The Natural Gas Industry in Alaska

The 1959 discovery of natural gas on the Kenai Peninsula marked the beginning of what is almost certain to become one of Alaska’s most stable and important industries. Natural gas has long been the Cinderella of fuels, while oil, which is easily exported and readily marketable, has stirred imaginations and drawn financial backing for exploration and development. Yet gas, being easy to handle, uniform in heat content and output, extremely clean burning and requiring little or no refining or processing, has unique advantages as an energy source for most applications.

The future of the industry in Alaska already looks bright. One gas-based chemical complex is under construction and others are being seriously considered. A multi-million dollar facility to liquefy and export methane (natural gas) is in the advanced planning stage and natural gas provides a source of low cost energy on which to base further industrialization in the state.

The gas fields found in Southcentral Alaska were the first to be developed on a large scale commercially, although Alaska’s first big gas strike occurred some years earlier. The Gubik field on the North Slope, was discovered during the U.S. Navy’s search for oil in Petroleum Reserve No. 4 between 1945 and 1953. Most subsequent discoveries of gas in Alaska were also by-products of the search for oil. Not only is natural gas a by-product, but in many cases its unwanted “discovery” makes production of the more immediately valuable petroleum more difficult and expensive.

The Alaskan Resource

According to the very conservative estimates (which do not include Naval Petroleum Reserve No. 4) published by the American Petroleum Institute, Alaska has two billion Mcf (thousand cubic feet) of “proved” natural gas reserves, or enough to last 283 years at the 1965 rate of consumption. But such impressive statistics understate both the potential availability of Alaska’s natural gas resource and the foreseeable demand for gas. It has taken only seven years to establish today’s level of reserves. Considering the present high level of exploratory drilling and the huge number of potentially favorable structures yet to be drilled, it is probable that only a superficial scratch has been made on the petroliferous geology of Alaska.

Conservative estimates by industry geologists of the economically producible gas stocks in the Cook Inlet Basin alone have ranged up to ten billion Mcf and are being revised upward each year. Many other regions, such as the
Alaska Peninsula, Bristol Bay and the Alaska Gulf Coast are geologically similar to producing areas elsewhere, but so little exploration has been done that any evaluation of their reserves must remain pure speculation. Nevertheless, a gross comparison of the geologically favorable acreage in Alaska with similarly favorable but proven acreage in other states indicates that as much as 100 billion Mcf of natural gas may someday be available in Alaska.

The Gas Utility Sector

Utilization of natural gas to meet Alaska’s needs for heat and power has been hindered by the same problems facing many northern developments — long distances and sparse, scattered populations. Although a relatively large amount of energy is required to maintain an American standard of living during Alaskan winters, the total demand for energy has so far not been sufficient to justify the extension of gas pipelines beyond the Anchorage-Kenai Peninsula area.

At present, Anchorage Natural Gas Corporation, and its parent firm, Alaska Pipeline Company, with a total of 75 year-round employees, represent the only large-scale investment in the distribution of natural gas for intra-state consumption. Organized in 1959, the two firms have spent approximately $22 million in transmission and distribution facilities to serve the Greater Anchorage, Soldotna and North Kenai areas.

The history of Alaska Pipeline’s operations illustrates the early frustrations and ultimate rewards which may face anyone contemplating similar large-scale investments in Alaska. Originally planned for completion in 1960 at a total cost of $12 million, the 90-mile transmission line suffered early construction difficulties, particularly in the 8.5 mile segment of the line that crosses the tide-swept Turnagain Arm. Completion of the facility was delayed a full year when the original contractor could not finish the project.

When gas finally did reach the distribution system in Anchorage, further difficulties arose. Although natural gas received rapid acceptance in the civilian market, conversion from coal to gas of the two military steam and power plants at nearby Elmendorf Air Force Base and Fort Richardson (upon which feasibility of the pipeline investment had been predicated) encountered resistance from interests sympathetic to the Matanuska Valley coal industry. Despite an apparent saving of more than $1.5 million a year and the strong support of military officials, congressional approval has not, to date, been forthcoming. The firm’s early promise to reduce civilian rates by 10 percent on commencement of military deliveries has not since been reasserted.

