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The energy sector in Chile : an
introductory outlook

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**THE ENERGY SECTOR
IN
CHILE**

AN INTRODUCTORY OUTLOOK

**PREPARED BY
EMPRESA DE INGENIERIA INGENDESA S.A
SANTIAGO - CHILE**

OCTOBER 1991

**Dept. of External Affairs
Min. des Affaires extérieures**

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THE ENERGY SECTOR

OF THE CANADIAN EMBASSY IN CHILE

IN

CHILE

AN INTRODUCTORY OUTLOOK

PREPARED BY
EMPRESA DE INGENIERIA INGENDESA S.A
SANTIAGO - CHILE

OCTOBER 1991

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Gerente General : General Manager
Secretario : Secretary
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CHILMETRO

: Compañía Chilena Metropolitana de Distribución Eléctrica

(Metropolitan Electric Distribution Company)

CHILGENER

: Compañía Chilena de Generación Eléctrica (Chilean Electric Generation Company)

COCAR

: Compañía de Carbones de Chile (Chile Coal Company)

COGIDAS

: Compañía Distribuidora de Gas (Gas Distributing Company)

COLBUN

: Empresa Eléctrica Colbún-Machicura (Colbún-Machicura Electric Power Company)

COMAR

: Compañía de Combustibles Marítimos (Marine Fuels Company)

CORFO

: Corporación de Fomento a la Producción (Chilean Production Development Corporation)

COPEC

: Compañía de Petróleos de Chile (Chile Petroleum Company)

CNE

: Comisión Nacional de Energía (National Energy Committee)

EDELNOR

: Empresa Eléctrica del Norte Grande (Far North Electric Company)

EMALCO

: Empresa Almacenera de Combustibles (Fuels Storage Company)

ENACAR

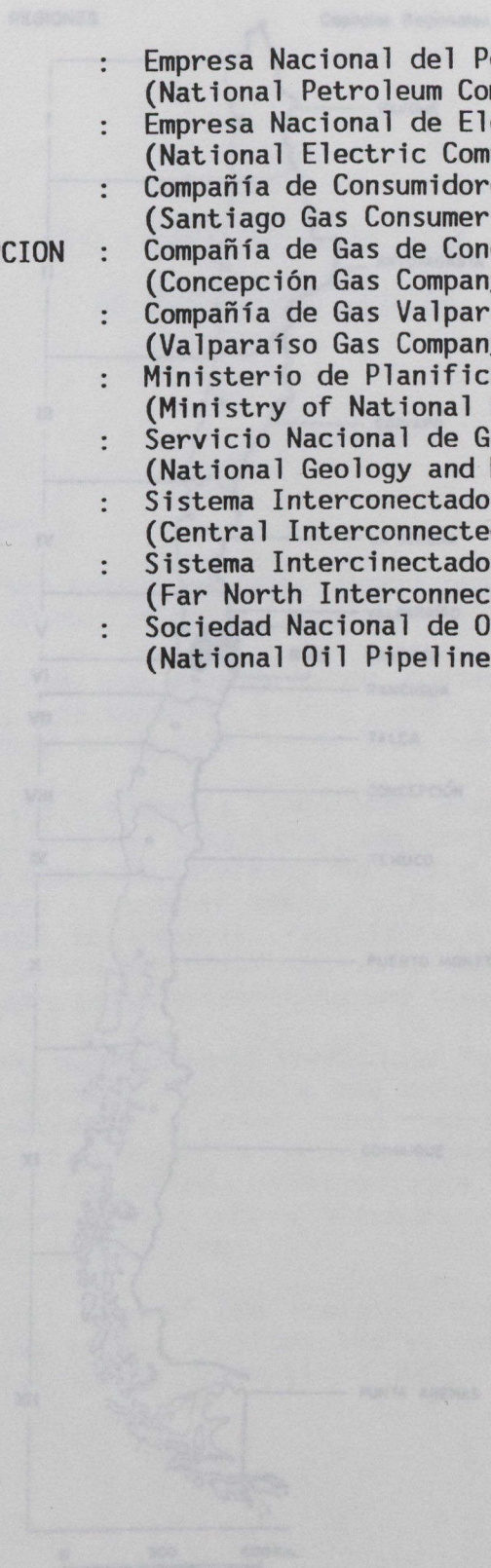
: Empresa Nacional del Carbón (National Coal Company)

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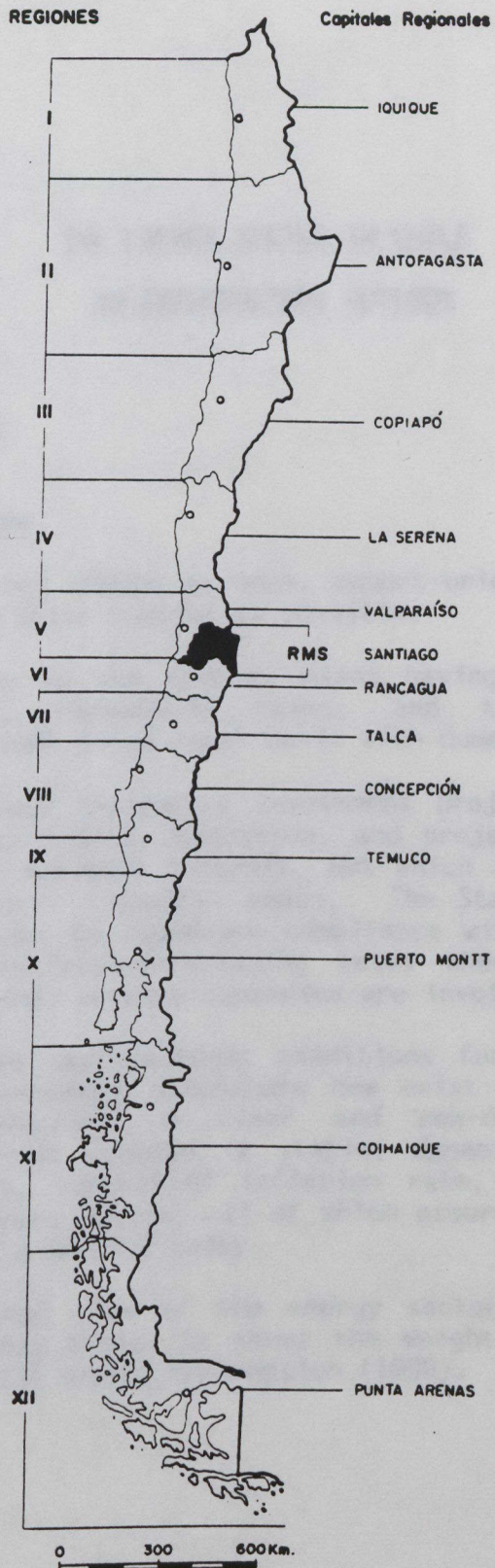
ENAP	:	Empresa Nacional del Petróleo (National Petroleum Company)
ENDESA	:	Empresa Nacional de Electricidad (National Electric Company)
GASCO	:	Compañía de Gasoductores de Gas Santiago (Santiago Gas Conveyors Company)
Presidente	:	Compañía : President
Superintendente	:	(Concepción : Chairman
Gerente General	:	Compañía : General Manager
Secretario	:	(Valparaíso : Secretary
Ministro	:	Ministerio : Minister (Sección Nacional
Gerente de Administración y Operaciones	:	Servicio : Operational and Administration Manager
Gerente Desarrollo	:	(Sociedad : Development Manager
SIC	:	Sistema Interconectado Central (Central Interconnected System)
CCHEN	:	Comisión Chilena de Energía Nuclear (Chilean Nuclear Energy Commission)
CDEC	:	Centro de Despacho Económico de Carga (Economic Generation Dispatch Center)
CGEI	:	Compañía General de Electricidad Industrial (General Industrial Power Company)
CHILMETRO	:	Compañía Chilena Metropolitana de Distribución Eléctrica (Metropolitan Electric Distribution Company)
CHILGENER	:	Compañía Chilena de Generación Eléctrica (Chilean Electric Generation Company)
COCAR	:	Compañía de Carbones de Chile (Chile Coal Company)
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CNE	:	Comisión Nacional de Energía (National Energy Committee)
EDELNOR	:	Empresa Eléctrica del Norte Grande (Far North Electric Company)
EMALCO	:	Empresa Almacenadora de Combustibles (Fuels Storage Company)
ENACAR	:	Empresa Nacional del Carbón (National Coal Company)

CHILE - 2 -

- ENAP : Empresa Nacional del Petróleo
(National Petroleum Company)
- ENDESA : Empresa Nacional de Electricidad
(National Electric Company)
- GASCO : Compañía de Consumidores de Gas Santiago
(Santiago Gas Consumers Company)
- GASCO-CONCEPCION : Compañía de Gas de Concepción
(Concepción Gas Company)
- GASVALPO : Compañía de Gas Valparaíso
(Valparaíso Gas Company)
- MIDEPLAN : Ministerio de Planificación Nacional
(Ministry of National Planning)
- SERNAGEOMIN : Servicio Nacional de Geología y Minas
(National Geology and Mining Society)
- SIC : Sistema Interconectado Central
(Central Interconnected System)
- SING : Sistema Interconectado del Norte Grande
(Far North Interconnected System)
- SONACOL : Sociedad Nacional de Oleoductos
(National Oil Pipeline Company)



CHILE



...entad economy, with as
...ing low and flat import
...treatment of foreign
...estic investment.
...jects in social areas,
...cess that are relevant
...are beyond the private
...state reserves, however,
...with current legislation
...necessary in social
...favorable commercial
...successful returns
...discriminatory foreign
...oriented
...and reasonable laws
...the most open market
...is presented in the
...of each component of

	Equiv. Oil Barrels x 1000	Percent (%)
Petroleum	136	42
Hydroelectricity (1)	46	14
Natural Gas (2)	43	13
Coal	15	5
Firewood	15	5

THE ENERGY SECTOR IN CHILE

AN INTRODUCTORY OUTLOOK

Note: 1. Caloric equivalent for hydroelectricity: 2750 kcal/kwh
2. Includes LPG and natural gasoline obtained from natural

I. INTRODUCTION

1. Overview

Chile has chosen an open, export-oriented economy, with as little State control as possible.

Opening up the economy means having low and flat import duties, reasonable taxes, and treatment of foreign investment on an equal basis with domestic investment.

The State implements investment projects in social areas, such as health, education, and projects that are relevant in the national interest, but which are beyond the private investors' financial means. The State reserves, however, the right to supervise compliance with current legislation and regulations-including rates when necessary-in social areas when private companies are involved.

Excellent macroeconomic conditions for favorable commercial and investment atmosphere now exist: a successful return to democracy, a clear and non-discriminatory foreign investment statute, a stable, dynamic, export - oriented economy, controlled inflation rate, and reasonable taxes and import duties; all of which assure the most open market in Latin America today.

A general view of the energy sector is presented in the following table. It shows the weight of each component of the total energy consumption (1990).

are as follows:

	Equiv. Oil Barrels x 1000	Percent (%)
Petroleum	136	42
Hydroelectricity (1)	46	14
Natural Gas (2)	43	13
Coal	49	15
Firewood	51	15

Note: 1. Calorific Equivalent for hydroelectricity: 2750 kCal/kWh
2. Includes LPG and natural gasoline obtained from natural gas.

Energy Dependency (1990)

Imported Energy : 42 %
Domestical Energy : 58 %

Source: CNE

2. Chilean Policy on Energy and the Role of the Government

The strategy that leads the way for the development of the energy sector in Chile is consistent with the nation's general policy for its economic and social development. The energy policy attempts to maximize the welfare of the national community through establishing conditions for economic efficiency in the energy sector.

In order to optimize the use of State funds in the energy sector, a policy of governmental project coordination has been implemented. Private investors use the government program only for reference.

3. Chilean Government Structure in the Energy Sector

A legal framework and organizational structure have been established for the public (government) energy sector, with separate agencies handling the regulatory and promotional functions.

Basic responsibilities of the main administrative bodies are as follows:

NATIONAL ENERGY COMMITTEE (CNE, Comisión Nacional de Energía)

- Studies and proposes legislation, regulations, and standards
- Plans the development of the sector to be used by private companies for reference only
- Coordinates investments for major projects, working jointly with the Ministry of National Planning (MIDEPLAN)
- Establishes price policies and regulates pricing
- Serves basically as an advisory agency.

MINISTRY OF ECONOMY (Ministerio de Economía)

- Approves standards on fuels and electric power
- Regulates prices under the advise of CNE

MINISTRY OF MINING (Ministerio de Minería)

- Represents the government in oil related contracts
- The Minister of Mining is Chairman of the National Petroleum Company (ENAP)

MINISTRY OF NATIONAL PLANNING (MIDEPLAN, Ministerio de Planificación Nacional)

- Controls investments by state entities and enterprises

OFFICE OF THE SUPERINTENDENT OF ELECTRICITY AND FUELS (Superintendencia de Electricidad y Combustibles)

- Supervises operation of electric power companies
- Controls safety of electric facilities and products
- Controls safety of fuel-related facilities and quality of liquid and gaseous fuels

CHILEAN PRODUCTION DEVELOPMENT CORPORATION (CORFO, Corporación de Fomento a la Producción)

- Represents the government in the management of state-owned companies active in the energy field

NATIONAL ENERGY COMMITTEE (CNE, Comisión Nacional de Energía)

- Studies and proposes legislation, regulations, and standards
- Plans the development of the sector to be used by private companies for reference only
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CHILEAN PRODUCTION DEVELOPMENT CORPORATION (CORFO, Corporación de Fomento a la Producción)

- Represents the government in the management of state-owned companies active in the energy field

4. General Foreign Investment Regulations

There are two basic legal procedures governing foreign investments entering Chile: a) 1977 Decree-Law N° 600, Foreign Investments Statute, and b) debt-equity swap mechanisms, regulated by the provisions of Title I, Chapter XIX, Foreign Exchange Regulations of the Chilean Central Bank.

The main principles, rules, and guarantees of these official regulations are described in Annex N° 1.

II. PETROLEUM SECTOR

A. GENERAL DESCRIPTION

1. General Overview

The Chilean petroleum sector includes the following activities:

- Exploration and exploitation of petroleum fields
- Importing, transportation, and refining of crude
- Importing, production, transportation, and distribution to primary and final users of petroleum derivatives, including gasoline and propane obtained from natural gas

1.1 Exploration and production

More than sixteen sedimentary basins have been studied along the Chilean territory, both inland and offshore. The offshore sedimentary basins run along a narrow submarine strip between the coastal line and the Chile-Peru submarine depression. Sedimentary deposits, are up to 4,000 meters (13,000 ft) deep, and include submarine layers from the High Cretaceous and Tertiary ages.

Inland sedimentary basins are found in: the Straits of Magellan (or Magallanes), the southernmost end of the Central Valley, and northern Chile. Of these sites, the most significant is the Magallanes basin, located east of the Andes mountains. It has a central layer of over 8,000 meters (26,000 ft) deep, including marine strata from the Higher Jurassic, Cretaceous, and Lower Tertiary ages, and continental strata from the Higher Tertiary age.

Nearly 300,000 sq.km (116,000 sq.mi) of sedimentary basins are known. However, the Magallanes basin, representing 29% of the total area, has been the only oil producing basin, and represents 90% of the exploration activity. In fact, other than the Magallanes sites, only 94 exploratory oil wells have been drilled in more than 210,000 sq.km (81,000 sq.mi). 18 of those drillings have been done offshore.

The only active company operating in the Magallanes basin is the state-owned NATIONAL PETROLEUM COMPANY (ENAP), which concentrated its activities, up to the late sixties, on

Tierra del Fuego island and the mainland. By the mid-seventies works were started offshore in the Straits of Magellan, between its first narrow inlet and its eastern inlet. In 1988, ENAP operated in this area with nearly 2,100 workers.

Several oil exploration operations have begun in northern Chile through risk-contracts made by ENAP with several foreign firms (HUNT-USA, HAMILTON-NORCEN-USA, MAXUS-USA, EUROCAN-CANADA). To-date, results have been negative.

1.2 Crude Oil Refining

There are two oil refineries and a topping plant in the country, all of them subsidiaries of ENAP. One refinery, (commissioned late 1954), is situated in Concón, near the Valparaíso and Quintero harbors in Chile's Fifth Region. The other, is located 10 km (6 mi) from Concepción in the Eighth Region and was commissioned in 1966.

The Gregorio topping plant (commissioned in 1980), 100 km (62 mi) from Punta Arenas in the Twelfth Region with a 1,600 cu.m/day (56,500 cu.ft/day) distilling capacity. It produces kerosene, diesel, petroleum, gasoline and reduced crude for regional consumption. The latter is added to the native crude sent to refineries in central Chile. Formerly, there was another topping plant near Manantiales, in southern Chile, but it closed operations in 1978.

The present capacity of these refineries is shown in the following table:

the system distributes refined products to an area of clean oil products is concentrated in Magallanes, an area which is self-sufficient, the rest of the country is supplied by ship and truck. Nearly 60 % of the oil pipelines are owned by ENAP. The remainder belong to the National Oil Pipeline Company (SINACOL).

ENAP, through its subsidiary Fuels Storage Company (ENALCO), controls four storage centers used as a safety reserve stock for primary distribution. The refineries rent storage facilities from these centers and supply local distributors.

Up to 1980, distribution of liquid fuels obtained from oil was traditionally handled by only three distribution companies.

PRESENT NATIONAL REFINING CAPACITY (cu ft/day)

	Concón Refinery	Concepción Refinery	Gregorio Topping
Topping I	185,000	202,000	56,500
Topping II	185,000	202,000	---
Catalytic cracking	77,700	102,700	---
Catalytic reforming	17,300	22,250	---
Alkylation	3,885	---	---
Solvents	2,650	---	---
Visbreaking	52,900	47,675	---
Ethylene	---	47,675	---

Source: ENAP

There are two sea port terminals, Quintero and San Vicente, for incoming crude oil: a) Quintero terminal is connected to the Concón refinery by a 20-km (12.4-mi) long pipeline; b) The San Vicente terminal is connected to the Concepción refinery by a 7-km (4.4-mi) pipeline.

1.3 Distribution to consumers

The Concón and Concepción refineries are connected to Santiago through a 700-km (435-mi) multiple-duct system. This system distributes refined products to an area reaching from Concepción to Valparaíso where 70 % of the national demand for clean oil products is concentrated. Except for Magallanes, an area which is self-sufficient, the rest of the country is supplied by ship and truck. Nearly 60 % of the oil pipelines are owned by ENAP. The remainder belong to the National Oil Pipeline Company (SONACOL).

ENAP, through its subsidiary Fuels Storage Company (EMALCO), controls four storage centers used as a safety reserve stock for primary distribution. The refineries rent storage facilities from these centers and supply local distributors.

Up to 1980, distribution of liquid fuels obtained from oil was traditionally handled by only three distribution companies:

- Esso Chile Petroleum Company (ESSO), operating in Chile since 1913.
- Shell Chile Company (SHELL), in Chile since 1919.
- Chile Petroleum Company S.A. (COPEC), a private Chilean company, established in 1934.

Since 1979, when the 1964 Decree N°20, which virtually blocked establishment of new oil distribution companies in Chile, was abrogated, five new ones have started operations (APEX, ENEX, ABASTIBLE, COMAR, TEXACO, GAZPESA).

With the exception of COMAR, these new distribution companies do not own any facilities for wholesale distribution. They rent storage capacity from EMALCO and surface space from ENAP. They do have their own loading systems, though.

