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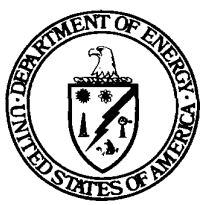
An Analysis of Markets for Small-Scale, Advanced Coal-Combustion Technology in Spain, Italy, and Turkey



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1 INTRODUCTION

This report describes the results of an in-depth analysis of markets for U.S.-developed, advanced coal-combustion technology (ACT) in the residential, commercial, and industrial sectors of three countries -- Spain, Italy, and Turkey. These countries were chosen in a previous study, in which member countries of the Organization for Economic Cooperation and Development (OECD) were rated on eight factors influencing their propensity to use small-scale, U.S.-developed ACT.[1]

As a result of the U.S. government's commitment to research and development (R&D) in clean coal technology, various types of ACT -- including fluidized-bed combustors, coal gasifiers, and coal-water slurry technologies -- are being demonstrated and developed in the United States.[2] These technologies have distinct advantages over conventional coal combustors, being considerably more efficient and hence more economical as well as environmentally sound. Therefore, ACT is expected to compete successfully with oil- or gas-based combustion technology and to offer a method by which coal can be used instead of other scarce and costly energy resources.

Significant penetration of ACT could help ameliorate problems such as an overdependence on imported oil or the air pollution that is now being caused by the use of poor-quality coal and lignite in certain foreign nations. Moreover, exporting U.S. ACT overseas can serve U.S. interests -- by expanding potential markets for U.S. coals, opening markets for other U.S. technological goods, and generally improving the U.S. trade imbalance.

In the United States, the heaviest users of coal have traditionally been power plants, the steel industry, and large industrial boilers and process heaters. This analysis, however, is based on the premise that the small-scale application of ACT -- in apartments, hospitals, hotels, schools, universities, and light industrial establishments -- is both feasible and desirable. In at least one of the countries included in this analysis -- Turkey -- a significant portion (20% in 1986) of the total coal and lignite consumption already takes place in the residential sector.[3] Additionally, all three countries -- Spain, Italy, and Turkey -- have a relatively high or growing demand for energy in the residential, commercial, and industrial sectors and hence are good candidates for a small-scale-ACT market study. Other factors examined in the previous screening study also signaled that these countries were good candidates for further analysis.[1]

Any foreign enterprise's choice to purchase ACT -- in particular, U.S.-developed ACT -- will be influenced by a number of complex factors. First, the choice of a coal-based technology, as opposed to one that uses oil or gas, will be affected by coal availability, the price and availability of competing fuels, environmental regulations and conditions, government policy toward coal use, local building requirements and fuel-use restrictions, and other factors.

The manner in which U.S. firms market technology abroad is another important factor. Implementing a marketing strategy -- such as exporting U.S. technology to a foreign country, licensing U.S. technology for foreign production, establishing agents or distributorships, or setting up foreign production facilities for manufacturing U.S. ACT overseas -- can be a complicated endeavor. A multitude of foreign and some U.S. laws, regulations, and policies influence the relative ease with which a U.S. manufacturer of ACT could pursue any one of these marketing options. The perceived current and future size of the foreign market for ACT would be a key factor affecting whether U.S. ACT developers would seriously consider becoming involved in the potentially complex negotiations and legalities associated with market entrance. The size of the market would be appraised based on both the current and projected demand for combustors (uses for which include space heating and space cooling, steam power, and electricity generation) within one target country as well as the extent to which penetration of the market in that country could be expanded to neighboring or affiliated countries. The presence of competition within the country from domestic or foreign manufacturers would also influence the decision. Additionally, overseas marketing initiatives would be shaped by the internal policies of the U.S. ACT firm.

Spain, Italy, and Turkey maintain cooperative trade and political relationships with the United States, and in general, there are few barriers to energy-technology trade between the United States and the nations included in this study. However, the trade situation, specifically in Europe, is in transition because of the monumental restructuring of the trading environment that is occurring within the European Community (EC). This restructuring must be fully taken into account when marketing strategies are being assessed for the different countries.

In light of these complexities, a multi-faceted approach was taken in this analysis to analyze the potential markets for small-scale, U.S.-developed ACT in Spain, Italy, and Turkey. The following investigations were undertaken:

- General information on climate, geography, political structure, population and employment distribution/trends, industrial composition, and potential future economic growth was gathered for each country to obtain a broad picture of possible market segments that might be most successfully targeted.

- The characteristics of particular urban and high-density regional areas were researched, since these would most probably be the places where large buildings such as hospitals, apartment and office buildings, hotels, etc. would be located. Inventories of buildings were gathered for urban areas, and for each nation as a whole, and distributions of buildings by size and location were developed.

- The energy situation in each country was analyzed. Government energy policy, energy R&D activity, current and projected energy use patterns, indigenous energy supply, energy prices, and energy import patterns were researched.

- Constraints to coal use (such as coal transportation constraints) and potential factors affecting combustor design requirements in each country were examined.

- Details of the internal trade policies and regulations of each country were studied to determine if incentives or barriers to trade and investment exist between each of the three countries and the United States.

- Changes taking place within the EC were analyzed with respect to their possible effects on trade with the United States, and on U.S. ACT trade in particular.

- To the extent possible (without carrying out a complete, in-country survey), competition to U.S. technology was assessed by determining how widely manufacturers are already either marketing small boilers (or other combined technology) or actually operating in each country.

For the most part, these investigations were carried out through library research here in the United States. However, in-country interviews with a select number of government officials and boiler manufacturers in each country, as well as discussions with U.S. boiler manufacturers, were undertaken in an attempt to gain insight into views about the European energy and trade situations and into the level of competition U.S. firms would face abroad. Then the data gathered in these investigations were analyzed to answer the following questions:

1. What impact will changes in the EC have on prospects for U.S. ACT trade with Spain, Italy, and Turkey?

2. What are the economic, demographic, and energy-related factors affecting the potential for use of ACT in Spain, Italy and Turkey?

3. What possible niches for small-scale ACT exist in each country?

4. What marketing strategies (direct export, branches, wholly-owned subsidiaries, agent/distributorships, joint ventures, or technology licensing) would be best for each country?

The potential effects of changes in the EC (question 1) are analyzed in Sec. 2. Section 3 discusses the second question on factors that would tend to promote the use of ACT. Particular applications of the ACT and regional niches that appear promising in each country (the third question) are addressed in Sec. 4. Section 5 reviews possible marketing channels indicated in question 4. Finally, overall considerations and recommendations for further analysis are outlined in Sec. 6.

2 CHANGES IN THE EUROPEAN COMMUNITY: IMPLICATIONS FOR SPAIN, ITALY, AND TURKEY

The sections below provide an overview of the changes expected within the EC, with special emphasis on issues related to energy and environmental policy. The effects of changes within the EC on the three individual countries and the implications of those changes with regard to U.S. trade prospects are examined.

2.1 THE 1992 RESTRUCTURING OF THE EUROPEAN COMMUNITY

Italy and, more recently, Spain are members of the EC. (Other member "states" include Belgium, Denmark, the Federal Republic of Germany, Greece, France, Ireland, Luxembourg, the Netherlands, Portugal, and the United Kingdom.) Turkey applied for membership in 1962 and was granted status as an associate member; it has not been granted full membership rights. The EC is actually three communities. The first, established by the Paris Treaty in 1952, is the European Coal and Steel Community (ECSC). The other two -- the European Economic Community (EEC) and the European Atomic Energy Community (Euratom) -- were established by the Treaty of Rome and the Euratom Treaty, respectively, in 1957. Since 1967, a single commission and a single council have been responsible for all three communities. Additionally, the European Parliament and the Court of Justice have been common to the three communities since 1958.[4]

Since its inception, the EC has initiated agreements on mutual economic cooperation, the removal of internal customs duties on industrial goods, a common agricultural policy, and a common external tariff. The EC can make decisions, pass regulations, and establish directives that are binding on the member states. In fact, the individual members of the EC have to some extent ceded to it a part of their national sovereignty, with the goal of forming a cohesive, indissoluble organization and political unit.[5]

The fragmentation and nationalism that existed in the earlier years within the are rapidly disappearing. In 1985, a "White Paper" outlined over 300 directives for the establishment of a single community.[6] Since then, the world has been witnessing the transformation of the EC. Targeted to be restructured economically by 1992, the intent is the economic unification of Europe: a "Europe without borders."

Restructuring of the EC is certain to affect each member country differently. For example, although Spain has made great economic strides recently in manufacturing output and gross domestic product (GDP), it remains much less economically advanced than some of the other EC countries. The 1992 open-market deadline is creating a surge of defensive alliances in Spanish industry, with companies outside the EC as well as inside. To some extent, Spain must restructure its economy to accommodate EC-mandated changes, such as tougher environmental regulations, elimination of tariffs within the EC, and standardization of technical requirements for equipment.

Italy is poised to benefit significantly from the planned intervention of the EC member states. Ranking third economically in the EC, it has a very diverse industrial structure, ranging from automobile production to textile manufacturing. Investment in Italy is high and serves as a base for increased economic growth.

"Europe 1992" has ramifications for non-EC countries too, perhaps especially so for Turkey, an associate member of the EC that is still considered to be a developing country. Unlike the United States, which possesses the economies of scale and capital resources to compete with and within the EC, less-developed non-EC countries such as Turkey may find themselves at a significant disadvantage. Since Turkey seeks membership in the EC, it will experience pressure to conform to EC practices. Standards within the community, such as those related to the environment and energy efficiency, will tend to encourage the Turkish government to divert capital into improving technology in those areas.

Ramifications of the restructuring on U.S.-EC bilateral trade are speculative. The economies of the EC and the United States are inextricably linked; the United States and the EC are each other's largest trading partners.[7] Most U.S. firms that have established a presence in the EC market feel confident that they will be able to keep up with the sweeping reforms and posture themselves successfully as the reforms are implemented. Other companies that do not yet have a presence in Europe or continue to be unaware of the massive overhaul of the system are bound to be caught in a game of "catch-up" when trying to find niches in this changing trading environment.[8] While the ultimate goal of eliminating individual country constraints (e.g., different standards for labeling or cross-border checks) is designed to free EC members from trade restrictions, the spillover of new EC-wide regulations and standards will naturally affect external trade with the EC.

The EC delegation believes that creating a strong economic union will add to its internal strength in terms of productive capacity and economies of scale.[8] This additional strength may create a strong competitive force to U.S. manufacturers. However, a strongly united set of nations that is bound by one set of rules and policies may also represent a promising market for U.S. exports and an attractive opportunity for U.S. investment.

2.2 ENERGY MARKETS

The changes taking place in the EC revolve around the principle that every good produced and commercialized in one of the EC member states should be allowed to circulate freely within the community. This principal applies, in theory, to both energy products and energy technology. However, "integration of the energy market" will be one of the most serious challenges faced by the EC.

Individual nations differ widely in their views about how best to meet energy requirements. National energy policies in Europe today are influenced primarily by the type of domestic energy resources available, the energy infrastructure in place, and the level of environmental concern present in the country. Spain and Italy, being members of the EC, are influenced to some extent by the energy policy objectives set out by the EC

council. Turkey, as a prospective member of the EC, will also attempt to meet some of the energy policy objectives, especially those related to energy efficiency.

The stated energy policy goals of the EC include these:

- Increase the efficiency of final energy demand;
- Decrease oil consumption (one stated goal is to reduce oil's share of total energy consumption to approximately 40%);
- Maintain the share of natural gas in the Community's energy balance;
- Increase the share of solid fuels in energy consumption;
- Improve the competitiveness of coal production capacities;
- Reduce the proportion of electricity generated from oil and gas to less than 15%; and
- Substantially increase the output from new and renewable energy sources.

Although these goals serve only as guidelines to the EC member states, they reflect the general attitude in Europe toward various energy sources.[9]

The EC has taken some initiatives to promote these policy objectives. Of particular interest to this study are those aimed at promoting coal use, especially coal use in small combustors. One such initiative was the adoption in 1983 of recommendations encouraging the use of solid fuel in industry, public buildings (administrative buildings, barracks, schools, etc.), and district heating systems. These recommendations call on the member states to take "all environmentally-compatible measures which they consider appropriate to encourage the conversion or reconversion to solid fuel of existing combustion installations fired by fuel oil and to encourage the building of new solid-fuel-fired installations and district heating systems".[10]

However, the goal of increasing the use of solid fuels has not been fully realized. Although the EC's dependence on oil has decreased since the energy crisis of 1973, the use of solid fuels has also decreased over the past few years (see Table 2.1).[9] This decrease is primarily due to the fact that prices for oil and gas fell dramatically after 1986. Capital and maintenance costs of conventional coal-fired systems are considerably higher than those of gas- or oil-fired ones. For coal to be chosen over these other fuels, the price differential of the fuel must be high enough to offset the higher capital costs. Attempts at increasing coal use, even when the price differential was much greater than it is today, have met with limited success.

The uncertainty about future changes in the price differential and a sort of "attitudinal" barrier to the use of coal, even when it is economically warranted, undoubtedly play a role in such fuel-choice decisions. Coal is sometimes viewed as being

TABLE 2.1 Shares of Primary Energy Consumption in the European Community in Selected Years (%)

Resource	1973	1980	1983	1987
Solid fuels	23.5	23.1	23.9	22.2
Oil	61.3	53.9	48.5	45.1
Natural gas	11.8	16.7	17.4	18.5
Nuclear	1.9	4.3	8.2	12.8
Other	1.5	2.0	2.0	1.4

Source: Ref. 9.

a more troublesome fuel to use, especially by small consumers. To overcome negative attitudes toward conventional coal-combustion technologies, researchers are paying considerable attention to ACT R&D. Such research is geared toward making coal use easier and more environmentally sound and efficient.

Natural gas clearly represents the primary competitor to ACT in Europe. Gas use has been steadily increasing in Europe as the distribution network has expanded. Within the EC, the major gas producer is the Netherlands, followed by the U.K., Germany, and Italy.[11] The natural gas industry in Belgium, France, Germany, Italy, Luxembourg, and Switzerland developed primarily as a result of exports from the large fields in the Netherlands. An integrated, international network, linked with major trunk lines, eventually developed among Belgium, Luxembourg, the Netherlands, France, West Germany, Austria, Switzerland, and Italy. Additionally, the EC now depends on imports from non-Community countries (primarily the Soviet Union, Norway, and Algeria) for 35% of its gas supplies,[12] which are also integrated into the European gas grid.

Figure 2.1 shows the present and expected future gas pipelines throughout the EC. The entry points for North African liquefied natural gas (LNG) are France, Spain, Italy, and now Belgium. The Algerian imports have led to a north-south pipeline through Italy. Supplies from the Netherlands and the North Sea have also resulted in a north-south set of pipelines, and the imports from the Soviet Union have led to pipelines in the east-west direction. The new infrastructure to be constructed in the North Sea to transport Norwegian gas from the Troll and Sleiper fields to Belgium will undoubtedly expand the use of gas in Europe. New pipelines carrying Soviet gas are also being built in countries outside the EC, such as Turkey.

The U.K., Ireland, and Spain have discovered indigenous supplies but are not yet connected to the European grid. The isolation of these three countries is likely to change. Supplies in the U.K. could dwindle in the future and be replaced by imports through a pipeline, perhaps from the newly discovered Norwegian fields. In Spain, plans have been advocated for a link with France, which could supply imported natural gas

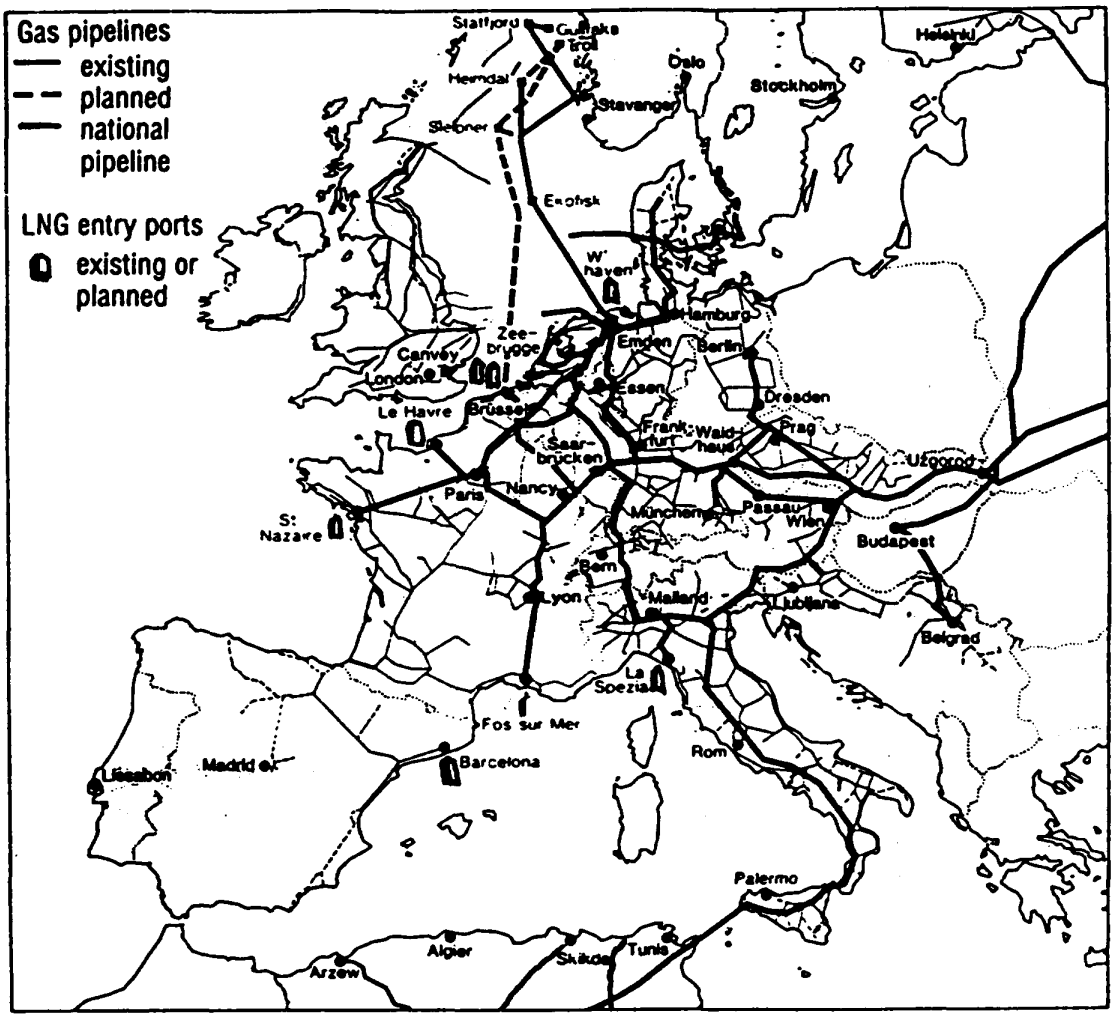

FIGURE 2.1 European Gas Pipeline Network (Source: Ref. 4)

from sources such as Norway and the Soviet Union. Ireland could link up with the grid in the U.K. Countries with no current internal gas supply network whatsoever, such as Portugal and Greece, are currently considering options to link to other networks.[4]

Based on the prospect of "Europe 1992" in the near future, increased attention has been focused on the further integration of the gas network. Efforts could include diversification of supply sources, increased underground storage, production and contractual flexibility, harmonization of gas specifications, and further cooperation among European gas companies. Integration would greatly promote the security of the supply and would lower prices. In Italy, for example, such integration has met with considerable success. The four import lines into Italy are connected to each other, the main indigenous gas fields, and the natural gas storage system, so that supply sources are totally interchangeable.[4]

The extent to which the gas grids in the individual countries expand will be somewhat demand-driven. Competition between gas-fueled residential/commercial

furnaces and appliances and those that use electricity, oil, or coal and coal-derived fuels will continue to exert pressure on gas. Furthermore, the local gas-supply infrastructure does not develop quickly. In countries that have not extensively used gas in the past, an infrastructure for gas access is not in place; for instance, only 23% of the households are connected to the natural gas network in Spain.[13] Although the prospect for growth in gas use in countries like Spain is good, competition from other energy forms including ACT could curtail the expansion of the grid, at least in some locales.

In addition to the integration of the natural gas market, some of the actions the EC is contemplating in anticipation of creating a common energy market are the following:[12]

- *Harmonization of technical rules and norms.* The EC will be adopting rules on specifications for fuels, technologies, and equipment. A directive already adopted concerns "simple pressure vessels"; other anticipated directives will deal with machines, electronic measurement instruments, gas appliances, etc.

- *Standardization of procedures for government procurement.* The energy sector will be included in a new set of EC provisions on the award of public contracts, so that "national chauvinism" in purchasing will be avoided and obstacles to reducing energy prices and costs will be removed.

- *Harmonization of the way energy is taxed.* This policy would primarily affect petroleum products, where taxing policies vary considerably among nations.

- *Examination of individual member-state aid to energy producers.* The EC will be examining situations in which direct aid (e.g., for investments) and indirect aid (e.g., for R&D on nuclear energy) are involved.

- *Provision of EC funds for large-scale infrastructure development projects.* In the future, large-scale infrastructure development (such as energy reception, storage, transmission, and distribution infrastructures), especially those related to natural gas and electricity, might be supported, based on the fact that they would promote a greater integration of the EC energy market.

Very few specific actions have been taken so far by the EC to integrate the energy market. However, the goal of a common energy market, in which product and technology standards would be universal and products (including energy equipment destined for energy users) could flow barrier-free among nations, has strong implications for this analysis. First, the EC might develop technical specifications for combustion equipment. Since U.S. manufacturers would not be involved in the formulation of these specifications, they might have to make costly changes in their equipment designs to sell it to the EC. Second, manufacturing of U.S.-developed ACT within the borders of the EC

via avenues such as joint ventures or wholly-owned subsidiaries would be likely to open up a large, barrier-free market for such technology. Third, energy prices would change in some of the countries that currently alter their fuel prices by taxation or that subsidize fuel production. Fourth, the integration of the gas market and the provision of EC funds for further development of the gas infrastructure could make the competition between coal and gas even more intense than it is already.

2.3 ENVIRONMENTAL PRESSURE IN EUROPE

Aside from being convenient to use, natural gas has certain environmental benefits, the principal one being that it emits less sulfur dioxide (SO_2, a precursor to acidic deposition and a respiratory irritant) to the air. Chiefly for this reason, gas is the fuel favored by many European nations. Many countries have committed themselves to a 30% reduction in emissions of acidic deposition precursors, including SO_2 and nitrogen oxides (NO_x). (Emissions of NO_x come from all fossil fuels, including natural gas.) In some countries like Italy and Greece, the concern about air pollution is related to the concern about preserving buildings, statues, and monuments of historical value.

Concern about the environment has been growing over the last decade in Europe. The Green Party, the environmental-interest political group spread throughout Europe, has offered candidates for election in several nations, and many have been elected. Local Green lobbies have prevented or delayed numerous energy projects, both nuclear- and coal-related. The Greens tend to favor the development of renewable energy forms (e.g., solar technology) and energy conservation.

Environmental protection has been the subject of a number of actions on the part of the EC council. Uniform legislation on environmental issues, applying to all member states, can be adopted by a majority vote of the council. Such legislation is binding on EC nations, each one of which must introduce it into its legislation within a specified time. The EC recently passed legislation controlling large combustion plants. It includes emission standards (limits) for SO_2, NO_x, and particulate matter. (The standards are listed in App. A of this report.) The council will also consider enacting control requirements for small- and medium-sized combustors soon.

In Italy, air quality is now controlled largely through regional strategies. Although there are no emissions constraints for small boilers *per se* in Italy, limits may be imposed on a case-by-case basis by local or regional authorities, who base such limits on ambient air quality. Heavily polluted areas are regulated more strictly than is the rest of Italy. Although in Italy, all industrial installations must reduce their air emissions to the lowest possible level in line with state-of-the-art technology (i.e., the lowest emission levels resulting from the most advanced technologies being used; in Italy this is considered to be "high stacks"), interpretations of what constitutes state-of-the-art technology, ambient air standards, and approval procedures vary considerably among regions.

In Spain, SO_2 emission limits for industrial boilers are very lenient (1.94-4.8 lb/10^6 Btu) to allow for the use of indigenous, high-sulfur coal. NO_x emission standards do not exist. However, Spain, like Italy, will be required to comply with the

new EC standards for emission limits. Environmental awareness is increasing in Spain. An example is the recent changes made to the price formula being used for the high-sulfur, domestic coal that is used to generate electricity, which will tend to encourage coal washing.

Outside the EC, especially in newly industrializing countries such as Turkey, environmental pressure is less intense but nevertheless present. Although Green lobbies have not taken hold, the Turkish government recognizes that a lack of concern for the environment will have negative effects in the long run and, in fact, has already created problems. Ankara is a city plagued with serious air pollution problems due to the extensive use of poor-quality lignite without pollution control. Although natural gas use is seen as a remedy, the infrastructure for distribution will take a long time to develop, and gas will not be available to cities and towns outside the gas pipeline corridor in the near future. Therefore, clean coal technology (CCT), especially that designed to use domestic lignite, could be a key tool for reducing environmental problems in Turkey.

Environmental pressure can be viewed as a promoter of CCT in the EC as well. Although conventional coal technology is not always viewed favorably, new technologies that can meet the new, more stringent emission regulations should be able to find markets, especially in countries that already have domestic coal production or that wish to continue to use coal as part of their national energy plans. Advanced coal technologies offer a way to meet energy goals in an environmentally acceptable manner.

3 COUNTRY STUDIES: SPAIN, ITALY, AND TURKEY

The state of economic development and the energy situation vary considerably in the three countries selected for study -- Spain, Italy, and Turkey. Turkey has a much less developed economy than most countries in Europe, but it is rich in energy resources including coal and, more abundantly, lignite. Italy is a technologically and economically advanced country that imports a very large percentage of its energy due to its insufficient level of domestic reserves. Italy has almost no domestic coal production. Spain is somewhere inbetween, both in its economic and technological development and its coal resources.

The state of a country's economic development and its energy situation are the key factors to consider in an analysis of its potential market for ACT. Even if enormous coal reserves exist, penetration of ACT will probably not be accomplished without the presence of a certain level of technological sophistication and economic infrastructure. In the case of small-scale ACT, this infrastructure must include a significant number of large residential and commercial buildings or small- to medium-sized industrial plants, as well as the means to make coal accessible to these buildings. Therefore, an examination of the three countries should consider the whole picture and not just one factor. Because of their differences, Spain, Italy, and Turkey represent an interesting set of countries for the kind of case-study analysis carried out in this study. The sections below address Spain, Italy, and Turkey with respect to demographic and economic factors, building infrastructures, and energy production, import, and use patterns.

3.1 DEMOGRAPHIC AND ECONOMIC FACTORS AND BUILDING INFRASTRUCTURES

Descriptions of various conditions in the three countries that might affect their likelihood to use ACT follow. Tables present economic, energy, building-inventory, and other statistics.

3.1.1 Geographic Considerations

All three countries are in southern Europe -- between 35° and 45° latitude. As such, the winter heating demand is not as high in these three countries as it is in the more northern European nations such as Germany or Denmark. Nevertheless, winters are cold enough for heat to be required and central heat to be desirable. Furthermore, summers are very warm in these three countries, indicating a potentially large market for new coal-based technologies for space cooling.