Despite the setbacks of the early years, the consolidated financial statement of Alaska Pipeline Co. and Anchorage Natural Gas Corporation shows that they have made substantial profits since 1964 as product and service continued to win acceptance. According to the statement which the companies submitted to the Securities and Exchange Commission, net earnings exceeded 29 percent of stockholders’ equity in 1965 and were at a rate of above 64 percent for the first half of 1966. The rates of return on total assets for the same periods were approximately 7 percent and 11 percent respectively.
While residential rates are not low by national standards (see Figure 3), they provide the home heating customer a slight money saving—and considerable convenience—when compared with alternative fuels. In large commercial use, where consumers are more price conscious, the competitive advantage of natural gas has been reported to range from 20 percent to 50 percent. As might be expected, most large commercial buildings in Greater Anchorage are using natural gas where it is available.

It is difficult to measure the effect of natural gas service on the cost/price structure in Southcentral Alaska, but it has undoubtedly been more important than is generally realized. Especially significant are the considerable reductions in the price of competing fuels, apparently as a result of growing competition in the heating fuel market. In Fairbanks, where natural gas is not available, the prices of fuel oil and solid fuel have, by contrast, tended to move upward (see Figure 4). The presence of inter-fuel competition in Anchorage is particularly important since the consequent price reductions benefit all area consumers, including those located some distance from the existing gas system.

Electricity from Gas

Although the industrial consumers which usually provide the base load for gas utility and pipeline operations

ALASKA'S GAS RESERVES

At this infant stage in Alaska's gas industry development it is easy to give a field by field summary of the gas reserves thus far discovered:

In Northern Alaska

- **GUBIK**—First drilled by the U.S. Government in 1951, the field is located just outside Naval Petroleum Reserve No. 4. Two wells and seismic testing indicate a minimum containment of 300 million Mcf. Similar structures in the immediate vicinity have been investigated but not drilled.

- **EAST UMIAT**—Containing both oil and gas, this field is located in the Naval Petroleum Reserve. Presently shut in and undefined.

- **SOUTH BARROW**—A relatively minor field now producing utility gas on a small scale for consumption in Barrow.

In the Cook Inlet Basin

- **KENAI**—With 12 wells and 11,000 acres developed, Union-Marathon's Kenai unit contains the most extensively drilled gas field in Alaska. Present production provides utility gas to Anchorage, Soldotna and Kenai areas plus reinjection gas to the Swanson River field; slated to provide feedstock gas to Nikiski Chemical Complex. Estimated to contain more than 2 billion Mcf (as of December 1966 about 47 million Mcf—or less than 3 percent of this figure—had been produced).

- **SWANSON RIVER**—Discovered by Richfield and operated by SOCAL (Standard Oil Company of California), all gas produced here (6 million Mcf in 1966) is either used in the field or reinjected. A portion of this gas comes from a gas producing zone separated vertically from the oil strata by almost a mile.

- **STERLING**—A two-well field operated by Union. Gas is sold in small quantities to Consolidated Utilities, Inc., which supplies electric power to the City of Kenai from a modest wellhead generating plant.

- **BELUGA**—Presently shut in, this field contains what is one of the larger gas reserves yet discovered in Alaska. Although no firm statistics are available, Beluga has been reported to contain nearly a billion Mcf.

- **COOK INLET**—A large offshore oil and gas field with plans being made to pipe gas ashore to supply projected LNG or chemical plant(s). Pan American.

- **WEST FORELAND**—Shut in and limits undefined. Pan American.

- **NORTH FORK**—Shut in and undefined. SOCAL.

- **WEST FORK**—Shut in and undefined. SOCAL.

- **FALLS CREEK**—Shut in and undefined. SOCAL.

- **BIRCH HILL**—Shut in and undefined. SOCAL.