2. Government Policies

2.1 Historical background

Since 1928, the State is the legal owner of all oil deposits and has the right to exploit and develop them. This ownership right was strengthened by the 1932 Mining Code and the 1950 ENAP Act, which stated that "the State has the absolute, inalienable, and indefeasible right of property to oil deposits, wherever they may be."

The exclusive rights of the State regarding refining activities were reaffirmed by the ENAP organic law, which states that only ENAP is allowed to refine oil in Chile. Some small private refineries were allowed to operate, however, by special laws and under fairly restrictive conditions, until the sixties when they closed down.

Primary and secondary distribution of oil-based products has been traditionally carried out by private firms, under strict State enforcement of 1932 Decree Law N°519.

2.2 Current policies

Current policies for the petroleum sector were implemented gradually since 1974. The main changes in said policies have been :

- State rights and duties regarding exploration and production of hydrocarbons now have been transferred

from ENAP to the Ministry of Mining. Therefore, the Ministry of Mining is authorized to enter into contracts regarding oil operations. This is the usual way "the door is opened" to private investors to participate in exploration and production projects in the country.

- Approval of a new, free price policy for petroleum and its derivatives, along with authorization to import, refine, and distribute oil in the country. As long as Chile continues to be a net oil importer, and if custom duties are kept low and flat, this policy drives prices near to their true economic value, i.e. their opportunity value.

Foreign investment in the petroleum sector is important for the country, because it means new jobs, increased economic activity, and decreases the need for State investments. In addition, there is a willingness to encourage oil exploration and production as a means to face declining oil production levels and reduce the country's dependence on imported oil.

In the petroleum sector, the Chilean state is the owner of all hydrocarbon deposits. However, exploration and commercial operation of said deposits may be made in association with national or foreign private investors. Indeed, the government authorizes private operation of oil deposits under the system of Special Contracts for Petroleum Operations (see 3.1 and Annex N°2) in the entire country, except for the Magallanes area, which is reserved exclusively for ENAP.

Oil refining and distribution activities are considered a separate economic sector. Therefore, both national and foreign private investors may access this market by themselves or in association with the State. To participate companies can purchase a significant portion of the share capital of some of the existing company or incorporate a new firm.

3. Current Legislation

Below is a description of the most relevant legislation presently in force applying to the petroleum sector,

especially regarding the areas of exploration, production, refining, importation, and distribution.

3.1 Exploration and exploitation

Present legislation in this area is based on the Political Constitution of the Republic of Chile, enacted in 1981. Article 19 of the Constitution reads as follows:

"The exploration, development, or exploitation of deposits containing substances not subject to concession may be managed directly by the State, or by state-owned enterprises, or by means of administrative concession arrangements or special petroleum operation contracts. In this regard, all requirements and conditions set forth by the President of the Republic, in each case by presidential decree, must be met. This standard shall apply also to deposits of any kind found under sea water within national jurisdiction, as well as to deposits located totally or partially within areas considered of importance for national security. The President of the Republic is authorized to terminate, at will and at any moment, with the payment of indemnity amounts when applicable, administrative concessions or petroleum operation contracts referring to operations sited in areas considered of importance for national security."

Other important statutes on the subject are Law N° 9618, known as the "ENAP Law", and Decree Law N° 1089 on special contracts for oil operations.

ENAP Law

This law provides that ENAP is authorized to carry out hydrocarbon exploration and exploitation activities within and without the national territory, directly or indirectly through participating companies, or in association with other parties. When activities are carried out within the national territory, through companies or other partnerships, such arrangements must operate under administrative concessions or special petroleum-operation contracts, and they must meet the requirements and conditions set forth by the President of the Republic by presidential decree. In addition, ENAP is authorized, although not exclusively, to refine petroleum and develop any other industrial activities related to hydrocarbons and their derivatives and byproducts. ENAP may also be authorized by the

Ministry of Mining to perform the duties and exercise the rights of the State as stated in a special petroleum-operation contract and in the applicable presidential decree.

SPECIAL PETROLEUM OPERATION CONTRACT LAW

Some relevant regulations contained in this law are as follows:

Terms such as "Special Petroleum-Operation Contract", "Contractor", "Compensation", "Specific Petroleum Job Contract", and other expressions are defined.

States that, if it is so specified in the special petroleum - operation contract, the contractor is allowed to export the hydrocarbons received as payment, without the limitations imposed by the normal regulations applied to exports. The right to freely make use of foreign currency generated by exports of such hydrocarbons is guaranteed.

In Annex N° 2 a summary of the principal regulations contained in this law is presented.

3.2 Refining, importation, and distribution

Present legislation on refining, importation, and distribution of petroleum and derivatives of petroleum is contained in 1978 Decree Law N° 1, Mining Law (as amended by 1979 Decree Law N° 3,001 and 1982 Law N 18,179):

All entities that engage in the business of importing, refining, distributing, transporting, or retailing petroleum, petroleum derived fuels, natural gas and LPG directly to the consumer must be registered with the Ministry of Economy.

The law provides that the President of the Republic is authorized to impose, by Presidential Decree issued through the Ministry of Economy, certain duties on registered entities, with the purpose of preventing actions or activities harmful to the population or to property.

The President of the Republic is authorized to establish, as national policy, the technical and quality standards applicable to different kinds of petroleum,

petroleum-derived fuels, and any other fuels. Likewise, he is also authorized to set forth standards applicable to the marketing of these products.

The law provides that any producer or importer of liquid fuels derived from petroleum is responsible for maintaining an average reserve stock for each product in an amount equivalent to a 25-day average sale computed over the last six months, or the average import amount for the same period, provided it is kept for his own consumption.

The pricing system must comply with regulations set forth by the Organic Law of the Ministry of Economy.

4. Incentives, Regulations, and Restrictions to Petroleum Production

The main incentives in the area of exploration and exploitation are described in the system of special petroleum-operation contracts (see Annex No 2). These are risk-contracts guaranteeing the contractor a previously agreed compensation in petroleum, which is to be exported or purchased by the State. In addition, when authorized by the President of the Republic, the contractor is assured a special tax treatment.

In the refining and distribution area, any company is allowed to run refineries. Advantages include freedom to import crude oil and derivatives, free access to the market by new distribution companies, and free access through rental of storage facilities from ENAP. Prices of petroleum derivatives are also freely set.

Applicable regulations and restrictions are those generally on quality and safety standards presently in force in the country.

5. Enterprises, Organizations, and Agencies Having a Bearing on Policy Design for the Oil Sector.

The main agency participating in the design of Chile's energy policy is the National Energy Committee (CNE). It is an advisory body reporting directly to the President of the Republic, and its mandates are described in Chapter I, section 3.

Another influential government department is the Ministry of Mining. The Minister is the chairman of ENAP, and he represents the State in petroleum operations contracts.

The Office of the Superintendent of Electricity and Fuels has the responsibility to enforce current legislation, regulations, and standards in this area.

The main corporation working with CNE in the design of policies for the petroleum sector is ENAP, the executive arm of the State in the sector.

ENAP is the only producer of national crude oil, and it has the exclusive concession to the Magallanes deposits. It owns the two refineries existing in the country. Through its subsidiaries, it controls fuel storage centers and multiple-duct systems.

Other major companies in the primary and secondary distribution business have a minor role in policy design for the sector. They participate only as required by the government.

6. Comparative Contribution of Oil Production to the Gross Domestic Product

Petroleum consumption in the main economic sectors is roughly as follows: 50% in transportation, 25% in industrial works and mining, 13% in commercial, residential, and public services. The remaining 12% is used for electricity production in thermal power plants. The latter figure has been declining since the 1973 oil crisis, because a substitution of coal for oil.

The major oil substitution in the country is occurring in the industrial sector, where the rate of industrial production to oil consumption has been significantly reduced. Specific examples of petroleum substitution by coal, firewood, and domestically-produced electricity may be found in certain major energy consumption centers, such as paper-cellulose mills, sugarmills, and cement plants. In each of these sectors, oil participation in total energy consumption declined 40%, 20%, and 10%, respectively (in 1973) to 10%, 0% and 3% in 1988.

- B. ANALY The overall result has been a diminishing comparative importance of oil in total energy consumption, from 58% in 1972-73 to 47% in 1987-88.

In general, the oil consumption/GDP ratio dropped from a pre-oil crisis index of 100 in 1973 to an index of 72 in 1988. This means that production of one unit of GDP in 1988 required nearly 30% less petroleum than in 1972-73.

(approximately 35% in exploration and 65% in exploitation).

Petroleum is the main energy source presently used in the country, representing 49% of total energy consumption. National demand for petroleum derivatives in 1991 has been estimated at 133,000 barrels of oil per day.

If the Chile-Argentina gas project does not come on stream and there is a steady rise of 5% in the yearly GDP rate, the yearly average rate of growth in the demand for petroleum derivatives in the country has been estimated at 4% (up to 1998).

It is worth mentioning that a significant part of the liquid fuel consumption increase will be caused by a major rise in the number of automobiles in circulation. Assumptions are that, up to 1998, nearly 60% of petroleum derivatives will be consumed in the transportation sector. Current consumption is 43%.

Also worth mentioning is the fact that a gas pipeline connecting Chile with Argentina is under study. If successful, there will be important changes in the petroleum consumption patterns, particularly in the industrial and public transportation sectors.

The public transportation system, for example, could face important technological changes (replacement of diesel engines by natural gas-fueled engines) and subsequently need to build stations and implement systems for distributing and retailing natural gas in the industrial sector. Petroleum fueled furnaces and boilers would have to be adapted to burn natural gas.

B. ANALYSIS OF THE PETROLEUM SECTOR

1. **Overview**

The average investment figure in the Chilean petroleum sector for the last 10 years has been close to 150 million dollar/year (currency value of 1990), 75% of which has been earmarked for exploration/production activities (approximately 35% in exploration and 65% in exploitation).

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The public transportation system, for example, could face important technological changes (replacement of diesel engines by natural gas-fueled engines) and subsequently need to build stations and implement systems for distributing and retailing natural gas. In the industrial sector, petroleum fueled furnaces and boilers would have to be adapted to burn natural gas.

2. Exploration and Production Sector

The internal production of crude oil, including liquid products obtained from natural gas, amounts to only 30,000 barrels a day and it is entirely produced by ENAP. Therefore, it contributes only 23% to the national supply. This figure has diminished significantly in recent years due to a decline in national production levels and a rise in consumption levels.

A steady decline in production is expected for the Magallanes basin, the only oil producing area in Chile. According to currently available information, prospects are that petroleum production in Magallanes, including gasoline and LPG, will fall from 1,8 million cu.m in 1988, to 1,1 million cu.m in 1993 (from 63.6 million cu.ft in 1988 to 38.8 million cu.ft in 1993) , 0.5 million cu.m (17.7 million cu.ft) mark in 1998, unless there are significant findings in new areas presently under exploration in the Andes foothills.

The challenge is, therefore, to attract risk capital to continue oil exploration and production in different areas of the country.

Presently, northern Chile is the most promising area. So far, five risk-contracts have been made with foreign companies, representing significant investments in seismic studies and well drillings (MAXUS-USA, HUNT-USA, HAMILTON & NORCEN-USA, EUROCAN-CANADA).

The sixth risk-contract covers an area in Tierra del Fuego (TEXACO-USA).

Taking into accounts these facts, projections for crude oil production (natural gasoline and LPG included), in million cubic feet, for 1993 and 1998 are as follows:

	1993	1998
6. Pessimistic Hypothesis	38.8	17.6
2. Central Hypothesis	53.0	35.3
3. Optimistic Hypothesis	70.6	77.7

3. Refining and Distribution Sector

In 1990, ENAP imported 6,152,000 cu.m (217 million cu.ft) of crude oil for refination, this represented 894 million US\$. The suppliers were : Nigeria (24%), Gabón (21%), Venezuela (14%), Colombia (9%), Argentina (7%), Ecuador (5%), Omán (2%) and Angola (2%).

Future expectations are that major investments will focus on projects designed to adapt refineries to the changing demand, mainly increased production of lighter products (gasoline and diesel fuels). Heavier products will be replaced by more economic alternatives, such as coal or firewood.

The project for natural gas transmission from Argentina, if approved, or the discovery of gas in northern Chile, are two factors that could have a strong impact on current petroleum derivative refining and distribution. A reduction in the production and consumption of petroleum derivatives of nearly 15% might be contemplated by the year 2000.

4. Areas of Interest and Business Opportunities for Canadian Investors

The Chilean government has a clear interest in attracting foreign investors for exploration and exploitation of new oil deposits, inland and offshore.

To participate in these activities, interested parties must settle and sign a Special Petroleum Operation Contract (see Annex N° 2).

The supply of equipment for exploration and eventual exploitation of new and existing deposits is also a business possibility.

In the refining area (presently under ENAP's control), there exists the possibility of supplying spare parts for plants presently in operation and equipments for minor changes.

The distribution area is open to new investors through the establishment of new firms or joining existing ones.

Another possibility is the construction and operation of gasoducts to import natural gas from Argentina and/or Bolivia.

5. Companies Active in the Petroleum Sector

- National Petroleum Company (Empresa Nacional de Petróleo, ENAP)

Activities: Crude oil production, refining, primary distribution, and storage of petroleum and derivatives. Business for imported crude oil, are made through his offices located at New York and Huston.

Market share: It is the only crude oil producer in Chile. It is also the only firm that operates oil refineries.

1990 ENAP's sales and percent over the total domestical consumption were:

	Sales (cu.ftx1000)	(%)
Gasoline	64,000	96
LPG	35,000	97
Kerosene	18,000	91
Diesel	89,800	96
Refined Pet.	45,700	99
Ethylene	3,000	100
Solvent, Naphta	5,700	100
Natural Gas	37,000	100

Source: ENAP

Through its subsidiaries, it controls storage centers and operation of multiple-duct pipelines.

It has a 15% share of the primary distribution market, through direct retailing to big-scale consumers. Does not retail to small-scale consumers.

Technological features: Owns seismic and drilling equipment, and has a seismic analysis center.

In offshore works, it uses three different drilling equipments, two of which are on lease (variable height platforms).

In addition, it has oilducts, gasoducts, and storage terminals.

Market share: At present, COPEC supplies 41% of the liquid fuels market, provided by primary distribution

It owns three refineries and runs processes for topping, catalytic cracking and reformation, alkylation, solvents, visbreaking, and ethylene.

Ownership Structure: ENAP is owned by the Chilean State. Its equity capital amounts to US\$420 million.

New projects: In the exploration and development area, it may be emphasized that ENAP has signed six Special Petroleum- Operation Contracts with foreign firms. Five of these risk- contracts, where ENAP's share ranges from 20 to 35%, are aimed at opening up development in northern Chile areas, from where preliminary data are encouraging. The agreed exploration area for each contract covers 5,000 sq.km (1,900 sq.mi) of land.

The sixth exploration contract, where ENAP's share amounts to 50%, covers a 3,300-sq.km (1,300 sq.mi) area in Tierra del Fuego, Twelfth Region.

Regarding oil derivatives refining and distribution, the design of new projects depends on the final approval of a natural gas transmission from Argentina. There is also the possibility of eventually using natural gas that might be found as a result of the special petroleum- operation contracts in northern Chile.

Some other projects under study by ENAP's subsidiaries, are a lubricants plant, in conjunction with Texaco, US\$ 100 million; a polypropylene plant, US\$ 51 million; a hydrocracking project, US\$ 22 million; an expansion of the refinery in Concepción, US\$ 9 million, etc.

- **Chile Petroleum Company (Compañía de Petróleos de Chile S.A., COPEC)**

Activities: Distribution of liquid fuels. Production and marketing of lubricants. Through subsidiaries and affiliated companies, marketing of LPG (Abastible), electricity (SAESA, FRONTEL), and mining and marketing of coal (COCAR).

Market share: At present, COPEC supplies 41% of the liquid fuels market, provided by primary distribution

companies. This means 2 million cu.m (70 million cu.ft) per year.

Technological features: It owns a retail network of over 500 service stations, five storage plants with a total capacity of 68,000 cu.m (2.4 million cu.ft), and nine additional plants, totalling 33% of the market.

Ownership: Controlled by the Angelini Group with a participation of 60% (private sector).

New projects: Recently (August 1991), COPEC formed a consortium in conjunction with Shell, Abastible, and ENAGAS, to negotiate the purchasing of natural gas from Argentina. If the deal is settled, a gas-pipeline of approximately 1000km (600 mi), from Neuquén to Santiago, vía Chillán, could be built.

- **ESSO CHILE Petroleum Company (ESSO CHILE Petrolera Ltda.)**

Activities: Direct distribution to primary and secondary consumers, is its main activity. Production and marketing of lubricants.

Market share: 22% of the market supplied by primary distribution companies.

Technological features: It owns a retail network of approximately 260 service stations, as well as storage and selling facilities at main airports in the country.

Ownership: A subsidiary of Exxon.

- **SHELL CHILE COMPANY**

Activities: Direct distribution of liquid fuels. Production and marketing of lubricants and chemical products.

Market share: 25% of the market supplied by primary distribution companies.

Technological features: Owns a retail network of approximately 270 service stations, as well as storage facilities.

Ownership: Owned by the Dutch Shell Group, with Dutch and British capital.

- **MARINE FUELS COMPANY (Combustibles Marítimos S.A., COMAR)**

Activities: Supply and distribution of liquid fuels and lubricants to marine consumers.

Market share: 6% of the liquid fuels market.

Technological features: Owns a retail network of approximately 120 service stations, as well as six storage facilities throughout the country.

Ownership Structure: Two stockholders own entirely this Company; CASTROL, holding 50% and CODIGAS, holding 50%.

- **FUEL PROVIDING COMPANY (Abastecedora de Combustibles S.A., Abastible)**

Activities: Supply and distribution of LPG and liquid fuels (gasoline, diesel, and kerosene).

Market share: 33% of the LPG distribution market, with 168,000 tons of yearly retail sales.

Technological features: Owns three facilities for LPG filling and storage of cylinders, twelve distribution centers, and 1,8 million cylinders.

Ownership Structure: 98% of the company is owned by COPEC.

- **GAS DISTRIBUTING COMPANY (Compañía Distribuidora de Gas S.A.C. e I., CODIGAS)**

Activities: Storage, transportation, and distribution of LPG. Also, manufacture of LPG storage cylinders.

Market share: 20% (52,000 tons/year) of the industrial and retail LPG market in the Metropolitan Region (Santiago).

CODIGAS and all of its affiliated companies operating in the rest of the country, own approximately 48% to 50% of the national market.

Affiliated Companies:

- **ENAGAS**, distributing in 8th, 9th, and 10th Regions, with a 46% share of the market in those regions. 100% of its is owned by CODIGAS.
- **LIPIGAS**, distributing from Region 1 to 5, covers 100% of the market from Regions 1 to 4, and 85% of the market in the 5th Region. 80% of its stock is owned by CODIGAS.
- **AGROGAS**, distributing on the 6th Region, covers 54% of the market in that Region. 100% of its stock is owned by CODIGAS.

Future Projects: Through its affiliate ENAGAS, it participates in the COPEC-SHELL-ABASTIBLE consortium which is presently studying the feasibility of implementing the gas interconnection project between Chile and Argentina.

Technological features: Owns two distribution centers. Distributes gas in cylinders and by trucks to major consumers.

