies which are appropriate for local community development;" and
- "collect data on promising new technologies now being innovated in energy, waste disposal, housing, agriculture, and health that may provide an alternative and possibly more effective approach to community and regional development. "

In response to this request, OTA surveyed a wide, representative range of technology projects undertaken by public and private groups in urban, suburban, small-town, and rural communities. Several factors posed methodological problems:

- lack of agreement on what constitutes an "appropriate" technology;
- variation in the definition of "community" and "community development;"
- the wide range of technologies to be studied;
- the focus on AT as a community initiative; and
- the fact that many ATs are still in the early stages of development and use by the community.

The case study approach, chosen in part to overcome these difficulties, meshed well with the nature of the technologies referred to as "appropriate" because it focused on the experience of specific communities in trying to develop technologies tailored to particular local needs, resources, and constraints. Projects for the case studies were chosen by an ad hoc OTA Task Force on Appropriate Technology (a panel of individuals representing various AT interests) from a list of candidates identified through literature searches, questionnaires, and interviews. Care was taken that the case studies would reflect:

- the basic needs of human settlements (housing, food, and health care, as well as energy, resource recovery, and waste management);
- different types of "community" and different regions of the Nation (a farming county in Nebraska, a village in New England, a small town in California, an industrial city in the Midwest, and so on);
- the various software and hardware aspects of AT; and
- the different ways of financing community projects (some were financed by Federal grants, others by community groups, and a few by individual families).

Five of the case studies were conducted by community teams made up of 10 to 12 local residents, eight were conducted by teams from the Harvard University Workshop on Appropriate Technology; and the remaining case studies were conducted by OTA contractors and staff. This made it difficult to generalize from the data, since each case study had to be treated as a separate entity and there was a wide variation in the study teams gathering the data. An initial set of guidelines was developed to demarcate the major areas of inquiry, and for purposes of comparison the case studies are presented in the following format:

. Community setting (a profile of the community> its needs, and its resources);

- *development* (the original initiative, the various groups and institutions involved, and the process by which the project was selected, planned, and organized);
- *technology* (a brief discussion of the technology itself and the ways in which it was applied to local uses); and
- *performance* (the problems and/or benefits of the completed facility, but not a full evaluation of its social and economic impacts).

In each chapter, the case study is preceded by an introduction that establishes the context for the technology and, in some cases, by a discussion of the conventional technology it might replace or supplement.

Several "critical factors" encouraged or impeded the process of community adoption. Because they also affect the transferability of the technology to other communities, these factors are discussed in each chapter as a way of framing issues for further analysis:

1. *Public perception and participation.—*
   - the degree of citizen initiative and access to decisionmaking bodies;
   - the extent to which those who will use the technology are actively involved in its development, construction, and management;
   - the degree to which the general public accepts and supports the project; and
   - the extent to which education and outreach activities are able to influence public perceptions.
2. *Essential resources.—*
   - the ability to utilize available resources and raw materials, particularly salvage or "waste" materials;
   - the ability to acquire the needed information, tools, hardware, and facilities; and
   - the ability to acquire or train labor for construction, operation, and maintenance.
3. *Technical information and expertise.—*
   - the availability of reliable, detailed information on the design, costs, and performance of the technologies;
   - the accessibility of this information to potential users; and
   - the ability to locate or develop the needed managerial know-how and skills in the user community.
4 *Financing.–*
   - the ability of individuals, community groups, and municipalities to finance their own projects, either out-of-pocket, through donations, or through general revenues and local bond issues;
   - the availability, size, and effectiveness of tax credits, cost-sharing, grants, low-cost loans or loan guarantees, tax-free bonding, and other incentives;
   - the stability and flexibility of grants and subsidies from both public and private sources;
   - the availability and costs of conventional market financing;
   - the degree to which potential lenders perceive an AT project as a high risk, due to unfamiliarity with the technology or lack of confidence in the credit worthiness and management ability of the borrower; and
   - the degree to which the decisions of potential investors and/or lenders are distorted by considering only initial capital costs, rather than lifecycle costs, in comparing conventional and innovative options.
5. *Institutional factors.—*
   - the degree of opposition from vested commercial, professional, and political interests who feel threatened by AT and community initiatives;
   - the degree to which regulations, such as health and building codes, are either out of date, arbitrarily applied, or prescriptive rather than performance oriented; and
   - the extent to which regulatory requirements and permitting procedures require as much time and money for small-scale projects as for much larger projects.

Because these technologies promise substantial benefits in areas of major national concern, each chapter concludes with a discussion of relevant Federal legislation, existing Federal programs of technical and financial assistance, and the issues and options for possible further Federal action.