- **MOQUAWKIE**—Shut in and undefined. Mobil.
are largely missing from the Anchorage market, this role has been at least partially assumed by the electric utilities, Anchorage Municipal Light and Power and Chugach Electric Association. During the past year these consumed about half of the natural gas delivered in Anchorage (see Figure 5). The cost savings that have helped bring about this large level of consumption are shown in Figure 6. Today more than 55 percent of Southcentral Alaska's civilian generation capacity is fired on natural gas, and it appears that new plants to be constructed in the foreseeable future will also use gas.

Low cost power has long been recognized as one of the most critical requirements for industrial development in Alaska. Although the state abounds in potential hydroelectric sites, they have remained largely undeveloped due, in part, to high first costs and the limited markets available under present patterns of distribution. The past five years, however, have seen not only the establishment of a natural gas industry in Alaska, but developments in gas turbine technology making it possible to build relatively inexpensive gas-burning turbine generators. Such turbines allow utilities to meet expanding power needs in small increments, as they develop, rather than the large blocks required with hydro and, to a lesser extent, steam plant installations. Recent reductions in Anchorage power rates have been ascribed to low cost natural gas generation—an indication of how these developments have brightened the Alaskan power picture. Four gas turbines with a total capacity of 72 megawatts are now in operation in Anchorage, and the CEA Knik Arm steam plant was recently converted from coal to gas.

Despite the progress of the past several years, all segments of the Alaska natural gas industry realize that further reductions in the cost of gas generated power are imperative if the industry is to remain competitive. Up to now, the low (and probably declining) price of gas relative to other energy sources in Alaska has lessened the importance of the gas turbine's greatest drawback—its relatively high fuel consumption and low efficiency, particularly at partial loading. The problem of high operating costs is likely to become a more serious deterrent to the use of gas-fired thermal power as rapidly growing loads and more efficient distribution networks provide the economies of scale which are more favorable to hydro power development.

Gas industry officials hope that a reduction in operating costs can be effected by “waste heat recovery”, in which the exhaust from a gas turbine is used to make steam for operation of a second generator driven by a steam turbine. No plant of this kind has yet been built in Alaska, but it would go far toward answering the power industry’s need for “spinning reserve”, since there would be no

![Figure 3: Anchorage Gas Rates](image-url)
additional fuel cost for the steam-powered unit. Also under consideration is the "total energy" concept, in which electric energy is generated at the point of use and the waste heat captured and used for space heating. Wide experience in other states indicates that "total energy" systems can bring about significant cost savings in the operation of shopping centers, offices and other large buildings.

The boldest scheme for utilization of natural gas in electrical generation is the power complex now in the first stages of construction at the Beluga gas field, 50 miles west of Anchorage. Discovered in 1962 by Standard Oil Company of California (SOCAL), the Beluga field is reported to contain reserves of nearly a billion Mcf. The present contract between CEA and SOCAL specifies a price of 15 cents per Mcf at the wellhead. (By comparison, the lowest rate now in effect for gas delivered to power plants in Anchorage is 38 cents per Mcf.)

The economic success of the Beluga project depends largely on its rapid expansion to the point where total costs of transmission facilities can be lowered by spread-

![Figure 5: Natural Gas Sales in Anchorage](image)

**FIGURE 5**

**NATURAL GAS SALES IN ANCHORAGE**

The economic success of the Beluga project depends largely on its rapid expansion to the point where total costs of transmission facilities can be lowered by spreading fixed costs over a greater output and reducing operating costs by economies of scale. If such high outputs can be successfully developed and marketed (perhaps through better interconnection of existing systems), CEA predicts that Beluga power can be delivered in Anchorage at a cost of 5 to 5½ mills per kwh, which would be more than ½ mill below the present Anchorage costs for fuel alone (see Figure 6).