- **SANTIAGO GAS CONSUMERS COMPANY (Compañía de Consumidores de Gas de Santiago S.A., GASCO)**

Activities: Production, distribution, and commercialization of manufactured gas in Santiago, and of LPG cylinders in Santiago and in Chile's Twelfth Region.

Market share: Has 45% (140,000 tons a year) of the industrial and retail LPG market in the Metropolitan Region (Santiago), and 2% in Concepción city.

Ownership structure: The CGEI Electric Company is the main stockholder (54,6%)

Future projects : Recently, GASCO formed a consortium with an Argentinian firm, Pérez Companc, for the construction of a nearly 500 km (300 mile) long gasoduct, to transport natural gas from Argentina to Santiago, through the Maipo Passage. Estimated cost is about US\$ 140 million.

III. ELECTRIC POWER

A. GENERAL DESCRIPTION

1. General Overview

Due to the geographical features of Chile, the electric power sector is physically divided into four independent zones of electric power supply:

a) In the far north (1st and 2nd Regions, with 0,7 million inhabitants), we have the "Sistema Interconectado del Norte Grande (SING)" (Far North Interconnected System), which is a transmission system reaching over 1,000 km (600 mi), from Arica to Antofagasta. In this desert region of the country, power plants are mostly coal- and oil-firing thermoelectric plants. Total installed power, by late 1990, was 677 MW (10,2 MW hydro, 406 MW coal, 261 MW oil), producing 2,860 GWh per year. Transmission lines amounted to 675 circuit km (420 circuit mi) in 220 kV, 850 circuit km (530 circuit mi) in 110 kV, and 200 circuit km (125 circuit mi) in 66 kV.

b) In central Chile (3rd to 10th Regions, with 12 million inhabitants), we have the "Sistema Interconectado Central (SIC)" (Central Interconnected System), which is the country's main system, reaching over 2,000 km (1,250 mi) from Taltal to Chiloé. Here live 92% of the national population. Present installed power is 3,700 MW (2,850 MW hydro, 655 MW coal, 195 MW oil), producing about 15 TWh per year.

Hydroplants are located mainly in the southern section of this central area, while thermoplants are mainly used in the northern end, where water supply is scarce.

The transmission system adds up to 580 circuit km (310 circuit mi) in 500 kV, 3,220 circuit km (2,003 circuit mi) in 220 kV, 1,510 circuit km (940 circuit mi) in 154 kV, 950 circuit km (600 circuit mi) in 110 kV, and 2,910 circuit km (1,750 circuit mi) in 66 kV.

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Note:

It is worth mentioning that in the two systems described, the generating (transmission) companies are separate from distributing companies. There are many generating companies competing among each other, and only one distribution company for each specific geographical area.

For the next two zones, however, there is a single company at every location handling both generation and distribution.

- c) In southern Chile (part of 10th Region and 11th Region, with 0,2 million inhabitants), we have three separate systems, operating on low voltages, with little installed power (15 MW, mainly oil, and mini-hydroplants). Transmission lines, of 13 and 23 kV, add up to 680 circuit km (420 circuit mi).
- d) At the far south (12th Region, with 0,16 million inhabitants), electricity is generated only by independent diesel or natural gas plants for some locations (Punta Arenas, Puerto Natales, and others). Total installed power, by late 1990, amounted to 45 MW, producing 95 MWh per year.

Standardized frequency in Chile is 50 Hz. Home distribution voltages are 220 V monophasic, and 380 V triphasic.

2. Government Policies

2.1 Historical evolution

The first general law on electric power supply was enacted in 1925. After the oil crisis of 1978, the government established the National Energy Committee (CNE) who changed 1980 the rating system, and put in place a new version based on marginal generation and transmission costs. Finally, during 1982, the government issued a new electric statute (Decree-Law N°1), which maintained marginal costs. The new system included also the possibility of using transmission lines owned by others, through payment of a suitable toll.

Additionally, and to avoid competition that is contrary to the national interest, CNE established the Economic

Generation Dispatch Center (CDEC), with the responsibility of determining regulations for electricity generation.

2.2 Current Policies

The current democratic government considers the private sector to be the driving force within the electricity sector, making investments in new generation, transmission, and distribution works. The State reserves the right to ensure compliance with all laws, rules, and regulations on the part of the companies. It also regulates rates, and recommends new facility building programs with a view to minimizing updated costs of investment, operation, and reliability of the power system. However, it does not force solutions or interfere with projects investors seek to develop.

The State continues to coordinate major investment projects for various reasons, including:

- a) The State must have complete, adequate, and updated information on the development of the electricity sector, and future prospects concerning evolution of demand and supply.
- b) The Electric Supply Law provides that electricity rates at generation level should be established considering a minimum cost investment program, with a minimum duration of at least 10 years. To meet this legal requirement, it is necessary that the State safeguards the progress of investment programs.
- c) Finally, decisions concerning investments in distribution are taken independently by each company. As each distribution concession is a natural monopoly, rates and quality of service must be regulated.

3. Current Legislation

- 3.1 The activities of generation, transmission, and distribution of electricity, as well as the concession and pricing systems are currently governed by Decree-Law N°1, in force since 1982.

This decree requires the State to establish:

- a) Concessions to build power plants, substations, transmission lines, and facilities for public service distribution.
 - b) Pricing systems for the marketing of electrical energy (see Annex N° 3 for pricing policies).
- 3.2 Generation plants other than hydro, such as thermal, nuclear, eolic, and geothermal, do not require a concession. They may be freely built by any company, provided they are economically attractive, and that all safety, health and environment laws and regulations are observed.
- 3.3 Regarding operation and exploitation of generation and transmission facilities, the major features of Decree-Law No 1 are:
- a) Power generating and tranmission companies are not required to provide service to demanding customers.
 - b) There are coordination standards for operation of interconnected systems, with the purpose of preserving the reliability of the service, thus guaranteeing overall economic operation and allowing for shared use of transmission lines.

These rules are enforced by the Economic Dispatch Centers established in each interconnected system site.

4. Incentives, Regulations and Restrictions Applicable to Electric Power Generation

4.1 Incentives

The main incentives to generation of electric power are:

- a) Free prices between generators and big-scale clients (over 2 MW). 35% of the public service energy in the Central Interconnected System is sold at freely negotiated prices, therefore, there is strong competition to supply these clients.
- b) Freedom to build power generating plants, other than hydro. Easy access to the interconnected system, and equitable conditions for marketing electric power.

- c) Legislation assuring a shared use of transmission systems, and preventing the formation of monopolies by owners of existing lines in areas where new customers appear.

4.2 Regulations and restrictions

Construction of hydro power plants requires submission of a certificate of "water utilization rights," which are granted in accordance with the Water Code. This Code governs the general use of water resources in the country, authorizing the charging of easements for water conduction.

If an investor who is interested in preparing a study or building a power station or transmission line does not reach an agreement with the owner of the land, the government may grant an "Electrical Concession," which allows for imposition of easements.

A granted concession may expire if works do not start by the agreed date or if at least 2/3 of the works have not been completed by the pre-determined date, unless force majeure may be claimed.

The Economic Generation Dispatch Centers (CDEC), which were established by CNE and representatives from generating companies, sets regulations and restrictions for the production of electrical power.

4.3 Position on Foreign Investments

The generation and transmission of electrical power represent an open market in which foreign investments are welcomed.

Foreign investors can make their own decisions as to selection of activities, form of organization, possible partnership with other investors, size of the project, its subsequent development, etc., on the basis of individual judgment and ideas on revenue and efficiency.

The most relevant features, rules and guarantees of this legislation concerning admission of foreign investors, are presented in Annex N° 1.

5. Enterprises, Organizations, and Agencies that Have an Impact on Policy Formulation for the Electric Power Sector

The main agency having an impact on the formulation of energy policy in Chile is the National Energy Committee (CNE). It is a direct adviser to the Chilean President, and has the responsibility of making and coordinating plans, policies, and rules for ensuring the smooth operation and development of the energy sector.

To meet these goals, CNE requests the participation and collaboration of major companies and entities operating in the sector.

Enforcement of legislation, regulations, and standards in the electric power sector is carried out by the Office of the Superintendent of Electricity and Fuels.

6. Electric Power Contribution to the GDP and its Relationships with other Economic Areas

The contribution made by the electric power sector (generation, transmission, and distribution) to the GDP has been around 2.7% in recent years.

Historical growth rates for electricity demand in Chile have been greater than the corresponding growth rates of the Gross Domestic Product. For example, total gross consumption of electricity (public service and self-suppliers) in Chile grew at a rate of 5.3% per year in 1975-1988, while the GDP did at a rate of 4.1% per year. The Central Interconnected System (SIC) registered annual average rates of growth for public service demand of 5.9% for 1975-1980, and of 5.5% for 1980-1988.

B. ANALYSIS OF THE ELECTRIC POWER SECTOR

1. Overview

The electric power market in Chile is an attractive one. In fact, it is one of the most dynamic ones in the Chilean economy, supplying electricity to a growing number of new projects.

Electrical activities are carried out basically by utility companies. In Chile, there are eleven operating

generation-transmission companies and 23 distributing companies of various sizes (see Directory).

Nevertheless, at the generation-transmission level there is a noticeable percentage of electricity produced by industrial and mining companies (self-suppliers), more or less meeting their own demand and mostly interconnected to utilities. There are also 14 electric cooperatives distributing electricity to their members, mainly in rural areas (see Directory).

Gross power generation in Chile was 17,810 GWh in 1989, of which 54% was hydro and 46% thermal (70% coal and 30% oil). On the average, the hydro portion has been 60% for the last 20 years, however yearly production strongly depends on annual rainfall and on the number of new plants entering the sector.

The relative weight of major activities related to the electric power sector, measured by the cost of generating, transmitting, and distributing electricity, depends on the particular characteristics of every power system. Figures appearing below are an estimate of the average costs in the SIC:

Activity	Cost (US\$/kWh)	%
Generation	3.2	51
Transmission	0.7	11
Distribution	2.4	38
Total	6.3	100

Source: CNE

The average level of investment in the electricity sector during the last 10 years has been around US\$200 million per year (1990 currency value).

2. Generation-Transmission Subsector

As discussed in paragraph A.6, the growth rates of electricity demand in Chile are greater than GDP growth rates. Consequently, important investments in generation and transmission projects should be made in the next 10 to 20 years.

Regarding generation, investments should focus mainly on hydroplants, for which Chile has significant potential.

Recent studies on resources indicate that hydroelectrical potential in Chile is about 24,000 MW, with a possible average annual generation of 130,000 GWh. Only 10% of this is now exploited.

This potential is distributed throughout the country as shown on the next table. The greatest potential (65%) is concentrated in central Chile.

Region	Power (MW)			
	Installed & Installable	Economically Feasible	In Operation	Future Installation
North				
Regions I to IV (North of Aconcagua River)	300 (1.2%)	200 (1.2%)	35 (1.5%)	165 (1.15%)
Center				
Regions V to X (Between Aconcagua and Puelo rivers)	15,550 (64.8%)	11,000 (64.7%)	2,236 (98.1%)	8,764 (59.6%)
Far South				
Regions XI & XII (South of Puelo river)	8,150 (34%)	5,800 (34.1)	9 (0.4%)	5,791 (39.3%)
TOTAL	24,000	17,000	2,280	14,720

Specific projects under consideration for the next few years are as follows:

- a) ENDESA's 110 million dollar, 86 MW Curillínque power plant, planned for 1994 on the Maule River.

- b) Guardia Vieja's 50 million dollar, 50 MW Blanco power plant planned for 1994 on the Aconcagua River.
- c) ENDESA's 460 million dollar, 450 MW Pangué power plant planned for 1996 on the Biobío River.
- d) ENDESA's 600 million dollar, 500 MW Ralco power plant planned for 2001 on the Biobío River.
- e) ENDESA's 300 million dollar, 260 MW Huequecura power plant on the Biobío River.
- f) ENDESA's 150 million dollar, 92 MW Corrales power plant on the Cachapoal River.
- g) Alumysa's 265 million dollar, 360 MW Cuervo power plant on the Cuervo River.

Transmission works will also require significant investments in order to be able to transfer great blocks of energy from the hydroplants located further down south in Chile to consumption centers located north of central Chile.

Electrical development in the far north will proceed in a coordinated fashion together with the expansion of the important mining sector. Due to the absence of water resources in this area, coal-fired plants should be built in the foreseeable future. A 125 MW to 175 MW plant should be constructed between 1995 and 1996 (Tocopilla or Mejillones).

3. Distribution Subsector

A classification by categories of consumption of electrical energy distributed for public service in Chile in 1989 is given below. It should be kept in mind that 67% of public service energy consumed in the country was sold by distributing utility companies. The rest was sold directly to large industries and mining companies by the generating utilities.

There is also an attractive market for the supply of equipment (turbines, generators, transformers, etc.). Imports in this area amounted to US\$317 million in 1990.

- d) Guardia Vieja's 50 million dollar, 50 MW Blanco power plant planned for 1994 on the Aconcagua River.
- c) ENDESA's 480 million dollar, 450 MW Panguo power plant planned for 1998 on the Bío Bío River.
- b) ENDESA's 600 million dollar, 500 MW Rajco power plant planned for 2001 on the Bío Bío River.
- e) ENDESA's 300 million dollar, 280 MW Huepucura power plant on the Bío Bío River.
- f) ENDESA's 150 million dollar, 92 MW Corrales power plant on the Cachapoal River.
- g) Aynusa's 255 million dollar, 380 MW Cuervo power plant on the Cuervo River.

Transmission works will also require significant investments in order to be able to transfer great blocks of energy from the hydroplants located further down south in Chile to consumption centers located north of central Chile.

Electrical development in the far north will proceed in a coordinated fashion together with the expansion of the important mining sector. Due to the absence of water resources in this area, coal-fired plants should be built in the foreseeable future. A 125 MW to 175 MW plant should be constructed between 1995 and 1998 (Tocopilla or Mejillones).

3. Distribution Subsector

A classification by categories of consumption of electrical energy distributed for public service in Chile in 1989 is given below. It should be kept in mind that 67% of public service energy consumed in the country was sold by distributing utility companies. The rest was sold directly to large industries and mining companies by the generating utilities.

Public Service Energy Distributed During 1989

Category	GWh	%
Residential	2,472	13.9
Commercial	1,168	6.6
Municipal government	605	3.4
Public lighting	437	2.5
Transportation	216	1.2
Irrigation	50	0.3
Copper mining	4,519	25.4
Paper & cellulose	1,106	6.2
Iron	615	3.5
Cement	268	1.5
Nitrate	264	1.5
Oil	252	1.4
Petrochemical	242	1.3
Coal	113	0.6
Sugar	82	0.5
Other	3,178	17.8
Subtotal	15,698	88.2
Losses	1,818	10.2
Consumption in power stations	294	1.6
Total	17,810	100%

Industrial and mining sector self-suppliers (Codelco, CMPC, and CELCO among others) account for 23.3% of this amount (4,146 GWh). 3,789 GWh were consumed directly by them, and 357 GWh were sold to utilities.

4. Areas of Interest and Business Opportunities for Canadian Companies

The generation and transmission field is fully open to private capital, domestic or foreign. Canadian capital can operate independently or in partnership with Chilean capital, for the building of generating plants, whether hydro, coal-fired or geothermal (such as El Tatio and Puchuldiza plants).

There is also an attractive market for the supply of equipment (turbines, generators, transformers, etc.). Imports in this area amounted to US\$317 million in 1990,

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Irrigation	50	0.3
Copper mining	4,519	25.4
Paper & cellulose	1,106	6.2
Iron	616	3.5
Cement	268	1.5
Nitrate	264	1.5
Oil	222	1.4
Petrochemicals	242	1.3
Coal	113	0.6
Sugar	82	0.5
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Subtotal	15,698	88.2
Losses	1,818	10.2
Consumption in power stations	294	1.6
Total	17,810	100%

327 GWh were sold to utilities. (4,146 GWh). 3,789 GWh were consumed directly by them, and (4,146 GWh) account for 23.3% of this amount. Industrial and mining sector self-suppliers (Codelco, CMPC, and CELCO among others) account for 23.3% of this amount.

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and they will probably reach the US\$350 million mark in 1991. Nearly 20% of this equipment comes from the USA. Other important suppliers are Germany, France, Japan, and Brazil. Canadian suppliers wishing to get a share of the market will need to focus their attention on having appropriate representation as well as competitive financing, providing first quality service, and so on.

The most significant kinds of equipment are listed in the following table.

TOTAL IMPORTED ELECTRICAL POWER EQUIPMENT
(US\$ Millions)

	1989	1990
Hydraulic turbines & wheels	10.3	16.4
Gas turbines	6.6	6.1
Generators	14.7	15.4
Boilers	33.2	64.0
Generating sets	34.0	40.5
Transformers	25.1	26.7
Converters & coils	16.2	17.8
Electrical panels & boards	32.2	36.7
Electrical safety devices	4.5	4.6
Circuit breakers, fuses, etc.	65.4	71.9
Insulators	5.6	6.1
Meters	3.1	4.0
Conductors	9.1	6.8
Total	260.0	317.0

Source: Chile's Central Bank Foreign Trade Statistics, 1990.

5. Relevant Entities Participating in the Electric Power Sector

- **NATIONAL ELECTRIC COMPANY (EMPRESA NACIONAL DE ELECTRICIDAD S.A., ENDESA)**

Activities: Generation, transmission, and selling of electric power.

Market share: During 1989, ENDESA generated 6,835 GWh, 38.4% of the total public supply generation in the country.

ENDESA owns the entire transmission system in central Chile.

Technological features: ENDESA has a total installed generation capacity of 1,600 MW hydro (82%) and 346 MW thermal (18%). 59% of thermal power corresponds to backup generating plants (oil firing).

Ownership structure: ENDESA is owned by many stockholders, including several private Social Security Funds (AFPs) holding 24%, and the Enersis group holding 12%.

New projects: Through its affiliate **Pehuenche S.A.**, ENDESA is presently developing (with Asea-Brown Boveri-Swiss) the Curillinque hydro-project, with 85 MW, 590 GWh per year, located on the Maule River, between the existing Isla and Pehuenche plants. Estimated cost: US\$110 million. Commissioning scheduled for 1994.

The Pangué hydroplant, with 450 MW, 2,200 GWh per year, will be located on the Biobío River. It will have an hourly regulated impounding. Estimated cost: US\$460 million. To be commissioned in 1996. Its associated transmission system shall operate in 220 kV, 32 km (20 mi) of double circuit, and 51 km (32 mi) of a 500 kV line, operated as a double circuit in 220 kV.

Ralco hydroplant, with 500 MW, 3,400 GWh per year, scheduled for 2001, on the Bío-Bío River. Estimated cost: US\$600 million.

- **CHILEAN ELECTRIC GENERATION COMPANY (COMPAÑIA CHILENA DE GENERACION ELECTRICA S.A., CHILGENER)**

Activities: Generation, transmission, and selling of electric power.

Market share: During 1989, Chilgener generated 3,887 GWh, or 21,8% of total public supply generation.

Technological features: Chilgener has a total installed generating capacity of 247 MW hydro (33%) and 509 MW (67%) coal-fired plants.

Ownership structure: Main stockholders are Continental International Finance Corporation (14%), several Social Security Funds-AFPs (19%), the Inversiones Financieras FP Chile S.A. group (20%), and held by the public (47%).

New projects: Chilgener is now starting up the new Alfalfal hydroplant, with 160 MW, at a US\$300 million cost.