Table 3.1 shows the average temperature ranges in January and July in the most populated cities in Spain, Italy, and Turkey -- Madrid, Milan, and Istanbul.[2,13-16] They are very similar. However, in Italy and Turkey, the climate does vary significantly from region to region as the topography changes. For instance, in the interior of Turkey, the climate is characterized by great extremes, with snowy, cold winters and hot, dry

TABLE 3.1 Geographic, Demographic, and Economic Factors

Factor	Spain	Italy	Turkey
Geographic factors			
Temperature range in January (°F)[a]	36-48	32-41	37-46
Temperature range in July (°F)[a]	63-88	68-84	64-82
Avg. no. of days per year with rain	87	88	127
Land area (10^3 km^2)	520	300	780
Population			
Total, 1987 (10^6)	40	57	52
Average annual growth, 1973-86 (%)	0.80	0.34	2.17
Projected annual growth, 1986-2000 (%)	0.54	0	2.01
Density (persons/km^2)	75	190	66
Number of cities, by population			
>3 million people	1	3[b]	2
1-3 million	1	1	3
500,000-1 million	3	2	13
Gross domestic product (GDP)			
GDP, 1987 (1980 10^9 U.S. $)[b]	246	522	83
GDP per capita, 1987 (1980 10^3 U.S. $)	6.15	9.16	1.59
Average annual growth, 1973-86 (%)	2.07	2.33	4.75
Projected annual growth, 1986-2000 (%)	2.95	2.48	6.91
GDP distribution (%)			
Agriculture	15	11	58
Industry	32	32	17
Services	53	57	25

[a]Range of average daily low temperature to average daily high temperature in the largest city (Madrid in Spain, Milan in Italy, and Istanbul in Turkey).

[b]The official populations of Milan and Naples are 1.5 and 1.2 million people, respectively. However, the estimated populations for the whole urban area of these two cities are 6 and 3.6 million, respectively. Rome has a population of slightly more than 3 million.

Sources: Refs. 2, 13-16.

summers; whereas the coastal regions (including Istanbul) have milder winters and warm summers. In Italy, the northern region (in the Alps) can be extremely cold in winter (this region has begun experimenting with district heating),[10] but the narrow peninsula has hot, dry summers and mild, wetter winters. Therefore, in Italy and Turkey, regional heating and cooling needs can be expected to vary considerably, and temperatures in some parts of the countries are much more extreme than those indicated in Table 3.1. In Spain, temperatures vary less from region to region; regional differences exist mainly in the amount of precipitation.

In terms of land area, Turkey is the largest of the countries studied -- about twice the size of California. Spain is about twice the size of Italy (and about four times the size of England).

3.1.2 Population Statistics

The total populations of Spain, Italy, and Turkey are similar. A fairly large difference in the land areas of the countries accounts for the dissimilarity in population density; Italy has 190 persons/km^2, Spain and Turkey have densities close to 70 persons/km^2. All three countries have several very large cities, which would indicate the existence of large residential and commercial buildings there. In Turkey and Spain, therefore, the lower population density must result from the presence of large areas that are very sparsely populated. (In Turkey, low population density exists in the eastern part of the country, and in Spain, it exists in the northwestern and central parts, excluding Madrid.)

Statistics on urban and rural populations are defined differently for each country. Table 3.1 shows the number of large cities in the three countries, based on estimated "metropolitan area" statistics. According to these estimates, the largest cities in Turkey are Istanbul (4.5 million people), Ankara (3.2 million), Izmir (1.7 million), Konya (1.4 million) and Adana (1.2 million). Thirteen other metropolitan areas in Turkey have populations of more than 500,000 people.[14] In Italy, three cities have populations of more than 3 million, based on "urban-area" population (as opposed to population within city limits). These are Milan (about 6 million), Naples (3.6 million), and Rome (slightly more than 3 million). One other city, Turin, has a population of more than 1 million, and two cities, Genoa and Palermo, have populations between 500,000 and 1 million people. In Spain, only one city, Madrid, has more than 3 million inhabitants. Barcelona is the second largest city in Spain, with a population of 1.7 million. Three other cities (Sevilla, Valencia, and Zaragoza) have populations between 500,000 and 1 million.

In terms of population growth, Italy's population grew 0.65%/yr between 1951 and 1971, then 0.39%/yr between 1971 and 1981. However, growth has recently dropped dramatically and is expected to be almost 0% between 1986 and 2000. In Spain, population growth boomed in the 1960s, followed by a 0.8%/yr growth rate between 1973 and 1986. Growth in Spain's population is expected to continue, but at a less rapid rate (0.5%/yr), between 1986 and 2000. The population in Turkey has grown on the average of 2%/yr since 1973 and is expected to continue to grow at a similarly high rate through the year 2000.

3.1.3 Gross Domestic Product

GDP, the value of goods and services produced, measures a country's productivity. Table 3.1 shows that Italy has a high GDP in terms of both total and GDP per capita for all European countries. It is ranked third economically in the EC. Growth has been at the rate of 2%/yr since 1973, and is not expected to change dramatically to the year 2000. Spain's total GDP (at U.S. $246 billion) and GDP per capita (at U.S. $6,000) has reflected a growth rate of approximately 2%/yr for the past 10 years. Projected growth from the present to the year 2000 is expected to increase by 1%, to achieve an average annual of 3%. In Turkey, total and per capita GDP appear low, but the economy is showing signs of growth, with an annual average growth in GDP of 4% since 1973, and a projected growth of almost 7% from now to the year 2000.

The growth in Turkey's GDP has been very strong, and is projected to continue to increase as the country further develops its economy. Despite the projected 0% population growth, Italian GDP is expected to continue to grow at slightly more than 2%/yr, as it has in the past decade. In Spain, a healthy growth in GDP has and will be accompanied by a moderate growth in population.

The distribution of GDP, shown at the bottom of Table 3.1, reveals the present structural difference of the three economies of Spain, Italy, and Turkey. Turkey's economy is still largely agriculturally based, whereas commercial and industrial activity account for over 85% of the GDP in both Spain and Italy.

3.1.4 Building Infrastructure

Table 3.2 shows the number of industrial establishments in each country.[17] Spain has a large number of them, mainly because they are small. The majority of manufacturing establishments in Spain are in the food-products, wood-products, metal-products, machinery, and furniture industries. In terms of value added, however, the highest ranked industries in 1984 were (in order) food products, transport equipment, petroleum refining, machinery, and electrical machinery. In Italy, industrial establishments are most concentrated in the machinery, textiles, metal-products, wearing-apparel, and food-products industries. Industries with the highest value added in 1985 (in order) were machinery, industrial chemicals, transport equipment, electrical machinery, and textiles. In Turkey, the food-products, textiles, metal-products, nonmetal-products, and machinery industries are dominant. The petroleum-refining, textiles, food-products, tobacco, and iron-and-steel industries produced the most value added in 1985. Table 3.3 shows the numbers of other commercial and institutional buildings in Spain, Italy, and Turkey, such as schools, hospitals, hotels, and office and commercial buildings.[18-25]

As shown in Table 3.4, the number of new buildings being built in Turkey is quite high, which indicates that Turkey's economy is growing.[26] The residential and commercial sectors exhibited the strongest growth for 1983-1985. The industrial and residential sectors in Italy displayed high growth, whereas the commercial sector maintained a steady pace over the three-year period. The number of residential building

TABLE 3.2 Number of Industrial Establishments, 1984

ISIC[a]	Industry	Number of Establishments		
		Spain	Italy	Turkey
311/2	Food products	37,327	1,885	794
313	Beverages	5,462	474	70
314	Tobacco	33	40	51
321	Textiles	5,528	3,558	660
	Spinning, weaving, etc.	2,357	2,270	453
322	Wearing apparel	5,945	2,642	231
323	Leather and products	1,172	627	75
324	Footwear	2,054	1,799	34
331	Wood products	19,149	1,073	105
352	Furniture, fixtures	11,306	1,593	44
341	Paper and products	1,087	689	88
3411	Pulp, paper, etc.	171	194	23
342	Printing, publishing	5,600	1,022	97
351	Industrial chemicals	536	1,101	77
3511	Basic, excluding fertilizers	266	-	42
3513	Synthetic resins, etc.	110	-	17
352	Other chemical products	1,929	-	166
3522	Drugs and medicines	321	-	58
353	Petroleum refineries	10	118	4
354	Petroleum products	169	-	25
355	Rubber products	1,113	375	88
356	Plastic products[b]	2,436	1,236	130
361	Pottery, china, etc.	841	-	33
362	Glass and products	669	2,572	34
369	Nonmetal products[b]	6,942	-	328
371	Iron and steel	1,156	1,151	185
372	Nonferrous metals	475	329	75
381	Metal products	14,856	2,857	358
382	Machinery[b]	14,031	4,134	311
3825	Office, computing, etc.	34	77	9
383	Electricity machinery	2,437	1,544	218
3832	Radio, television, etc.	469	231	37
384	Transport equipment	1,304	771	210
3841	Shipbuilding repair	121	230	22
3843	Motor vehicles	925	541	175
385	Professional goods	459	324	31
390	Other industries	2124	331	56
Total manufacturing		150,924	35,788	5,414

[a]International Standard Industrial Classification code.

[b]Not elsewhere cited.

Source: Ref. 17.

TABLE 3.3 Number of Commercial and Institutional Buildings

Building Type	Spain	Italy	Turkey
Schools			
Universities	36	59	28
Upper secondary	2,635	7,564	1,283
Lower secondary	5,694	10,033	4,501
Hospitals[a]	1,111	1,837	798
With >100 beds	317	1,197	NA[b]
With >500 beds	59	295	NA
Total beds	201,000	542,000	127,000
Hotels with >100 rooms	799	365	98
Office and commercial buildings	476,000	1,496,000	NA

[a]General and surgical hospitals only.

[b]NA = not available.

Sources: Refs. 18-25.

permits issued in Turkey and Italy were similar in 1984. However, for industrial, health, and educational buildings, fewer building permits were issued in Turkey than in Italy.

3.2 ENERGY-RELATED FACTORS

The sections below discuss historical and projected energy production and consumption patterns in the three countries.

3.2.1 Indigenous Fuel Supplies and Imports

In terms of indigenous energy resources, Italy can be characterized as being rather poor, having virtually no oil or coal but some natural gas. Spain has some indigenous oil, gas, and coal but is still highly dependent on energy imports. Turkey possesses vast supplies of coal and lignite and some oil reserves; natural gas reserves have only recently been found. As are most other industrialized countries, Spain, Italy, and Turkey are heavily dependent on oil imports. Table 3.5 shows domestic production and import patterns in the three countries.[3,11,27]

Despite Italy's early development of its abundant hydro resources in the late 1800s, the country's increasing demands for energy and lack of sufficient fossil-fuel supplies has forced it to import more than 80% of its energy requirements, including almost all of its coal and oil and almost 60% of its gas. Although oil production is expected to rise, from 6.69 million metric tons of coal equivalent in 1986 (Table 3.5) to 11.4 million in 2000, oil production will only meet a small fraction of the total demand.* Coal production was about 0.57 Mtce in 1986 and, like oil production, it is expected to rise but not by enough to significantly lessen import requirements. The outlook for gas production is more optimistic: gas production was about 20.6 Mtce in 1986 and is expected to increase substantially by the year 2000.

TABLE 3.4 Number of Building Permits Issued in Italy and Turkey (10^3)[a]

Building Type	Italy	Turkey
Residential		
1983	51.0	49.2
1984	49.3	52.8
1985	39.4	NA[b]
Industrial		
1983	6.1	1.2
1984	6.5	2.3
1985	5.5	1.8
Commercial		
1983	1.6	4.3
1984	1.9	4.2
1985	1.7	4.9
Health and educational		
1983	19.7	4.3
1984	18.8	3.8

[a]No such information is available for Spain.

[b]NA = not available.

Source: Ref. 26.

Spain is also highly dependent on imported energy. Oil is Spain's major energy source, but almost 95% of its supply is imported. Following the exhaustion of two major oil fields, the production of indigenous crude fell by 14% in 1987; 90% of total production is now from a single field (Casablanca). Results of oil exploration have been disappointing, and policy emphasis has shifted from exploration to long-term supply agreements for the purchase of proven reserves abroad.[28] Most of Spain's natural gas needs are also met by imports (87% in 1985). Domestic gas production began in 1984 and reached 670 million m^3 in 1987; natural gas deposits on the continental shelf in the Gulf of Cadiz and the Aragonian Pyrenees are thought to be promising. Coal production more than doubled between 1973 and 1985 and amounted to 18.7 Mtce in 1986 (Table 3.5). Spanish coal reserves are estimated at 4.3 billion t (of which 1.14 billion t are considered very probable). Coal and anthracite are estimated at 2.3 million t, black lignite at 1.5 billion t, and gray lignite at 0.5 billion t. Coal use in Spain has been most successful at in situ power plants located alongside the mines themselves. Domestic coal is of relatively poor quality, with low a calorific value and high ash and sulfur content, and coal production is fairly costly. As a result, the share of imports in total coal requirements rose from 20% in 1983 to 32% in 1987.[3]

*In this report, t indicates metric tons, or tonnes. Mtce stands for million metric tons of coal equivalent.

TABLE 3.5 Fossil-Fuel Supply and Disposition (10^6 t of coal equivalent)

Country and Year	Coal, Including Lignite		Oil[a]		Natural Gas	
	Domestic Prod.	Net Imports[b]	Domestic Prod.	Net Imports[b,c]	Domestic Prod.	Net Imports
Spain						
1978	11.10	3.7	1.5	70.7	0	0
1986	18.66	8.4	4.5	56.8	0.5	3.2
Italy						
1978	0.43	12.9	2.28	151.2	17.5[d]	19.1[d]
1986	0.57	20.1	6.69	124.7	20.6	25.9
Turkey						
1978	10.0	0.5	4.03	21.8[e]	neg.[f]	neg.
1986	16.9	2.8	3.8	25.0	0.6	0

[a]Based on value of 5.8×10^6 Btu/barrel for all imports and exports.

[b]Imports minus exports.

[c]Includes crude and refined products.

[d]1979 value (1978 value not available).

[e]1977 value (1978 value not available).

[f]neg. = negligible.

Sources: Refs. 3, 11, 27.

Turkey has been heavily dependent on imported oil for many years, which has lead to the underutilization of its domestic energy sources. Between 1977 and 1986, domestic oil production dropped from 4.03 to 3.8 Mtce and net imports increased from 21.8 to 25.0 Mtce. The country's proven oil reserves are estimated at 14 Mtce, and total reserves could be 10 times greater. Oil and gas exploration are continuing, and the World Bank is supporting the Turkish Petroleum Association with a $62 million assistance program to develop a secondary recovery operation at the Bati Ramin oil field. Natural gas production began in 1978, but it accounted for less than 2% of total energy consumption in 1986. In 1984, Turkey signed an agreement with the Soviet Union for the purchase of 5 to 6 billion m^3 of gas over a 25-year period beginning in 1987. The gas will be used mostly in Ankara after 1989, where air quality deterioration has prompted the use of imported gas. Turkey has large potential hydroelectric resources, but by the end of 1989 only 25% of the potential is expected to be used. Coal production began in

Turkey in the mid-1800s. The largest deposit of bituminous coal is in the Zonguldak basin, where proven reserves amount to 1.4 billion t, 2.1 million t of which are economically recoverable. Because of the lack of skilled labor, poor transportation facilities, and the friability of the coal, the Zonguldak reserve has not been used at optimum capacity, resulting in the increase in coal imports over the last decade. Other coal fields have total estimated reserves of 20 million t. Lignite reserves amount to 8.2 billion t, of which 4.9 billion t are economically recoverable. Although lignite production is expected to reach 33 Mtce by 2000, the World Bank and other international lending institutions favor the use of high-quality imported coal at competitive prices over the use of poor-quality domestic lignite.

Table 3.6 presents coal production statistics for the three countries.[3] The greatest increase in coal production for 1986-2000 is expected in Turkey, where it should grow by 23 Mtce, a 136% increase. (The level of domestic coal production appears to be one of the most important factors affecting a country's propensity for increased coal use in the small-combustor market. A recent study carried out by the EC found that, with the exception of Belgium, only coal-producing member states have taken measures to promote the use of coal in industry and the residential and commercial sectors.) Turkey's higher level of indigenous coal production seems likely to predispose this country to a greater level of coal use in the future. Similarly, those countries with relatively high levels of indigenous oil and gas production are more likely to continue to use those fuels. In 1986, Italy produced more than 40% of the natural gas it consumed, but Spain relied on imports for more than 85% of its gas needs in 1986. As stated previously, Turkey's gas discoveries are very recent.[27] Since Italy is expected to produce more gas over the next decade or so, while increases in coal production there will be minimal, Italy will probably use gas rather than coal as an alternative to oil. None of the three countries produces enough oil to meet more than a small fraction of its needs.

3.2.2 Trends in Total Primary Energy Requirement

The total primary energy requirements (TPERs) for the three countries are shown in Fig. 3.1.[3] Turkey's TPER was 64 Mtce in 1986; Italy's was 205 Mtce; and Spain's was 108 Mtce. This difference in energy demand is linked to the differences in GDP for the three countries (Table 3.7).[3] TPER is expected to increase at the rate of 6.7% annually (almost the same rate as projected GDP growth) in Turkey. In Italy, TPER is forecast to grow 1.4% annually. In Spain, the annual growth of TPER is projected at 2.3%. The TPER per dollar of GDP is quite high in Turkey, and this amount is expected to increase even more by the year 2000. In this same time frame, Italy will probably experience a drop in this ratio. All three countries are characterized by TPER-to-population ratios considerably below the overall OECD level, which was 6.6 Mtce in 1986. (This difference is due to both climatic and economic differences.)

Fuel shares of TPER are shown in Fig. 3.1.[3] In Italy, coal supplies only about 10% of TPER, with oil and gas more dominant at 60% and 20%, respectively. Spain's TPER is now met 25% by coal, 52% by oil, and only 3% by gas. Turkey relies on coal for 31% and oil for 43% of its TPER. Gas supplied less than 2% of Turkey's TPER in 1986

TABLE 3.6 Coal Production by Coal Type, 1986 and 2000

Coal Type	Italy		Spain		Turkey	
	1986	2000	1986	2000	1986	2000
In 10^6 t of coal equivalent						
Total	0.6	1.4	18.7	26.4	16.9	39.9
Hard coal	-	-	12.3	19.2	3.3	6.6
Coking	-	-	1.1	2.1	2.1	3.7
Steam	-	-	11.2	17.2	1.2	2.9
Brown coal and lignite	0.6	1.4	6.4	7.2	13.6	33.3
In 10^6 t						
Total	1.6	-	38.3	-	45.7	-
Hard coal	-	-	15.9	-	3.5	-
Coking	-	-	1.1	-	2.2	-
Steam	-	-	14.8	-	1.3	-
Brown coal and lignite	1.6	-	22.4	-	42.2	-

Source: Ref. 3.

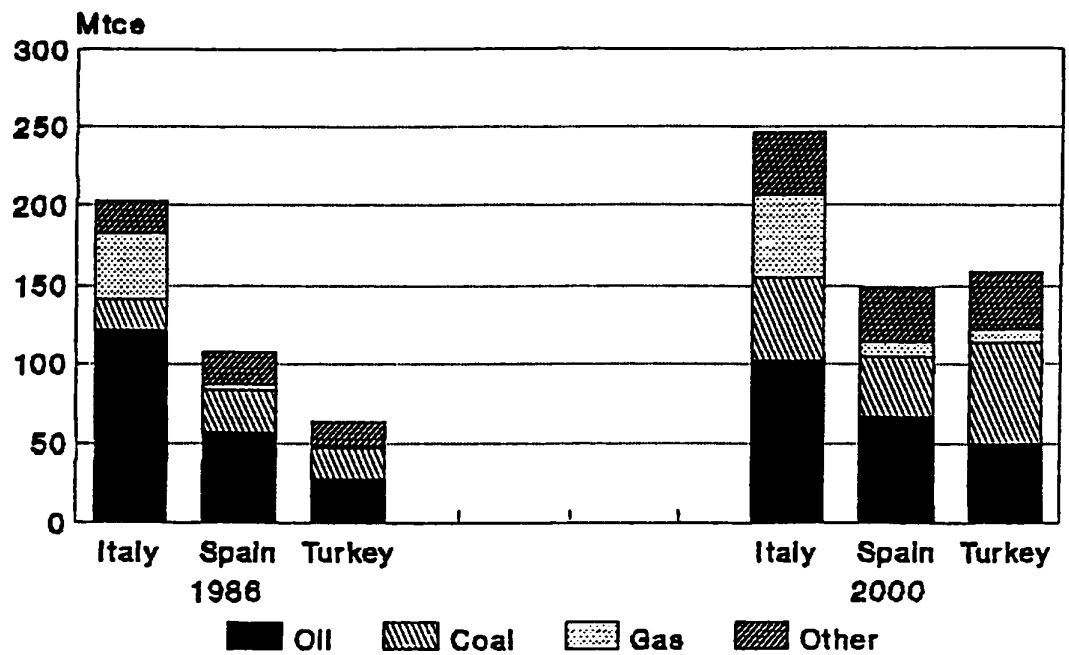

FIGURE 3.1 Total Primary Energy Requirements by Fuel, 1986 and 2000 (Source: Ref. 3)

TABLE 3.7 Trends in Total Primary Energy Requirement (TPER), Gross Domestic Production (GDP), and Population

Variable	Italy			Spain			Turkey		
	1973	1986	2000	1973	1986	2000	1973	1986	2000
TPER (10^6 t of coal equivalent)[a]	192.7	204.9	248.6	80.4	107.5	148.3	35.3	63.7	158.1
GDP (1980 10^9 U.S. $)	376.18	507.54	715.40	180.10	234.93	353.1	542.5	477.81	198.33
TPER/GDP[b]	0.51	0.40	0.35	0.45	0.46	0.42	-	0.83	0.89
TPER/GDP (1973 = 100)	100	94	68	100	102	94	100	99	96
Coal requirements/ GDP (1973 = 100)	100	130	239	100	160	155	100	148	184
Population (10^6)	54.78	57.22	57.20	34.81	38.54	41.58	38.45	50.85	67.20
TPER/population[c]	3.52	3.58	4.35	2.31	2.79	3.57	0.92	1.25	2.35

[a]Net imports of electricity are included in total TPER.

[b]In units of t of coal equivalent/1980 10^3 U.S. $.

[c]In units of t of coal equivalent/person.

Source: Ref. 3.

but is expected to supply 5% in 2000. Coal use is expected to increase in all three countries -- in Turkey, by 43.5 Mtce; in Italy, by 23 Mtce; and in Spain, by 12 Mtce -- between 1986 and 2000.

The current and projected consumption of coal by end-use sector is shown in Fig. 3.2.[3] Although coal is used primarily in power plants in Italy and Spain, in Turkey 20% of the coal is used in the residential/commercial/institutional (RCI) sector. By 2000, coal use in that sector is projected to grow to 12 Mtce in Turkey. RCI coal use in both Italy and Spain is projected to be 1-2 Mtce by the year 2000.

3.2.3 Fuel and Electricity Use Trends in the Demand Sectors

For this analysis, the most important sectors are the RCI and industrial sectors, since those are where small-scale ACTs are most likely to be used. Figures 3.3 and 3.4 show current and projected energy consumption in those sectors.[3] If the current share of coal use in these sectors is high, such as in the case for Turkey, the likelihood for using ACT would be good. Since ACT can provide higher fuel-use efficiency and lower emissions, the prospect of retrofitting existing coal-fired units and using ACT in new units would be high.