**Gas for Alaskan Communities**

Although studies have been made to determine the feasibility of supplying natural gas to several Alaskan cities, particularly Seward and Fairbanks, no major service extensions are known to be seriously under consideration at the moment. The Fairbanks area, located approximately 300 miles from the Beluga gas field and even further from the Cubik field of northern Alaska, is a potential market for 15,000 Mcf per day. It has been estimated that a pipeline large enough to supply the peak seasonal load in Fairbanks would cost in the neighborhood of $100,000 per mile, for a total cost of $30 million or more. It is unlikely that the revenue from a Fairbanks distribution
and transmission system could meet interest payments, operating expenses and principal retirement on an investment of this magnitude.

It is possible, however, that undiscovered natural gas reserves exist in the vicinity of Nenana, within 100 miles of the Fairbanks area. An exploratory well drilled in this vicinity by Union Oil in 1958 yielded discouraging results, but further work might change this picture. A significant discovery in this location could no doubt be profitably marketed in the Fairbanks metropolitan area.

The lack of low cost energy at isolated communities and potential industrial sites in Southcentral Alaska has in the past been a brake on such developments as mineral and fish processing plants. Today, given a moderately large and firm industrial load at such locations, it may be feasible to reach them with natural gas pipelines. For example, the availability of gas 11 miles northwest of Homer in the North Fork field makes the supply of gas to this Kachemak Bay community a comparatively simple proposition.

As in the case of Homer, Alaskan villages and communities which are situated near gas strikes stand to profit as a result of both reduced heating costs and the industry-attracting possibilities of low cost energy. An example of such benefits can be observed in Barrow, the United States' northernmost municipality. Until 1965, when gas became available for local heating and cooking from a development well drilled in the nearby South Barrow gas field, liquid petroleum products were imported at great expense, i.e. $1.00 per gallon for fuel oil. Today Barrow residents heat their homes at no greater expense than their fellow Alaskans in Anchorage.

LNG—Gas by the Tankerload

Faced with a constantly expanding worldwide demand for energy with the form advantages of natural gas, the industry has made vigorous attempts to develop an economic means of transporting natural gas in a liquid state to large markets which could not feasibly be supplied by pipelines.

Liquefied natural gas (LNG) is formed when ordinary natural gas is refrigerated to \(-258^\circ F\). LNG's great attractiveness lies in the fact that one cubic foot of the supercold liquid equals 630 cubic feet of gas. It has been known for some years that this extreme volumetric reduction would, theoretically at least, make long distance transportation by ocean tanker economically feasible. At present, LNG is being shipped in commercial quantities from Algeria to the energy-short countries of France and Great Britain, and deliveries to Spain and Italy are expected to begin in 1968.

Over the last six years, owners of Alaskan gas have been actively pursuing the possibility of selling Kenai gas as LNG in the energy-deficient markets of the U.S. West Coast and Japan. During the past year, a combine composed of the Marathon Oil and Phillips Petroleum Companies announced an agreement to sell 50 million Mcf yearly to Tokyo Gas Company, Ltd., and Tokyo Electric Power Company, Ltd. Site selection and foundation surveys have been conducted at Port Nikiski, north of Kenai, for the proposed liquefaction plant.

The parties on both sides submitted applications to their respective governments for the necessary consent to go ahead with this project, but there remained a question as to the strength of the Marathon group's position in relation to competitive offers from the Soviet Union, Brunei (Borneo) and Iran. It had been calculated that the offer of Conch International (Conoco-Shell-Union Stock Yards) to supply the Japanese market from Borneo would have resulted in lower delivery costs to the Japanese. Nevertheless, the desire of Japan to diversify her sources of supply, high level international pressures relating to the U.S. balance of payments problem, and the extreme purity of Alaskan gas, were among the factors leading to final approval by the Japanese and U.S. governments.