Jointly with other investors (Colbun S.A., COCAR and CAP), Chilgener is engaged in conducting feasibility studies for the Guacolda coal-fired plant, with 125 MW, at US\$150 million, to be built in the 2nd Region by 1995.

In the pre-feasibility stage is the Alfalfal II project, on the Colorado River, with a possible 180 MW, at US\$235 million.

- **COLBUN-MACHICURA ELECTRIC COMPANY (EMPRESA ELECTRICA COLBUN- MACHICURA S.A., COLBUN S.A.)**

Activities: Generation and selling of electric power.

Market share: During 1989, Colbún generated 2005 GWh, or 11.2% of total public service generation.

Technological features: Colbún S.A. owns the hydrocomplex formed by Colbún, with 400 MW and 2,380 GWh per year, and Machicura, with 90 MW and 540 GWh per year.

Ownership structure: The main stockholder is the Chilean State represented by the Chilean Production Development Corporation, CORFO.

New projects: Colbún is studying the possibility of participating in the construction of the Guacolda coal-fired plant, with 125 MW, at US\$150 million, 1995.

Other feasibility studies are being conducted for the San Ignacio hydroplant, 50 MW (US\$25 million) and the Chiburgo hydroplant, 23 MW (US\$14 million) both of them on the Maule River.

- **FAR NORTH ELECTRIC COMPANY (EMPRESA ELECTRICA DEL NORTE GRANDE, EDELNOR)**

Activities: Generation, transmission, and selling of electric power in northern Chile (SING).

Market share: During 1989, EDELNOR generated 185 GWh and purchased another 309 GWh from Tocopilla (Division of Codelco). EDELNOR is the sole owner of the northern power transmission system (SING).

Technological features: EDELNOR holds a hydroplant with 10.2 MW and several diesel motors and gas turbines, producing a total of 86 MW. The transmission system consists of 720 circuit km (450 circuit mi) of 220 and 110 kV lines.

Ownership structure: The main stockholder is the Chilean State, through CORFO.

New projects: EDELNOR is studying the feasibility of building a new coal-fired plant, with 125 to 175 MW, at US\$150 million, to be commissioned in 1995, in Mejillones, SING.

- **METROPOLITAN ELECTRIC DISTRIBUTION COMPANY (COMPAÑIA CHILENA METROPOLITANA DE DISTRIBUCION ELECTRICA S.A, CHILMETRO)**

Activities: Public service distribution and selling of electric power.

Market share: Chilmetro is the utility company distributing electrical power in Santiago (1 million customers). During 1989, it sold 4,000 GWh.

Technological features: Chilmetro owns the 220kV, 110kV, and 12kV distribution lines.

Ownership structure: 87% of the company is owned by the Enersis group.

New projects: Chilmetro expects to invest nearly US\$300 million during the next decade in the development of the metropolitan network.

- **GENERAL INDUSTRIAL POWER COMPANY (COMPAÑIA GENERAL DE ELECTRICIDAD INDUSTRIAL S.A., CGEI)**

IV. **GAS SECTOR**

A. **GENERAL DESCRIPTION** Activities: Public service distribution.

1. **General Description** Market share: CGEI distributes power in Concepción, Rancagua, Talca, Temuco and other important cities in central Chile, with a total of 450,000 customers. During 1989, it sold 285 GWh.

Technological features: CGEI owns 154, 66, and 15 kV distribution lines.

Ownership structure: Main stockholders are the Marín family (15.7%), Investments Pathfinder Chile (Ben Mafhouz) (13%), and Indiver (9%).

Exploration and production of natural gas is presented in this section only in a summary form, since this fuel has been produced up to now only in the Magallanes area, associated with oil production.

Town gas is presently used only in some districts of the 5th Region (Valparaíso and Viña del Mar), the Metropolitan Region (mainly Santiago downtown and Providencia, Las Condes and Ñuñoa districts), the 8th Region (Concepción and Talcahuano) and the 12th Region (Punta Arenas, Puerto Natales and Puerto Porvenir). Except for the 12th Region, where natural gas is produced by ENAP, the other regions mentioned above are supplied with privately manufactured and distributed gas. It should be pointed out that, except for the 12th Region, town gas consumption is not very significant, since it represents less than 10% of the residential fuel consumption in cities, and less than 3% of industrial energy consumption.

At the national level, gas represents only 6% of total energy consumption: (excluded natural gasoline and LPG obtained from natural gas).

1.1 **Natural Gas**

Natural gas is used only in the surroundings of the Magallanes production area, in deposits lying in the Springhill sandstone, corresponding to the Lower

IV. GAS SECTOR

A. GENERAL DESCRIPTION

1. General Overview

The gas sector includes all gas fuels which are transported or distributed through pipeline networks.

"Town gas" includes natural gas and manufactured gas, produced from coal distillation, naphta craking or a mixture of one of them with biogas. It is also usual to include in this sector gas produced at steel mills, like coking plant gas or blast furnace gas. Propane or liquefied petroleum gas (LPG) is discussed in chapter II (fuels obtained from mineral oil).

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At the national level, gas represents only 6% of total energy consumption: (excluded natural gasoline and LPG obtained from natural gas).

1.1 Natural Gas

Natural gas is used only in the surroundings of the Magallanes production area, in deposits lying in the Springhill sandstone, corresponding to the Lower

Cretaceous. Exceptionally, small deposits of gas are also found in Higher Tertiary sandstones in the Magallanes basin.

As indicated in chapter II, on mineral oil, ENAP is the only company working in that area.

Natural gas produced in Magallanes is extracted from deposits in the continental area in Tierra del Fuego and offshore, together with other liquid hydrocarbons included in crude and condensed oil.

Presently, conversations as well as technical and economic analysis are underway regarding the feasibility of importing natural gas from Argentina to central Chile. There is also the possibility of importing from Bolivia for use in northern Chile.

1.2 Manufactured Gas

The production of gas from naphta cracking processes has been used mainly in Santiago. The first production unit was commissioned in 1966, and its capacity was doubled in 1971. A second plant was commissioned in 1975.

Since 1978, Santiago Gas Consumers Company (GASCO), a private distributor of manufactured gas in Santiago, has been conducting studies jointly with the Santiago local government for production and use of biogas from trash landfills.

This idea was successful and, since 1982, biogas is being extracted from the La Feria landfill. Biogas from the Lo Errázuriz and Cerros de Renca landfills is now being used. The process for extracting biogas from landfills was developed in Chile and has allowed production of over 30% of manufactured gas in Santiago.

The same technology has been applied since 1988 by GASVALPO, a private gas distributor in Valparaíso and Viña del Mar. In this case, manufactured gas is produced from a coal plant in combination with a watergas plant.

Up to 1986, the manufactured gas distributed in Concepción and Talcahuano by GAS CONCEPCION, a private company, came from gas produced at the Huachipato steel mill. The gas was a combination of gases from the coking plant and blast furnaces. Due to an increase in the internal use of gas at

the steel mill, it was necessary for GAS CONCEPCION to build its own manufacturing plant, and a technology of production based on coal was chosen. This plant started production in 1986. It has a capacity of 140,000 cu.m/day (4.9 million cu.ft/day), thus allowing for total substitution of gas previously obtained from the steel industry.

2. Government Policies

2.1 Historical Evolution

Legislation on the exploration and exploitation of natural gas has the same historical evolution as to the one referring to mineral oil. Since 1920, ownership of deposits, as well as the rights for exploration and exploitation of hydrocarbons (oil and natural gas) have been governed by the State. Since its establishment in 1950, ENAP was, up to the mid-70's, the only company authorized to carry out these activities in the country.

On the other hand, manufactured gas production began in Chile around the middle of the last century, and since then it has been produced under administrative concessions granted by Presidential decree.

Production and distribution of manufactured gas was governed since 1931 by the Gas Services Act, which was also applied to liquefied gas up to 1978. This legislation standardized concessions under which the various gas companies operated in the country, establishing franchises, requirements, and conditions applying to those concessions. The Act also regulates all matters related to gas supply, mode of exploitation, concession expiration, pricing, State supervision, and so on.

By mid-1982, subsidies to gas prices were eliminated. Since then, prices are freely set, a policy which remains in force.

2.2 Current Policies

The activities of exploration and production of natural gas is currently governed by the provisions of the Constitution and of legislation applicable to oil, as discussed in chapter II. Such legislation stipulates that operator shall be either ENAP, or private or mixed companies, under

special operation contracts made by the State for the exploitation of hydrocarbons.

The State encourages natural gas use in the Magallanes area, and promotes capital investments in related projects. Natural gas transportation over longer distances is privatized. If gas deposits were found in northern Chile, and if it were convenient to transport it to the central area, the State would promote such projects and even contemplate a subsidiary role in them, to bring the project into completion.

As mentioned above, government authorities are fostering imports of natural gas from Argentina to central Chile. If an agreement is reached for construction of this gasoduct, it will represent a turning point for the industrial energy sector. Boilers and furnaces will have to be adapted to burn natural gas. Even the substitution of natural gas for diesel oil now used in public transportation systems is considered viable because of reduced air pollution.

For the transportation system, however, it would mean important technological changes, because diesel engines would need to be replaced by gas-fueled engines. In addition, systems and stations for distribution and retailing of natural gas would need to be built and implemented.

Manufactured gas production would operate through private companies locally, in a decentralized fashion. A similar notion is assumed for distribution franchise operators, whose rights and duties are established in the "town gas" legislation.

Installation of manufactured gas plants operating with coal in cities where there is no gas distribution network, is a favorable situation, since it allows for utilization of an abundant raw material. Gas is less polluting than oil, kerosene, wood or coal.

Meanwhile, as long as production of oil and its derivatives continues to decline, and natural gas imports from Argentina are not yet materialized, manufactured gas will be a competitive alternative.

3. Current Legislation

Legislation presently governing the relationships among gas companies and the central government, municipalities, and individuals, within their concession areas, is contained in the Gas Services Act, and 1931 Decree-Law N°323 partially amended by 1989 Law N°18,856 (see Annex No 4).

4. Incentives, Regulations, and Restrictions to Gas Production

4.1 Natural Gas

The main incentive for natural gas exploitation lies in the fact that it acts as a substitute for the more expensive imported fuels.

As indicated in chapter II, dealing with oil, domestic or foreign investors may associate with the State, through risk- contracts, for exploration and exploitation of natural gas reservoirs.

The incentive consists of the right to exploit any gas discovered, receiving for it an agreed compensation.

There is also the possibility of installing gasoducts from the newly discovered reservoir, or from reservoirs already under exploitation. Such is the case, under study by several companies for different alternative plans to determine the feasibility of installing a gas-pipeline from an Argentinean deposit.

Regulations and restrictions pertaining to the exploitation and production of natural gas are described in Annex N°2, which deals with special contracts for petroleum operations.

Regarding utilization of natural gas, there are incentives to foster the use of existing reservoirs in the Magallanes area encouraging participation of investors who may develop these projects at their own risk.

Such is the case of a group of investors (Fletcher Challenge) that own a methanol plant in the Magallanes area, with an investment of US\$300 million, and a production of 750,000 tons/year. A project for ammonium-urea production has also been evaluated in the same region.

4.2 Manufactured Gas

This fuel is not as economically attractive as natural gas, since it is more expensive. In fact, if the project for importing natural gas from Argentina is completed, or if natural gas were eventually found in northern Chile, natural gas will also be used as raw material for manufactured gas, in combination with some percentage of biogas and LPG. This mixture could be distributed using existing equipment and distribution networks.

5. Enterprises, Organizations, and Agencies Having an Impact on the Design of Policies for the Gas Sector

The main agency having an impact on the design of energy policies in Chile is the National Energy Committee (CNE). In the case of natural gas, CNE studies and coordinates, in conjunction with ENAP, the best way to use the Magallanes reservoirs.

6. Comparative Contribution from Gas Production to the GDP

Within the national energy context, gas has a relatively small participation, representing approximately 6% of total energy consumption.

Its contribution to the GDP has been of around 0,1% in recent years.

B. ANALYSIS OF THE GAS SECTOR

1. Overview

1.1 Natural Gas

So far, natural gas has only been found, in relatively significant amounts, in the southern area of Magallanes. Distance makes it unfeasible to be used as a fuel in the more industrialized central portion of Chile. That is why it is only used locally (Punta Arenas, Puerto Natales, Puerto Porvenir), where it is an important source of energy for industrial, domestic, and heating uses. There is also an incentive to use it in chemical processing plants, such as methanol, ammonium-urea, and the like.

Record production of natural gas in Magallanes occurred in 1972, with 8,073 million cu.m (285,000 million cu.ft). Subsequently it began decreasing steadily, reaching only 4,280 million cu.m (151,000 million cu.ft) in 1988. 2,890 million cu.m (102,000 million cu.ft) were reinjected.

Regarding gas exploration in the rest of the country, apart from the existence of some sub-commercial offshore gas findings near Valdivia, expected oil prices for the future do not economically justify a gas exploration project in the area.

In spite of this, several oil exploration operations have begun in northern Chile through risk-contracts made by ENAP with several foreign firms (HUNT, HAMILTON & NORCEN, MAXUS, EUROCAN). If gas is discovered there, and depending on the magnitude of the deposits, these projects could lead to the development of important consumption markets for this fuel in the country.

A more certain possibility for using natural gas in central Chile is an importation and/or exchange program with Argentina. This alternative could trigger major changes in the national energy consumption market.

The project for importing natural gas from Argentina (through the Maipo Pass), would mainly supply industrial and residential consumers in Santiago, plus the actual oil requirements of the El Teniente copper mine. It would require the construction of a 190-km (118-mile) long

gasoduct in Chilean territory (including a branch connecting El Teniente), and a 350-km (217-mile) long gasoduct in Argentina, from the Centro-Oeste Gasoduct, located near the city of San Rafael. Studies made by CNE estimate a purchase price for imported natural gas, at the border, of approximately US\$2.5 per million BTU. At this price, natural gas could be sold in Santiago at a price competitive with fuel oil. This would create a demand of about 1.3 million cu.m per day in 1995 (46 million cu.ft), provided sales start in 1992. The demand could reach 2,1 million cu.m per day in 2005 (74 million cu.ft/day). These volumes of gas would imply a substitution of about 70% (12,000 barrels per day) of the projected consumption of oil and derivatives, in residential, commercial, and industrial sectors of Santiago.

Chile has submitted an alternative project, where part of the imported gas (between 0.5 and 0.8 million cu.m per day (17 and 28 million cu.ft/day)) would correspond to an exchange of gas between both countries. Chile would deliver gas in Magallanes, which could be transported through the existing gasoducts in Argentina, for which a toll would be paid. This gas would be supplemented with Argentinian gas to complete the total amount to be exported to Chile.

Other alternatives for importing gas from Argentina, for example through the Butamallín (8th Region) or Pino Hachado (9th Region) Pass have been considered. These options, however, imply the construction of rather long pipelines, from 500 to 1,000 km (300 to 1600 mile), in Chile and over 250 km (155 mile) in Argentina, if they are to supply Concepción and the main cities located near the Longitudinal Highway, up to Santiago. Imported volume would amount to between 2 and 4 million cu.m (70 and 140 million cu.ft), at a total investment of US\$300 million.

If natural gas would be offered in Santiago at competitive prices, it could be used as compressed gas even for use in the bus transportation system, with great benefits for the population due to a reduced air pollution level.

It is worth mentioning that the actual consumption of natural gas in 1988 was 1,010 million cu.m (35,600 million cu.ft), with 486 million cu.m (17,000 million cu.ft) for ENAP's own consumption, 270 million cu.m (9,534 million cu.ft) for the methanol plant, 174 million cu.m (6,144

2. million cu.ft) for public service, and 80 million cu.m (2,825 million cu.ft) for electric power generation.

Studies related to a 700-km (435-mile) long gasoduct between Tarija, Bolivia and Tocopilla, northern Chile, is still in its prefeasibility stage. It would represent sales to copper mining and electric power generation plants for US\$100 million per year.

1.2 Manufactured Gas

Manufactured gas is distributed and marketed only in Santiago, Valparaíso, and Concepción. In each of these cities there exists only one distributing company.

3. In general, manufactured gas is distributed in the older districts of these cities. Expansion to new residential areas is rather slow, due to the high relative price of this fuel. For this reason, future consumption levels will be about the same as current ones, with some penetration in highrise buildings in middle and high income areas.

The net consumption of town gas was 167 million cu.m (5,900 million cu.ft) in 1988. Iron mill consumption of coking plant gas and blast furnace gas was 209 million and 1,057 million cu.m (7,380 and 37,000 million cu.ft), respectively.

In case natural gas is obtained from Argentina or from new developments in northern Chile, manufactured gas will continue to be distributed in the existing areas of Santiago, but using natural gas as the raw material, combined with a percentage of biogas and LPG, through existing networks and equipment.

Significant technological changes will occur if this inter-connection project is implemented. Public transportation fleets would need to adapt bus engines, which presently burn diesel oil, and new distribution networks and gas stations would need to be built.

Equipment in energy production centers in the mining and industrial sectors, such as kilns, boilers, electricity generators, would also need adaptation or modification.

Future projects in Chile, GASCO formed a consortium with an Argentine firm, Pérez Companc, for the construction of a nearly 500-km (300-mile) long gasoduct to transport natural gas from Argentina to

2. Areas of Interest and Business Opportunities for Canadian Investors

Best opportunities for natural gas related business are found in the exploration of new reservoirs in northern Chile, or in partnerships that will build gasoducts from Argentina and Bolivia. Also important are the supply of equipments required for gas transportation networks, and participation in modification projects for industries and public transportation systems enabling them to use this "new" fuel on a massive scale.

There is also the possibility of developing new industrial operations in Magallanes using natural gas as raw material, such as methanol and ammonium-urea plants, etc.

3. Relevant Entities Participating in the Gas Sector

3.1 Manufactured Gas

- SANTIAGO GAS CONSUMERS COMPANY (COMPAÑIA DE CONSUMIDORES DE GAS DE SANTIAGO S.A., GASCO)

Activities: Production, distribution, and selling of town gas in Santiago, and of LPG cylinders in Santiago and the 12th Region.

Distribution of natural gas through gasoducts in Punta Arenas, Puerto Natales and Puerto Porvenir.

Market share: Only company producing, distributing, and marketing manufactured town gas in Santiago (in strong competition with LPG).

Technological features: Naphta cracking plant and town distribution network. Installed capacity is 1.08 million cu.m/day (38 million cu.ft/day), with 1,200 km (750 mi) of gas pipes ranging from 3 to 24 inches in diameter.

Ownership structure: Main stockholder is the GEI electric company (54.6%).

Future projects: Recently, GASCO formed a consortium with an Argentinian firm, Pérez Companc, for the construction of a nearly 500-km (300-mile) long gasoduct to transport natural gas from Argentina to

3.2 Natural Gas: Santiago through the Cajón del Maipo Pass. Estimated cost is about US\$140 million.

- **CONCEPCION GAS COMPANY (GASCO CONCEPCION S.A.)**

Activities: Production, distribution, and selling of manufactured gas.

Market share: Only company producing and distributing manufactured gas in the city of Concepción (in competition with LPG).

Technological features: Cyclic coal gasification plant and supplementary distribution facilities. Productive installed capacity is 188,000 cu.m/day (6.6 million cu.ft/day). 265 km (164 mi) of gas pipes, with diameters ranging from 1 1/2 to 16 inches.

Future projects: Since 1987 the company has been facing serious financial trouble and finally went bankrupt. Later it was sold by competitive bidding and it was acquired by GASCO.