High oil consumption could also indicate the potential for increased coal use, since reduction in oil use is high among the energy policy priorities of all three countries. As Figures 3.3 and 3.4 show, oil consumption is highest in Italy (where 52 Mtce was consumed in the RCI and industrial sectors combined in 1986). Oil's share of total demand is highest in Spain, where it accounts for 57% and 59% of the industrial and RCI energy consumption, respectively. In Turkey, oil use accounts for 55% of the industrial

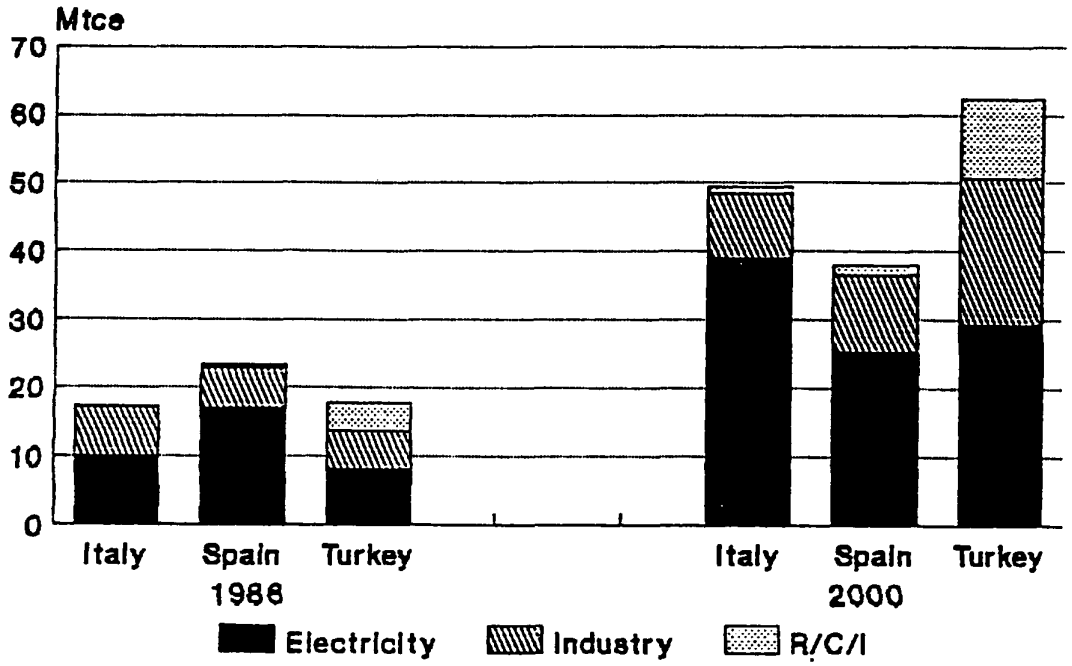

FIGURE 3.2 Coal Consumption by Sector, 1986 and 2000 (Source: Ref. 3)

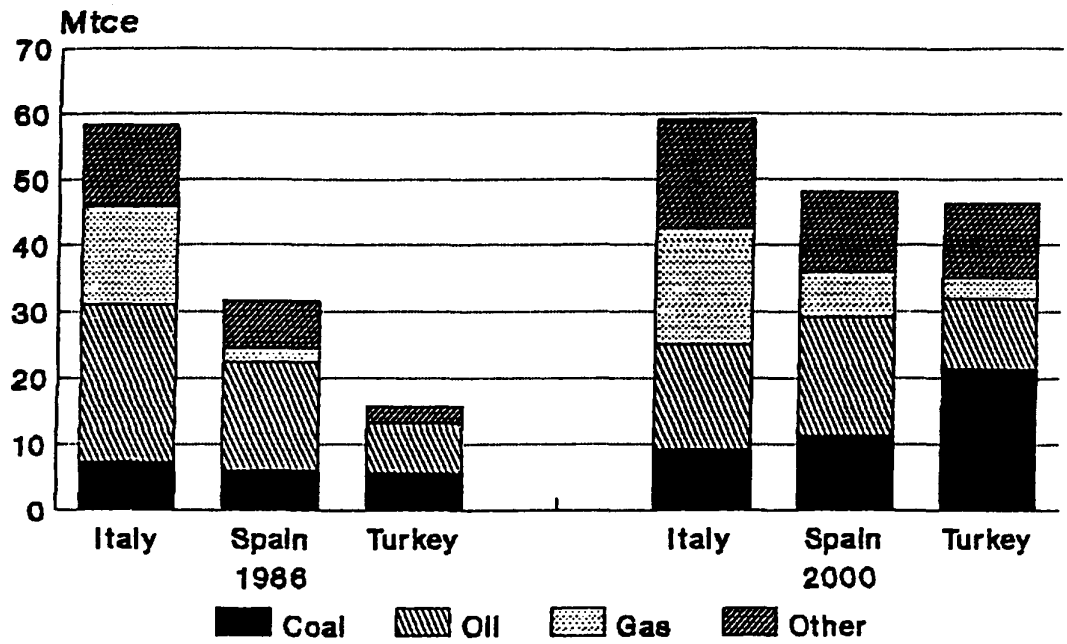

FIGURE 3.3 Industrial Energy Consumption by Fuel, 1986 and 2000 (Source: Ref. 3)

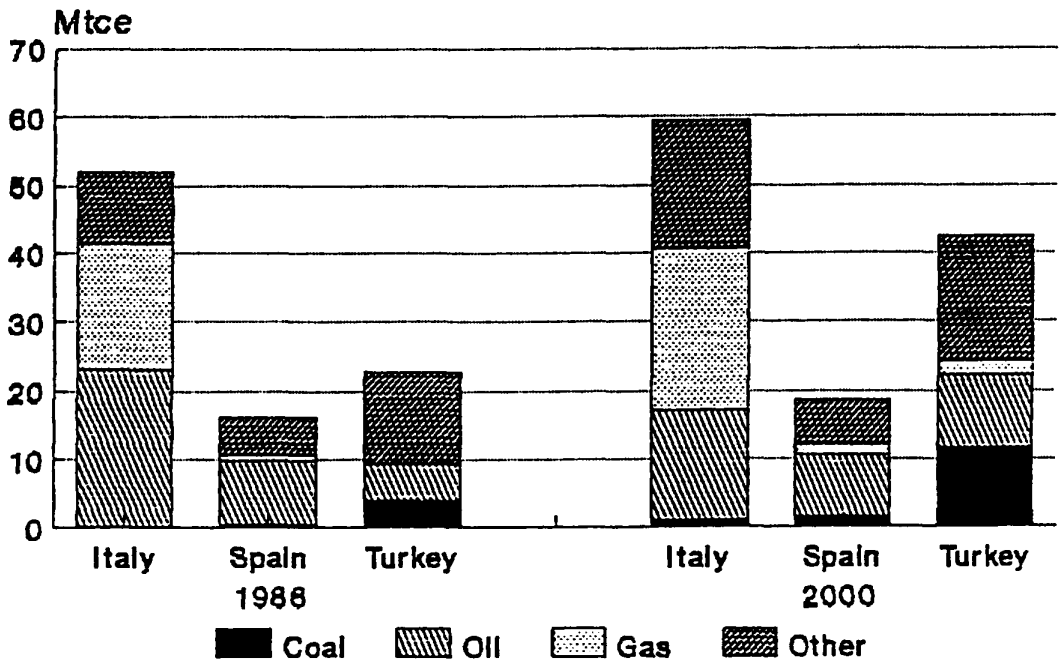

FIGURE 3.4 Residential/Commercial/Industrial Fuel Consumption, 1986 and 2000 (Source: Ref. 3)

consumption but only 24% of the RCI consumption (fuel wood is a major contributor in the residential sector of Turkey).

Figures 3.3 and 3.4 also show the relative magnitude of the demand for fuel by different sectors in the three countries. The share of demand by the industrial sectors differed a great deal for the three countries in 1986, but this difference will become much smaller by 2000, when the demands from the industrial sectors of Spain and Turkey are projected to catch up to that of Italy. In the RCI sector, Turkey is projected to experience dramatic growth. Historical trends in both RCI and industrial energy-use patterns are discussed below.

The RCI Sector. In Spain, energy consumption by RCI establishments increased at an average annual rate of 3.44% from 1973 to 1986 (see Table 3.8).[3] Oil remained the major fuel source, accounting for 50% of the total energy consumed in 1986. Among energy sources, electricity registered the largest increase (6.48%) over the period, accounting for 32% of the total energy consumed in 1986. The share of solid fuels used in household consumption over the period 1983-1987 remained at about 3-4%.[10]

In Italy, total RCI energy use grew at an average of 1% per year from 1973 through 1986 (from 46 to 49 Mtce). Energy use in this sector grew somewhat faster than did the population, which grew at 0.34% per year over the same period. The RCI sector saw a fall in oil use that was compensated for by dramatic increases in the use of gas (9%/yr) and electricity (5%/yr). Coal plays a very minor role in this sector. Oil's 1973 share of 71% fell to 51% by 1986. It was replaced by gas, which increased its 1973 share of 13% to 30%, and electricity, which increased its 1973 share of 11% to 17%.

In Turkey, total energy consumption in the RCI sectors increased 31%, from 16 Mtce in 1973 to 21 Mtce in 1986; the 1986 level is expected to almost double by 2000. By that time, coal use will have increased by almost 9 Mtce and will make the greatest contribution of conventional fuels (see Table 3.8) to total RCI energy use, with 11.6 Mtce expected from coal. This level of coal consumption surpasses projected fuel oil consumption, which in 1986 was almost double that of coal. In Turkey, other solid fuels (e.g., peat, wood, and garbage) play a large role in RCI energy consumption: 1986 use of such fuels was 12.4 Mtce compared with 2.7 Mtce for coal and 5.1 Mtce for oil. Although consumption of such fuels is expected to decrease by 2000, it will still remain high relative to that of other fuels. Gas and electricity are both projected to show substantial growth over the period 1986-2000, with gas consumption increasing by 1.8 Mtce and electricity by 5.3 Mtce.

The Industrial Sector. Table 3.9 shows industrial energy consumption by fuel and industry type.[11] In Spain, of the 6.4 Mtce of coal consumed by the industrial sector in 1985, 62% was consumed in the iron and steel industry, 28% in the nonmetallic minerals industry, and less than 5% in the chemical industry. Electricity consumption by industry is dominated by the following sectors: iron and steel; nonmetallic minerals; chemicals; and nonferrous metals.[29] Natural gas consumption is dominated by these same sectors, with the exclusion of nonferrous metals. Petroleum products are the primary fuel for the chemical, petrochemical, nonmetallic mineral, food and tobacco, paper and pulp, textile

TABLE 3.8 Historical and Projected Energy Consumption by Sector and Fuel (Mtce)

Sector and Fuel Consumed	Italy			Spain			Turkey		
	1973	1986	2000	1973	1986	2000	1973	1986	2000
Industry[a]	71.8	58.1	59.0	32.0	32.9	48.3	6.6	12.7	46.3
Coal	6.0	6.6	9.3	7.6	6.4	11.2	2.1	3.8	21.4
Oil	42.8	27.1	15.9	19.2	18.6	18.0	3.7	7.0	10.5
Gas	12.6	13.2	17.3	0.6	1.2	6.7	-	0.1	3.1
Electricity	9.5	10.7	15.6	4.7	6.7	12.4	0.8	1.8	11.3
Heat	-	-	0.9	-	-	-	-	-	-
Other[c]	0.9	0.5	-	-	-	-	-	-	-
RCI[b]	45.8	49.1	59.4	10.4	14.9	18.6	16.1	21.4	42.4
Coal	0.7	0.2	1.1	0.4	0.6	1.5	1.9	2.7	11.6
Oil	32.5	25.0	15.9	7.1	8.8	9.0	4.5	5.1	10.7
Gas	5.8	14.5	23.7	0.4	0.7	1.6	0.1	0.1	1.9
Electricity	5.2	8.4	16.7	2.4	4.8	6.4	0.4	1.1	6.4
Heat	-	-	1.0	-	-	-	-	-	-
Other[c]	1.6	1.0	1.0	-	-	-	9.2	12.4	11.8

[a]Includes nonenergy use of hydrocarbons.

[b]Residential, commercial, and institutional category includes use in the agricultural, commercial, public service, and residental sectors but not in transport.

[c]Includes other solid fuels (peat, wood, garbage, etc.)

Source: Ref. 3.

and leather, and construction industries. The cement industry relied primarily on fuel oil as its energy source until 1981.[30] Since then, coal consumption has increased steadily, while consumption of fuel oil in 1987 was only 3% of 1980 levels. This transformation may be partially a result of the establishment, in January 1980, of a duty-free coal import quota for the cement industry.[31] Since that time, there have been specific tonnage quotas for coal imports by cement firms every year.

In the Italian industrial sector, total energy use has been falling by about 1.6% per year since 1973 (see Table 3.8). Almost all the decline was in oil use, which fell by 4.4% per year. Reasons for the decline include the oil crises of the 1970s and the shift of Italy's economy from energy-intensive manufacturing to the services sector. As shown in Table 3.9, in 1985, the major consumers of petroleum products were the chemical, non-metallic mineral, and machinery industries. These represent potential coal-conversion industries. Electricity and coal use have grown steadily, at an average of 1.6% and 1.4% per year, respectively. However, only in the traditional coal consuming industries --

TABLE 3.9 Energy Consumption in Selected Industries, 1985 (10^6 t of coal equivalent)

Industry	Italy				Spain				Turkey			
	Solid Fuels	Petro. Prod.	Gas	Elec.	Solid Fuels	Petro. Prod.	Gas	Elec.	Solid Fuels	Petro. Prod.	Gas	Elec.
Iron and steel	2.89	0.40	1.02	1.10	1.95	0.41	0.19	0.70	1.15	0.22	-	0.15
Chemical	0.10	3.14	2.60	1.32	0.14	1.20	0.17	0.60	0.08	0.45	-	0.11
Petrochemical	-	2.58	1.38	-	-	2.44	0.01	-	-	0.45	-	-
Nonferrous metal	0.03	0.06	0.10	0.34	0.02	0.17	-	0.49	-	-	0.02	0.13
Nonmetallic mineral	1.08	5.52	1.44	0.57	0.90	1.04	0.20	0.66	-	-	-	0.18
Transport equipment	-	-	-	0.17	-	0.13	0.03	0.18	-	-	-	-
Machine	0.03	0.85	0.54	0.65	0.04	0.14	0.01	0.22	0.01	-	-	0.03
Mining	-	-	0.01	0.07	-	0.10	-	0.10	-	-	-	0.02
Food and tobacco	0.01	0.43	0.55	-	0.01	0.78	0.05	0.24	0.15	-	-	0.14
Paper and pulp	-	0.36	0.33	0.34	0.02	0.39	0.05	0.18	-	0.17	-	-
Wood	-	-	-	0.13	-	0.03	-	0.06	-	-	0.01	0.01
Construction	-	-	-	0.06	-	0.05	-	0.03	0.41	-	-	-
Textile and leather	-	0.47	0.27	0.46	-	0.28	0.08	0.15	0.07	0.24	-	0.17
Other	0.01	0.72	0.13	0.03	0.05	0.04	0.06	0.18	0.23	1.78	-	0.05

Source: Ref. 11.

iron and steel and nonmetallic mineral — was coal use appreciable in 1985. Industrial gas use has grown by an average of 1.3%/yr; it declined in the early 1980s during Italy's economic recession but recovered by 1984. Gas supplies an appreciable share of the total energy consumed in almost all industries in Italy (see Table 3.9).

In Turkey, industrial consumption is expected to rise to 46.3 Mtce by 2000, surpassing growth in RCI use by 12.6 Mtce over the same period (see Table 3.8). Turkey's industrial sector currently uses fuel oil as its primary energy source, followed by coal. Although growth in fuel oil use will continue commensurate with growth in industrial output, oil's dominance over coal is expected to be reversed by 2000, when coal use should amount to 21.4 Mtce and fuel oil use should be 10.5 Mtce (see Table 3.8). Solid fuels currently are used primarily in the iron and steel industry, where consumption increased from 0.40 Mtce in 1970 to 1.15 Mtce in 1985. Electricity consumption has also increased in this industry, from 0.02 Mtce in 1970 to 0.15 Mtce in 1985. Smaller quantities of solid fuels are used in the construction, food and tobacco, chemical, and textile and leather industries. In the chemical industry, petroleum products have replaced solid fuels, whose consumption fell from 0.28 Mtce in 1975[11] to 0.08 Mtce in 1985. Negligible amounts of solid fuels are used in the machinery industry.

The projections for the three countries presented here were made by the country governments and do not necessarily reflect changes in fuel markets that could occur if ACT develops successfully. Changes in prices of competing fuels (e.g., oil and gas) will also influence the market penetration of coal.

3.2.4 Energy Prices

Fuel prices currently differ quite a bit in the various countries of Europe because of differences in energy-product taxing policies. For instance, within the EC, obstacles such as "cost structures, the lack of transparency in pricing (i.e., hidden costs), and certain inconsistencies between the respective price and tariff structures for various fuels, (particularly gas and electricity) and price levels between member states" are recurrent problems.[12] Differences among countries also are evident in fuel acquisition, transport, and production costs. Some historical prices of industrial oil and gas in Spain and Italy are found in Table 3.10.[3]

The price of gas is very high in Spain, primarily because there the supply is more diversified and the pipelines are much more widespread. Oil, on the other hand, is less expensive in Spain, since Spain is a major producer of refined petroleum products, taking most of its imports as crude oil. In Italy, gas prices were running parallel to oil prices until 1986, when the price of oil, on a tce basis, was reduced by almost 50%. To some extent, these price differentials have influenced fuel choice in Italy and Spain.

Until 1986, price differentials between coal and oil/gas were wide enough for coal to be an economical choice in both Spain and Italy. In 1986, the drop in the price of oil and, to a lesser extent, gas, significantly reduced that differential. However, low oil and gas prices may be temporary. Furthermore, pricing policies in the EC may change in the future, leading to more consistency among countries as the European economy is restructured. Changes in the availability of fuels (e.g., through expansion of pipeline networks) will also affect fuel prices in the future.

3.2.5 Energy Policy and Strategies

Spain and Turkey emphasize development and use of their indigenous energy resources in their national energy plans. The Italian government, because of the country's paucity of indigenous resources, focuses on diversifying energy supplies to

TABLE 3.10 Historical Fuel Prices in Spain and Italy (U.S. $/t of coal equivalent)

	Spain			Italy		
Year	Gas	Oil	Coal	Gas	Oil	Coal
1980	181	115	70	132	137	56
1983	201	140	50	135	134	57
1986	197	109	51	125	67	52

Source: Ref. 3.

achieve the same objective of reducing the heavy dependence on imported oil. Although coal use is officially encouraged in Italy, coal research receives only about 1% of government R&D funds. Coal R&D in Italy has been largely undertaken by industry. The Spanish government plays an active role in encouraging coal use; it has established the Institute for Energy Diversification and Energy Savings (IDAE) to work with regional and local authorities to develop a program to include the creation of regional stockpiles, offers of appropriate coal-burning equipment, and investment subsidies of between 10% and 20%. Response to the plan, however, has been modest, because of lower oil and gas prices. Projects funded from 1984-1987 are estimated to have increased coal consumption by 0.46 million t. The Spanish government is also trying to modernize and integrate the Spanish coal industry, considered the most fragmented in Western Europe. In Turkey, 24% of the government R&D budget is being spent on coal research, geared toward applications that would use Turkey's indigenous lignite.

Although both Spain and Turkey have taken steps to stimulate greater coal use, both countries also favor the increased use of natural gas to replace oil products. In July 1986, a protocol was signed by major Spanish gas companies that provides government funding for facilities designed to raise the share of gas in TPER. As noted earlier, Turkey has signed an agreement to import natural gas from the Soviet Union. Turkish government policy also requires the maximum use of hydroelectric sources as a clean and relatively cheap source of energy.

3.2.6 Coal Transportation Constraints

An adequate coal transportation infrastructure is a key factor in the availability of markets for ACT. Coal transportation constraints exist to some degree in each of the countries studied. In particular, both the lack of an adequate transportation network and low port capacity may inhibit increased coal use in Turkey. Currently, inland transport of coal in Turkey is accomplished primarily by truck, which is expensive and inadequate for future development. Railway improvements are essential if coal use is to meet its anticipated targets in the residential and industrial sectors. Improvements in port capacity appear likely, given the country's many favorable locations for large bulk carriers.

Because most of the coal Italy imports is used in coastal power plants, coastal transportation constraints are minimal; however, the infrastructure for inland transport is not yet adequately developed. As in Turkey, coal is usually shipped by truck. Some 90% of the coal is transported inland in this manner, commonly by trucks that have a maximum capacity of 28 tons. Although Italy is reportedly upgrading its national rail system, inland coal transport by rail is not likely to increase since Italy has dispensed of all coal cars.

Coal transport in Spain is provided primarily by railways, which are adequate to handle domestic coal production but not suited to the efficient movement of large quantities of coal on reliable schedules. Coastal roads are also especially slow and congested. Both the Spanish railway and roadway systems are being upgraded. Coal-consuming facilities tend to be located adjacent to the coal mines that supply them or the ports capable of handling coal imports.

The regional analyses developed for Spain, Italy, and Turkey reflect these transportation constraints. In many cases, population centers that appear to be promising markets for residential and industrial ACT applications are located on the coast, where nearby ports can provide access to coal supplies. Certain regions with favorable ACT demand characteristics appear to be promising because they are near domestic coal reserves, which would alleviate the expense of long-distance truck or rail transport.

4 NICHES FOR ACT: SPAIN, ITALY, AND TURKEY

The following sections describe regional and application niches for ACT in Spain, Italy, and Turkey. These regions exhibit several key characteristics that make them good candidates for ACT: (1) a high regional population density or a high urban population density within the region; (2) a high level of economic activity or, if relatively low, signs of a growing economy; and (3) a location conducive to the use of domestic or imported coal.

4.1 SPAIN

Based on an analysis of regional data for a variety of demographic, economic, locational, and other factors, five regions stand out in terms of their potential as ACT markets. These regions are Galicia, Catalonia, Valencia, the Balearic Islands, and Madrid. Table 4.1 provides the data used to analyze eight of the 17 Spanish regions in terms of population, economy, climate, location near energy resources, and building inventory.[16-19,32] The nine regions that were excluded from the analysis were determined to be poor candidates for ACT for a variety of reasons. For example, the Basque region experienced declines in both population and per-capita income growth over the period 1981-1986, partially due to its political difficulties with the central government and terrorist activities that have discouraged foreign investment.[32] Other regions such as Estremadura, Castille-La Mancha, and Aragon are unattractive because of the combination of low GDP and low population density. Regions such as Cantabria, La Rioja, and Navarra are smaller and did not exhibit any characteristics that would have made them any better candidates for further study than the eight regions selected. The following text highlights the strengths and weaknesses of the five regions with best potential market for ACT.

4.1.1 Galicia

Situated in the northwest corner of Spain, Galicia is the most economically backward of the regions selected but exhibited the strongest growth among all Spanish regions in GDP and per-capita income from 1973 to 1981.[32] It ranks fifth among regions in total population, although population growth is behind the national average. Regional population density is not particularly high, but two provinces within this region, Pontevedra and La Coruna (see Figs. 4.1 and 4.2), rank among the top 15 Spanish provinces in terms of population density. The cities of La Coruna and Vigo both have populations of more than 200,000.

Galicia is a major coal mining area; lignite is produced around La Coruna and large new deposits were found in Orense in 1982.[31] The neighboring Asturias-Leon region is a major producer of hard and anthracite coal. The ENDESA power plant (at 1,288 MW, the largest in Spain) is fueled by both domestic and imported lignite; the UE-FENOSA is fueled by locally mined lignite. Both the ENDESA and UE-FENOSA power plants are located in the province of La Coruna. Although there are no coal

TABLE 4.1 Regional Analysis of Spain

Variable	Galicia	Asturias	Catalonia	Valencia	Balearic Islands	Canary Islands	Madrid	Andalusia
Population								
Total, 1986 (10^6)	2.8	1.1	5.9	0.7	.68	1.4	4.7	6.8
Increase, 1975-1986 (%)	3.4	0.9	4.9	9.6	13.5	10.4	9.3	11.1
Population density, 1981 (people/km^2)	96	107	187	156	131	196	588	74
Urban density, 1981 (people/km^2)	14	107	598	198	131	205	586	134
Economy								
GDP, 1981 (10^9 ptas)	995	498	3,328	1,680	381	586	2,756	2,102
GDP/km^2, 1981 (10^6 ptas)	9.6	13.5	28.9	20.0	19.7	21.3	90.3	6.8
Annual growth, 1973-1981 (%)	3.6	1.3	2.1	2.8	0.6	2.9	3.0	2.7
Per-capita income, 1981 (10^3 ptas)	314	384	502	400	509	347	572	287
Annual growth, 1973-1981 (%)	2.3	1.5	0.58	0.76	0.50	1.2	1.4	1.1
GDP distribution, 1981 (%)								
Agriculture	12.8	5.3	2.7	6.2	3.2	7.0	6.4	12.5
Industry	31.7	45.7	40.4	35.8	20.3	20.5	26.3	27.8
Services	55.5	49.0	56.9	58.0	76.5	72.5	73.3	59.7
Average daily temperature (°F)								
Winter (Dec. through Feb.)	50-51	45-48	50-51	51-53	52-54	NA[a]	42-44	52-55
Summer (June through Aug.)	61-66	63-66	70-75	71-77	72-77	NA	69-77	77-83
Location[b]								
Coal mines	+	+	+	+	+	-	+	+
Port capacity	-	+	+	+	+	+	-	+
Oil - pipelines, refineries	+	+	+	-	-	+	+	+
Gas - pipelines	-	-	+	-	-	-	-	-

TABLE 4.1 (Cont'd)

Variable	Galicia	Asturias	Catalonia	Valencia	Balearic Islands	Canary Islands	Madrid	Andalusia
Number of buildings								
Hotels, 1985	597	169	759	198	1,358	371	809	1168
With >100 rooms	21	5	75	14	403	104	59	118
Hospitals, 1981[c]	70	32	173	72	[e]	37	57	105
Number of beds	11,555	6,990	31,951	15,582	3,870	7,276	27,158	31,215
Apartment buildings, 1981[d]	36,868	18,084	105,895	82,938	21,431	28,118	53,932	89,960
Office and commercial, 1980	28,725	10,847	70,209	50,810	17,848	17,114	25,346	85,265
Industrial, 1980								
Utility	121	141	284	163	80	499	154	115
Minerals, mining, chemicals	279	312	2,305	1,429	333	141	1,156	474
Iron and steel, other metals	792	827	9,420	2,951	729	394	4,900	1,199
Other manufacturing	3,309	2,683	20,568	9,849	3,169	1,650	10,101	3,033
Construction	250	566	3,298	1,592	573	236	2,468	469
Commercial restaurants, hotels, repairs	26,925	26,967	119,731	48,392	24,894	17,507	94,936	26,925
Transportation and communications	884	2,075	5,583	2,821	1,125	822	2,844	1,228
Services	9,199	11,400	42,550	19,639	7,454	5,751	32,156	10,409

[a]NA = not available.

[b]+ = located in the region or easily accessible.
- = not located in the region or not easily accessible.

[c]Acute care hospitals only (general and surgical).

[d]Buildings with two or more apartments.

[e]Included in Catalonia figures.

Sources: Refs. 16-19, 32.

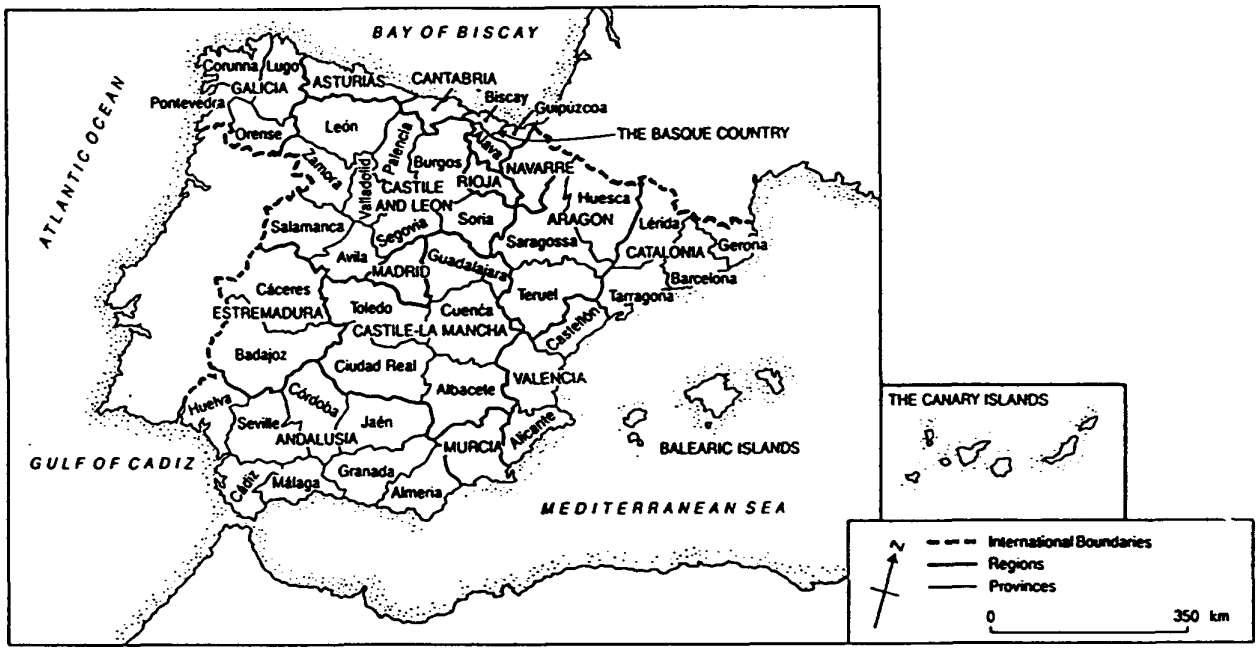

FIGURE 4.1 Regions and Provinces in Spain (Source: Ref. 32,© London: C. Hurst; New York: St. Martin's)

importing ports in Galicia, the port of Gijon-Musel in Asturias is approximately 125 miles to the east of La Coruna (see Fig. 4.3).