Often overlooked in the analysis of LNG's impact on

FIGURE 6

NATURAL GAS REDUCES ELECTRIC UTILITY FUEL COSTS

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<tbody>
<tr>
<td>COST</td>
<td>20.00</td>
<td>19.50</td>
<td>19.00</td>
<td>18.75</td>
<td>18.50</td>
<td>18.25</td>
<td>18.00</td>
<td>17.75</td>
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</table>

SOURCE: City of Anchorage Municipal Light and Power Department, Annual operating reports.
the Alaskan economy is the “fallout” of LNG technology on the local Alaskan energy scene. Anchorage Natural Gas Corporation is investigating the possibility of marketing LNG in Alaska by barge, railroad, or truck. Even without the Alaska/Japan project it might be possible for a small liquefaction plant in the Cook Inlet area to supplement the normal gas supply in Anchorage during periods of peak demand, and also supply LNG to other Alaskan towns. Income which accrues to the state from oil and gas royalties and other taxes, may at present seem to many residents and officials to be the most important effect of the development of the petroleum and natural gas industries. However, the view of the gas company is that LNG for local consumption may well prove to be the greatest and most enduring benefit of the Alaska/Japan gas project.

**Petrochemicals**

The use of Alaska gas for heating and power, and its conversion to LNG, are not the only possibilities that exist for the beneficial exploitation of Alaska's vast gas reserves. In recent years about 5 percent of all gas produced in the U.S. has been used as fuel and feedstock (raw material) by the rapidly growing chemical industry.

Existing chemical plant locations in the U.S. are clustered around locations such as the Louisiana Gulf Coast and Southern California Coast where the raw material and tidewater are found in proximity. Recent developments indicate that a similar pattern is developing on a smaller scale in Alaska. Now under construction at Nikiski on Cook Inlet by Collier Carbon and Chemical Corporation is a $50 million fertilizer manufacturing complex which will use natural gas from the Kenai field for the synthesis of anhydrous ammonia. Collier, a subsidiary of Union Oil, will supply approximately 40 percent of the plant's 1,500 ton per day ammonia output to an adjacent urea facility, owned jointly by Collier and Japan Gas Chemical Co., which will, in turn, use it as raw material in the production of prilled urea fertilizer for export to Southeast Asia. It is expected that a significant portion of the remaining 900 tons of daily ammonia output will be marketed on the U.S. mainland.

In view of the need for increased food production throughout the world and our present balance of payments difficulties, it is not unreasonable to expect that the demand for Alaskan produced fertilizer will increase in the near future. Pan American Petroleum Corporation, with a huge unmarketed gas reserve in its Cook Inlet field, is said to be considering the construction of an ammonia facility similar to Collier's to transform its Alaskan gas into a salable product.

Although no official word has been released, Skelly Oil and Gas Corporation, in association with Japanese interests, is reported to be evaluating the feasibility of methanol manufacturing in the Cook Inlet area. The conversion of natural gas (CH₄) into methanol (CH₃OH) is only the first of a number of molecular rearrangements which generally take place before a final product is produced. From methanol comes, for instance, formaldehyde (CH₂O), a principal building block of resins and fabrics. Despite the reluctance of industry officials to comment on this development, it is reasonable to expect that the success of a methanol synthesis plant would depend upon roughly the same economic factors as ammonia manufacturing, namely the world market price of methane and methane derivative products, which presently appear favorable to continued expansion of output.

**UP ONE WELL AND DOWN ANOTHER**

Today about 90 percent of the gas produced in Alaska stays above ground for only a matter of hours.

The reason: It is needed in Standard Oil Co. of California's Swanson River Oil field to provide the energy that lifts oil on its two mile trip to the surface. When first discovered in 1957 Swanson River's “bottom hole pressure", a measure of the oil's ability to flow upward against gravity, seemed more than adequate. As more wells were drilled and oil production increased, however, a disturbingly rapid drop was noted in the bottom hole pressure. Without special efforts a corresponding drop in the field's production could soon be expected.

SOCAL's answer to this problem was to replenish the field's pressure and thus extend its productivity by reinjecting large amounts of natural gas into the producing formation. Once underground, a portion of the gas would become dissolved in the oil and just as dissolved carbon dioxide creates a pressure on the inside of a Coke bottle, so would the reinjected natural gas create a pressure within the producing formation.