Looking out into the future, there is a feasibility study for linking up this company to gasoducts interconnecting Argentina and Chile in case the final interconnection layout would cross the Andes Mountains close to Concepción.

- **VALPARAISO GAS COMPANY (COMPAÑIA DE GAS VALPARAISO S.A., GASVALPO)**

Activities: Production, distribution, and selling of manufactured gas in Valparaíso and Viña del Mar.

Market share: Only company producing and distributing manufactured gas in Valparaíso and Viña del Mar (in competition with LPG).

Technological features: Combination of coal and a watergas plant. Installed capacity is 105,000 cu.m/day (3.7 million cu.ft/day). 250 km (155 mi) of gas pipes, with diameters ranging from 2 to 14 inches.

Ownership structure: 60% of the capital stock is controlled by Lipigas.

3.2 Natural gas

Presently, distribution of natural gas produced by ENAP in the 12th Region is carried out by GASCO in Punta Arenas, Puerto Natales and Puerto Porvenir, under a contract awarded in 1981 through public bidding.

The project for interconnection with Argentina is under study by various companies including the GASCO-Pérez Companc consortium, and the COPEC, SHELL, Abastible and ENAGAS consortium.

V. COAL SECTOR

A. GENERAL DESCRIPTION

1. General Overview

In 1988, Chile produced 2.5 million metric tons of coal, a figure roughly equivalent to 1.8 million tons if expressed on a 7000 kcal/kg basis for the Upper Calorific Power as received (UCPar).

Coals are classified as anthracite, bituminous, subbituminous and lignites, depending on their characteristics. Commercial coal mining in Chile takes place in the bituminous coal fields existing in the 8th Region (Arauco) and subbituminous coal fields in the 10th Region (Los Lagos) and 12th Region (Magallanes).

As shown in the table below, the most important exploitable coal reserves are located in the 12th Region. Somewhat less important are those in the 8th and 10th Regions. Other deposits exist in the 3rd, 5th, Metropolitan (Santiago), 6th, and 9th Regions, where low-rank coal seems to have been detected, but with only marginal mining activity.

Most of the coal demand originates in transformation centers, such as thermoelectric plants, mineral coking plants, and town gas works. These centers represent nearly 70% of the national demand of this fuel. Most of them are located on the coastal areas of the 2nd, 5th, and 8th Regions. These Regions account for nearly 80% of the coal consumption in Chile.

Final uses of the energy derived from coal represent approximately 30% of the national energy consumption, basically used in the industrial and mining sectors, where copper and iron mines, as well as cement, sugar, and fish processing industries take the higher share.

With respect to coal mines existing in private grounds, the Code granted exploitation rights to the owner of such grounds, and in the case of mines located in uncultivated areas owned by the State or a municipality, they were declared open for acquisition by the private sector.

**COAL RESERVES 1986
(Million metric tons)**

Region	8th	10th	12th
Area	Concepción- Arauco	Valdivia- Chiloé	Magallanes
Grade	Bituminous	Subbituminous	Subbituminous
Sulfur	2 - 4%	< 1%	< 1%
UCPar (kCal/kg)	6000-7000	4000-5000	4000-6000
Reserves, as defined by the U.S. Bureau of Mines:			
			Total
- Measured	10	3	181
- Indicated	25	6	410
Total charted	35	9	591
Inferred	100	20	5,000
			5,120

2. Government Policies

2.1 Historical evolution

The 1888 Mining Code declared the Chilean State owner of all coal fields, and stated that ownership of mines was independent of the ownership of surface grounds. In addition, the Code determined that the State had the authority to grant concessions to private entities or individuals for exploitation of mines under the conditions and procedures provided for in applicable legislation. With respect to coal mines existing in private grounds, the Code granted exploitation rights to the owner of such grounds, and in the case of mines located in uncultivated areas owned by the State or a municipality, they were declared open for acquisition by the private sector.

The 1888 Code remained in force up to 1932, when a new Mining Code was enacted.

In many respects, the 1932 Code used a different approach to coal property regulations, as compared to the rest of mineral deposits for which concessions are grantable. Exemptions established for the coal sector became, in practice, a sort of legal obstacle hindering competitive development of this sector, as it raised difficulties to the participation of new producers, and increased production costs unnecessarily.

The 1932 Code set forth the legal system governing rights to work mining properties requiring concession holders to keep a minimum level of ore production, consistent with the characteristics of coal fields. This system intended to ensure continued exploitation of properties under concession, but the requirement of a minimum tonnage yield introduced a higher degree of risk into the business, because failure to comply with that requirement could lead to the loss of the rights protected by the concession granted.

The new Mining Code approved in 1983 in substitution of the 1932 Code, eliminated discriminatory regulations on the coal sector. Since then, the same legislation applied both to coal and to other minerals. Proposals from the National Energy Committee (CNE) were then included in the new Code, whereby the legal right-to-work system based on licensing was reinstated, royalty payments to ground owners were eliminated, and the granting of concessions was decentralized and expedited through the introduction of automation.

2.2 Current Policies

As mentioned above, coal exploration and mining are two activities for which concessions are granted. That means that the State may grant or establish property rights to private sector parties to undertake these activities over certain areas. Therefore, coal is considered a strategic resource not limited to exclusive exploitation by the State, but capable of being explored and exploited, like other minerals, by private investors, either domestic or foreign.

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It is worth mentioning that at present government authorities are considering the possibility of subsidizing coal production in the Concepción and Arauco areas. In fact, the Chilean Government announced recently its intention to submit to Congress a bill that would give the bituminous coal producers a declining subsidy over the next three years. The subsidy would start at between 5% and 14% in order for producers to reduce costs from around US\$60/ton to US\$53/ton. This subsidy would decrease the second and third year, to disappear completely by 1994.

The reason for this unusual and totally exceptional decision by a government (which has not interfered in any way with market prices) is the dependence of some 150,000 people on these mining works. The government has made it clear that this is only a temporary measure, in order to give producers enough time to modernize their plants and make their operations more efficient to compete against imported coal and heavy oil producers.

3. Current Legislation

Basically, current legislation considers ownership of mines as being independent of the ownership of surface grounds. It also declares the State as the owner of all deposits, but authorizes it to grant concessions to private investors for exploitation and working of the mines under the conditions and procedures established by law. Main laws and regulations in this matter are:

- Chilean Civil Code, article 591
- 1980 Political Constitution (Article 19, Nº24, par. 6 and following)
- Organic Law on Mining Concessions (1982 Law Nº18,097)
- 1983 Mining Code

Both the Political Constitution of Chile and the Mining Code provide that: "The State has the sole, exclusive, inalienable, and indefeasible right of property over all mines, including minepits, metal-bearing sands, washing sediments, coal and hydrocarbon deposits, and other fossil substances, except for surface clays, notwithstanding the ownership rights that may be claimed by individuals or corporate bodies over the ground overlaying such mines."

However, the State authorizes individuals to perform exploration and mining activities in the case of substances

for which concessions are grantable. The Organic Law (Article 3) and the Mining Code (Article 5) determine which substances may be exploited under a concession: "Subject to concession or to denunciation are all mineral substances, metallic or non-metallic, and in general all fossil substances, whatever the form in which they may naturally exist, including those underlying sea waters within national jurisdiction, to which access is gained through tunnels from shore."

Additionally, article 2 of the Mining Code stipulates that "a mine concession is a real and immovable right." This is equivalent to establishing a property right over a demarcated area, which is able to be explored or exploited. Thus, "a mining concession may be granted for exploration or exploitation works, the latter also called a claim."

The only requirement for establishing a concession on a coal mine, as for any mine, is a court order issued by a civil judge having jurisdiction over the area where the concession is situated. "A court decision granting the concession constitutes legal property title to the mine and grants original ownership over it." The concession holder has exclusive rights to freely explore and exploit his claim, without limitations other than those stated in the mining legislation and in regulations on public order and safety in mines. A mine concession may be sold (transferred), rented, bequeathed (transmitted) or mortgaged.

4. Incentives, Regulations, and Restrictions to Coal Mining

Current coal legislation is also applicable to other mineral substances. Therefore, the only regulations and restrictions specifically on coal extraction are those related to concessions granted to private entities for carrying out exploration and exploitation works (see paragraph 3, current legislation), as well as the standards and rules governing the coal sector in areas relating to environmental conditions, safety and personnel.

The main incentive for the production of coal is the existence of freedom regarding price setting, marketing, and consumption, as well as for imports and exports.

Another incentive regarding coal mining is the existence of extensive recoverable reserves in Chile, particularly in the 12th Region. Considering the local characteristics of the coal strata, mining in these fields can be carried out with open-pit technology, allowing for substantial reductions in production costs as compared to underground mining.

5. Enterprises, Organizations, and Agencies that Have an Impact on Policy Formulation for the Coal Sector

Several state organizations and agencies, as well as state and private enterprises have an impact on the formulation of policies in this sector.

The main state agency responsible for utilization of coal as a source of energy is the National Energy Committee. The overall and specific standards are issued and enforced by the Ministry of Mining through the specialized National Geology and Mining Service (SERNAGEOMIN).

Investment policies and general development strategies for state enterprises in the coal sector are recommended specifically by the National Energy Committee, in coordination with the Ministry of National Planning (MIDEPLAN).

The most relevant state-owned enterprise operating in the coal sector, which renders advisory services for the formulation of policies, is ENACAR, the National Coal Company.

6. Comparative Contribution of Coal Energy to the GDP

Coal energy contributes only 0.2% to the gross domestic product.

B. ANALYSIS OF THE COAL SECTOR

1. Overview

From the standpoint of coal reserves, domestic resources are enough to support the estimated local demand for a very long time. Taking into account only demonstrated reserves (measured and indicated), which amount to about 600 million metric tons, it may be confirmed that Chile's demand for

thermal coal may be met for 150 years at current consumption rates. The fact that the biggest reserves are concentrated in the 12th Region, should possibly cause a persistent increase in the relative importance of this Region, as compared to other producing regions, assuming that costs of production and transportation remain lower in the 12th Region.

Projected levels of consumption for the 1991-1997 period show that overall demand should fluctuate between 2.7 to 3.2 million tons/year (at a rate of 7,000 kcal/kg), which is comparable to the effective demand observed by the late seventies, when consumption volumes fluctuated from 1.3 to 1.5 tons/year.

In Chile, thermal coal is mainly used in thermoelectric power stations. Metallurgical coal is used in plants producing coke for iron-making furnaces. In 1988, coal consumption reached 2.5 million tons (at a rate of 7,000 kcal/kg UCPar), including imported coal, of which 70% was used in transformation plants.

Thermoelectric stations connected to the Central Interconnected System supply only a supplement to overall electric generation, which is mainly produced from hydro power stations. Therefore, coal consumption is conditioned to the unpredictable behavior of hydrology. An example of this situation occurred in 1987 (wet year, low coal consumption) and 1988 (dry year, high coal consumption, which coincided with an increase of nearly 8% per year in public demand for electricity).

In 1988, total consumption of coal at all thermoelectric stations throughout the country was 1.3 million tons (at a rate of 7,000 kcal/kg).

It is expected that coal consumption levels at thermoelectric stations will have a greater impact in the overall consumption in future years. The Far North Interconnected System (SING) predicts a volume of approximately 0.9 million tons in 1991, and the Central Interconnected System (SIC) a yearly consumption in the range of 0.51 to 0.8 million tons from 1991 up to 1997.

The projections on coal consumption may have a positive variation, if installation of a new thermal plant, of approximately 125 MW in power, is confirmed in northern

Chile, to be incorporated to the SING network. A feasibility study was initiated recently (August 1991), induced by the increase of new clients operating in large-scale mining. This new power station should start operation around 1995- 1996, provided further studies confirm the analysis made so far.

In the iron and steel area, a large coking plant exists in Chile, located in Huachipato (8th Region), with a production capacity of 500,000 tons/year of metallurgical coke.

As for coal gasworks, there are two plants operating in Valparaíso and Concepción, with a combined consumption level of about 40,000 tons/year. This represents a low percentage of the demand required by transformation centres.

The end uses of energy derived from coal are concentrated basically in industry and mining, where specific activities of consumers are: copper and iron mining, as well as cement, sugar and fish processing plants.

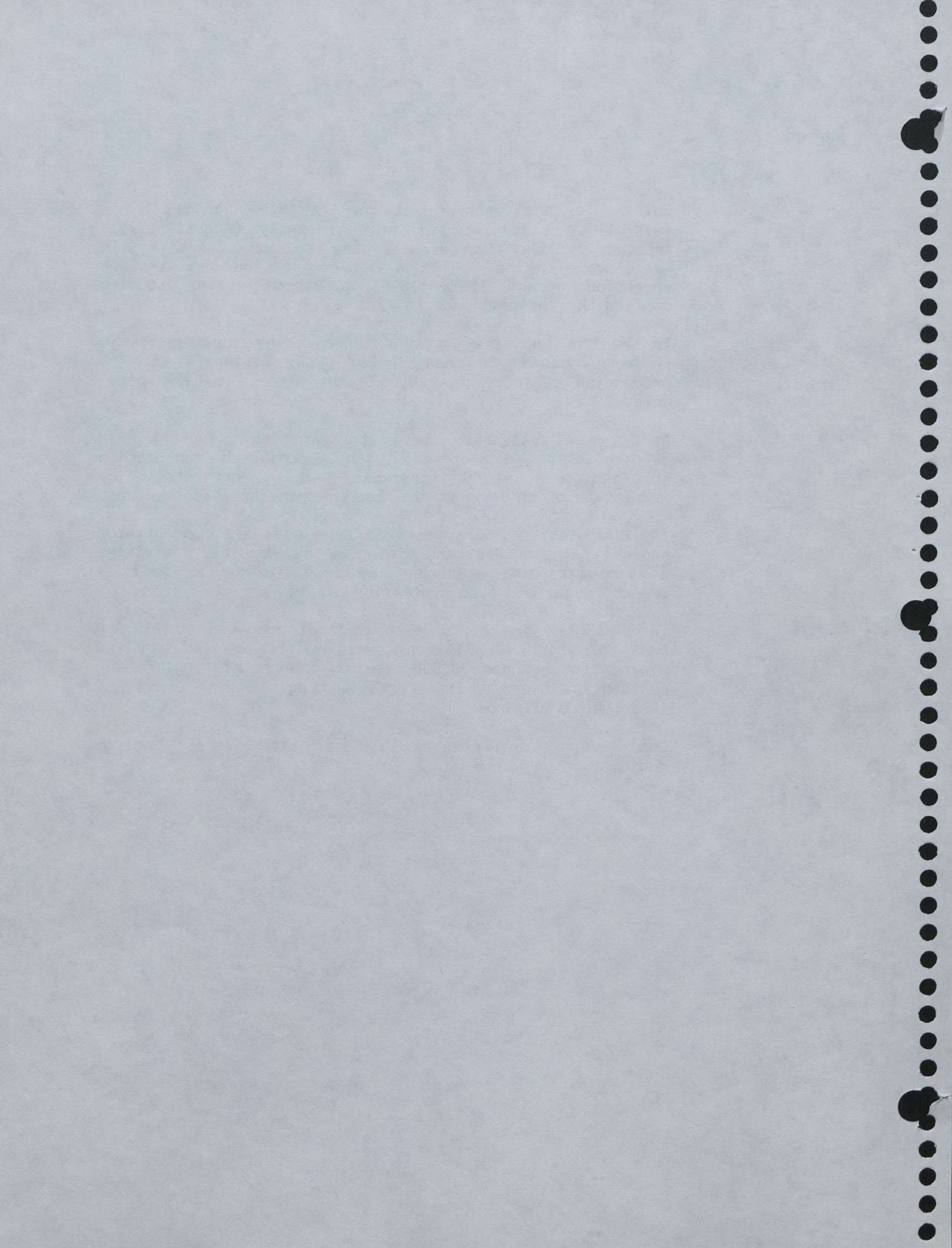
In 1988, the end consumption of coal amounted to 735,000 tons, of which 705,000 tons pertained to the industry and mining sectors, and 30,000 tons to commercial, public, and residential users. Transportation registered a demand of less than 1,000 tons.

2. Coal energy represents 15% of the overall energy consumption in Chile.

A summary of possible opportunities for investment includes open-pit mining in the Magallanes area, and the supply of technology intended to reduce production costs (underground extraction of coal) in Arauco, of electro-mechanical equipment for thermoelectric power stations, of boilers and burners for industries, and of equipment to substitute oil-powered machinery in industries, etc.

Increase the market share of the imported coal is challenge for canadian producers. An increase competition can be expected from third countries, specially from Colombia which has great amount of reserves and low cost production.

3. Relevant Entities Participating in the Coal Sector



STATISTICAL DATA OF IMPORTED COAL
(1990)

Metallurgical Coal

Total Imported : 473,000 tons

Main Suppliers :

	(tons)	CIF Cost (million US\$)
Canada	259,000	15.7
Australia	155,000	8.9
Indonesia	35,000	1.6
USA	28,000	1.7

Bituminous Coal

Total imported : 703,000 tons

Main Suppliers :

	(tons)	CIF Cost (million US\$)
South Africa	232,000	10.7
USA	167,000	8.0
Canada	77,500	4.3
Australia	64,000	3.5
Colombia	100,000	4.9
Hong Kong	62,000	2.9

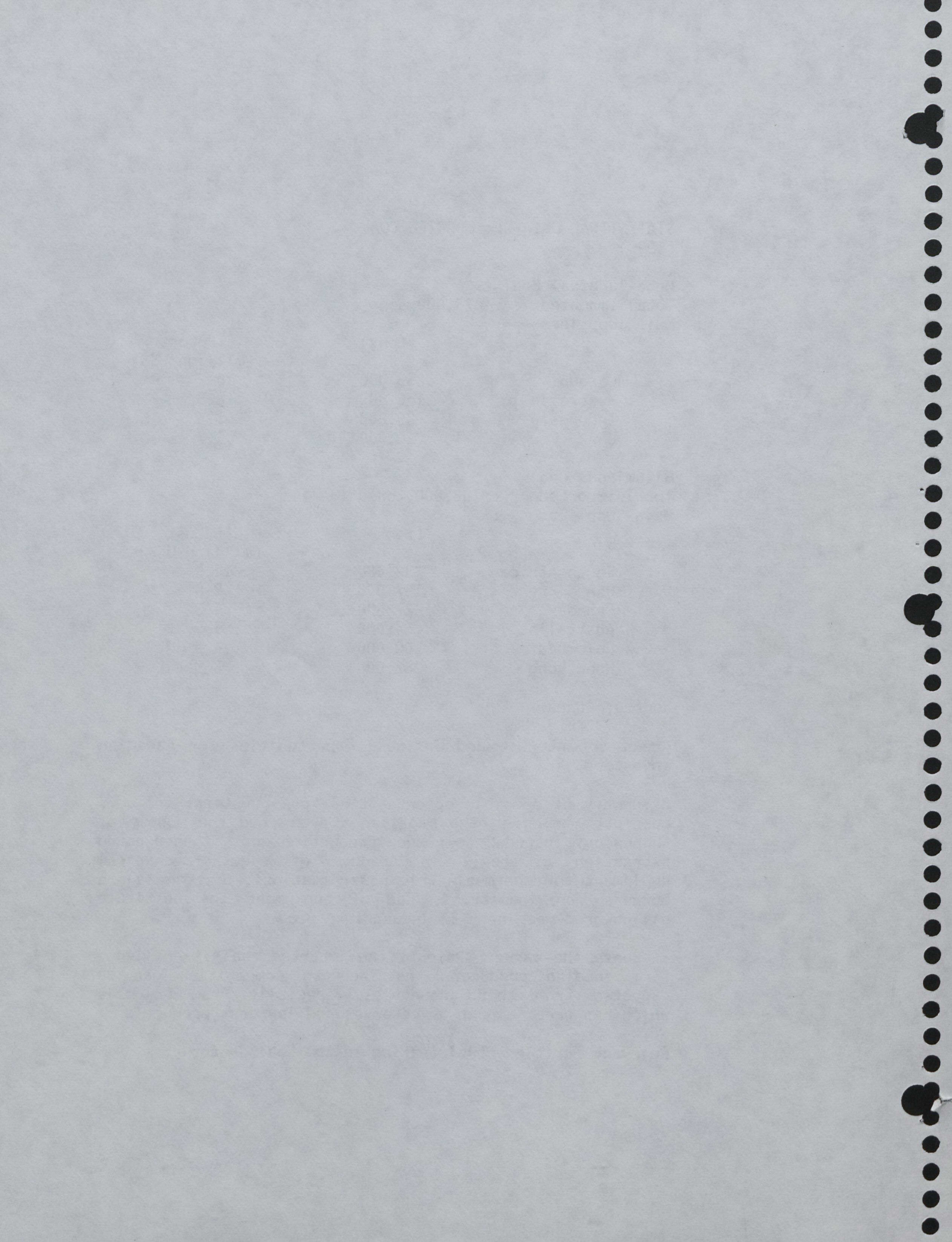
Source: Enacar

2. **Areas of Interest and Business Opportunities for Canadian Investors**

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3. **Relevant Entities Participating in the Coal Sector**



- **NATIONAL COAL COMPANY (EMPRESA NACIONAL DEL CARBON S.A., ENACAR)**

Activities: Exploitation and marketing of coal.