Oil use in this region is facilitated by the Petroliber petroleum refining plant (11 Mtce annually) in La Coruna, which depends on imported crude oil (see Fig. 4.4). There are no pipelines in the area for distribution. Natural gas is not expected to pose much competition in this area; there are no plans for pipelines of imported gas, and although domestic production of gas is increasing in the nearby Bay of Biscay, the proposed distribution system is oriented more toward the eastern and northeastern regions.[16]

Major industries include shipbuilding, aluminum production, cellulose production, and automobiles (Citroen). Because of this area's favorable climate, agriculture is productive, accounting for 12.8% of GDP in 1981 (down from 19.7% in 1973). Consequently, food processing and packaging industries are likely to be situated in the region. These industries are among the strongest growth industries in Spain and are attractive in terms of cogeneration.[16]

In summary, Galicia is of interest due to its economic growth, the existence of two densely populated provinces, its domestic coal reserves and (through inference) existing substantial coal use. The iron and steel, nonmetallic mineral, food and tobacco, and paper and pulp industries are candidates for ACT. Each of these industries has consumed coal to varying degrees.[11] Although this region ranks last among the regions selected in terms of the total number of building types, a substantial number of buildings in the main cities of La Coruna, Vigo, Pontevedra, and Santiago are probably fueled by coal, given this area's historic and current status as a major coal producer. The production of oil in the region is the one drawback to ACT penetration in this area.

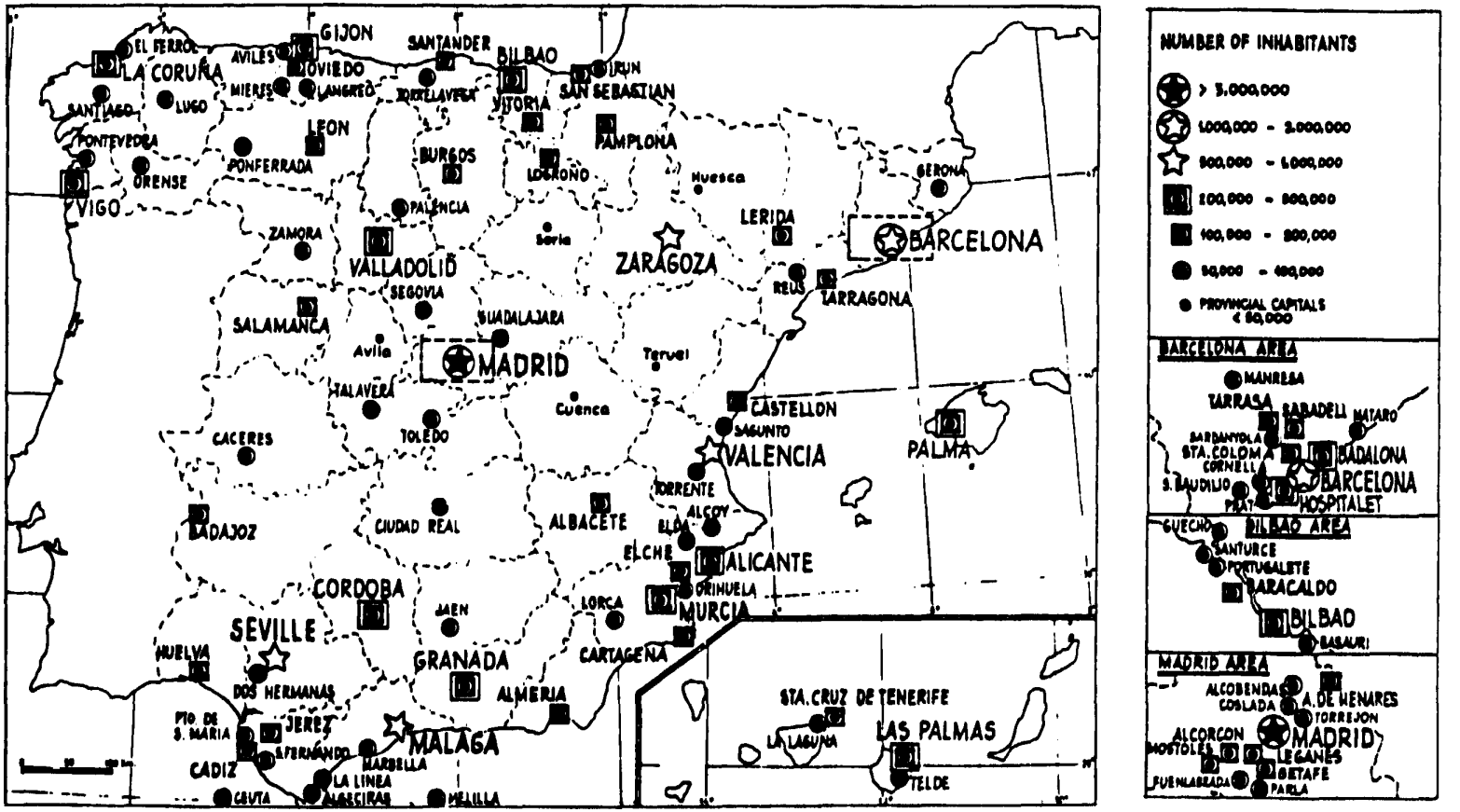

FIGURE 4.2 Spanish Population Centers According to the 1981 Census (Source: Ref. 32,© London: C. Hurst; New York: St. Martin's)

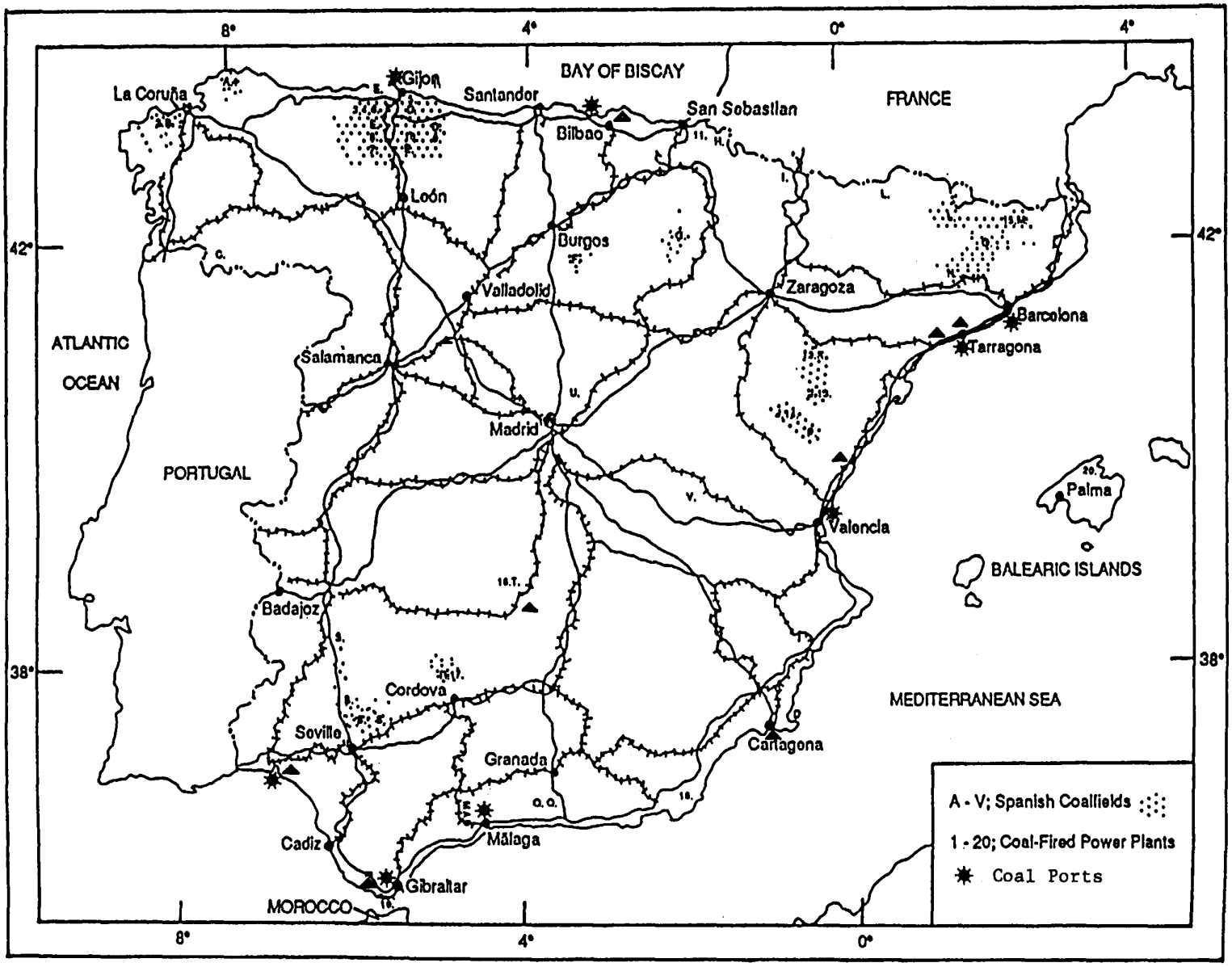

FIGURE 4.3 Coal Fields, Coal Ports, Coal-Fired Power Plants, and Railroads in Spain (Source: Ref. 31)

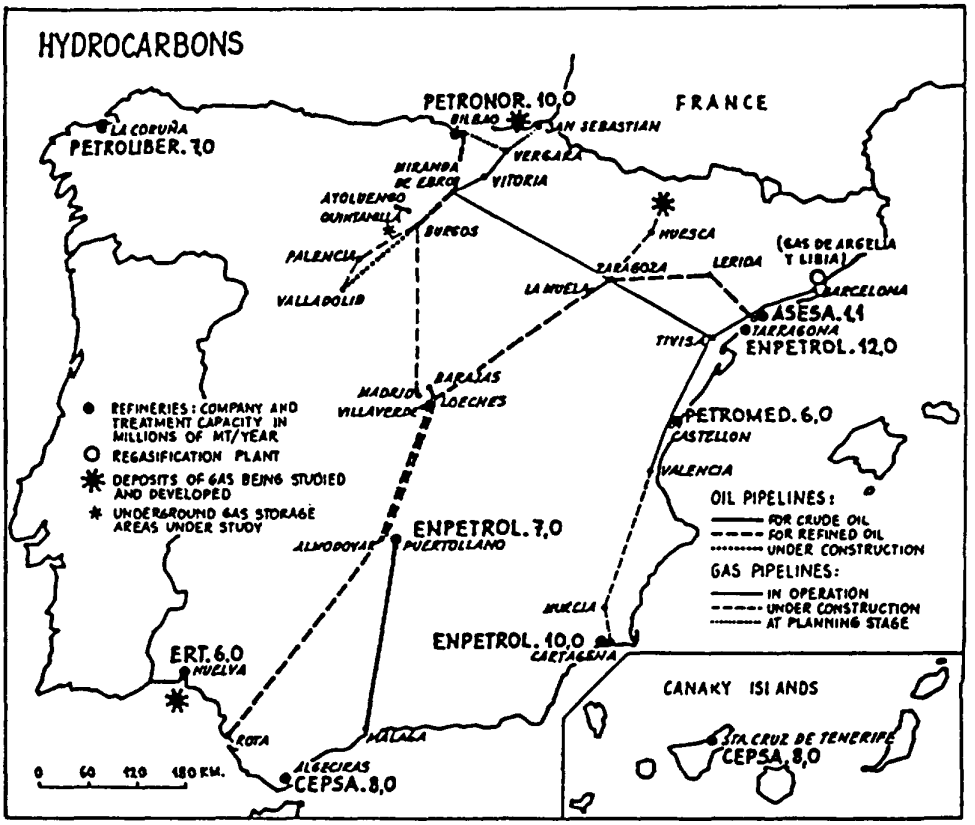

FIGURE 4.4 Oil and Gas Pipelines in Spain (Source: Ref. 32,© London: C. Hurst; New York: St. Martin's)

4.1.2 Catalonia

Catalonia ranks first among the regions considered in a number of important areas: the highest in total population; highest population density of a major city (Barcelona); highest GDP; and most industrial and commercial buildings or establishments. Although they are a cosmopolitan city and a major tourist area, Barcelona and the region of Catalonia retain a surprisingly strong industrial base; industrial activity, including construction, provided 40.4% of the GDP in 1981.[32]

Major industries include the manufacturing of motors (for cars, industrial vehicles, and tractors), textile machinery, industrial machine tools, cotton, leather, and paper. Of these, the machine industry and paper industry hold the most potential for coal use and related ACT applications, as these industries have historically consumed coal to some degree.[11] In addition, there is a heavy concentration of cement plants in Catalonia (four of which produce more than 100,000 t per year), which have been shown to rely increasingly upon coal as their primary fuel.[31] A 1987 study by the Catalonian government ranked the following industrial sectors in terms of their share of total industrial energy consumption: chemicals, 25.7%; paper, 16.7%; textiles, 14.2%; food, 9.3%; metal fabrication, 8.0%; building materials, 7.1%; and glass, 6.3%.[33] The food processing and packaging industry, a major growth industry in Spain, holds potential for ACT cogeneration applications.

The region of Catalonia has the greatest choice of fuel types because of its location. Lignite and hard coal is mined in Catalonia and neighboring Aragon. Four power plants in the Catalonia and Aragon regions are fueled predominantly by domestic lignite. The port of Barcelona is a major coal-importing port that maintains berths for serving the local cement industry. Tarragona, approximately 80 miles to the south, is another large coal-importing port, and another port of larger capacity is scheduled for commissioning in 1990-1991.[3]

Tarragona is also the site of two oil refineries -- the ENPETROL refinery (18.8 Mtce annually) and the ASESA refinery (1.7 Mtce annually). Refined oil from these plants is piped to Madrid.

Imported natural gas comes from Algeria and Libya as LNG through the reception facilities in the port of Barcelona (see Fig. 4.4). Deliveries from Norway's Troll field are expected to begin in 1992.[16] The gas pipeline system extends from Barcelona down the coast to Valencia (eventually to be extended further down to Cartagena) and from Barcelona northwest to the Basque country.

In summary, Catalonia's status as a major population and economic center makes it a promising market, but its access to both oil and gas require the identification of very specific niches for coal-based technologies. The lignite mining area in western Catalonia is an economically depressed area that should be receptive to appropriate small scale ACT. Lignite mines in Berga fuel the Serchs 161 MW power plant and fuel local heat demand in factories and homes. Just north of Barcelona, in Bardalona, is a 150-MW conventional coal-fired power station, St. Andria de Besos. This site has a small (2-MW) circulating fluidized-bed boiler installed by Foster Wheeler Espana to test the technology. Partly funded by the government and the EEC, it has an annual demand for 6,000 tons of coal, but concerns about coal dust have held up the operating license. The province is interested in the feasibility of a slurry reception facility -- an interest that most likely applies to other coal plant managers along Spain's coastline. Finally, the opening up of Spain's power market to independent power producers is expected to create a new industry in Spain that will be concentrated in Catalonia: the manufacturing of components for turbines, boilers, generators, and related equipment. Although interest to date has focused on cogeneration sets based on the combined-cycle gas turbine, an effective marketing campaign to increase awareness of the advantages and efficiencies of ACT could create a promising niche for this technology in Catalonia.

4.1.3 Valencia and the Balearic Islands

Valencia and the Balearic Islands are grouped together in this analysis because of their geographic proximity and the dependence of the Baleares upon Valencia for imports of raw materials and other goods and services. These are both prosperous regions, with high population densities and strong population growth rates. Per-capita income in the Balearic Islands is second only to Madrid among the regions considered. Both these areas depend on tourism, with Valencia having a much stronger industrial base.

Of particular interest is the heavy concentration of hotels and apartment buildings on the Balearic Islands -- 403 hotels here have more than 100 rooms, compared

with 59 in Madrid and 75 in Catalonia.[19] These facilities do not have access to the public electricity grid; therefore, independent power facilities are required. Hotels in Valencia establish standby capacity to ensure against breakdowns in air-conditioning systems. The 230-MW GESA power plant in Mallorca is fueled by local lignite deposits as well as imported hard coal and oil. In terms of ACT applications for residential buildings, the Balearics are a market worthy of further investigation.

Industrial activity in the Balearic Islands is limited. The footwear industry is centered here and in Valencia. Cement plants in Valencia and the Balearics supporting the active construction industry are potential candidates for ACT. Major industrial activity in Valencia is centered on automobiles, iron and steel, shipyards, and the computer industry. Agricultural establishments are highly concentrated in Valencia, indicating a good potential for ACT applications in the food processing industry.

Whereas oil is the major competitor to coal in the Balearics, Valencia can also increase its use of natural gas because it is located on the gas pipeline from Barcelona. In the near term (to 2000), however, natural gas use is not projected to make significant inroads in Spain as a whole.[34] Refined oil is available from the PETROMED refinery (9.4 Mtce annually) north of Valencia. Domestic coal is accessible from the lignite mines in the Aragon region.

4.1.4 Madrid

Several characteristics make the Madrid region an outstanding market for ACT: (1) it is densely populated, both regionally and within the city of Madrid; (2) its economy is strong and expanding, providing the highest per-capita income and production intensity (measured as GDP/km^2) of any region; (3) it is characterized by a profusion of high-rise "tower blocks" which, given the cool winter climate, require heating systems; and (4) it is the hub of the road and rail transportation system, facilitating coal transport from the mining areas of Asturias-Leon in the north, Aragon in the East and Castille-La Mancha to the South (see Fig. 4.3).[32]

The services sector is very strong in Madrid, providing 73% of the GDP in 1981, because of the concentration of financial and tourist-oriented establishments. The iron and steel and motor manufacturing industries are the major heavy industries; smaller and high-technology industries are located in the suburbs of Madrid. Cement plants are clustered in the northern suburbs.[31]

Coal could substitute for oil in Madrid. The region is heavily dependent on oil, which is supplied through pipelines from Andalusia's southern coast as well as Catalonia's east coast. Natural gas will be available from the pipeline originating in Barcelona upon completion of the distribution system.

4.2 ITALY

Data on population, economy, climate, location of nearby energy resources, and building inventories were used to screen 10 of the 20 Italian regions for potential ACT

markets (see Table 4.2).[22,25,35-37] Of these, four were selected as being more favorable toward the new technology (see Fig. 4.5): Sardinia, Campania, Latium, and Veneto.[38] Although these regions are presented here as potential markets, their selection implies only that they are likely to be better than other regions in Italy. Overall, ACT penetration in Italy, including these regions, is expected to be poor for a number of reasons given below.

The chief reason for poor market penetration is Italy's lack of indigenous coal resources. Except for a small area in Sardinia, there are no significant coal deposits in the country. Consequently, coal has never been a popular fuel in either industry or residential sectors. Italy has a number of coal-fired power plants that operate on imported coal, but these are all at coastal locations, and even here, ports are inadequate to handle today's large ships. Coal must be frequently off-loaded from large ships to smaller ones capable of entering Italy's ports, which adds to the expense.[39] Overland transport of coal in Italy is difficult given the terrain and inadequate rail freight system.[40]

Another reason is the strong anti-coal bias presently held by the Green party.[41] Opposition to new coal-fired power plants has been strong. In addition, many of Italy's industrial cities are very badly polluted. The disposal of ash is a significant problem since landfill capacity is limited.[42] Despite the advantages of ACT, licensing of new coal boilers in this environment will be quite difficult.

Other factors include Italy's stable population, indicating that few new schools and hospitals will be built. However, some expansion may occur in the underdeveloped south (Mezzogiorno). In addition, using ACT for retrofits of existing boilers and combustors is a possibility, since the economic infrastructure built in the period 1950-1963 (when the economy grew at almost 6% per year) is at or nearing replacement age. As of 1989, all of Europe is in the middle of a gas glut, which has kept gas prices low and encouraged gas use. This glut is expected to continue until 2000 before waning.[43]

One last important factor in ACT penetration is the trend toward electrification of industry, which is expected to continue.[38] This may work in ACT's favor by encouraging cogeneration, or may discourage ACT use if electricity prices are low. It is difficult to predict which scenario will develop.

Given the caveats above, the four regions of Italy that offer the most favorable climate for ACT penetration are described in more detail below.

4.2.1 Sardinia

The island of Sardinia, located off Italy's west coast, is the least populated of the regions analyzed in detail here -- just 68 people per square kilometer, compared with the national average of 190 (see Fig. 4.6).[38] Its largest cities are Cagliari (population 223,000) and Sassari (119,000). It shares the general characteristics of the Mezzogiorno region in that it has a warm climate, low GDP (lowest among the regions analyzed), low per-capita income, and high birth rate. Its chief advantage as a potential market for

TABLE 4.2 Regional Analysis of Italy

Variable	Latium	Liguria	Campania	Lombardy	Veneto	Sardinia	Apulia	Emilia Romana	Tuscany
Population									
Total, 1985 (10^6)	5.0	1.8	5.4	8.9	4.3	1.6	3.8	3.9	3.6
Increase, 1971-1981 (%)	6.0	-2.9	6.9	4.2	4.5	7.6	7.4	2.4	2.8
Density, 1985 (people/km^2)	297[a]	326	417[b]	372[c]	238	68	207	178	155
Economy									
GDP, 1985 (10^{12} lire)	63	27	43	135	51	13	30	56	46.3
GDP/km^2, 1985 (10^9 lire)	3.6	4.9	3.1	5.7	2.7	0.6	1.6	2.5	2.0
Annual growth, 1981-85 (%)[d]	16.5	15.9	14.4	15.7	14.6	15.1	14.3	14.8	15.3
Average monthly family income (10^3 lire)	632	740	479	740	685	479	479	685	632
GDP distribution									
Agriculture	6.7	4.9	17.8	4.0	8.3	13.4	25.5	12.9	6.7
Industry	28.3	32.0	31.3	51.4	45.3	32.1	28.9	40.4	43.8
Services	65.0	63.1	50.9	44.6	45.9	54.5	45.6	46.7	49.5
Average daily temperature (°F)									
Winter (Dec. through Feb.)	49	48	50	36	43	46	50	45	45
Summer (June through Aug.)	82	78	83	75	77	80	83	77	77
Location[e]									
Coal mines	-	-	-	-	-	+	-	-	-
Port capacity	+	+	+	-	+	+	+	+	+
Oil - pipelines, refineries	+	+	+	+	+	+	+	+	+
Gas - pipelines	+	+	+	+	+	+	+	+	+

TABLE 4.2 (Cont'd)

Variable	Latium	Liguria	Campania	Lombardy	Veneto	Sardinia	Apulia	Emilia Romana	Tuscany
Number of buildings									
Hotels	1856	2644	1576	3996	3948	532	573	6302	3273
With >100 rooms	69	12	36	21	48	19	15	18	37
Hospitals, 1980	224	69	159	215	122	43	114	157	111
Number of beds	48,668	20,668	40,599	78,463	56,103	12,123	36,821	42,244	37,708
Schools									
Secondary	753	261	715	1066	522	232	507	434	397
University	6	1	5	11	4	2	2	4	7
Office and commercial, 1981	119,044	57,773	119,582	224,498	128,006	40,216	94,069	129,214	103,447
Industrial, 1981									
Utility	67	79	128	370	132	23	65	111	33
Manufacturing, mining	29,915	13,277	29,264	128,593	60,672	9,277	26,774	64,760	65,310
Construction	12,031	9,344	9,310	55,099	35,630	6,889	12,928	32,838	21,928
Transportation and communications	7,084	6,109	5,579	20,976	13,272	3,647	4,716	22,060	10,132
Services	17,590	8,375	16,298	33,682	15,175	4,264	12,173	21,260	15,243

[a]Rome urban area = 701 people/km^2.

[b]Naples urban area = 2,617 people/km^2.

[c]Milan urban area = 1,442 people/km^2.

[d]Uncorrected for inflation.

[e]+ = are located within the region or are easily accessible.
- = are not located in the region or are not easily accessible.

Sources: Refs. 22, 25, 35-37.

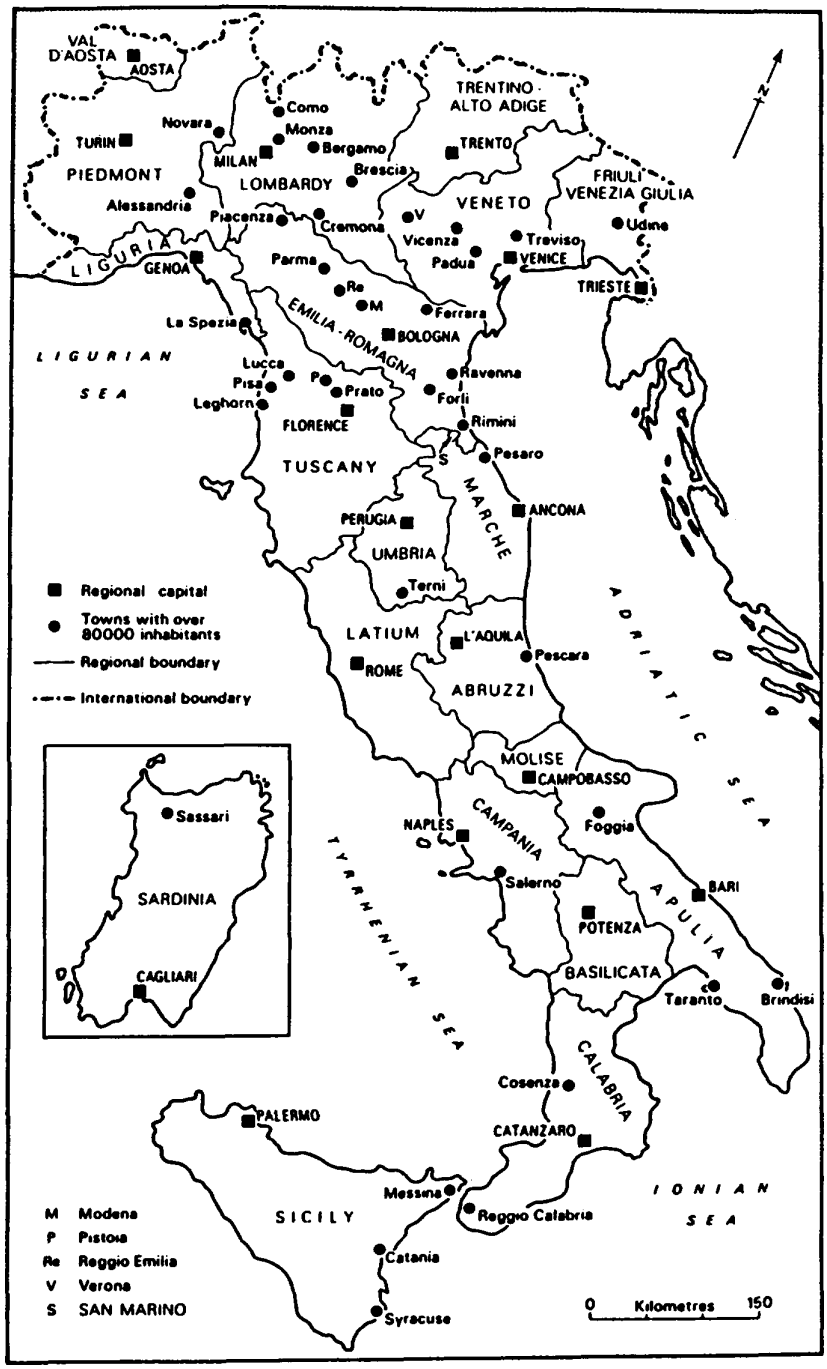

FIGURE 4.5 Regional Boundaries and Main Towns in Italy (Source: Ref. 38,© as appears in book)

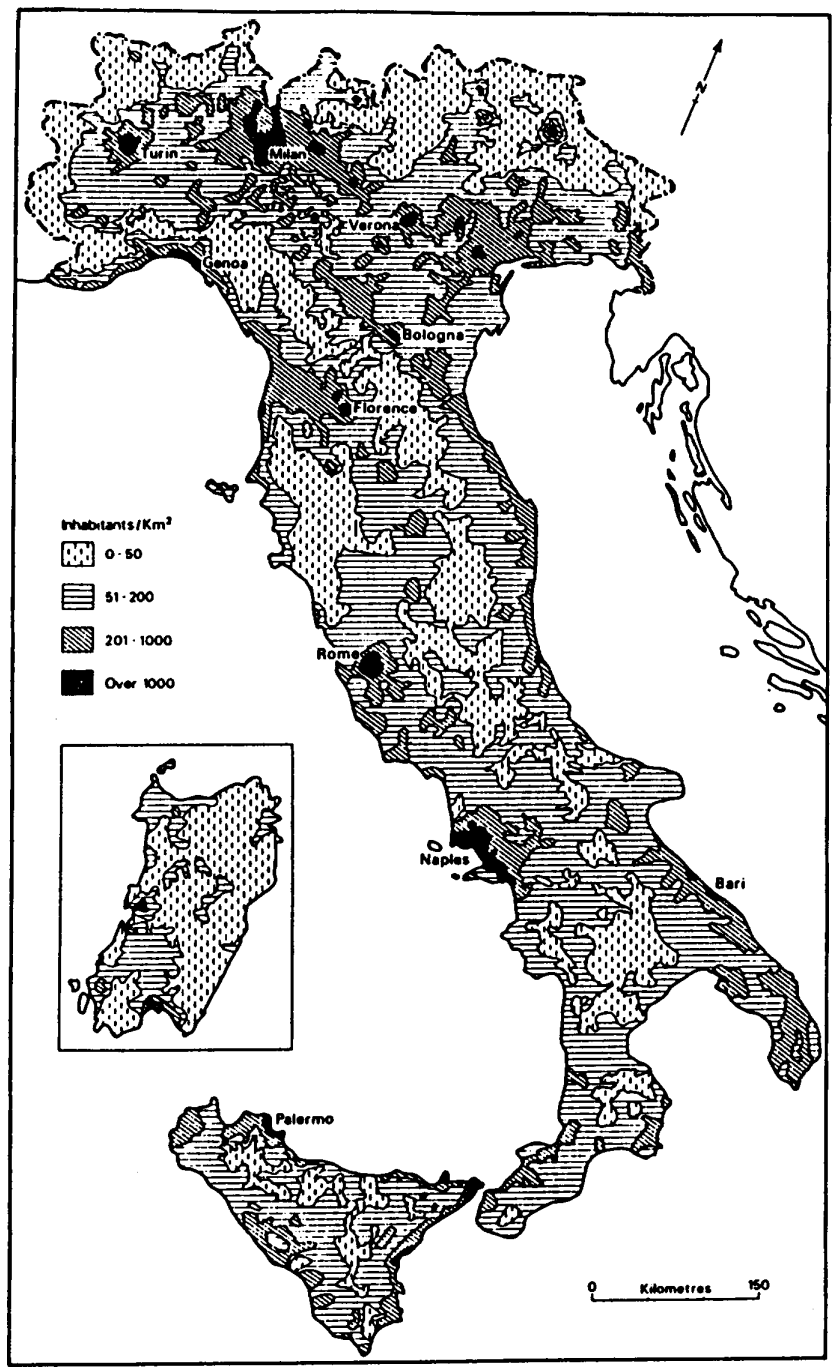

FIGURE 4.6 Population Distribution in Italy, 1981
(Source: Ref. 38,© as appears in book)

ACT is the presence of coal mines. Coal is mined in Carbonia and Bacu Abis in quantities of about 1.5 million t per year. Despite the mines' relatively small production rate, the availability of coal in this area could give ACT a distinct advantage. In addition, the island has no natural gas pipelines with which coal would compete. Oil, however, is readily available on the island. Porto Foxi, near Cagliari, is one of Italy's biggest oil ports (see Fig. 4.7).[44,45] In addition, Porto Torres in the north is another significant oil port. The island has no major oil pipelines.