Lacking the large quantities of gas necessary to the field's “pressure maintenance", Standard negotiated the rental of gas from Union-Marathon's Kenai field some 20 miles to the south. Ten to twenty years hence, when the oil field reaches the end of its economic life, the rented gas will be available for reclamation and return to its owners.

**The Economics of Gas**

In 1961, when the initial price of gas was established at 32.5 cents per Mcf, there was only one sizable gas
field available for production in Alaska. Since that time additional discoveries have been made, causing the state's gas reserves to outdistance immediate requirements. This highly unequal development of supply and demand, coupled with an increasing number of firms offering gas for sale, has resulted in downward pressure on prices.

Present average wellhead charges on the Kenai Peninsula rest in the neighborhood of 25 cents per Mcf, and gas produced for reinjection at Swanson River is being valued by the federal government for royalty purposes at 16 cents per Mcf. Another indication of the downward trend is SOCAL's agreement, mentioned earlier, to sell its less accessible Beluga gas to Chugach Electric Association at 15 cents per Mcf. Many observers expect this trend to continue, with prices to large volume purchasers possibly falling as low as 7 cents or 9 cents per Mcf. Whether or not this comes about will, of course, depend on the amount of competition within the industry, the long-run costs of production (below which prices may not fall for any extended period) and government regulatory policies.

Regulation has not, so far, had an important effect on gas prices in Alaska. The Federal Power Commission's mandate to regulate the natural gas industry in the interest of consumer protection and resource conservation does not presently apply to the Alaskan market, in that Alaskan gas crosses no state lines on its journey from producer to consumer. The price of exported gas, which must be approved by the FPC, may, however, affect the price which large domestic consumers, including public utilities, will be willing to pay. State regulatory authority is divided between the state Department of Natural Resources, charged with preventing waste or misuse of natural gas, and the Alaska Public Service Commission, which exercises nominal control over gas pipelines and utilities.

Lacking a well developed regulatory apparatus, Alaska must, at least for the present, depend on competition to bring about and maintain gas prices which accurately reflect the real long-run costs of production. Any level of charges which remained for a long period above costs would have unwelcome results, not the least being higher business and living costs. Furthermore, an inflated price for fuel and feedstock would, in itself, discourage new industrial and utility developments.

In spite of the problems mentioned above, Alaska's infant gas industry may look to a bright future. In its short history it has already shown startling economic achievements. This record, and the state's rich endowment of natural gas, indicates the expanding challenge and opportunity facing the natural gas industry in Alaska.

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**THE ALASKAN LNG PLANT AT A GLANCE**

<table>
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<tr>
<th>Present status</th>
<th>Advanced planning</th>
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<tbody>
<tr>
<td>Owners</td>
<td>Marathon Oil Company and Phillips Petroleum Company</td>
</tr>
<tr>
<td>Cost (production, liquefaction and storage facilities in Alaska)</td>
<td>Approximately $85 million</td>
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<tr>
<td>Natural gas input</td>
<td>Approximately 165,000 Mcf per day</td>
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<tr>
<td>Value at 20 cents per Mcf</td>
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<tr>
<td>Product output</td>
<td>140,000 Mcf per day</td>
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<td>Total year-round employment</td>
<td>50 persons</td>
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**THE ALASKAN FERTILIZER COMPLEX AT A GLANCE**

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<thead>
<tr>
<th>Present status</th>
<th>Under construction (completion 1968)</th>
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<tbody>
<tr>
<td>Owners</td>
<td>Collier Carbon and Chemical Corp. (Union subsidiary), and Japan Gas Chemical Co., Ltd.</td>
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<tr>
<td>Cost</td>
<td>$45 to 50 million</td>
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<tr>
<td>Natural gas input</td>
<td>60,000 Mcf per day</td>
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<td>Value at 20 cents per Mcf</td>
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<tr>
<td>Product output</td>
<td>1,500 tons per day</td>
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<tr>
<td>Ammonia</td>
<td>1,000 tons per day</td>
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<tr>
<td>Urea</td>
<td>Approximately 125 persons</td>
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**SOURCE:** Author's calculations and estimates; detailed official figures have not been released.