Market share: Heavily dependent on thermoelectric power generation, but it represents about 30% of domestic production.

Technological features: Underground mining, 650 m (2,150 ft) down under sealevel; extraction by long wall cutting; transportation by electric shuttle-car system. Production capacity: 540,000 metric tons/year.

Ownership structure: The State, through CORFO, controls 83% of the stock.

New projects: A feasibility study for a 100 MW coal-fired power plant in Lota is underway. Estimated cost: US\$100 million. To be commissioned around 1995.

- **VICTORIA DE LEBU COAL COMPANY (CARBONIFERA VICTORIA DE LEBU S.A., CARVILE)**

Activities: Exploitation and marketing of coal.

Market share: About 6% of domestic production.

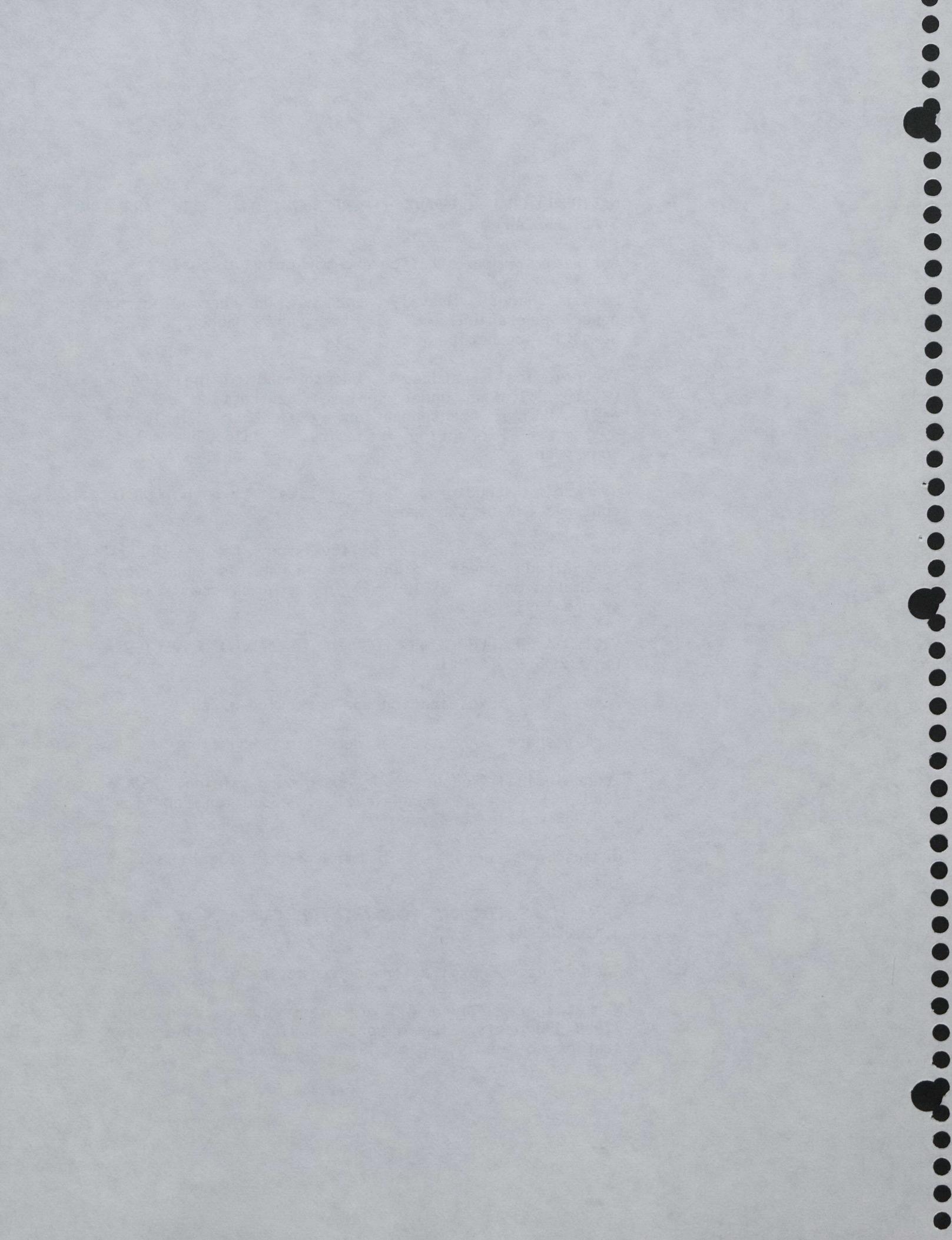
Technological features: Underground mining, 250 m (800 ft) down under sealevel. Production capacity: 110,000 metric tons/year.

Ownership structure: The main stockholder (98%) is Enacar.

- **CHILE COAL COMPANY (COMPAÑIA DE CARBONES DE CHILE S.A., COCAR)**

Activities: Exploitation and marketing of coal.

Market share: About 27% of domestic production, on a 7,000 CPU basis. Has a contract with Tocopilla power station to supply, up to 1996, 880,000 metric tons of coal per year.



Technological features: Open-pit exploitation.
Capacity: 1,1 million metric tons/year.

Ownership structure: Main stockholders are Copec S.A. (45%), Von Appen Investments (45%), and International Financing Corporation (10%).

New projects: COCAR is evaluating its participation in the construction of the Mejillones and Guacolda thermal power stations, both with 125 MW to 175 MW, at US\$150 million each, to be commissioned around 1995-1997. COCAR would also supply the coal required for these power stations.

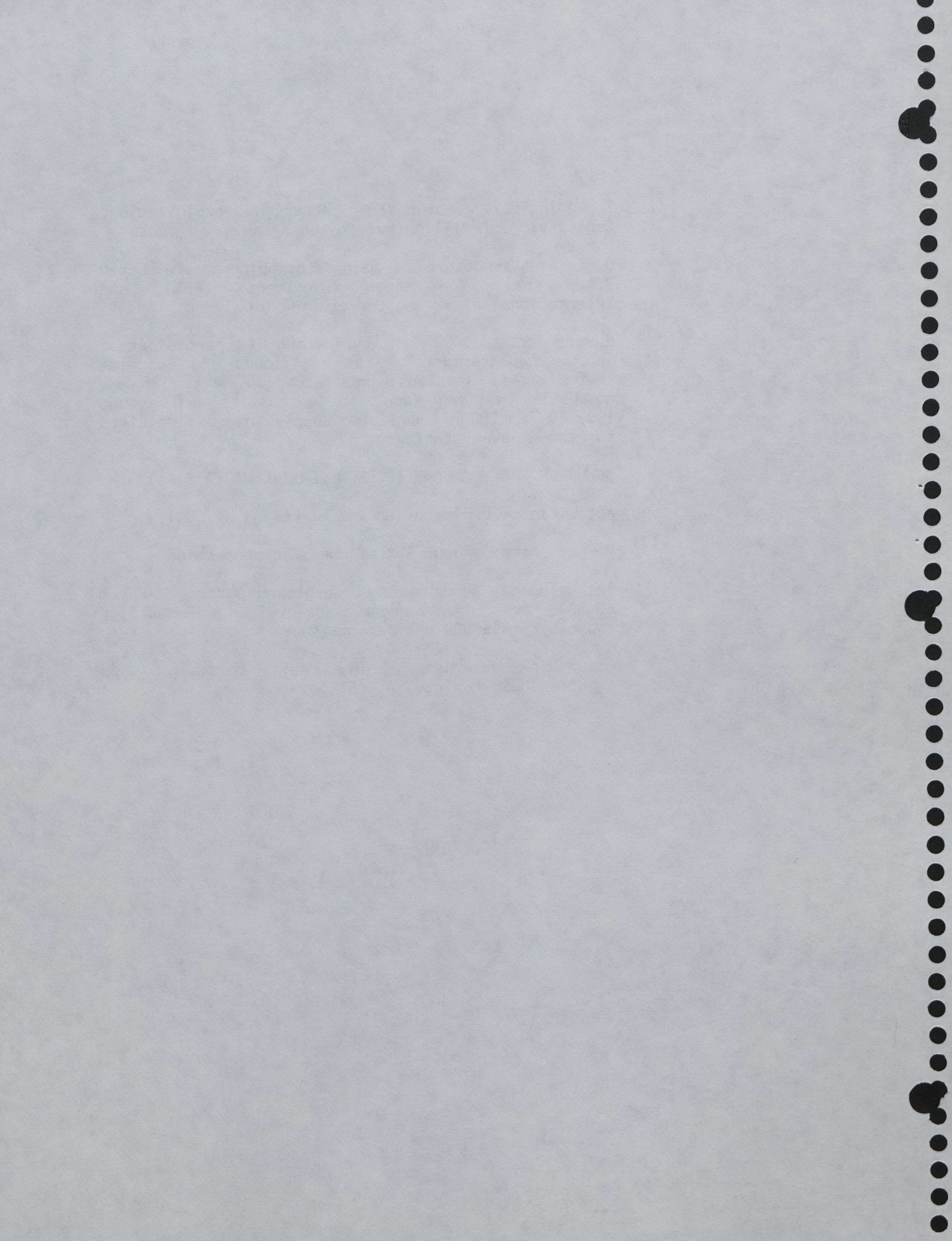
- **SCHWAGER COAL COMPANY (CARBONIFERA SCHWAGER S.A.)**

Activities: Exploitation and marketing of coal.

Market share: About 18% of domestic production.

Technological features: Underground mining, 1000 m (3,300 ft) down under sealevel. Production capacity: 335,000 metric tons/year.

Ownership structure: The main stockholder is Agencias Universales S.A. (61%).



VI. NON-TRADITIONAL ENERGY SOURCES SECTOR

This chapter contains information concerning various minor energy sources in the country, which are at different stages of development.

These sources are:

- A. Firewood
- B. Geothermal energy
- C. Solar and eolic energy
- D. Nuclear energy

A. FIREWOOD SECTOR

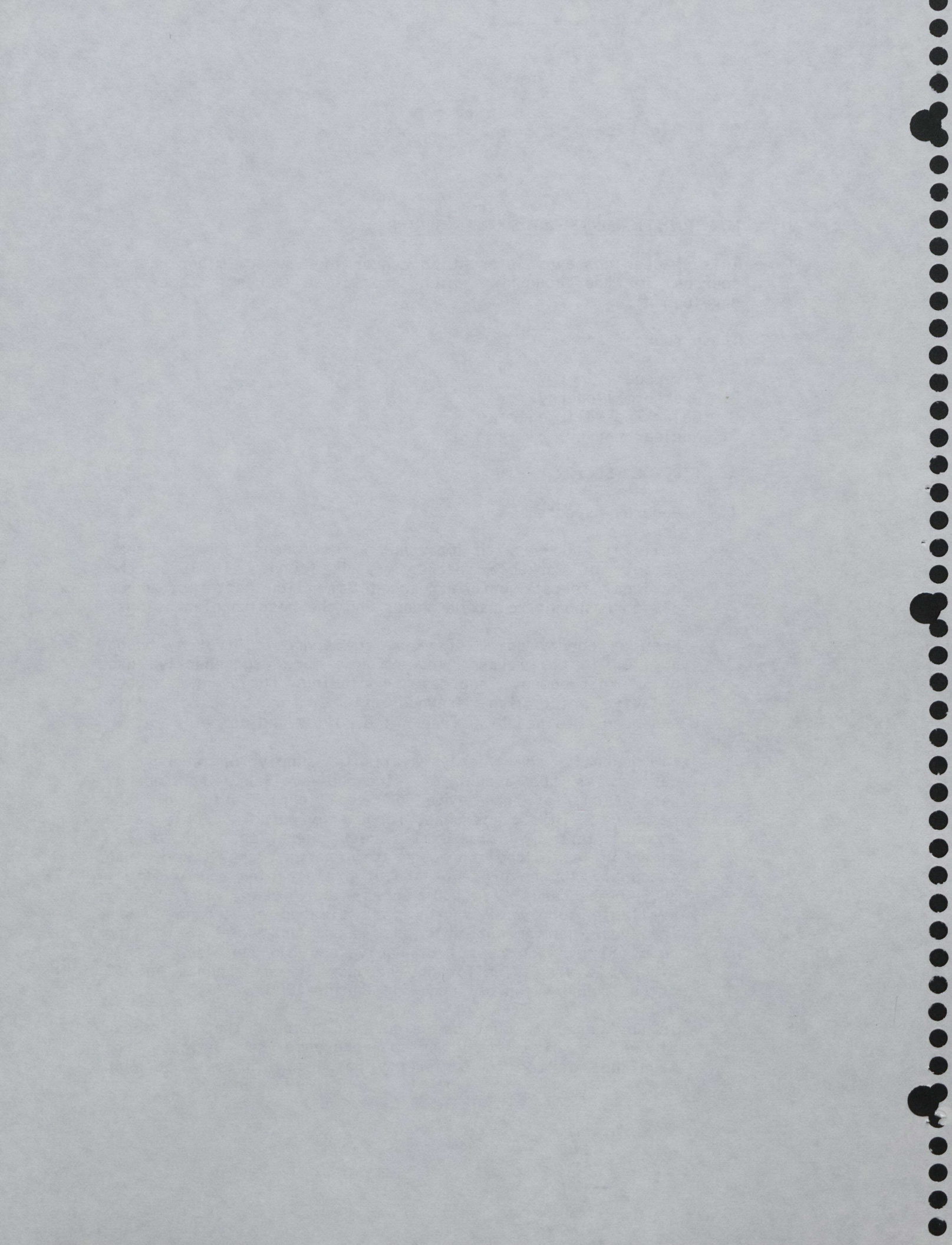
1. General Aspects

Chile is endowed with important forest areas, where a great variety of workable species may be found. In 1986, the national forest surface reached 9 million hectares, where 87% corresponds to native woods and the rest to plantations.

From an energy point of view, the economic strategy being applied in Chile has allowed for a more comprehensive use of forest-energy sources, replacing fuels of higher relative price with firewood or with forest waste. This has been obtained by a free price policy and competition.

In general, the yearly available supply of energy is defined as the amount of firewood available for energy generation, at the rate of real exploitation of the resource. This means that, for energy purposes, only waste amounts left by commercial forest operations and forests directly exploited to generate energy, are taken into account. At the present rate of exploitation approximately 30,000 hectares (74,000 acres) per year, the yearly available supply of energy is estimated at around 13,500 Tcal/year; an amount which is tantamount to 1.46 million cu.m (51 million cu.ft) of equivalent oil per year. This figure is very significant, because it corresponds to 26% of the consumption of crude oil during 1988.

In any case, it must be taken into account that the above figure is given only as a reference to indicate the magnitude of the forest energy resource. It does not mean



that firewood could really become a substitute for crude oil.

It has been estimated that potential energy resources from forests specifically planted for energy production would be around 2,600 to 3,000 Tcal/year, that is, 0.28 to 0.32 million cu.m (10 to 11 million cu.ft) of equivalent oil per year.

2. Legislation and Present Policies

Firewood, as an energy product obtained from commercial forestry operation waste, is not governed by special legislation, and therefore may be freely marketed. However, utilization of firewood must be made observing regulations and legislation related to pollution.

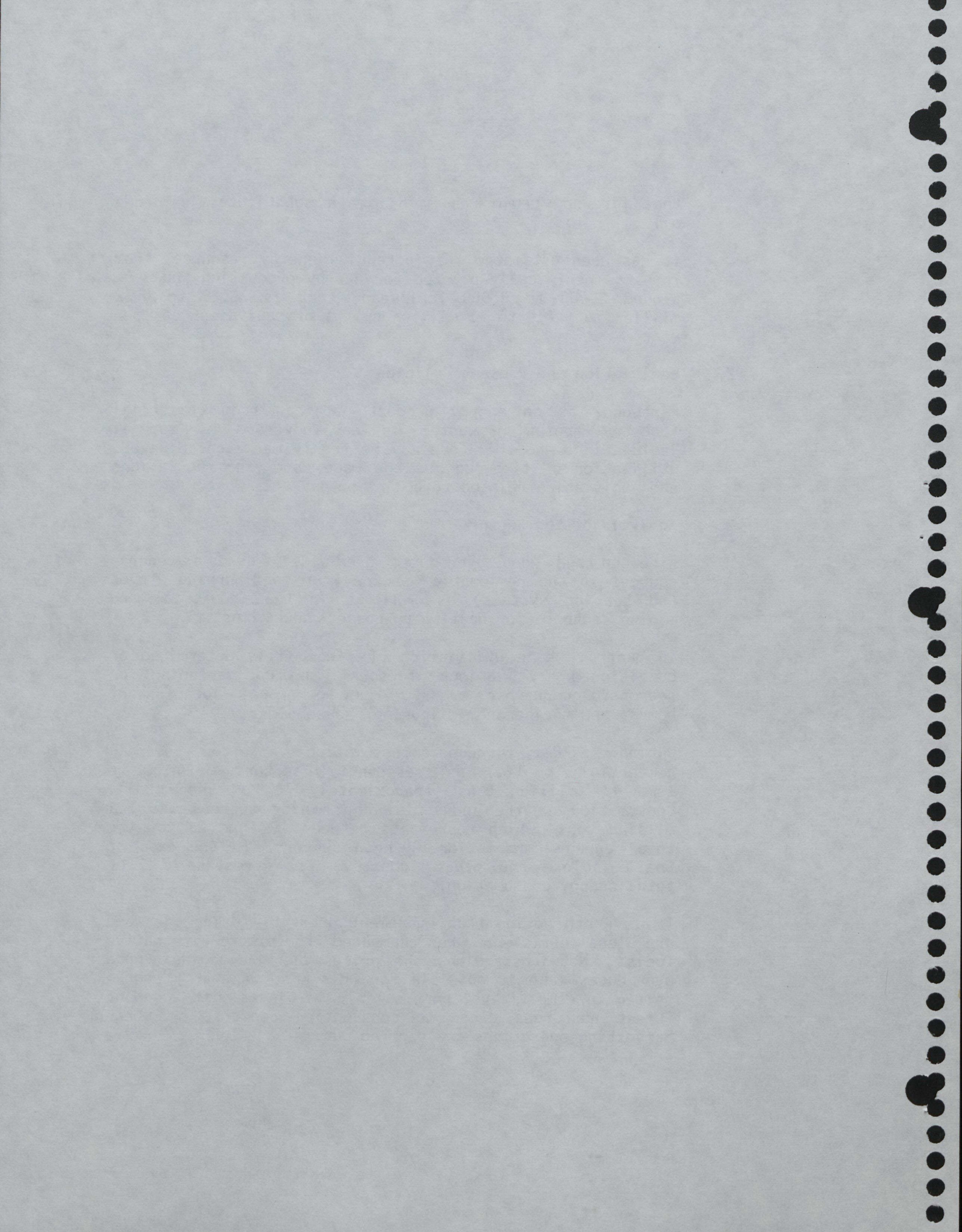
3. Analysis of the Sector

Firewood and wood byproducts are widely used as energy sources in the residential sector (for wood-burning stoves and heating systems) as well as in the industrial and mining sectors (for heating up boilers and kilns).