The island's principal industries are chemicals (Cagliari), petrochemicals (Porto Torres, Sarrach), metalworking (S. Antioco, S. Gavino Monreale, Monetponi, Villasalto), and cement (Cagliari). In addition, papermaking, sugar refineries, and crafts are important.

Small-scale ACT might be attractive to any of these industries except crafts. In addition, the growth of tourism may mean a possible market niche for ACT in new hotels. The government has numerous incentives to promote growth of industry and business in the Mezzogiorno.

4.2.2 Campania

The region of Campania surrounds Naples, Italy's most densely populated city (2,617 inhabitants per km^2) and the largest in the Mezzogiorno (see Fig. 4.6).[38] It lies on the Tyrrhenian Sea and is chiefly a maritime region. The coast is highly urbanized; inland area is less populated and largely agricultural in nature. Other large towns are Salerno (156,000) and Caserta and Benevento (both 66,000).

Campania has a relatively low GDP compared with the country as a whole, but it is more prosperous than the other southern regions. Average family income is approximately 80% of the national average. Unemployment in Naples is particularly high, due to the constant inflow of unskilled workers from the rural Campania. Farmers and agricultural workers from the depressed countryside seek jobs in the city, where the manufacturing base is too small to absorb the influx.[38]

The energy infrastructure of the area is adequate. An oil refinery and oil tanker port ensure the availability of oil (see Fig. 4.7);[44,45] gas pipelines also traverse the region (see Fig. 4.8).[4] Road and rail networks are well developed. Although Naples is a busy passenger port, it is not well equipped for handling coal. Throughout the Mezzogiorno, water resources are sometimes scarce and occasionally hinder industrial development. Pollution in the Bay of Naples is severe.[38]

In Campania, employment is 18% agricultural, 31% industrial, and 51% services. The industrial structure exaggerates the pattern found throughout Italy; industries are either tiny one-person (or one-family) affairs or giant, often state-run corporations. Few medium-size organizations exist. Because of the agricultural significance of the region, food processing is an important industry in the area and one that is fairly widely distributed outside Naples. The traditional industries of textiles and paper have declined in recent years, but footwear, gloves, and furniture are typically healthy industries and make up the bulk of the smaller industries. Larger industries consist of engineering,

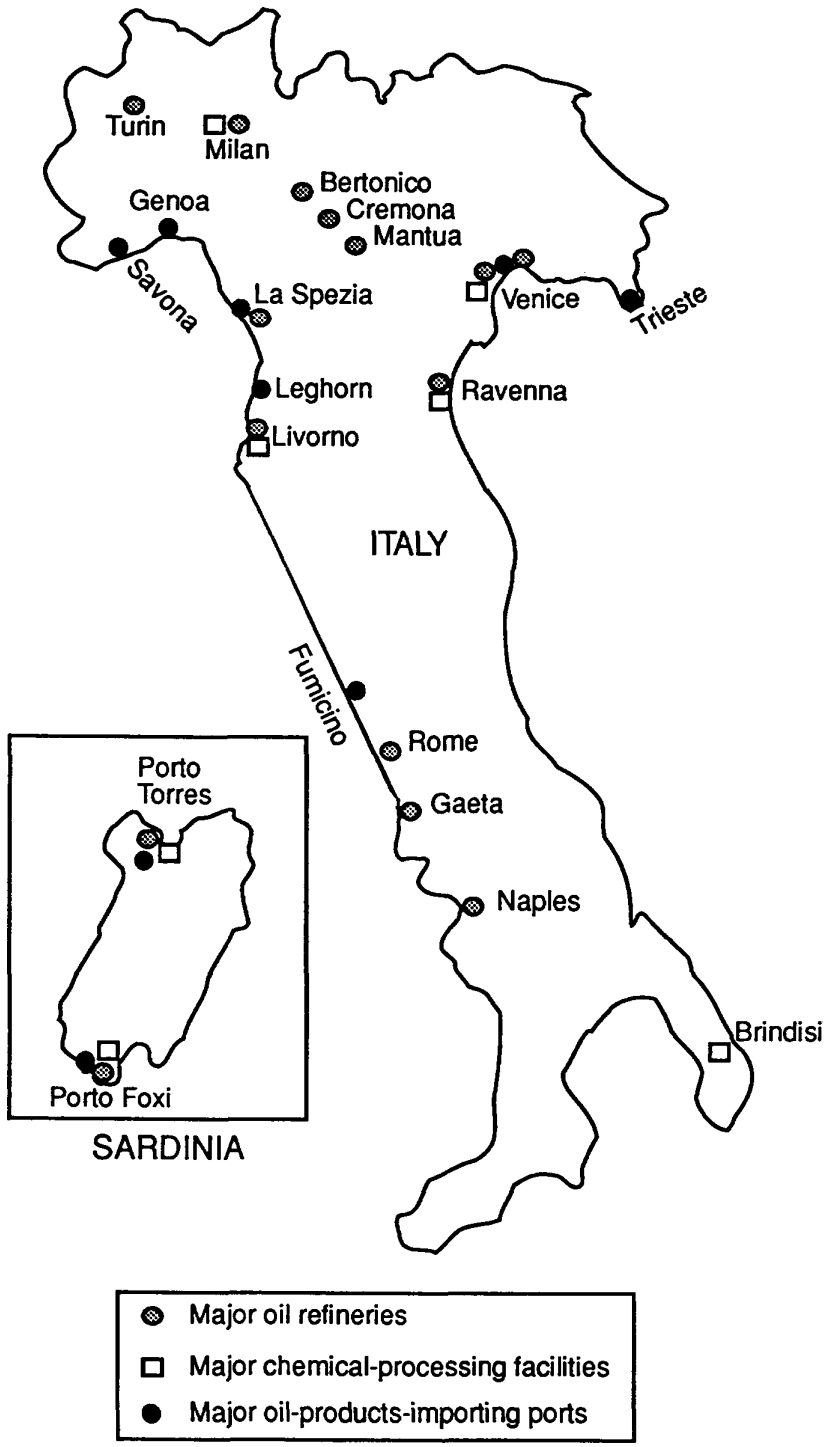

Figure 4.7 Major Oil Refineries, Chemical-Processing Facilities, and Oil-Products-Importing Ports in Italy Source: Modified from Refs. 44 and 45)

FIGURE 4.8 Gas Transmission Network in Italy, March 1986 (Source: Ref. 4)

metal-working, chemicals, petrochemicals, and construction. Expansion of these established large industries in the area around Naples has been difficult because residential developments have hemmed them in.[38]

Possible niches for ACT might be in the food processing, metal-working, and chemical industries of Campania. Housing in Naples is in extremely poor condition; building speculation, corrupt politics, and organized crime have hindered new housing developments. Yet apartments and other housing are desperately needed, and ACT could possibly play a role if new dwellings are constructed. The mild winters and hot summers of southern Italy do not create a large space heating load. Again, incentives exist for investors in the Mezzogiorno's industries.

4.2.3 Latium

The region of Latium surrounds Rome, Italy's administrative center. This region lies on the Tyrrhenian sea, just north of Campania in central Italy (see Fig. 4.5). The presence of Rome dominates the region. Technically, Rome is the largest city in Italy, with a population of 2.8 million, but that status may be a misrepresentation of the city's population, due to the traditional manner of Italian census reporting. Italian statistics are generally reported by commune; in large cities, the boundary of the urban or developed area may be very different from the boundary of the commune. For example, Rome is in a commune of 1,500 km^2, which encompasses both the city and a wide swath of rural territory that includes other towns. In contrast, Milan is in a commune of 180 km^2, all of which is urban. Much of Milan's development is reported to the census bureau as belonging to the communes surrounding Milan, rather than Milan itself. Researchers who have tried to account for this misrepresentation have estimated that the Milan area has a population of about 6 million. Similarly, the Naples urban area is estimated to have a population of about 3.6 million rather than the 1.2 million officially reported.[38] These discrepancies should be considered when reviewing the regional data presented here.

Outside of Rome, Latium is largely agricultural. The undeveloped north has undergone much out-migration, which continues today. Around Rome, a ring of small towns has grown up since the 1930s and brought the region some industrial development and a concomitant population increase. Overall, the region's standard of living is somewhat higher than the national average, but as might be expected, north Latium's living standards are lower than average, while standards in the industrial southern region are higher. Population growth in the region is fairly high, and the region claims the country's fastest growing GDP. The GDP in 1985 was distributed accordingly: 6.7% agricultural, 28.3% industrial, and 65% services.[35]

Clearly, the services sector dominates the region's economy. In the agricultural sector, primary crops are wheat, corn, grapevines, and olives. Part-time farming is becoming more prevalent; workers in other economic sectors spend some time growing fruits and vegetables.[35] In the industrial sector, development is recent and most occurs outside of Rome itself; important industries are food processing, construction, paper, petrochemicals (along the coast near small ports), textiles, and engineering. Much of the development has resulted from incentives to invest in the Mezzogiorno. Within the city,

lack of water, power, efficient transportation, and suitable land have discouraged development. Most industry in Rome serves the local market: construction, printing, mechanical servicing, food, etc.[38]

No significant coal movements occur in the region, which is a significant drawback to the introduction of ACT. However, the region's growth in GDP and population are positive factors. ACT might find a foothold in the small- to medium-size food, mechanical, and chemicals industries in the towns surrounding Rome. Space heating loads in the region are low because of the mild climate, so the residential market for ACT would be limited.

4.2.4 Veneto

The Veneto region lies in Italy's northeastern corner on the Gulf of Venice (Fig. 4.5).[38] Its capital and major city is Venice (333,000 inhabitants), but the presence of other large towns keep Venice from dominating the region. Verona has a population of 260,000; Padova has 227,000; and Vicenza has 111,000. The region is the least developed of the wealthy north. Population is fairly high (4.3 million) and increasing faster than that in the rest of northern Italy. Veneto's density of 238 people/km^2 is about average (Italy as a whole has 190/km^2).[35]

Average per-capita income in Veneto is above the national average. GDP for the region is low compared to the rest of northern Italy (and again, higher than that of southern Italy) and growing at an average rate. Of the region's total GDP, 8.8% is agriculture, 45.3% is industry, and 45.9% is services.

Veneto's energy supply infrastructure is good. The pipeline bringing gas from the U.S.S.R. traverses the region, oil tankers deliver oil to the chemical plants at Marghera, and coal for two local power plants -- Porto Marghera and Fusina -- is delivered to Veneto's ports. Porto Marghera is a dual-fired (coal/oil) plant and Fusina is multi-fired (coal/oil/gas).[38]

The region's industry is characterized by small and medium-size firms. Textiles (natural and synthetic), shoes, household appliances, and ceramics are important. The Porto Marghera industrial complex outside of Venice is a major concentration of Italian industry and is home to chemical, petrochemical, metallurgical, and engineering establishments. Artisan crafts such as glass, lace, jewelry, ceramics, and reproduction furniture are also important. Tourism is vitally important to the area.

ACT could perhaps penetrate the smaller industrial market in this area since the ports are equipped for handling coal. The textile production industry might be especially receptive. Because of the colder climate in this section of the country, ACT might also be a candidate to meet the space heating needs of hotels and schools.

4.3 TURKEY

Upon analysis of economic, demographic, locational, and other data for a select group of provinces in Turkey, eight provinces were chosen as promising markets for ACT

applications. These provinces are Istanbul, Izmit, Mersin, Antalya, Izmir, Ankara, Zonguldak, and Bursa. Table 4.3 presents the data used to select these eight of Turkey's 67 total provinces (see Figures 4.9 and 4.10) in terms of population, economy, climate, proximity to indigenous energy resources and/or ports, and building inventories (as could be gathered).[17,20-22] Eregli (west of Zonguldak) and Iskenderun (east of Mersin on the Mediterranean) are currently the only coal-importing ports in Turkey. Given this country's strong current and projected growth in coal use, however, it is likely that several existing ports that are favorable locations for large bulk carriers (Istanbul, Izmit, Izmir, and Antalya) may be equipped to import coal to support the plans for developing and using coal in the future.

The remaining provinces were excluded based on a variety of factors that indicated they had little potential for U.S. ACT. For the most part, the regions east of Ankara (parts of central, eastern, and southeastern Anatolia) were excluded because they are poorer, more agricultural and mountainous, and less densely populated than the western provinces (see Fig. 4.11).[46] The eastern provinces are disadvantaged industrially because they lack nearby markets, raw materials, and other inputs and capital. For instance, the province of Kahramanmaras, which is nestled between the Afsin/Elbistan lignite basin and the Kirkuk/Iskenderun oil pipeline, is primarily agricultural, with 60% of the population located in the rural regions. Gaziantep, lying in southeast Anatolia, also did not appear to be a good candidate because of its distance from coal resources and coal ports, low GDP, and low industrial base.

A complete set of information on buildings, hotels, schools, and hospitals in Turkey was not found due to the lack of information maintained in the United States by the various Turkish Embassy offices. Much of the information available is national in scope. This national information, in combination with regional or provincial data, is useful for drawing logical inferences about regional or provincial economic factors. For instance, data for a province, Bursa, in the Marmara region, indicated that population increased 38% from 1975 to 1985 and the industrial GDP is 43%. The Marmara region has the highest industrial base of all provinces. It can be inferred that (1) to accommodate the large growth in population, the construction of houses had to have been undertaken on a large scale, (2) the infrastructure such as schools and hospitals had to have experienced similar growth, and (3) the province's industrial base must have grown to provide for the needs of the growing population. Further, since industrial sectors such as textiles, food and tobacco processing, iron and steel and machinery production, and construction rely to a significant degree upon coal, where a high percentage of a province's GDP is tied to the industrial sector, there is a strong probability of a niche for U.S. ACT.

Thus, various indicators of economic and population growth have suggested that eight key provinces might have a strong potential for U.S. ACT applications. The following sections highlight the strengths and weaknesses of these eight provinces selected as potential U.S. ACT markets.

TABLE 4.3 Provincial and Regional Analysis of Turkey

Variable	Adana	Ankara	Antalya	Balikesir	Bursa	Gaziantep	Istanbul
Population							
Total, 1985 (10^6)	1.7	3.3	0.89	0.91	1.3	0.96	5.8
Increase, 1975-85 (%)	39.2	27.9	33.2	15.2	37.8	34.9	49.6
No. of cities							
>3 million people	-	-	-	-	-	-	-
1-3 million	-	-	-	-	-	-	1
500,000-1 million	1	1	-	-	1	1	3
<500,000	13	23	12	17	10	6	15
Density, 1985 (people/km^2)	100	108	43	64	120	126	1,023
Urban (10^6)	1.1	2.7	0.40	0.41	0.8	0.64	5.5
Rural (10^6)	0.6	0.6	0.49	0.50	0.5	0.32	0.3
Economy							
GDP, 1979 (10^6 TL)	73	158	35	39	69	26	457
GDP, 1986 (10^6 TL)	95	214	47	52	105	35	647
Annual growth, 1979-86 (%)	6.3	4.5	5.2	4.3	6.3	4.3	5.0
Agricultural, 1986 (% of of total sectors)	17.65	3.25	33.95	27.51	14.54	22.93	1.09
Average daily temperature (°F)							
Winter (Dec. through Feb.)	49-52	33-34	50-53	40-45	41-46	37-40	41-46
Summer (June through Aug.)	77-83	68-75	77-83	72-76	70-75	74-82	69-74
Location[c]							
Coal and lignite mines	+	+	-	+	+	+	+
Port capacity	+	-	+	+	+	-	+
Oil - pipelines, refineries	+	-	-	-	+	+	+
Gas - pipelines	-	+	-	-	+	+	+
Number of buildings							
Hotels, 1988	13	56	87	28	32	4	133

Variable	Izmir	Izmit	Kahramanmaras	Manisa[a]	Mersin	Zonguldak[a]
Population						
Total, 1985 (10^6)	2.3	0.74	0.84	1.1	1.03	1.0
Increase, 1975-85 (%)	38.5	55.4	31.0	20.4	44.6	24.8
No. of cities						
>3 million people	-	-	-	-	-	-
1-3 million	-	-	-	-	-	-
500,000-1 million	-	-	-	-	-	-
<500,000	19	5	7	-	7	-
Density, 1985 (people/km^2)	194	205	59	NA[b]	65	NA
Urban (10^6)	1.8	0.41	0.34	NA	0.56	NA
Rural (10^6)	0.5	0.33	0.50	NA	0.47	NA
Economy						
GDP, 1979 (10^6 TL)	158	76	21	43	49	61
GDP, 1986 (10^6 TL)	237	137	29	66	77	64
Annual growth, 1979-86 (%)	4.3	10.1	5.1	6.6	7.8	1.6
Agricultural, 1986 (% of of total sectors)	7.83	2.30	22.81	28.52	18.43	8.67
Average daily temperature (°F)						
Winter (Dec. through Feb.)	42-46	41-46	35-41	41-45	49-53	41-46
Summer (June through Aug.)	70-74	70-74	72-80	71-75	77-82	66-70
Location[c]						
Coal and lignite mines	+	+	+	+	+	+
Port capacity	+	+	-	+	+	+
Oil - pipeline refineries	+	+	+	+	+	+
Gas - pipelines	-	+	-	-	-	+
Number of buildings						
Hotels, 1988	44	9	NA	2	18	5

TABLE 4.3 (Cont'd)

Variable	Marmara Region	(City of Istanbul)	Aegean Region	(City of Izmir)	Medit. Region	S.E. Anatolia Region
Number of buildings						
Industrial, 1980[d]						
Minerals, chemicals, mining	125	(90)	77	(538)	68	32
Steel (production in t/yr)	1.9	-	3.4	-	1.1	-
Other manufacturing	467	(266)	206	(938)	221	84
Transportation and communications	121	38	39	(693)	60	11

Variable	Central Anatolia Region	(City of Ankara)	E. Anatolia Region	Black Sea Region
Number of buildings				
Industrial, 1980				
Minerals, chemicals, mining	59	(53)	18	90
Steel (production in t/yr)	3.2	-	-	-
Other manufacturing	166	(199)	59	266
Transportation and communications	82	(129)	8	38

[a]Population breakdowns could not be found for these provinces.

[b]NA = not available.

[c]+ = located within the province or are easily accessible.
- = not located in the province or not easily accessible.

[d]Industrial data are typically reported by region (see Fig. 4.12), except for the major cities of Istanbul, Izmir, and Ankara. Data for these cities are given in parentheses on the right-hand side of the region in which they are located, and they are in addition to the overall regional data being reported.

Sources: Refs. 17, 20-22.

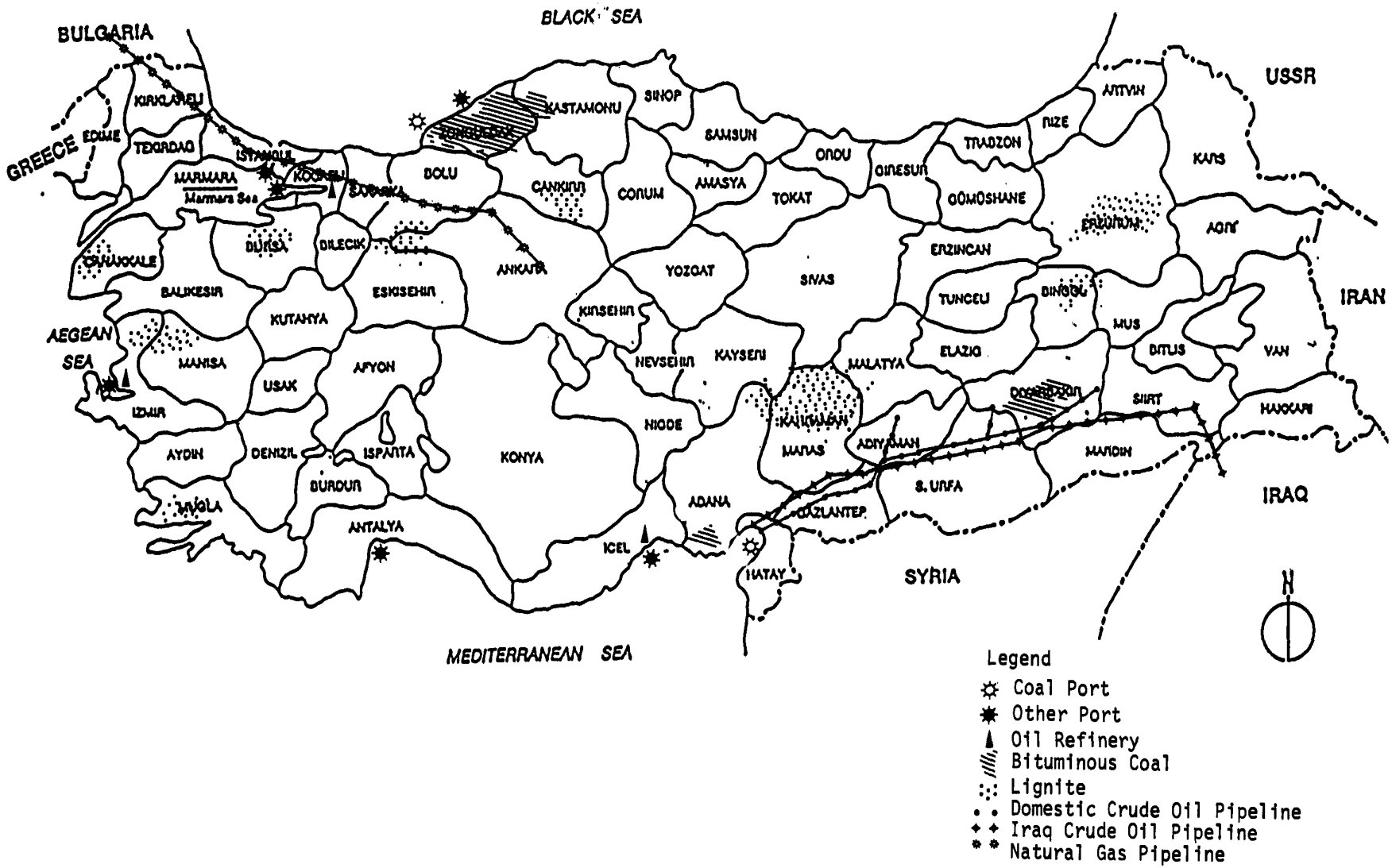

FIGURE 4.9 Energy Characteristics in Turkey (Source: Ref. 20)

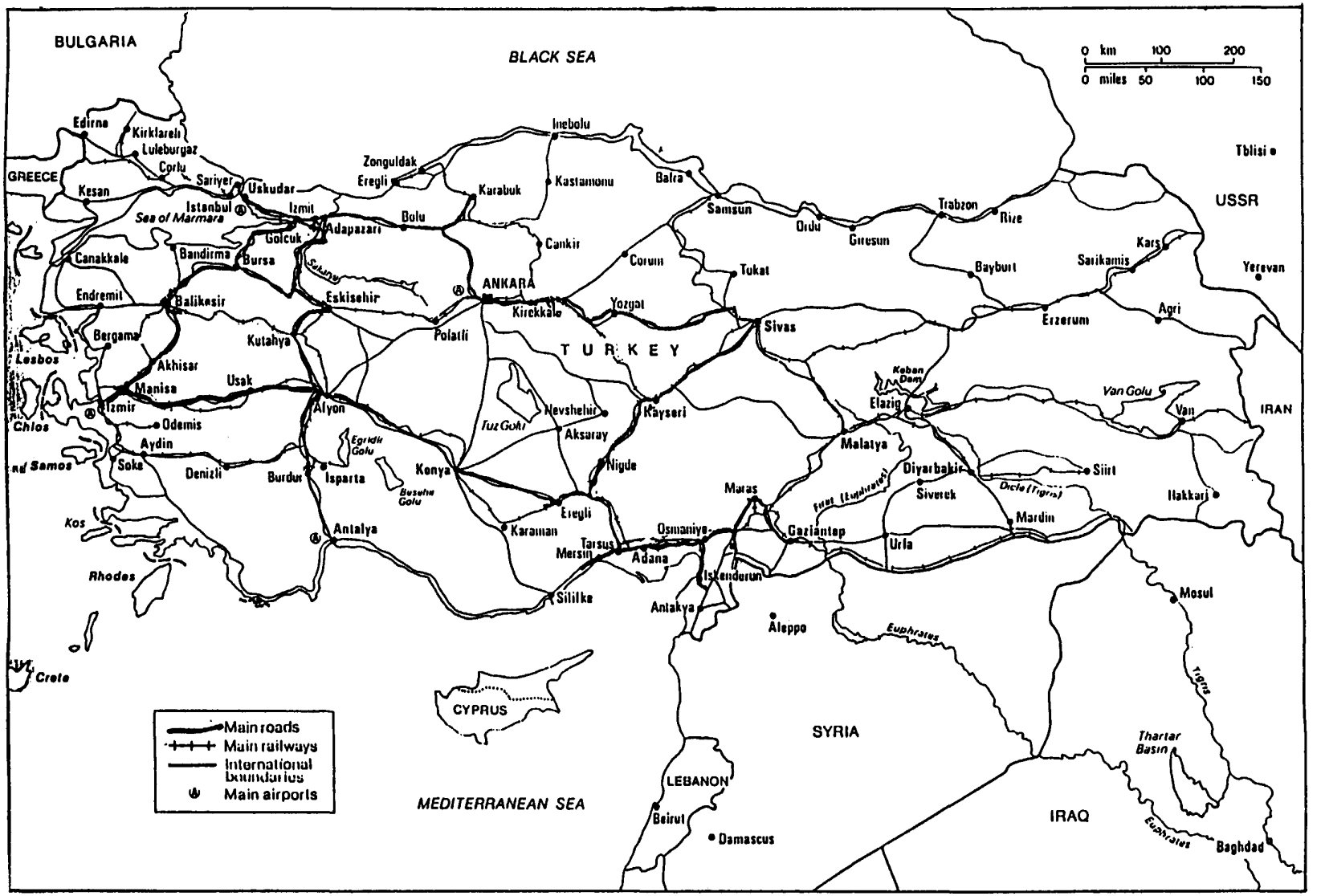

FIGURE 4.10 Main Cities, Roads, and Railways in Turkey (Source: Ref. 20)

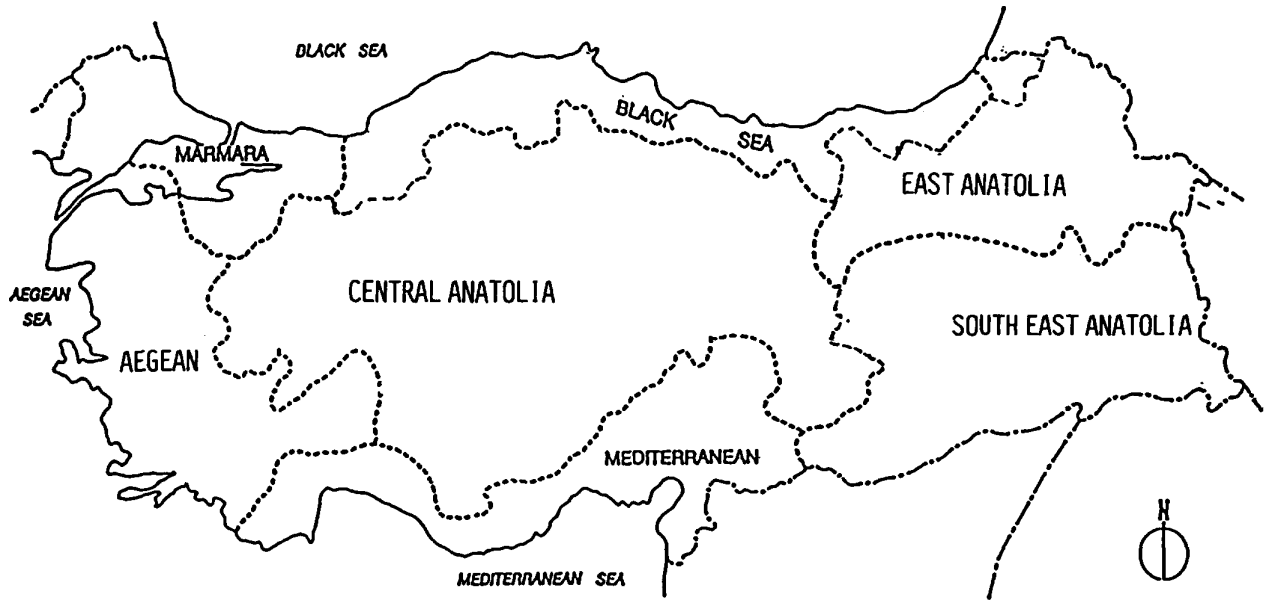

FIGURE 4.11 Major Regions in Turkey (Source: Ref. 48)

4.3.1. Istanbul

Located in the Marmara region, the most concentrated industrial region in Turkey, the province of Istanbul is the economic backbone of the country (Fig. 4.11 shows the regions of Turkey).[47] Here both the overall GDP and average annual growth in GDP since 1979 (at 5%) are among the highest in Turkey. In Istanbul, coal-intensive industries such as textiles, construction, food and tobacco processing, and steel production drive the industrial sector. The industries in Istanbul alone far surpass the total for the entire Marmara region. The total of seven regions in Turkey contain 1,391 food manufacturing enterprises, and 248 of these are located in Istanbul, with 211 in the entire Marmara region other than Istanbul. Istanbul is also the Turkish manufacturing center for textiles. There are 522 textile plants, which account for roughly half of the country's total. Chemical manufacturing is located predominantly in Istanbul, with 449 of the country's total of 743 being there.[46]

In addition to high economic growth, the province of Istanbul, which is actually a metropolitan area, contains the highest population density of all the Turkish provinces, with 1,023 people/km^2. The lowest percentage of GDP is in the agricultural sector in Istanbul, at 1.09%. The population increased 50% from 1979 to 1986, and at 5.8 million people, Istanbul has the largest population of all Turkish metropolitan areas.[48] Because the province contains the largest number of people living in an overwhelmingly (95%) urban setting, most people are forced to live in apartment buildings.[48] Furthermore, because of its high population, Istanbul has the largest number of hotels, hospitals, and schools in the country.

Nineteen cities compose the Istanbul metropolitan area. Bakirkoy, the largest, has 1.2 million inhabitants, while four others, Fatih, Kadikoy, Kartal, and Sisli, have

approximately 500,000 people each. The remaining 14 cities have less than 500,000 people each, the average being 170,000 per city.

Istanbul is a major port, but it does not currently handle coal. Coal and lignite reserves are not located in the general vicinity of Istanbul, but coal is imported for industrial and commercial applications. Istanbul is also located near the oil refineries of Izmit and Izmir. The Soviet natural gas pipeline that runs from Bulgaria through Istanbul, Izmit, and Ankara is fully operational. Istanbul has a rapidly increasing pollution problem, and it is thought that the use of this natural gas supply will help to abate it.[20]

Possible niches for ACT in Istanbul would cover the entire gamut of RCI applications, because of its large population, large industrial base (which indicates the present use of coal), and the high population density (with so many people living in apartment buildings).

4.3.2 Izmit

To the east of Istanbul in the Marmara region lies the province of Izmit (or, interchangeably, Kocaeli). Like Istanbul, Izmit is highly industrialized, with 75% of its provincial GDP in the industrial sector.[47] It also possesses the fourth highest GDP overall in Turkey. It has remained the strongest growing province in terms of GDP, with an annual average growth rate of 10% from 1979 to 1986.[47] No specific data on Izmit's industrial mix were available. Based on the facts that a high proportion of its GDP is in the industrial sector and it is located in Marmara, however, it can be inferred that industrial applications of ACT are feasible. Hotels licensed by the Ministry of Culture and Tourism report only nine hotels in Izmit, and data for hospitals could not be gathered.

In 1985, the population of Izmit was 740,000. The growth rate from 1975 to 1985 was the highest in Turkey; the population increased by 55%. It is a densely populated area, with 205 people/km^2, second only to Istanbul. Only 60% of the population is urban, compared with Istanbul's 95%. It ranks as second-lowest in the percentage of GDP in agriculture, at 2.3%, making it an important industrial and services center in Turkey.[47]

Another strong point about Izmit is that, like Istanbul, it has a major port on the Marmara Sea.[3] It is situated between Zonguldak, which has the largest coal reserves in the country, and Bursa, an area with major lignite reserves (see Fig. 4.9).[3] The drawbacks, however, are that the Soviet natural gas pipeline runs through Izmit and that an oil refinery is located in the province. Even though the coal is used in industry and the pipeline is used mainly for heating purposes, there is a possible niche for ACT in Izmit in the industrial sector because of its high propensity to use coal and its proximity to the mines at Zonguldak.

4.3.3 Mersin

Lying on the eastern coast of the Mediterranean Sea, Mersin (Icel) is a province that from 1979 to 1986, had the second-highest rate of GDP growth in the country, at

7.8%.[47] The overall GDP in Mersin was relatively low in comparison with that of the other Turkish provinces in this study, but the high rate of growth offset it. Mersin ranks third in the country in the percentage of its GDP that is in the industrial sector, at 46%, behind only Istanbul and Izmit. The Ministry of Culture and Tourism reports that it licensed 18 hotels, and that Mersin is considered to be a growing resort area.[21]

Mersin is a largely urban province, with close to 60% of the population located within the urban center. The total population of the province is 1.03 million, and it has the third-highest rate of growth in Turkey, at almost 45%.[48] The density of the population is average for this study, with 65 persons/km^2. In contrast with some of the larger cities, the percentage of its GDP in agriculture is relatively high, at 18%.

Mersin lies close to the major coal-importing port of Iskenderun. It is also very close to the Tarsus coal reserves, but the estimated reserves in that area are negligible, at 20 million t. A major petroleum refinery is located in Mersin, and the province is close to the domestic and Iraqi crude pipelines. The oil from both of these lines goes directly to the port of Iskenderun and does not supply any of the cities en-route to the port. The oil is still considered a major competitor to coal, but it will probably not affect coal use in the industrial sector. Mersin is not located near the natural gas pipeline, and according to the Turkish Energy Counselor in Washington, D.C., there are no near-terms plans to extend the pipeline to the Mediterranean coastline.[49]

The most probable niche for ACT in the province of Mersin appears to be the industrial sector. The tourism sector is not yet well developed, and the Mediterranean climate limits widespread heating applications.

4.3.4 Antalya

Like Mersin, Antalya is located on the Mediterranean coast, on the western side of the sea. The overall GDP of the province is relatively low, yet GDP growth was at pace with that of Istanbul at 5% annually from 1979 to 1986. In contrast with most of the other provinces in this study, Antalya has the lowest percentage of its GDP in industry, at 17%, and the highest percentage of its GDP in agriculture at 34%.[48] However, Antalya is considered a major and growing resort area, second only to Istanbul in the number of hotels licensed by the Ministry of Culture and Tourism, at 87.[21]

The population of the province is relatively low at 900,000, and it has the lowest population density of the provinces in this study, at 43 persons/km^2. It is also predominantly rural, with close to 60% of the population residing outside the urban centers. Growth, as in all other provinces, is high; 33% from 1975 to 1985, which demands construction of dwellings and infrastructure support.

Antalya is a port city. It is not located near the natural gas pipeline, any oil refineries, or oil pipelines, but it is in the vicinity of the major lignite reserves at Mugla.[3] These facts tend to overshadow the economic and demographic statistics presented above.

The most likely niches for ACT in Antalya, with its growing tourism and population bases, would appear to be the tourism and residential sectors. Since the industrial sector is not a factor in this province, and because coal and lignite are the major energy resources in the area, other sectors may be more amenable to employing ACT. The likelihood of success in marketing ACT in Antalya could be increased if ACT were to be used to maintain low pollution levels in this area with its growing tourism trade.

4.3.5 Izmir

Izmir, the third most populous Turkish province, is a major port on the Aegean Sea. Izmir's economy is strong, with the second highest GDP among provinces (237 million Turkish lire or MTL) and an average annual growth rate of 4.3% over the period 1979 to 1986.[47] Approximately 38% of the province's GDP is attributed to industrial activity, of which iron and steel production, food processing, textiles, and chemicals are major contributors. The tourism sector is also important to the area; Izmir currently ranks fourth nationally, with 44 hotels, and is expected to grow in importance as a tourist area.[21]

Although the mild climate may inhibit marketing of ACT for residential or commercial heating purposes, the high population growth rate and densities suggest there could be many high-rise apartment dwellings. Approximately 78% of the population resides in the metropolitan area (1.8 million), and the population density of the province as a whole is third among the areas analyzed, at 194 persons/km^2.[48] With its proximity to major lignite areas (Soma, Bursa, and Canakkale to the north; Mugla to the south), this province most likely relies on coal as an energy source to a significant degree (see Fig. 4.10). It is not part of the current gas distribution system, and extensions to Izmir are not planned in the near term. An oil refinery on the coast poses the major competition to increased coal use.

In sum, the potential markets for ACT in Izmir are many: the strong tourism sector is a growth area that may be open to ACT applications; the predominance of high-density residential dwellings is also favorable; and the iron and steel, food processing, construction, and textiles industries that are concentrated here all rely on coal to some degree.[48] The availability of domestic coal makes this an attractive area, as does its current isolation from both the gas and oil pipelines.

4.3.6 Ankara

The Turkish capital and province of Ankara are located in the western portion of the Anatolian plateau at an altitude of 3,000 feet. Ankara is the only interior province selected for this market analysis. The positive attributes of this region include its status as a major population center, with the third highest GDP among provinces, and its proximity to the major bituminous coal reserves of Zonguldak and the lignite reserves of Bursa and Nallihan to the east and Cankiri to the west.[3] Ankara's population of 3.3 million is second only to Istanbul's; Ankara is also second to Istanbul in terms of

urbanization, with approximately 81% of the population living in urban areas compared with 94% for Istanbul.[48]

Partly because of its interior location, Ankara experiences the coldest winters of the provinces selected, suggesting that the residential and tourism sectors are potential sectors for application of ACT. In fact, lignite is already used extensively for heating here, which has led to severe pollution problems that are exacerbated by the capital city's location at the center of a bowl formed by rugged hills. The country's only gas pipeline, which originates in Bulgaria, currently ends in Ankara, providing an alternative to coal. Oil is not easily accessible except by transport from the port of Izmit.

Major industries include iron and steel production and food processing, which both historically rely on coal.[46] The food processing and packaging industry holds potential for ACT cogeneration applications. With a heating season that lasts from mid-October to mid-April, both the tourism sector (Ankara has the third largest number of hotels) and the residential sector (which is increasingly oriented toward large apartment buildings) are promising ACT markets.

4.3.7 Zonguldak

In contrast to the more cosmopolitan areas of Ankara and Izmir, Zonguldak is an economically depressed, heavily industrialized area (61% of GDP) known for its extensive bituminous coal reserves. The province has a population of 1.03 million, which grew at an annual average of 25% over the period 1975 to 1985.[48] Data on population density were not available, but it appears that Zonguldak, although a major population center, is not highly urbanized. Therefore, residential applications for ACT are limited in Zonguldak because there are few high-rise dwellings. Similarly, its very limited tourism sector does not warrant ACT marketing efforts.

In 1986, GDP for the region was at the low end of the provinces analyzed (64 MTL), and GDP growth was extremely low over the period 1979 to 1986, at a 1.6% annual average. Nevertheless, because of this province's favorable energy resource characteristics (i.e., not on an oil or gas pipeline, close to the coal-importing port of Eregli, and a domestic coal producer), industrial ACT applications have promise here. In particular, the food processing and packaging and machinery manufacturing industries are historically major consumers of coal.[11] Given its heavy industrial base and reliance upon coal, a more extensive breakdown of the industrial makeup of this province might prove useful in terms of ACT marketing.

4.3.8 Bursa

Bursa, located approximately 25 km inland from the Sea of Marmara, is a major industrial and population center. The province's 1985 population of 1.3 million had grown at an average annual rate of 38% over the previous 10-year period.[48] Population density is fairly high, at 120 persons/km^2; however, urbanization is somewhat behind the other major provinces, at approximately 61% of the total population. Bursa ranks fifth among provinces in GDP (105 MTL), and its GDP showed strong growth, at an average annual

increase of 6.3%, in the period from 1979 to 1986. Industry contributed approximately 43% to the GDP in 1986, with agriculture maintaining a strong portion, at 15% of the GDP.[47]

Bursa's energy options are varied: lignite deposits have been found within the province, and additional domestic lignite reserves in Canakkale and Cankiri are accessible; the nearby ports of Izmit and Istanbul are potential coal-importing areas; the oil refineries at Izmit and Istanbul are close by; and, although not currently on the gas pipeline extending to Ankara, plans for feeder lines to Bursa are underway.

Although the Bursa province ranks fifth in terms of number of hotels, with 32, its location between the popular Aegean coast and Istanbul suggests that tourism will increase in this area. Residential and commercial construction is also likely to be on the increase, given the growth in population and GDP. The climate is similar to that of Istanbul, which is comparable to the mid-Atlantic United States. Coal, oil, and wood are the primary fuel sources. ACT marketing efforts should be targeted to the densely populated metropolitan area of 0.8 million people.

In terms of industrial ACT applications, the food packaging and processing, textiles, and machinery industries are good candidates for coal-based technologies; food processing is also of interest due to its cogeneration potential.

5 MARKETING CHANNELS

This section explores the mechanisms by which U.S. ACT firms might penetrate markets in Spain, Italy, and Turkey, and presents information on the competition to U.S. technology that may already be present in the three countries. Section 5.1 briefly describes the basic market-penetration techniques, including direct export, establishing local operations, using agents and distributors, participating in a joint venture, and technology licensing. General considerations for choosing among these alternatives are explained in Sec. 5.2. Each country has its own regulations and policies on investment and imports; these can take the form of either incentives or "protection." Incentives act as enticements for imported commodities or investments and may be in the form of tax holidays, reduced tariffs, or accelerated depreciation allowances for investments. Protectionist measures, on the other hand, act to preclude imports in the interest of domestic concerns and may appear in the guise of high tariffs or onerous standards requirements. These country-specific concerns are discussed in Sec. 5.3 (for Spain), 5.4 (for Italy), and 5.5 (for Turkey). Competition to U.S. ACT manufacturers is discussed and a competitive assessment of the three countries is provided in Sec. 5.6. Finally, Sec. 5.7 considers the trading environments and competitive factors that influence marketing strategies in each country, and suggests those strategies that appear to be most advantageous for Spain, Italy, and Turkey.

5.1 TYPES OF STRATEGIES FOR MARKET ENTRY

The sections below explain in general terms the marketing alternatives open to the manufacturer or distributor of small-scale coal technologies. The list begins with the strategy that affords the U.S. manufacturer or distributor maximum control over the sale of the commodity (establishing local operations in the foreign country) and ends with the strategy that affords the least amount of control (technology licensing).

5.1.1 Establishing Local Operations or a Branch

The organizational structures that provide for the most control in an overseas market are, in most cases, a wholly-owned subsidiary or a branch office. They require the most capital and managerial investment but offer complete control for the U.S. manufacturer. Establishing a local operation (manufacturing) is an extremely costly venture to undertake, and a complete understanding of the rules for operation, taxation, and capital repatriation, among others, in the foreign country is necessary. In terms of strategic placement of a company's physical resources, however, the main advantages in establishing a local operation are that the proximity between the product and customer are enhanced, and recognition of the company's product as being locally manufactured may provide it with a competitive edge in a country with many outside competitors.

5.1.2 Direct Selling

The strategy of selling directly to an end-user in an overseas market may initially appear to be a low-risk, low-cost endeavor, but this strategy does contain some risks and costs not associated with other types of marketing strategies. For instance, when transporting a commodity to an overseas market, issues such as tariffs, nontariff barriers, and import and export licenses must be thoroughly researched to determine whether any of these regulations impede the transaction into the foreign country. In direct sales, a company inherently retains a great deal of control over the product and the export process, but increased expenditures in areas such as market research, delivery, shipping, insurance, and maintaining overseas contacts combine to form increased risks and costs for the exporter. Ensuring that the goods enter the foreign country under the terms of the original contract and that they reach their destination on time are major areas of risk to the seller. If the goods become delayed in customs at the port of entry, timely delivery becomes a risk. Costs such as ocean freight, marine insurance, and customs duties are often borne by the seller, but once the goods are sold, the risks to the seller are minimized.

5.1.3 Agents and Distributorships

A contractual agreement that provides for securing an "independent intermediary," acting in the name of and for the seller, is called an agent's agreement.[50] An agent may act as a facilitator for the exporting firm or may sell the goods of the U.S. exporter on a commission basis in an exclusive territory. A contractual agreement whereby a U.S. manufacturer sells its products to a foreign merchant for resale is referred to as a distributorship.[51] One of the attractions of a distributorship is that the foreign distributor assumes the responsibility of marketing and support. In the case of a stocking distributor, the foreign agent will most often maintain inventory and a servicing operation for the products.

The decision to enter into an agent's or distribution agreement must ultimately serve the interests of the U.S. manufacturer in areas such as cost, service, and product knowledge.[51] It should also be based on the ability to contract with reputable agents or distributors who maintain a network of contacts and have backgrounds and established customer bases in the commodity field. The U.S. manufacturer must ensure that the contractor possesses sufficient product and marketing know-how.

5.1.4 Joint Ventures

A joint venture is a cooperative partnership with a foreign manufacturer that is formed to establish local manufacturing operations.[52] It allows a U.S. firm to align itself with a partner who is knowledgeable in local regulations, has requisite local market knowledge, and can develop a regional marketing strategy. Additionally, a joint venture may provide the necessary forum in which to spread the high costs and risks associated with establishing foreign operations. The major disadvantage in establishing a joint venture is that control can become a problem, as do the sharing of risks and coordination of responsibilities.

5.1.5 Technology Licensing

A contractual agreement whereby the holder of a U.S.-registered patent or trademark entitles a foreign manufacturer the right to (most commonly) sell, use, or distribute the patented product in the foreign licensee's market is referred to as "technology licensing".[50] A technology license established in agreement with a foreign manufacturer of small coal-fired combustor technologies would be an avenue by which a U.S. firm could gain quick entry into a foreign market with fewer financial and legal risks than other strategies such as a joint venture or foreign operations. Through licensing, a firm diminishes potential problems connected with the direct export of goods into a country that may have a myriad of tariff and nontariff barriers and regulations that impede the importation of goods.[52] U.S. firms with limited export knowledge may find this strategy less complicated but also less profitable than direct exporting.

The potential loss of control of the technology once it is in the possession of an unaffiliated foreign licensee becomes the prevalent concern for the licensor. The licensor's control over the manufacturing or marketing operations may not meet the product standards as initially outlined, and unless contractually agreed upon, the licensee may attempt to market to countries already engaged in trade with the original licensor, thus compromising the relationship between licensor and licensee.[52]

5.2 GENERAL CONSIDERATIONS FOR MARKET-ENTRY STRATEGIES

The particular strategy that is chosen to enter a foreign country's market is often the decisive factor in the success or failure of a marketing initiative. Many complex issues must be considered in an analysis of marketing options. For example, the internal policies and conditions of the firm attempting to enter the market will influence the type of approach taken. Important firm-specific factors include the availability of capital resources, the degree to which the firm wishes to retain control over the product (in terms of quality and technological integrity), the firm's long-term strategies, the experience of the personnel, and the firm's knowledge of overseas markets. Other factors to be considered when choosing a strategy include the following:

- *Tariffs.* Tariffs are the means by which a country "taxes" goods imported from another country. In the case where tariff rates are exceedingly high, the tariff acts as a deterrent (or barrier) for the importation of a certain goods. Tariff rates are usually based on the value of the goods being imported, but they may be controlled by international agreements or membership in international organizations.

- *Nontariff Barriers to Trade.* In addition to tariffs imposed on imported goods and services, countries also use nontariff barriers. These effectively restrain trade by implementing trade practices that are the most advantageous to home market firms. One such measure is excessive government intervention in the trade sector. Subsidies and state trading, for instance, give home-country goods

and services a distinct advantage over imported goods and services. Other forms of nontariff barriers include the establishment of quotas, restrictive forms of business transactions, and entry procedures in terms of classification, product standards, marking, and labelling.

- *Import Licensing.* Import licensing is often used to preclude a product's entry into a country by imposing country-specific rules and regulations on foreign business transactions, quotas, or local content requirements. Although import licenses may still be required for imports from non-OECD countries, no import licensing requirements currently exist for energy-related goods being manufactured in the United States and sold to any of the three subject countries.

- *Royalties and Fees.* Each country has regulations that influence the amount of the royalties or fees that foreign firms that are licensing technology (or entering into other business arrangements) can receive.

- *Intellectual Property Rights, Patent and Trademark Protection.* Intellectual property can be defined as the right to ownership of a process or products. This includes patents, trademarks, copyrights, and trade secrets (in addition to, for example, computer software, mask works, and designs). Before a technology is exported, the intellectual property laws of the importing country should be examined to protect the technology being exported. Many countries still do not provide adequate intellectual property protection, especially when technology licensing is explored. The number of instances of patent infringement and trademark piracy have increased in recent years. The U.S. Omnibus Trade and Competitiveness Act of 1988 has addressed these infringement and piracy problems, and the U.S. government has identified chronic violators. Furthermore, the EC, under its 1991 restructuring schemes, plans to codify Community-wide intellectual property laws. As of yet, however, there has been no unified proposal to which all countries agree.

- *Regional Incentives.* Some countries offer particular incentives for location in underdeveloped or economically depressed regions.

- *Corporate Taxation.* The rate at which profits are taxed in a country will affect the attractiveness of setting up operations within that country's borders.

With regard to direct exporting, representatives of the U.S. conventional-boiler industry interviewed during the course of this study indicated that costs of overseas shipping usually make U.S. boilers noncompetitive with European boilers. Presumably, this constraint to the direct export of conventional boilers would also be applicable to U.S. ACT, unless, for some reason, particular types of ACT are lighter and less bulky than conventional technologies and hence easier and less costly to ship. Moreover, direct sales of ACT may not be a sound market-entry strategy, because end-users would probably not be well versed enough in ACT to properly or effectively utilize it. Use of agents or distributors would lessen this constraint; however, finding agents or distributors who are familiar enough with U.S. ACT and who have sufficient marketing support for these new technologies could be difficult.

A group of U.S. manufacturers of large conventional boilers appears to be firmly entrenched in Spain, Italy, and Turkey, largely through the licensing route. Thus, U.S. firms have been able to successfully enter these markets, and licensing has been a successful route of entry for conventional combustion technologies. However, ACT represents a new "Phase I" technology, which has never before been introduced in the market. Hence, the marketing strategy used for it must allow for complete industry exposure to the technology, so an awareness of its benefits and advantages can be established and strengthened. Licensing would probably be inappropriate for marketing a new technology, because unless licensees could carry out successful promotional efforts, news of the technology might not reach all potential manufacturers or end-users.