In general, home utilization of firewood is determined or conditioned by various factors, mainly depending on seasons, geographic areas, urban or rural location of homes, and socioeconomic level of households.

During 1988, firewood consumption in the overall commercial, public, and residential sectors amounted to some 4.7 million tons (approximately 70% of the total). Consumption in the industrial and mining sectors was 2,2 million tons, which represents between 18% and 20% of the total energy consumption in both sectors. In the case of the cellulose and paper industry, it represents 77% of total energy consumption.

It is worth noting that equipment presently using firewood are less efficient when compared to other alternative fuels. Notwithstanding, the prices of firewood and wood byproducts make it possible for this kind of energy source to remain competitive, particularly in places with abundant forest resources close to consumption centers, or where harvesting operations are carried out.



4. General View of the Future of the Sector

It has been estimated that by 1997 total forestry planted areas will reach 2 million hectares (5 million acres), mainly made up of stocks of the "radiata" pinetree variety. Considering this increase in wooded areas, it is estimated that investments for a total of US\$2,500 to US\$3,000 million should be made during the next 15 years, mainly for the construction of pulp and paper plants.

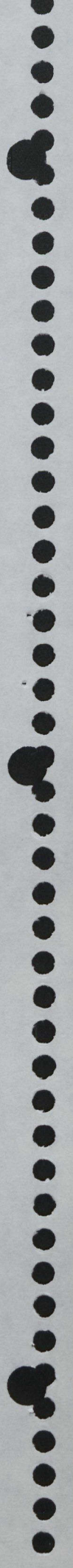
Concerning wood and cellulose exports, a figure of US\$1,200 million has been estimated for the end of this century. On the basis of these export projections, it is possible to estimate that the rate of exploitation of wood plantations will reach 50,000 hectares (120,000 acres) per year beginning on the year 2000. Such rate means that the available supply of energy would be around 20,000 teracal, equivalent to 2 million cu.m (70 million cu.ft) of oil per year.

To this, an additional 3,500 Tcal/year could be added as a result of direct exploitation of woods reserved for energy purposes. Use of the energy thus produced will depend on many factors, the most significant ones being the relative price of this resource, available technologies, and environmental restrictions.

A factor that will have a strong impact on the future supply of firewood will be the plantation of woods exclusively devoted to the production of firewood energy. According to available information, the "Eucalyptus globulus" variety seems to be the most adequate specimen for this kind of plantation on an extensive portion of the country, due to its quick growth and high density rates.

One element to bear in mind when considering firewood as an important energy source, especially in high urban concentrations, is the likely environmental impact of it and subsequent future regulations in this regard. This fact may push firewood prices up, if future regulations make mandatory the incorporation of technological improvements to reduce air pollution. Sawdust is another forest waste which can be increasingly used in the future, even though it is profitable only in areas close to source.

In fact, the main problem with sawdust is the high transportation costs relative to its low energy density.



However, the process of agglomerating sawdust into briquettes could make it possible to increase the competitiveness of this product.

Another interesting potential use of forest wastes is the generation of electricity by using medium- and small-sized units, either through a vapor cycle process or through wood gasification and the use of gas from diesel turbine groups.

5. **Areas of Interest and Business Opportunities for Canadian Enterprises**

Other than investments in the cellulose and paper areas, both of which are very important for the country and open to foreign capitals, but not related to the energy sector, possibilities for investments include the supply of non-polluting heating units and cooking stoves with better efficiency ratings, and projects for planting new energy-producing woods in lands with no alternative uses located close to important cities.

B. **GEOHERMAL ENERGY**

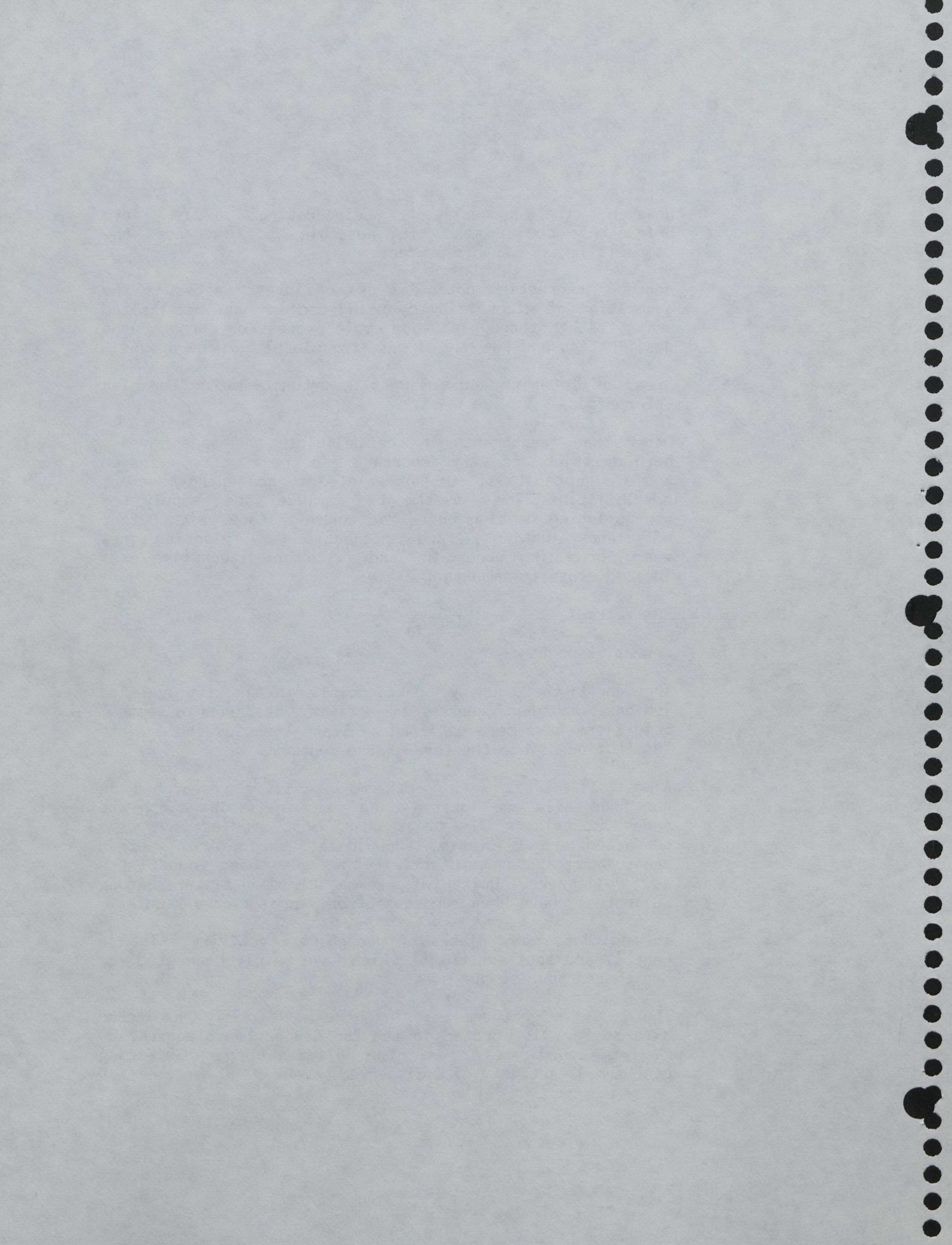
1. **General Aspects**

Throughout the country, particularly in the 1st and 2nd Regions, abundant geothermal activity has been detected. Some sites have been explored by State agencies and private institutions since the turn of the century.

Almost all areas with geothermal activity researched in northern Chile are located on a volcanic stripe along the Andes Mountains. The areas where most studies have been conducted are El Tatio, Puchuldiza, and Surire. Other areas where geothermal activity has also been found (such as, Polloquere, Quitariri, Pampa Lirima, Alitar, Aguas Calientes), have been subjects of only preliminary studies.

In addition, many places of geogthermal activity exist in central and southern Chile, which have mainly been used for health and tourist purposes.

The El Tatio geothermal spring, the most widely researched site so far, is located in the 2nd Region, Antofagasta, 90 km from Chuquicamata, near the Bolivian border. Surfacing geothermal activity is dispersed over a 10 sq.km (3.9



sq.mile) highland area located 4100 m (13,500 ft) above sea level.

In general, surface temperatures of the thermal springs reach 86 °C (187 °F), which corresponds to the boiling temperature of water at that altitude. At some points, temperatures in geysers and fumaroles are a little higher.

A total of 13 drillings have been made in this field, 6 of them were exploratory pits reaching up to 600 m (2,000 ft) deep, allowing for detection of aquifers with temperatures ranging from 210 to 240 °C (410 to 464 °F). The seven other pits, ranging from 900 m to 1,900 m (3,000 and 6,200 ft) deep were operational; three of these were producing pits, and the remaining four did not flow or flowed only temporarily. These 13 pits were drilled between 1969 and 1974.

Investments for these projects, made almost entirely by the Government, reached US\$23 million, at 1988 currency value.

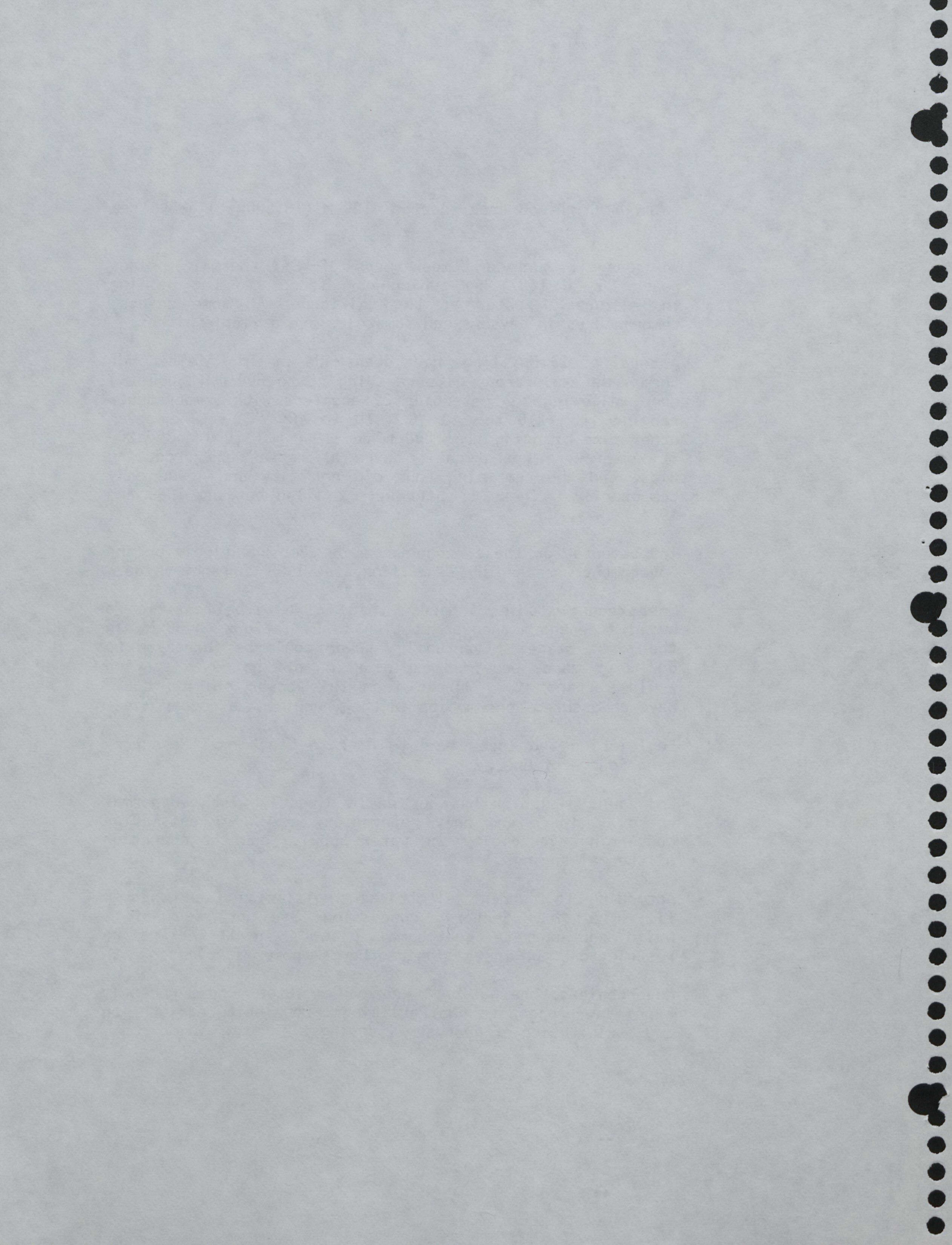
Most recent studies indicate that it would be feasible to build a geothermal power station in El Tatio with 30 MW in the first stage. Eventually, power could be increased to 60 MW or more, provided exploitation of the power station would warrant it. Output from this power station could have an assured consumption in the Chuquicamata copper mine.

2. **Legislation and Incentives to Operate Geothermal Resources as a Source of Energy**

Chilean legislation has not dealt directly with geothermal energy. There are only references to it in legislation concerning electricity and water supply, and the operation of thermal springs.

According to current electrical legislation (see chapter III, Electrical Sector), concessions are not required to build and operate geothermal plants, so there are no restrictions for installing geothermal power stations.

Nevertheless, the National Energy Committee sended recently a new law-project to the Parliament, regulating exploration and exploitation of geothermal springs.



Incentives for foreign capital investments in this sector are described in the 1977 Decree-Law Nº 600, called Foreign Investments Statute.

3. Areas of Interest and Business Opportunities for Canadian Enterprises

The high cost of electrical power in northern Chile is an encouraging factor for taking the risk of installing geothermal power stations.

C. SOLAR AND EOLIC ENERGIES

1. General Aspects

1.1 Solar Energy

Northern Chile has one of the highest incident solar radiation levels in the world, with approximately 200 kcal/sq.cm (1,290 kcal/sq.inches) per year. In general, Regions 1 to 4 receive at least 180 kcal/sq.cm (1,160 kcal/sq.inches) per year, so they are interesting areas for tapping this kind of energy.

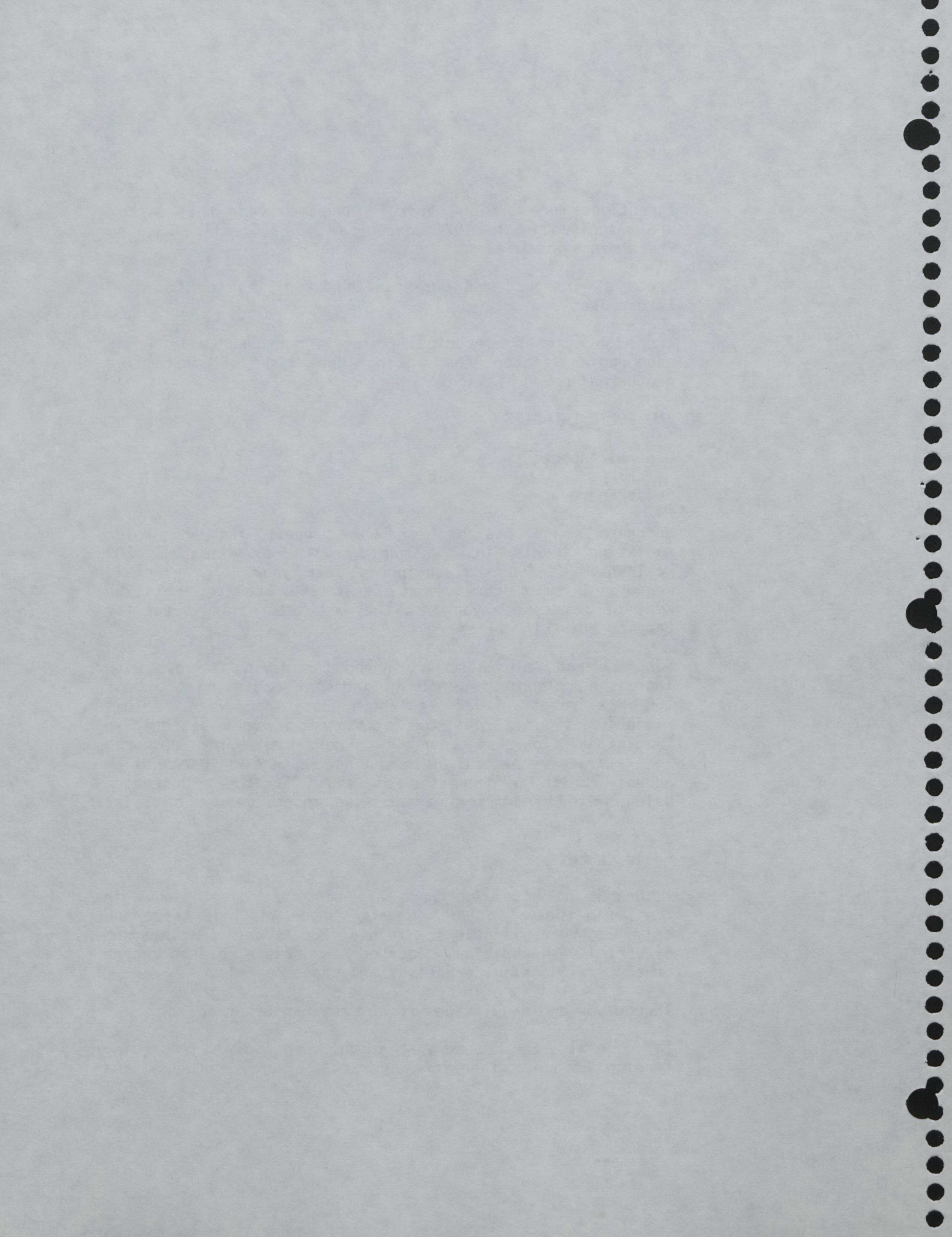
Santiago and Valparaíso are noted for having valleys with increasing cloudiness, and an incident radiation of about 160 kcal/sq.cm (1,032 kcal/sq.inches) per year. This radiation figure, plus the existence of many alternative traditional low-cost energy sources, make this resource less attractive here than in the north. In southern Chile, annual radiation decreases as south latitudes increase, being insufficient to guarantee an intensive use of solar energy.