Marketing efforts for U.S. ACT might best be those that would allow overseas manufacturers and end-users to gradually become familiar with the technologies. Most experts interviewed in the three countries believe that a strong in-country presence by U.S. firms now (e.g., through such means as demonstration projects) is a prerequisite for eventual market entry. In the long run, this condition might best be achieved though a joint venture, wholly-owned subsidiary, local operation, or branch office. These forms of organization would allow a U.S. ACT firm to monitor the utilization of the technology and to be on the site for support. All the countries analyzed in this study encourage direct foreign investment and provide incentives for U.S. firms to locate their operations overseas (see Secs. 5.3-5.5 for more details on these incentives).

Coal-based technologies sometimes face more hurdles than those based on other fuels, especially gas. Some "innovative" marketing initiatives may have to be used to promote coal use in the European small-combustor market. Certain strategies have proven somewhat effective; for instance, nongovernmental schemes have been employed by some European coal producers (Charbonnages de France, in particular).[10] These initiatives aimed at reducing the risk to buyers who decide to convert to coal. The package included the following offers by the coal producer:

- To carry out feasibility studies, select equipment, and provide assistance during construction, startup, and operation;

- To provide third-party financing, with only the heat actually being bought by the user (this financial arrangement provides a way to avoid the problem of the very short payback time required on investment by small establishments);

- To grant technical guarantees on the operation of the plant (which substantially reduces the maintenance and plant availability risk to the buyer); and

- To underwrite a minimum price differential between oil and coal for a certain length of time (if the price differential would fall below a guaranteed value, the coal suppliers would pay the difference; if it were higher, the two parties would share the difference).

Although these initiatives were developed by a coal producer, technology manufacturers could offer similar packages, perhaps in conjunction with the coal and lignite producers. If U.S. ACT is to be successfully produced and marketed in Europe, it is likely that in-country, innovative schemes such as the one described in this example could be very effective in promoting its purchase and utilization.

Marketing U.S. ACT in Europe should provide distinct advantages for all U.S. businesses in the energy field -- the foremost benefit being that a firm might be labeled a "technology leader" or "environmentally conscious." The transfer of U.S. technology abroad can also provide a "quid pro quo" related to the inputs for the transferred technology. For instance, the transfer can be contracted as a tie-in arrangement, whereby U.S. coal must be used as an input whenever the technology is transferred.

5.3 SPAIN'S TRADING ENVIRONMENT

Spain's foreign trade policy has undergone major overhauls and been greatly liberalized since Spain's 1986 accession into the EEC. Trade with the EC members has grown, while imports from the United States have nominally decreased, with West Germany supplanting the U.S. as Spain's major source of imports in 1987.[53] Spain has had to comply with the gradual reduction and elimination of customs barriers in trade with other EEC countries, and it must conform to the common external EEC tariffs (for non-EEC countries) by 1993.[54]

Royal Decree 2077 guides all foreign investment transactions and provides the legal framework for such.[55] The lead agencies responsible for all foreign investment are the Council of Ministers (at the Cabinet level) and the Ministry of Economy and Finance. The Directorate General of Foreign Transactions (DGTE) in the Ministry of Economy and Finance, with whom all investment must be registered, administers and approves all applications for foreign investment.[56]

Establishing Local Operations or a Branch. Upon accession into the EEC, Spain liberalized its investment regulations to conform to EEC regulations as well as to attract

badly needed foreign capital. Most investments are no longer subject to the intense scrutiny of the DGTE, nor do they generally require advance approval.[56] All forms of business organization are allowed, and foreign investment is defined as "participation in a Spanish firm that gives the investor influence over management or effective control of the company; or the establishment of a branch of a foreign corporation."[57] Registration with the Investment Register of the DGTE is still required and may be approved by the autonomous regional governments. Investors are entitled under the investment laws to transfer profits freely outside of Spain without limit.[55] While the requirements for setting up a branch are similar, the tax allowances made for investments are not applied equally to branch operations.[56]

Distributorships. The government of Spain recognizes the establishment of distributors throughout the country.[58] Distributor contracts, which are widely employed in Spain, are monitored by the Ministry of Economy and Finance. Agents in Spain who arrange for the documentation and customs clearance of imported goods must be accredited by the Customs Department of the Ministry of Economy and Finance and be members of the National College of Agents.[56]

Joint Ventures. The formation of joint ventures between foreign investors and privately held and government-owned firms in Spain is not prohibited by law, provided the companies comply with the registration and screening requirements set forth by the Ministry of Economy and Finance. However, the establishment of a joint venture between a foreign investor and the government itself (for instance, in a government-sponsored project), is not allowed.[57]

Technology Licensing. The Spanish government, along with changing the foreign investment regulations, instituted new approval procedures for licensing contracts intended to make the process more efficient and less bureaucratic. The DGTE is now empowered with the full responsibility for regulating and overseeing all licensing contracts, and all licensing and technical assistance agreements must be screened by the Ministry of Industry to ensure that they are in the national interest. Registration is then required with the Registro do Contraltos de Transferencia de Tecnologia (Registrar for the Control of the Transfer of Technology).[56] Under the new approval system for technology and technical assistance contracts, a company files its contract with the DGTE, which sends it on to the Ministry of Industry's Office of Technological Innovation (OTI) and to competition authorities. The OTI examines the contract conditions to ensure they reflect market values, and competition authorities check that they do not restrict trade. A contract not rejected within 30 days can be considered to have been approved by all the proper authorities, and royalty transfers can be made under it automatically.[56]

Royalty and fee rates for the licensing of technology, depending on the industry and the importance the government attaches to this industry in terms of national interest, will vary. The rates range from 0.5-3%, depending on the level of technology and whether there is equity participation by the parent company.[56]

Patent and Trademark Protection. The basic law concerning patent protection in Spain is the Industrial Property Law, passed in 1986 to conform with EEC practices. It provides for two basic forms of industrial property: patents of invention and utility models.[56]

Patents of invention cover, for a period of 20 years, industrial apparatus, machines, instruments, and mechanical or chemical processes for obtaining an industrial result or product. Utility models, for a 10-year duration, describe or present a process. Applications for patents and utility models are filed with the Industrial Property Registrar.

Registering a trademark requires the same review and procedures as those needed for a patent. To receive full legal protection under Spanish law, a trademark must be registered for exclusive use.

Tariffs. Presently, most duties are calculated on an "ad valorem" basis ranging from 5-35%. After its accession into the EEC in 1986, Spain agreed to restructure its tariff rates on imported industrial goods over a period of seven years (to the 1993 deadline) to conform to the EEC's common external tariff schedule. By the end of this period, U.S. products are slated to be subject to duties in the 5-10% range.[56]

For small combustors, which are identified as HS 8402, the U.S. Department of Commerce, Office of European Community Affairs (EC Affairs), quoted a duty of 8% ad valorem. For small combustors used for central heating, identified as HS 8403, the quoted duty rate was 7.8% ad valorem.[59]

Nontariff Barriers to Trade. State-held companies such as the Institute of National Industries (INI, Istituto Nacionale Industriale), state-supported educational institutions, and government and semi-government agencies are required by law to purchase domestic goods, since this is deemed to be in the national interest. The only exception to this rule is when goods are unavailable within the Spanish market. In this instance, a certificate from the Ministry of Industry and the trade organization of capital goods manufacturers, Sercobe, allows for the purchase of imported goods.[56]

Pursuant to the EEC declaration on quotas, the Spanish quota system has been amended on approximately 90% of commodities. Import declarations for most goods are now required only for statistical purposes. Under the "globalized trade" regime (government-imposed quotas), however, the government establishes annual quotas on certain products, not including boilers or combustors, on the basis of past performance.[57]

Import Licensing. In accordance with EEC trade policies, Spain is gradually reducing its import controls. While import licensing is still in effect for those goods upon which quotas have been levied, most imports not under the "global trade" regime, including energy products, are unrestricted in trade.[56]

Regional Investment Incentives. Spain is behind the other EC countries such as Italy and West Germany in terms of economic development, and it has a high rate of unemployment. For these reasons, Spain has been allotted incentives from the EC in the form of low-cost loans (loans with preferential interest rates and/or extended financing terms) for underdeveloped regions and grants for employment-generating investments.

Tax incentives are provided to companies that locate their facilities in regions where there is excessive dependence upon agriculture, relatively high unemployment, or major restructuring in the local industrial base.[57] All regions in the country are eligible for some type of regional tax incentive from the Spanish government. Regions specifically targeted for incentives include Galicia, the Canary Islands, Estremadura, Andalusia, Castilla y Leon, Castilla La Mancha, the Basque region, and Asturias.[56] Incentives include assistance in plant location; reduction of the transfer tax and other taxes related to establishing a business; rapid depreciation of capital investment during the first five years, starting with the first year of operation; access to official low-interest credits; and other subsidies determined on a case-by-case basis.[57] According to Spanish law, incentives are granted to national and foreign companies without discrimination.[54]

Corporate Taxation. The government of Spain taxes resident corporations on the basis of worldwide profits at the rate of 35%. In line with the EEC directives on corporate taxation, Spanish resident companies (i.e., those in which the majority is foreign-owned) and native Spanish companies are taxed on the same basis.[60] Tax and investment credits may be available for companies locating in one of the areas targeted for development or working in new R&D projects. Foreign tax credits are available to circumvent dual taxation with the United States, since no bilateral tax treaty is maintained between Spain and the United States. A U.S.-Spain dual taxation treaty is presently under negotiation. If successfully implemented, this treaty would provide an impetus to increased U.S. investment by eliminating the taxation problems.

5.4 ITALY'S TRADING ENVIRONMENT

Law No. 43 serves as the governing regulatory mechanism for foreign investments in Italy, and the Ministry of Foreign Trade provides the administrative rules for such investment. The official policy of the Italian government is to encourage all foreign investment, but extensive bureaucratic regulations tend to protract the process of authorization, which apparently has had little, if any, noticeable effect on impeding investment by U.S. firms - the United States ranks as the second largest foreign investor in Italy, behind only Switzerland.[61]

To conduct business in Italy, individuals and firms are required to register with the local Chamber of Commerce, Industry and Agriculture. This office is empowered by the Ministry of Industry and Commerce to act as its field representative. Investments are categorized as either productive (enterprises that augment Italy's foreign capital

reserves) or nonproductive (enterprises not contributing to foreign capital reserves) and, as such, are regulated according to category.[62]

Establishing Local Operations or a Branch. All investments must be approved before their establishment by the Ministry of Industry and Commerce. Major investments that constitute U.S. $8 million or more must be approved by the Inter-ministerial Committee for the Coordination of Industrial Policy (CIPI). Investments are bifurcated, as stated above, into productive and nonproductive enterprises. The laws for a productive enterprise include the right to unlimited capital transfers, while non-productive enterprises are prohibited from transferring capital for the first two years. Requirements for establishing a foreign branch are the same as those for investment.[63] The types of business organizations commonly employed in Italy consist of individual or sole proprietorships; simple, general, limited, and limited-with-shares partnerships; limited-liability companies; cooperatives; and corporations.[64]

Even though Italy has a rather protracted approval process for foreign investment, the United States has been the leading foreign investor in Italy since the mid 1970s. It is estimated that approximately 40% of U.S. investments are wholly owned, while 6,500 U.S. firms are represented through subsidiaries, distributorships, or licenses.[64]

Distributorships. Italian law provides for the establishment of distributorships in either exclusive or nonexclusive arrangements. In Italy, as in all countries, the local distributor of the commodity takes title to the imported merchandise and sells it on his/her own behalf. When contemplating exclusive distributorships, any antitrust implications of such arrangements must be considered, especially if arrangements are made to apply to the whole of the EEC.[64]

Joint Ventures. A joint venture (Associazione in Partecipazione) in Italy, according to the U.S. Department of Commerce, "involves the participation by supplier of capital in the profits of the business." The operator manages the business and is solely responsible for the obligations assumed toward third parties. The person furnishing capital is responsible for any loss in direct proportion to the share in the net profit, limited to the amount of personal investment.[64]

One approach to establishing a joint venture in Italy is to do so with a state-owned company. Since the state role in industry is pervasive, this strategy could circumvent some of the hurdles encountered when an industry must compete in fields controlled by state enterprises, which includes the power generation field. The government is advocating arrangements with its state-owned companies as a strategy for growth. Instead of encouraging outright privatization schemes for these industries, the government intends to foster growth and participation in joint ventures with foreign companies. This industrial-policy-type approach, the government believes, could reduce the number of more mature, less profitable industries and strengthen Italy's participation in emerging, more profitable industries such as telecommunications and electronics.[63]

Technology Licensing. Upon government approval, technology licensing, in line with policies for establishing joint ventures, is encouraged. Under the U.S.-Italy Double Taxation Agreement, royalties from patents and trademarks are exempt from withholding taxes and royalties can be freely remitted.[65]

Patent and Trademark Protection. Italy is a signatory to the Paris Union for the protection of industrial property. As such, those U.S. patents and trademarks registered within both the United States and Italy are accorded the same protection in Italy as would be accorded an Italian product. Patents are valid for 20 years, without renewal or extension, from the date the application is filed. Italy's patent protection has been cited as somewhat weaker than that of other European countries, but legislation to provide greater protection is pending.[63]

Tariffs. As a member of the EC, Italy is a signatory to the Harmonized System for the classification of goods and the assignation of tariff values on a value-added tax (VAT) system.[66] The VAT is based on the c.i.f. (cost, insurance, and freight) value, plus duties accorded the goods in the tariff classification scheme and any applicable surcharge imposed upon the goods at the port of entry.

For the small combustors identified as HS 8402, EC Affairs quoted a duty rate in Italy of 5.5% ad valorem. The small combustors designed for central heating purposes and categorized as HS 8403 are assigned a duty rate of 5.6% ad valorem.[59]

Nontariff Barriers to Imports. According to a recent statement by Ente Nazionale per l'Energia Elettrica (ENEL, the Italian National Electric Energy Council), Italy views itself as an energy-technology exporter (particularly with regard to South America and Africa). It is participating in over 50 general cooperative arrangements with electric power organizations and government agencies in 40 countries, and it has "advisory and assistance" contracts with Italian foreign operations and other foreign partners.[65] To help gain a presence in industrialized countries, ENEL intends to engage in cooperative research efforts to obtain knowledge about certain emerging and advanced technologies. The effects that this strategy could have on the export of U.S. technology to Italy remain to be seen, but it could certainly inhibit the import of foreign technologies, including those from the United States.

Italy does not currently advocate specific "buy Italian" policies to preclude the purchase of foreign commodities or services, but it does impose quotas on imports from Japan (in an effort to protect its domestic automobile industry) and regulate imports from centrally planned economies.[63] No import controls or quotas have been imposed on small combustors.[59]

Import Licensing. Most goods entering Italy are not subject to any import controls. In general, the only goods that carry a stipulation for licensing and controls are

agricultural items. Energy-related goods, specifically small combustors, do not require import licenses.[59]

Regional Investment Incentives. The Mezzorgiorno or southern region of Italy has been targeted by the government as a region where incentives will be offered to attract investment. This region extends from Rome south to Sicily, Sardinia, Elba, and other smaller islands along the coast. Since Italy's move from a largely agricultural to a more industrialized economy after World War II, the Mezzorgiorno has seen an exodus of its population to the more industrialized northern cities. This has resulted in a loss of productivity and a concomitant increase in unemployment in the south. To encourage industrial revitalization, development, and growth, incentives in the form of grants, tax remissions and VAT rebates, and low-cost government loans are offered by the Italian government to investors who locate their facilities in the Mezzorgiorno, subject to the targeted schemes for designated industries. These incentives also apply to service and trade firms operating out of the region. The Agency for the Promotion and Development of the Mezzorgiorno (Agenzia per la Promozione della Svillupo del Mezzorgiorno) is the organization responsible for carrying out the goals as established by the government, but it is the ministerial-level Mezzorgiorno Department that approves all projects of the Agency.[63]

Incentives exist even in the industrialized north central regions of Italy, largely in the form of low-cost loans and rebates for indirect taxes. Additionally, incentives for R&D are also made available through the Ministry of Industry and the Institute for Italian Mobilization (IMI, Istituto Mobiliare Italiano).[63]

Corporate Taxation. No discriminatory tax laws for foreign investments are present in Italy. Firms located in the country are subject to the national corporate income tax and the local income tax, which apply equally to foreign and domestic firms.[67] A double taxation treaty between the United States and Italy basically stipulates that taxes will be levied on the commercial or industrial profits of only those firms that have established permanent residence in Italy.[68]

5.5 TURKEY'S TRADING ENVIRONMENT

Before 1980, Turkey's economy was relatively closed and highly dependent on import substitution. Although this policy was initially beneficial for internal economic growth, it inhibited growth in hard-currency revenues. The government recognized that the only way to expand in its foreign trade and investment was to liberalize the trade regime to allow for greater infusion of capital and integration of international trade.

To encourage foreign investment, the government of Turkey does not prohibit or preclude most accepted forms of business organizations by foreigners. Typical forms of investment acknowledged as legitimate within the Turkish commercial codes are corporations, limited liability companies, partnerships (joint ventures), branches, and subsidiaries. The policy of the government allows for commissioned agents, distributors,

and licensing arrangements. Owing to the lack of foreign direct investment in Turkey, the Ozal administration has advocated the "build, operate, and transfer" (BOT) model as a prototype for foreign investment. Under this program, a foreign firm builds a project, operates it while selling the output to the state at a fixed profitable price, and then transfers the project to Turkish control. The U.S. Department of Commerce in an overseas business report noted that the first BOT Memorandum of Understanding for a $1.4 billion thermal power plant was signed in August 1988. This agreement has encouraged the Turkish government to view the BOT policy as a viable engine for foreign investment in the country.

The Undersecretariat of Treasury and Foreign Trade in the Turkish Prime Minister's Office is empowered with the sole responsibility of establishing foreign investment regulations and overseeing all foreign investment in Turkey. The Foreign Investment Department (FID), created by Decree No. 10353 in 1986, is the lead agency under which the Undersecretariat's Office operates.[69] Since approval is required for all foreign investment and business transactions of any nature, applications for performing business in Turkey must be sent directly to and approved by the FID before any action being taken.

Turkish trade with the United States is based on, inter alia, the GATT, the U.S.-Turkey Bilateral Investment Agreement, OECD guidelines, and the U.S.-Turkey Treaty of Commerce and Navigation, which combine to form a codified trade policy intended to shape the direction of trade between the two countries. A U.S.-Turkey bilateral tax treaty is presently under negotiation.[70]

Establishing Local Operations or a Branch. Previously only two forms of business organization were allowed for nonnational companies: the limited liability company and the corporation. Now foreign investors are able to participate in a variety of standard business organizations.[69] Investments must be registered with the Commercial Registry, and once registered, profits and income may be freely transferred. All forms of investment are gaining in popularity in Turkey, but still the most popular are the limited liability and the corporation.[70] While state-owned enterprises pervade the Turkish industrial sector (particularly mining, energy, and public utilities), there is a growing movement to privatize some industries to allow them to become more market-oriented. The government still controls about 47% of all industry but is increasingly willing to permit market forces to control the destiny of some industries.[69]

Distributorships. Just as all other business organizations are subject to prior approval by the FID, so must a distributorship be approved by the FID. Although distributorships are considered acceptable by the Turkish government, the use of agents in Turkey is less common. Because agents are not usually organized by product lines, their effectiveness is diminished. No minimums or maximums are determined by the government in commission-type agreements.[70]

Joint Ventures. This form of foreign investment is encouraged by the government because it adds to the economy of the country; it contributes to its employment, technological advancement, and ability to generate capital. Like all other investments and business transactions, the FID must approve all contracts for establishing joint ventures. Once approved, there is no limitation on the amount of capital repatriated, provided all stipulations under Decree No. 6224 (Law for the Encouragement of Foreign Capital) are met.[70]

Technology Licensing. Before the early 1980s, technology licensing in Turkey was rare. Most of the technology transfers were in the form of joint ventures or in the form of the BOT model as advocated by the government. All technology licenses must be approved by and registered with the FID. Although licensing is currently not as popular in Turkey as it is in the other countries included in this study, the government does encourage such agreements, especially the exchange of technological information. Licensing agreements are drawn up by the seller and the contracted agent, and the government has stated that the agreements should include technical support and should not contain any stipulations that would act to restrict the licensee's operations. While technology licenses are valid for the duration of the agreement between the contracting parties, patent licenses must be registered annually with the FID.

The licensing regulations appear to be rather restrictive for the licensor because the Turkish licensee has the right to set its own prices, and no limits may be placed on production or exports. For these reasons, the contracting parties should spell out all stipulations clearly so that no infringements on patents or technology are made and so that each party understands fully its rights and responsibilities as contained in the written contract.[69]

Contracting parties to licensing agreements are free to determine their own royalty payments and licensing fees. As in all business transactions, the FID has the final say in accepting or rejecting the agreements. The regulations are quite liberal for the payment of royalties and fees, and once approved by the FID, royalties and fees may be freely transferred through Turkish commercial banks.[69]

Patents and Trademark Protection. Turkey is a signatory to the Paris Union. The national law for patent protection is the Patent Law of 1880, as amended, for protection for periods of 5-15 years. Applications for patent and trademark protection are made to the FID (State Planning Organization). Patents that have been registered in the United States may be registered in Turkey through an agent, and exclusive rights will be accorded that patent as granted under the Turkish patent law.[70] There have been complaints by the international community of patent and trademark piracy in Turkey, but there has been no action by the Turkish government to deter such infringements.[69]

Tariffs. The government of Turkey implemented the Harmonized System on January 1, 1989, the same date of the United States' implementation. Duties are assessed, as they were before, on the c.i.f. ad valorem basis of the goods.[71] Turkish

tariffs, which are not subject to any international agreements such as those followed by countries that are members of the EC, are considerably higher than those in other countries. They contain charges such as a municipal tax (15% of the customs duty); wharf tax (5% of c.i.f. value); stamp tax (10% of c.i.f. value); Support and Price Stabilization Fund tax (PSF, 8% of the c.i.f.); and VAT (1-15% of the c.i.f. value); in addition to all the duties, taxes and charges, fund levies, and customs-clearing expenses being charged. The duties themselves range from approximately 10% to a ceiling of 50%.[69]

For the small combustors identified as HS 8402, the Commercial Office of the Turkish Embassy in the United States quoted a tariff rate of 50% (the ceiling or maximum tariff rate) *plus* U.S. $1.00/kg for the total weight of the combustor itself. The duty rate for combustors for central heating, HS 8403, is 40% exclusive of the additional weight charges. These tariff rates are in addition to the charges (municipal tax, wharf tax, etc.) cited above.[72]

Nontariff Barriers. According to the policies of the Ozal Administration for liberalizing trade in Turkey, the government of Turkey has attempted to remove many types of nontariff barriers. Import licensing and import deposits, however, still remain largely intact.[73] Furthermore, standards requirements, mainly in the area of labeling for machinery and mechanical equipment, act to preclude the expeditious entry of imported items.

Import Licensing. While the government espouses its liberal trading policies, it still requires import licenses through the Undersecretariat for the Treasury and Foreign Trade, mainly for those items that are "grown or manufactured domestically".[69] Of course, this type of licensing scheme acts as a nontariff barrier for imported items on the import control list. Because of the liberalization of the import market in Turkey, many of the import controls have been lifted. The licenses are valid for an average of six months but are subject to an extension to 12 months in many cases. All goods imported into Turkey are subject to an import deposit (currently at 15% of the value of the imported goods) to be paid by the importer, refundable after foreign payment is made and the goods have been cleared through customs. Business International has stated in the publication, *Investment, Licensing, and Trading Abroad* for Turkey, that the import deposit may be waived for certain categories of commodities, including those for electrical energy. Furthermore, if an import is to be used for a project in one of the targeted development areas, the import deposit will also be waived. The FID makes the final determination on whether the import will be excluded from the import deposit, which may delay the import process. The Embassy of Turkey in the United States has stated that import licensing is not a prerequisite for the importation of small boilers from the United States.[72]

Regional Investment Incentives. The State Planning Organization controls and reviews all applications for incentives that are available to both domestic and foreign investors. Incentives include, among others, exemptions or deferrals for duties and

taxes, and loan subsidies.[66] The government has designated the areas in eastern and central Anatolia as investment priority areas. Companies investing in the Anatolia region may be eligible for some of the incentives. Also, there are no requirements for equity participation or export performance for eligible firms.[69]

Corporate Taxation. The taxes in Turkey are rather high and the tax structure is clearly spelled out for all types of business transactions. All foreign investment is subject to the central government tax rate of 46.8% of gross profit, but the tax rate is effectively raised to 48% with the addition of the taxes for the Defense Fund, Social Solidarity Fund, and Technical Training Fund. Patents and royalties are subject to a 26% tax rate on transfers. There is no tax treaty between the U.S. and Turkey.[69]

5.6 COMPETITIVE ASSESSMENT

Any effective analysis of overseas markets containing information on how best to enter markets includes a competitive assessment. Key competitors in the country are identified; these are both domestic and foreign firms that have maintained a presence in the markets. In addition, the level of technology in each country must be identified to determine the appropriate marketing applications.

To accomplish these objectives, a survey of government and industry representatives was conducted. Information on which domestic firms currently sell small boilers in Spain, Italy, and Turkey was obtained.[74] The nature of the markets for conventional coal-fired boilers was also examined.

The foreign companies that represent the major source of competition overall for the U.S. boiler industry are as follows: Deutsche Babcock (no relationship to Babcock and Wilcox), EVT, Steinmueller, and Lurgi GmBH of West Germany; Ansaldo and Franco Tosi of Italy; Sulzer of Switzerland; Ahlstrom and Stein of France; British Babcock and NEI of the United Kingdom; Studvik of Sweden, and to a lesser degree, A. Ahlstrom of Finland. This list is only meant to represent the major competitors in Spain, Italy, and Turkey; it is not a comprehensive, all-inclusive list of conventional coal-fired boiler manufacturers. Other firms that are considered to be major competitors may not be included in this list.

Because proximity to the local markets certainly adds to a company's ability to effect a presence in a market, these foreign companies stated above that are near Spain, Italy, and Turkey have a firm place in the conventional coal combustor market. Yet the conventional coal-fired, small boiler industry is mature, with a wide variety of competitors who have nearly identical products in terms of quality and function. The fact that other European countries have a firm footing in the small boiler market should be no surprise to U.S. industry. The experience of the U.S. firms contacted indicates that the way to gain initial entry into foreign markets is through licensing, joint-venture operations, and establishment of branch offices. Direct exporting was never really considered to be a viable option because of the costs involved in shipping small boiler units overseas.[75]

Some EC member countries (West Germany, Italy, France, and the United Kingdom), in addition to being the major competitors, also receive EC funds for R&D in the ACT field. This subsidization gives these countries some competitive edge in pursuing advanced technologies. Furthermore, as members of the EC, these countries are also privy to any directives about technologies originating from the EC. As discussed earlier, it is not clear what the final directives on technology harmonization will cover in terms of safety, health, and the environment. Nevertheless, it will be a competitive advantage to the EC member countries if technological standards are introduced and can be adopted more readily by them. With no opportunity to participate in the direction and shape of policy, U.S. industry will be at a disadvantage.

5.6.1 Competition to U.S. Manufacturers in Spain

Barcelona and Berga (in the province of Catalonia) were chosen as the areas in which to analyze competition in the small boiler industry. To determine the level of domestic activity of small boiler manufacturers, the Consorcio de la Zona Franca, Departmento de Promocion Industrial (a public agency promoting economic development in the Barcelona area) contacted approximately 20 manufacturers (see list in App. B) to obtain their personal assessments of the industry.

Overall, the manufacturers were unaware of the advances made by U.S. firms in the field of small-scale ACT. Domestic manufacturers face competition mostly from northern European competitors such as Deutsche Babcock, Steinmueller, and Stein, which have had ready access into Spain for some time and have established a solid presence in the small boiler market. The consensus in Barcelona was that Spanish companies would be receptive to forming links with U.S. companies to offset the predominance of these northern European corporations. The manufacturers acknowledge the need to establish connections with the U.S. and international markets. For ACT to become fully integrated into the conventional small boiler industry in Spain, the Spanish manufacturers felt that U.S. ACT manufacturers must first attempt to advise local-industry representatives of the advances being made in combustion technologies; only then can decisions about their worth to the Spanish domestic market be made.[74]

5.6.2 Competition to U.S. Manufacturers in Italy

In Italy, there are approximately 10 manufacturers of small, high-pressure boilers and cogeneration systems in the 10-50 million Btu/h range that burn solid fuel in conventional furnaces. All manufactured boilers must be certified by the Italian Boiler Directorate, which imposes extremely rigorous regulations that include annual inspections, complete overhauls every five years, and constant attendance by certified boiler mechanics. In Italy, combined-cycle turbine sets are currently being employed to offset the higher prices set by ENEL. In fluidized-bed technology, the only competitors in Italy are Foster Wheeler Italiana (a subsidiary of Foster Wheeler in the United States) and Ansaldo (an Italian firm), which market only to ENEL. Foster Wheeler Italiana representatives said that almost no new large-scale nuclear or fossil plants would be built in the foreseeable future. Rather, any incremental capacity that might be needed will

come in part from nonutility cogeneration installations, such as what has occurred in the United States.[74]

The Italians perceive themselves as future exporters of indigenous technologies in the near term and are presently focusing on exporting and manufacturing gas turbines. The major competitors in the Spanish market seem also to be prevalent in the Italian market. Those countries are France, the FRG, Switzerland, and the U.K. The advantages that most of these countries have over U.S. firms are proximity, membership in the EC, and an ability to transport whole systems at a lower cost than could U.S. firms. U.S. firms would incur customs duties and inland and ocean freight costs.[74]

5.6.3 Competition to U.S. Manufacturers in Turkey

In an in-country assessment of the Turkish small-boiler market, five of an estimated total 25 firms (5 make large boilers and 20 make small boilers) were contacted about their industrial expertise in Turkey. One of those contacted was BIMAS, a consulting firm majority-owned by Foster Wheeler U.S. BIMAS representatives claimed that the current preoccupation of Turkey's energy sector was the installation of the natural gas network in Ankara and later Istanbul. However, another firm, Tefken Immalat ve Muhendiskik, which builds boilers and has technical agreements with Stork, Deutsche Boilers, Combustion Engineering, and Lummus, believes that the market focus for the medium term is on gas-fired combustion. ISSY (which claims to be Turkey's largest high-pressure, small-boiler manufacturer) has investigated ACT in West Germany and believes that advanced coal-combustion technologies (in particular, fluidized-bed combustors) will be the future technology of choice in Turkey, because of their potential to be used with domestic lignite. At present, however, Turkish industry is not technically sophisticated and is not sufficiently concerned about pollution. Registration, inspection, and insurance are not compulsory in Turkey as they are in Italy, and life-cycle costs are not usually taken into consideration when the use of ACT is being debated. ALARKO is a large, diversified conglomerate that manufactures large boilers and licenses from EVT in the FRG. ALARKO was introduced to fluidized-bed combustion technology by A. Ahlstrom, Steinmueller, and ASEA/Brown Boveri, and it agrees with ISSY that ACT will be the only way to burn lignite in the future.[74]

In Turkey now are three demonstration units from FRG companies -- Lurgis-Landis, Steinmueller, and Thyssen. Nevertheless, according to a leading authority in fluidized-bed combustion in Turkey, there is a very positive attitude toward U.S. industry and technology. Many Turkish engineers are now trained in facilities modeled after U.S. universities and by Turkish professors with advanced degrees from U.S. institutions.

5.7 OPTIMAL MARKETING STRATEGIES

This section takes into account both the trading and business environments of each country and the competitive factors and offers suggestions to those U.S. firms contemplating marketing U.S. ACT overseas.

5.7.1 Marketing U.S. ACT in Spain

Since Spain's accession into the EC in 1986, many changes have taken place in the trading environment. The Spanish government has had to liberalize its trade regime by lowering tariffs on imported goods both within and outside the EC. Increased competition is being encountered from other EC trading partners. EC partners have also begun investing more heavily in Spain because of common tariff and investment regulations. While still lagging behind some of its other EC partners in terms of real economic development, Spain still offers good opportunities as an overseas market for the introduction of U.S. ACT in terms of its trading environment.

U.S. boiler manufacturers initially entered the Spanish market largely through licensing and some joint-venture arrangements. These routes offered the quickest way to enter the market when U.S. firms first began expanding overseas. Today, however, with the rapid increase in the number of European firms locating in Spain and the advanced technologies being introduced, the most promising marketing strategy for gaining entry and competing in the Spanish small-boiler market would be a joint venture or partnership (or some type of cooperative manufacturing and distribution agreement) with an established, reputable Spanish firm. In introducing a new technology into the market, a joint venture would allow a U.S. firm to direct the technological imperatives while capitalizing on the Spanish firm's business savvy in the local market. The U.S. firm could also oversee the promotion of the technology in the initial stages, to ensure that the market is sufficiently aware of the potential benefits and environmental advantages of the technology.

Along the lines of a joint venture, another option would be to invest directly in Spain by setting up local operations in the form of a wholly-owned subsidiary or branch office. This strategy is much more expensive than a joint venture (in which costs are apportioned between the Spanish and U.S. firm), and the commitment to stay in the market would have to be a long-term one. If successful, a firm that invests directly reaps all the profits from sales and retains total control over all marketing decisions (different from the cooperative relationship in a joint venture).

Locating operations in an area with investment incentives would not only provide more attractive access to the market, but it would allow a U.S. ACT firm to strategically position itself for the 1992 restructure. Incentives are granted at both the regional and national levels, and Spain has garnered a disproportionate share of investment funds from the EEC as a means to bolster its economy and increase investments in the country. All regions in Spain provide a variety or combination of incentives, but companies that are locating in traditionally agricultural regions, where unemployment is high and industrial restructuring is occurring, receive investment incentives such as cash subsidies, low-interest loans, and accelerated depreciation on capital investment.[56] Some of the more promising regions appear to be Galicia, Asturias, and Estremadura.

Although there is currently no formal bilateral tax treaty between the United States and Spain, one is being negotiated, and foreign tax credits are presently available for U.S. firms that set up operations in Spain.[54] Tariff rates are relatively low, at 6-8%. Yet U.S. industry representatives indicated that it is not cost-effective to ship a boiler

overseas, so the option to export directly should not be considered when introducing new technologies.[64]

5.7.2 Marketing U.S. ACT in Italy

Even though Italy is the most economically developed of the three countries included in this study, as well as having one of the stronger economies of the EC, the introduction of U.S. ACT into the Italian marketplace would have negative as well as positive aspects. The Italian government officially encourages foreign investment and provides a wide range of incentives.[63] U.S. investment in Italy is high, partially because of the bilateral tax treaty between Italy and the United States.[63] This tax agreement, in addition to incentives for investment, allows for taxation to be bifurcated between the United States and Italy, so that taxes levied in Italy will not be levied again in the United States. Tariff rates in Italy are the lowest of the three countries, at 5-7% for imported small boilers;[59] all forms of business organization are widespread in Italy; and there are no import-license requirements, controls, or quotas on boilers from the United States. The government is highly bureaucratic, and approval processes can be protracted for the inexperienced foreign investor.[64] The fact that the Italians have publicly stated their desire to become exporters of energy technology also tends to overshadow many of the advantages that result from the strong economic forces and liberal investment regulations within the country.

Italy appears to be a worthwhile location for investment, whether it be in the form of a joint venture, branch, or local operation. Its proximity to other European markets makes it a prime site for distributing U.S. ACT throughout Europe, especially since it is situated between Spain and Turkey. The cost savings realized from locating a plant where investment incentives are high could help offset transportation costs to neighboring countries. The Mezzorgiorno (the area south of Rome, including Sicily, Sardinia, Elba and other small islands off the southern coast) is targeted as a priority region for investment and provides attractive investment packages in the form of cash grants and low-interest loans. Those firms "undertaking new industrial initiatives" may be eligible to receive 100% exemption from corporate and local income tax for 10 years.[63]

Competition with major Italian boiler manufacturers would be a deterrent to U.S. investors, especially since Italy perceives itself as fast-becoming an energy technology exporter. U.S. business experience in Italy has been mainly in the form of licenses, and the response that Italian industry would have to U.S. ACT firms establishing a presence in the form of a manufacturing operation is not clear. Nevertheless, using Italy as a base of operations, even if the market is not best-suited for U.S. ACT applications, could be extremely advantageous because of Italy's fairly extensive investment incentive laws.

5.7.3 Marketing U.S. ACT in Turkey

Turkey still maintains the status of a developing country, but this label belies the economic strides the country has made since its trade regime liberalization in 1980. Behind West Germany, the United States remains one of the largest foreign investors

there and the number of investments from other foreign sources has increased eight-fold since the economy opened its doors to foreign investment.[70] Most investment was previously in the form of licensing, but all types of business organizations and investments, especially BOT (build, operate, and transfer), are now encouraged and do take place in the country.[70] There is currently no bilateral tax treaty between Turkey and the United States, but an investment agreement is being negotiated and expected to be ratified by the Turkish government. It was ratified by the U.S. Senate in October 1988.[70] Turkey has not as yet been granted full membership in the EC, but its liberal economic policies show that the country could contribute significantly to the EC's economic strength. The government now stresses infusion of private capital, export-led growth, and market-force determination of its economic sectors.[70]

Exporting U.S. small-boiler ACT directly to Turkey is not considered a viable option. Tariff rates for small boilers imported from the United States are 40-50%; also, a surcharge is applied based on the weight of the boiler. These expenses are in addition to other charges that are levied on the boilers at the port of entry, such as the wharf charge, municipal tax, and stamp tax. Since the government encourages BOT and other forms of investment, restrictive import policies are in force. Fortunately, the government offers regional investment incentives designed to stimulate economically depressed areas, especially areas in the east and specifically the eastern and central Anatolia region.[69] Incentives are provided mostly in the form of tax reductions, subsidies, and credit facilitation and are offered only through the central government. Distinctions are made for first-, second-, and third-priority development areas. The eastern region of Turkey has been designated as a first-priority development area and is assigned the highest levels of investment assistance. The State Planning Organization makes the final decision about eligibility for the incentive system, and it grants "certificates of investment or export promotion."[76]

Joint ventures, BOTs, and wholly-owned operations all constitute legitimate forms of incentive-eligible investments. This situation is encouraging because the state of the technology in Turkey is somewhat less sophisticated than in either Spain or Italy, and incentives could make companies more willing to enter into a cooperative venture with a U.S. firm that is looking to promote ACT so that Turkey can capitalize on the transfer of advanced technology. Also, Turkish companies, desiring to shed the label of being less technologically sophisticated, might be more willing to aggressively market and adapt U.S. ACT into their energy picture. Furthermore, as Turkey draws nearer to entering the EC as a full member, its policies will be directed toward modernizing industry, controlling emissions, and keeping the environment clean. The government is trying to attract technology to the country by offering generous investment incentives and liberalizing the economy in general. The fact that several large, foreign, boiler-manufacturing firms are now located in Turkey is a barometer of the country's potential for U.S. ACT applications in the future.

6 CONCLUSIONS AND RECOMMENDATIONS

This section first highlights the positive and negative factors influencing the marketability of U.S. ACT in Spain, Italy, and Turkey. Then general conclusions and recommendations for further research are provided.

6.1 SPAIN

Spain appears to be fairly promising as a potential market for U.S. ACT. Some of the positive factors are as follows:

- Growth in population and in GDP have been relatively high over the last decade or so and are expected to continue at significant rates (0.5%/yr for population and 3% for GDP) between now and 2000.

- Spain has a very large number of industrial establishments (146,000). These include over 37,000 food-products plants and more than 14,000 each of metal-products and machinery plants. Many are small facilities, for which small ACT units would be appropriate. Also present are large buildings that include approximately 800 hotels and 400 hospitals, and many large apartment blocks are located in the Madrid area.

- Spain is highly dependent on imported energy, especially oil. Moreover, Spain does produce coal and lignite domestically and has ports for coal imports. Even though some natural gas is produced in the country and gas imports will rise as Spain links with the European pipeline, only 23% of Spanish households are currently connected to the gas network. ACT could compete with gas in certain locales, and in so doing, might curtail the growth of the gas-supply infrastructure in those regions.

- Several regions look promising for the application of ACT. These include Galicia, Catalonia, Valencia, the Balearic Islands, and Madrid.

- Spain recently joined the EC and is one of the weaker members economically. The Spanish economy must grow if Spain is to compete with other EC member states. Because the Spanish government is eager for investment, it is offering a variety of incentives in underdeveloped sectors of the country. Spain is particularly eager for investors other than northern Europeans, who some fear may eventually dominate Spain's economy.

- The fact that Spain is a member of the EC also has implications for the size of the potential market that might be opened up if U.S.

ACT manufacturers would eventually set up operations, license technology, or participate in joint ventures there. Since the EC will become a barrier-free market, technology manufactured in Spain could be exported to other EC member countries, including Portugal, which has no access to a natural gas pipeline but does have domestic coal. (Greece, also a member of the EC, is in a situation similar to that of Portugal.)

- The climate for U.S.-Spanish trade and U.S. investment in Spain is good. The Spanish government allows for and recognizes all common forms of business establishments and investments as legal. In the absence of a bilateral tax treaty (one is currently under negotiation), Spain offers foreign tax credits to U.S. firms. Once the dual tax treaty between Spain and the United States is concluded, it should provide increased incentive for foreign investors. The Spanish government officially encourages investment in high-technology R&D. U.S. companies already invest heavily in Spain, and U.S. conventional boiler manufacturers are currently represented in Spain, largely through licenses and joint ventures. Fairly low tariff rates (6-8%) are applied on the import of small boilers. No import licenses, controls, or quotas are imposed on combustors.

On the other hand, some factors could negatively influence the ability of U.S. firms to market ACT in Spain. In particular, the Spanish boiler industry seems to be unaware of the progress made by the U.S. in ACT development; therefore, northern European companies have found niches in the market, and these firms will present intense competition to U.S. firms vying for niches. U.S. manufacturers must actively market in Spain to do business there. Additionally, Spain's EC partners may pressure Spain to keep its business ties within the EC.

In addition, although ACT may be able to combat it, the competition from natural gas must be recognized. Spanish coal is expensive to produce, and ACT imports will not be cost-effective substitutes for natural-gas-based technology unless the price of gas escalates and ACT proves to be extremely efficient.

6.2 ITALY

Although some factors in Italy favor the use of ACT, the market appears somewhat limited at this time. Some of the reasons are as follows:

- Coal-import ports in Italy are inadequate, and transportation constraints exist for overland coal transport. Moreover, Italy lacks domestic coal resources. Additionally, Italy does have domestic gas reserves and a well developed gas-import infrastructure and gas-distribution network. Sources of imported gas to Italy are being diversified to strengthen the security of supply and lower the

price. Although coal is expected to be used in existing power plants, gas is expected to continue to be an almost overwhelming competitor to ACT in the small-combustor field.

- The Italians perceive themselves as future energy-technology exporters. This goal may influence the Italians to promote indigenous industry, which would affect the future direction of policies that have an impact on investments by U.S. ACT firms.

- The Green party, the environmental lobby in Europe, is strong in Italy and strongly opposes the use of coal. Italy already suffers from severe air pollution in many industrial cities, and disposal of ash is a significant problem since landfill capacity is limited. Although ACT might reduce or solve some of these problems, licensing and siting new coal-fired combustors would probably be quite difficult considering this strong anti-coal bias.

- No population growth is projected for Italy, which implies that new construction will be somewhat limited, especially when Italy is compared with countries like Turkey, where the population increase is expected to be high.

Nevertheless, Italy exhibits some conditions that favor U.S.-developed ACT. These are as follows:

- Italy's GDP and TPER are the highest among the three nations, and the building infrastructure in Italy is very well developed. Italy has many more schools, hospitals, offices, and commercial buildings than the other two countries. The number of building permits also indicates that some new construction is taking place in the RCI and industrial sectors. Many buildings in Italy were built in the 1950-1970 period, and energy systems in these will be ready for replacement. If ACT could overcome some obstacles, the retrofit market in Italy would be very large. A market for new combustors would also be present, since GDP is expected to continue to grow at a healthy pace, despite the lack of population growth.

- Italy has certain advantages in terms of its trading environment. A bilateral tax treaty between the United States and Italy has been in existence since 1956. U.S. investment in the form of wholly-owned subsidiaries, distributors, and licenses is already high. The Italian government encourages the establishment of joint ventures with state-owned companies. A wide range of tax and investment incentives for the Mezzorgiorno and other regions targeted by the Italian government for development are available to the foreign investor. Tariff rates (5.5-5.6%) on imported boilers are very low.

- Some regional niches exist in Italy for ACT. The island of Sardinia is rich in coal deposits and has no access to natural gas. Other niches may exist near ports that currently import coal.

- Italy is still very dependent on imported oil.

6.3 TURKEY

The market for ACT within Turkey appears to be large. Some of the advantages Turkey offers are as follows:

- Population and economic growth in Turkey over the last decade have been very high. Growth is expected to continue at high rates through the year 2000.

- Turkey has many population centers of considerable size. At least 18 cities in Turkey have populations of 500,000 or more people.

- Although the current building infrastructure in Turkey is not as well developed as it is in the other two countries, the amount of new construction in recent years has been high.

- Many potential regional niches for ACT can be identified. Provinces such as Istanbul, Izmit, Mersin, Antalya, Izmir, Ankara, Zonguldak, and Bursa have ready access to domestic coal or lignite, sizable populations, and concentrations of industrial and commercial activity.

- Turkey desperately needs mechanisms to reduce the air pollution caused by use of low-quality fuel. Although an increased use of gas would help solve this problem, gas will be accessible only to Ankara, Istanbul, and Izmit in the near future. Even in these locales, a distribution infrastructure will have to be built, and this process will take time. ACT could lower emissions at sites that already use lignite (or coal) and could be an alternative to gas-combustion technology in new buildings.

- Turkey continues to be heavily dependent on imported oil. Oil supplies more than one-half of Turkey's industrial energy needs and more than one-quarter of RCI energy consumption. Moreover, the country has large lignite and coal reserves and already uses coal in small combustors. Using more coal instead of imported oil would afford more energy security for Turkey.

- Investment prospects for the United States in Turkey are good. Regional investment incentives come in the form of cash grants, subsidies, and investment allowances. The Turkish government

officially encourages all types of foreign investment and acknowledges as legal all common business organizational structures. The creation of the Foreign Investment Directorate (FID) has provided direction and legitimacy to Turkey's foreign investment liberalization schemes.

- Associate status within the EC should give Turkey the incentive to maintain liberal trade policies and push economic development. It should also encourage Turkey to advance technologically and to comply with EC directives, such as environmental regulations. This factor strongly favors the use of ACT.

Some negative factors should also be considered, however; they are listed here:

- Despite its recent increasing economic trend, Turkey is still predominantly agricultural. GDP is low, although it has shown stable growth in the last decade and is projected to increase further to the year 2000. The infrastructure of Turkey is not highly developed and the number of Turkish hospitals, hotels, schools, etc. is also low.

- Turkey is not a member of the EC; therefore, setting up operations to market U.S. ACT in Turkey will not necessarily open up the larger EC market to U.S. firms.

- Exporting ACT directly to Turkey is not a viable option for U.S. developers. Tariffs on imported goods remain extremely high and include surcharges and miscellaneous taxes that effectively restrict the importation of many goods. Cash deposits on imports, in addition to the license, are generally still required. Foreign exchange is "tight," and the government cannot maintain sufficient ready reserves.

- Turkey is not a technologically sophisticated market. The advantages of ACT may not be fully recognized there unless active marketing and demonstration are carried out.

6.4 OVERALL CONCLUSIONS AND RECOMMENDATIONS

Both Turkey and Spain appear to have significant potential as markets for ACT. The domestic market appears to be highest in Turkey, since coal resources are plentiful, the economy is growing rapidly, and air pollution could be decreased through the use of ACT. However, as a locale for setting up an ACT manufacturing operation (via joint venture, technology licensing, or other means), Spain has more to offer. Spain is a member of the EC, so technology manufactured there could move freely to all EC member countries. Also, the EC has allocated a disproportionate amount of financial aid to Spain, so investment incentives are high. A region in which financial incentives are

offered by the Spanish government would be attractive for establishing an ACT manufacturing operation. Niches identified in Italy and other EC nations could be served from Spain. Moreover, establishing a joint venture or other form of business operation to manufacture ACT in Spain would not preclude marketing that technology in Turkey or other non-EC nations as well.

The direct export of technology to Europe may not be cost-effective. Technology licensing, joint ventures, wholly-owned operations, and in Turkey, BOTs, appear to be the most sound strategies. A U.S. presence in foreign countries must be established through demonstration projects and active promotion. Since the use of coal would be met with disapproval (i.e., the Green party) and has some financial constraints (i.e., high capital costs), incentive packages, such as those that have been somewhat successfully used by French coal producers, could be offered to enhance coal's attractiveness. These packages could include offers of feasibility studies, third-party financing, technical guarantees, and the underwriting of fuel-price differentials.

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APPENDIX A:

EUROPEAN COMMUNITY EMISSION STANDARDS FOR COMBUSTION PLANTS

GENERAL APPROACH

Under powers granted in the European Economic Community (EC) treaty, uniform legislation on environmental issues applying to all member states can be adopted by a majority vote of the Council (which consists of representatives of each member state). Legislation adopted as a directive is legally binding on the member states, who must introduce it into their national legislation within a specified time period. If this is not done, the country can be subject to proceedings in the European Court. The member states are Belgium, Denmark, France, the Federal Republic of Germany (FRG), Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, and the United Kingdom (U.K.).

The EC has recently agreed on legislation to control emissions from plants with large combustors, which includes emission standards for sulfur dioxide (SO_2), nitrogen oxides (NO_x), and particulates. The emission standards will be implemented by being adopted into relevant national regulations and then enforced by appropriate authorities within each country. The legislation also sets reduction targets for total national emissions of SO_2 and NO_x.

SOURCES OF REGULATION

The directive containing emission standards is the Council Directive on the Limitation of Emission of Pollutants into the Air from Large Combustion Plants (known as the large combustion plants directive).

SO_2 and NO_x Control

A key feature of the directive is that it sets targets for reducing the total SO_2, NO_x, and particulate emissions from existing large combustion plants in the 1990s and into the next century based on 1980 levels (Tables A.1-A.3). Although the directive sets a standard percentage reduction requirement for this period, certain member states do not have to meet this requirement in consideration of reductions they have already achieved before 1980 or their state of economic development. The emission ceilings and corresponding percentage reductions from 1980 values required of the member states are shown in Tables A.4 and A.5 for SO_2 and NO_x.

The directive requires that all new, large combustion plants (those generating more than 50 MW thermal) should be subject to a licensing procedure and should meet specified limits on SO_2, NO_x, and particulate emissions. Stack heights must not exceed 200 m.

Emission Standards for Other Pollutants

Emission standards for pollutants other than SO_2, NO_x, and particulates have not been introduced.

Measurement Basis

Emission standards are based on measurements of gas volumes taken at 273 K, 1.013 bar, after correction for water vapor, with an oxygen content of 6% by volume. Plant size is measured in MW of thermal output. Emission standards must be met on a calendar monthly mean basis (or a rolling monthly mean basis when percentage reduction requirements rather than emission limits are applied). For SO_2 and particulates, 97% of 48-hour mean values must be within 110% of the standard; for NO_x, 95% of 48-hour mean values must be within 110% of the standard.

TABLE A.1 SO_2 Emission Standards

Plant Type	Plant Size (MW)	Emission standard (mg/m^3 limit or % removal)
New	50-99	Limit to be decided in 1990
	100	2,000 mg/m^3
	101-499	Sliding scale between 2,000 and 400 mg/m^3
	500	400 mg/m^3
New, firing high- or variable-sulfur coal	100-166	40%
	167-499	Sliding scale between 40% and 90%, with 60% at 300 MW
	>500	90%

TABLE A.2 NO_x Emission Standards

Plant Type	Plant Size (MW)	Emission Standard (mg/m^3)
New	>50	650
New, firing coal with volatiles of <10%	>50	1,300

TABLE A.3 Particulate Emission Standards

Plant Type	Plant Size (MW)	Emission Standards (mg/m^3)
New	50-500	100
New	>500	50

TABLE A.4 SO_2 Emission Ceilings for Existing Large Combustion Plants

Member State	Emissions in 1980 (kt)	Emission Ceiling (kt/yr)			Reduction of 1980 Totals (%)		
		1993	1998	2003	1993	1998	2003
Belgium	530	318	212	159	-40	-60	-70
Denmark	323	213	141	106	-34	-56	-67
FRG	2,225	1,335	890	668	-40	-60	-70
France	1,910	1,146	764	573	-40	-60	-70
Greece	303	320	320	320	+6	+6	+6
Ireland	99	124	124	124	+25	+25	+25
Italy	2,450	1,800	1,500	900	-27	-39	-63
Luxembourg	3	2	1.5	1.5	-40	-50	-50
Netherlands	299	180	120	90	-40	-60	-70
Portugal	115	232	270	206	+102	+135	+79
Spain	2,290	2,290	1,730	1,440	-0	-24	-37
U.K.	3,883	3,106	2,330	1,553	-20	-40	-60
EC total	14,430	11,066	8,403	6,141	-23	-42	-57

TABLE A.5 NO_x Emission Ceilings for Existing Large Combustion Plants

Member State	Emissions of NO_2 in 1980 (kt)	Emission Ceiling (kt/yr)		Reduction of 1980 Totals (%)	
		1993	1998	1993	1998
Belgium	110	88	66	-20	-40
Denmark	124	121	81	-3	-35
FRG	870	696	522	-20	-40
France	400	320	240	-20	-40
Greece	36	70	70	+94	+94
Ireland	28	50	50	+79	+79
Italy	580	570	428	-2	-26
Luxembourg	3	2.4	1.8	-20	-40
Netherlands	122	98	73	-20	-40
Portugal	23	59	64	+157	+178
Spain	366	368	277	+1	-24
U.K.	1,016	864	711	-15	-30
EC total	3,678	3,306	2,584	-10	-30

APPENDIX B:

MANUFACTURERS OF SMALL COMBUSTORS IN CATALONIA, SPAIN

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