1.2 Eolic Energy

Although in this area there are big size developments in the world today -in the megawatt range- in Chile there are only minor applications, mainly for water pumping and electricity generation, located in remote places where other traditional alternatives are uneconomical.

2. Incentives and Regulations for Energy Exploitation

In general, the country has an open policy regarding foreign trade, therefore marketing of products and



technologies for the use of solar and eolic energies is unrestricted.

At present, Chilean import duties amount to 11% of CIF values, for all kinds of equipment.

3. **Areas of Interest and Business Opportunities for Canadian Enterprises**

The best business opportunities are related to the selling of eolic-energy equipment, solar pannells, high capacity battery and battery chargers, converters DC/AC, for installation in remote, isolated areas.

D. **NUCLEAR ENERGY**

1. **Overview**

The Chilean Nuclear Energy Comission (CCHEN, Comisión Chilena de Energía Nuclear) is, according to present legislation, the agency responsible for promoting production and use of nuclear energy for pacific purposes, including the generation of electrical and thermal power. The agency also enforces nuclear safety regulations. It is, therefore, the scientific-technical nuclear energy controlling agency at national level.

However, priorities regarding construction of nuclear power facilities are determined by national agencies responsible for electrical energy planning and, since such facilities would be State entities, by the recommendations of the National Energy Committee (CNE, Comisión Nacional de Energía) and MIDEPLAN.

Currently there are two centers for nuclear studies in Chile, controlled by CCHEN, both located in the Metropolitan Region (La Reina and Lo Aguirre).

The La Reina center has a 5 MwT research reactor, of the MTR type (Materials Testing Reactor), used mainly for studies on neutronic physics and for the production of some radioisotopes used in medical and industrial applications. This reactor operates since 1974, having generated 65,000 MWh up to now.



The Lo Aguirre center has a 10 Mwt research reactor, also of the MTR type, which is being adapted to operate with less enriched U235 than the original design calls for.

2. Prospects for Development of Nuclear Power Stations

While the country has abundant hydroelectric resources, it is necessary, in order to ensure a reliable supply, to have an installed capacity for thermoelectrical generation, ranging from 10% to 40% of total generation capacity at the Central Interconnected System. This proportion depends on rainfall variability and economics.

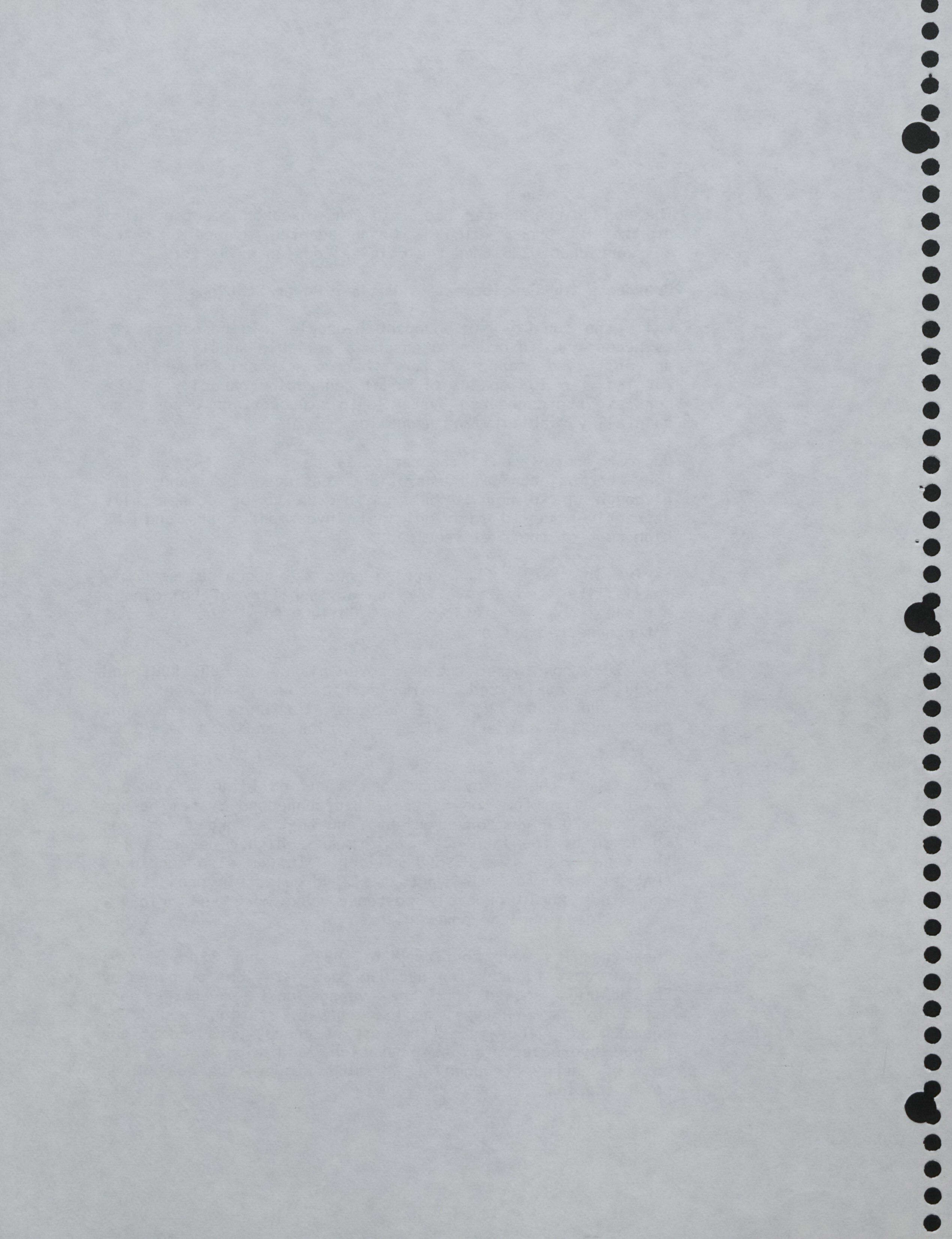
Nuclear energy could theoretically be one of the choices for thermoelectrical generation, besides coal and oil, although up to now it has not proven to be economically attractive due to high original investment costs and the high cost of the fuel required.

Early in 1979, CNE carried out a technical-economic feasibility study to verify the advisability of building a nuclear power station in Chile for the Central Interconnected System.

The study considered nuclear power plants of 600, 900, and 1,200 MW, coal-fired thermoelectric power plants of 300, 450, and 600 MW, 50 MW gas turbines, and eight hydroelectric projects with capacities ranging from 70 to 500 MW.

Basically, the study concluded that building a nuclear power station for the Central Interconnected System before the year 2000 was inconvenient, and that a forced decision to do so by the late 80's would mean a higher net cost for the country of some US\$500 million. It was also concluded that inclusion of other potential hydroelectric projects in the study would probably postpone even more the priority for building nuclear power plants.

These results were confirmed in 1989. A new study, using present cost figures for nuclear power stations prepared by ELECTROWATT, showed that the average cost of energy generated by a PWR-type nuclear power station would be approximately four times the cost of energy produced at the Pangué hydroelectric power station, and almost twice the cost of energy produced at the most competitive coal-fired power station.



ANNEX Nº 1

**SIGNIFICANT FEATURES OF CHILEAN REGULATIONS
ON FOREIGN INVESTMENTS**

DECREE-LAW Nº 600, FOREIGN INVESTMENTS STATUTE

This Annex contains a summary of the most significant features of regulations, guarantees and basic procedures provided for in Decree-Law Nº 600 (DL 600), Statute of Foreign Investments in Chile.

1. BASIC POLICY PRINCIPLES

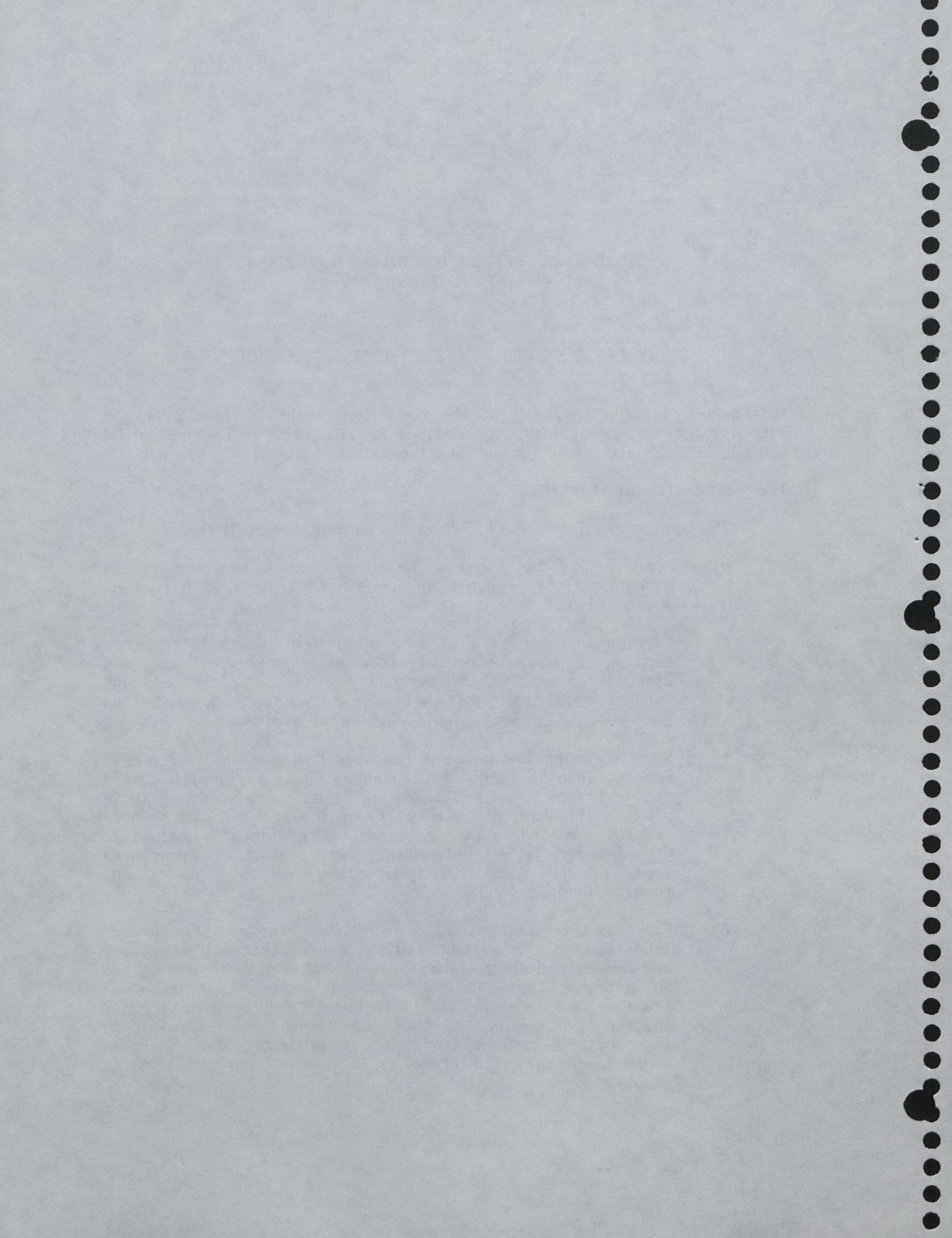
The basic principles of DL 600 may be summarized as follows:

- a) Free access by foreign investors to both the national market and the economic sector, in accordance with current legislation.

Foreign investors are able to make their own decisions concerning activity selection, form of organization, possible association with other investors, volume of operations and further development of their projects, based on their own judgements and profit/efficiency considerations.

- b) No discrimination between domestic and foreign investors. Foreign investors are treated on an equal basis with domestic investors, as the Statute is based on objective principles, applicable to the totality of investments, and on procedures of analysis and non discretionary decisions. Chilean legislation, standards, and regulating procedures apply equally and with identical force to domestic and foreign investors.

- c) Fairness and automation in procedures required for foreign investments. Investment rules and contractual framework are determined in advance, as well as investors' rights and obligations, thus eliminating the practice of preferential transactions between the government and certain foreign investors. This system guarantees an expeditious, standardized, and nonbureaucratic procedure for approval and implementation of foreign investment contracts in the country.



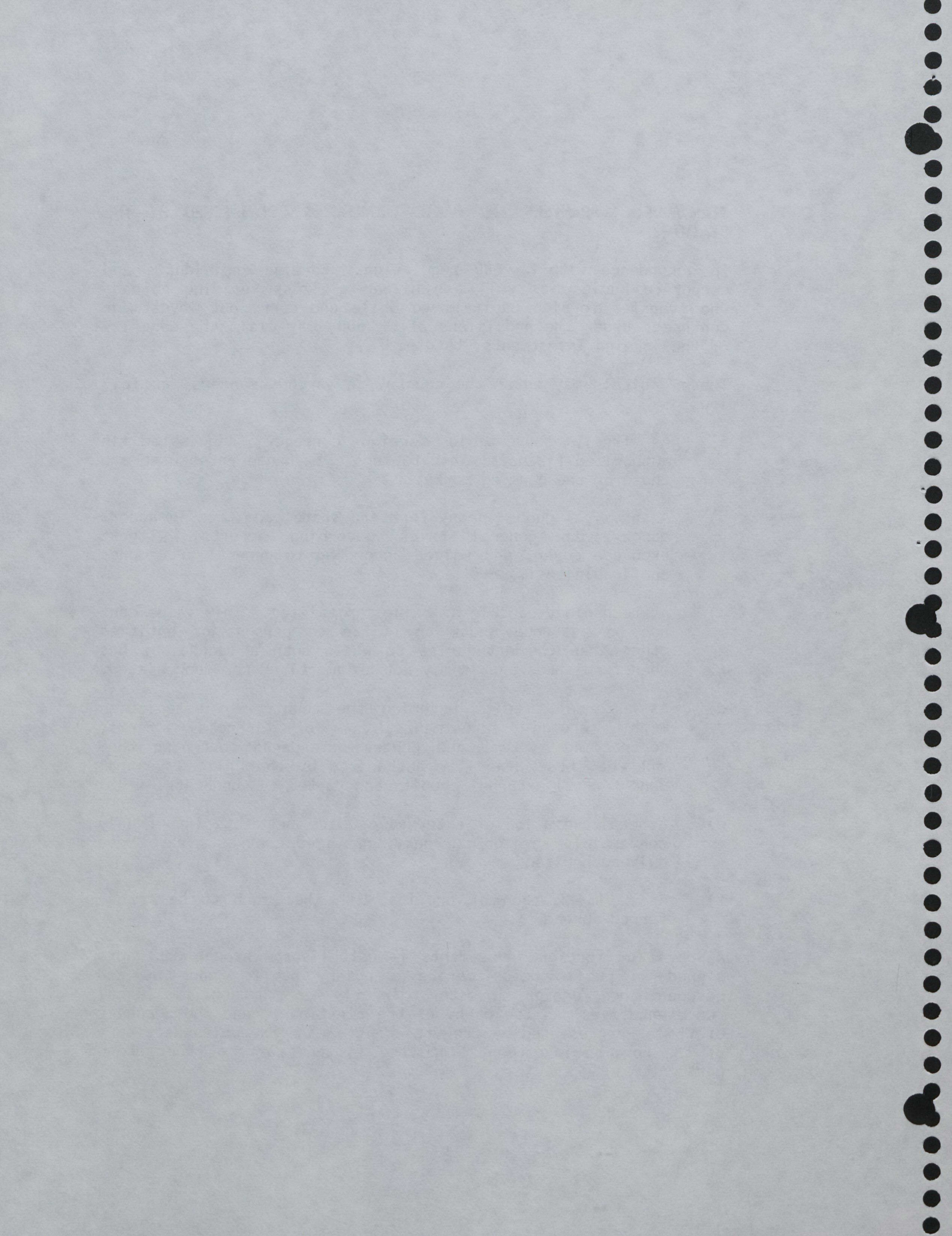
2. **STANDARDS, GUARANTEES AND BASIC PROCEDURES ESTABLISHED BY THE STATUTE**

In accordance with DL 600 regulations, foreign individuals and corporate bodies, as well as Chilean citizens residing abroad, who transfer foreign capitals to Chile and carry out investment contracts under the provisions of DL 600, may claim the benefits of the Foreign Investments Statute.

These capitals may enter the country in various manners, as follows:

- a) As freely convertible foreign currency, liquidated in authorized financial institutions. Exchange rates used are those of the banking market.
- b) As physical goods in any form and state, admitted in accordance with general rules governing imports, without exchange cover, and valued according to general procedures applicable to imports.
- c) As technology capable of being capitalized. This value cannot be assigned under any title to persons or entities other than the enterprise to which such a technology has been furnished, and it may not be amortized nor depreciated.
- d) As external credits entering the country in association with foreign investments, where financial terms, contracting system, and general standards governing them will be those generally authorized by the Chilean Central Bank for all external credits contracted by the State.
- e) As capitalization of external credits and debts into freely convertible foreign currency, provided contracts have been duly authorized.
- f) As capitalization of profits with the right to be transferred abroad.

Approval of foreign investments is established through contracts signed as public deeds before a notary public, made by and between the foreign investor directly or through his legal representatives, as the party of the first part, and the Republic of Chile, represented by the President or the Executive Secretary of the Foreign Investment Committee, as the party of the second part.



It should be pointed out that these are government official contracts (contrato- ley), which means they are contracts entered into by the Republic of Chile exercising its legal authority, by virtue of which the government commits itself with respect to the investor, a commitment which is immovable in the eventuality of legislative changes.

Official contracts are recognized by Chilean legislation and jurisprudence, so they may only be amended by mutual consent of the contracting parties.

These contracts essentially consist of a basic format and clauses establishing the amount of the investment, the purpose of the contribution, the authorized time period for its materialization, and the guarantees given to the foreign investor.

The usual term for entering the contributions is up to 3 years. For mining investments, the term is up to 8 years, and it may be extended up to 12 years, if so decided unanimously by the Foreign Investment Committee, in cases where previous exploratory studies are required, considering their nature and estimated duration.

Guarantees given to investors are the following:

1. Right to transfer abroad their capitals and net profits without limitation as to amount or time. Yet, capitals cannot be transferred abroad before three years after entering Chile. Profits may be transferred abroad at any moment. In any case, foreign currency amounts needed to effect remittances of capitals can only be purchased by using the proceedings received from disposition of stocks or titles representing the foreign investment, or from disposition or liquidation of the companies acquired or incorporated on the basis of said investment.

The net proceedings from the disposition or liquidation of companies are exempt from any taxation, duties or assessments up to an amount equivalent to the investment authorized by the Foreign Investment Committee, and duly paid by the investor. Any surplus amounts exceeding the above figure shall be subject to general tax regulations.

The exchange rate applicable to the transfer of capitals and profits out of Chile is the banking market rate, which applies to all foreign trade operations, external credits and receipts of capital from abroad. The investor has



guaranteed access to the exchange market for the purchase of foreign currency and the transfer of it out the country.

2. The second guarantee is the right of the investor to include in the investment contract, at his request, a provision establishing that a rate of 49.5% as total tax burden on the income he receives from his contribution shall be kept invariable for a 10-year period from the date of the starting up of the company.

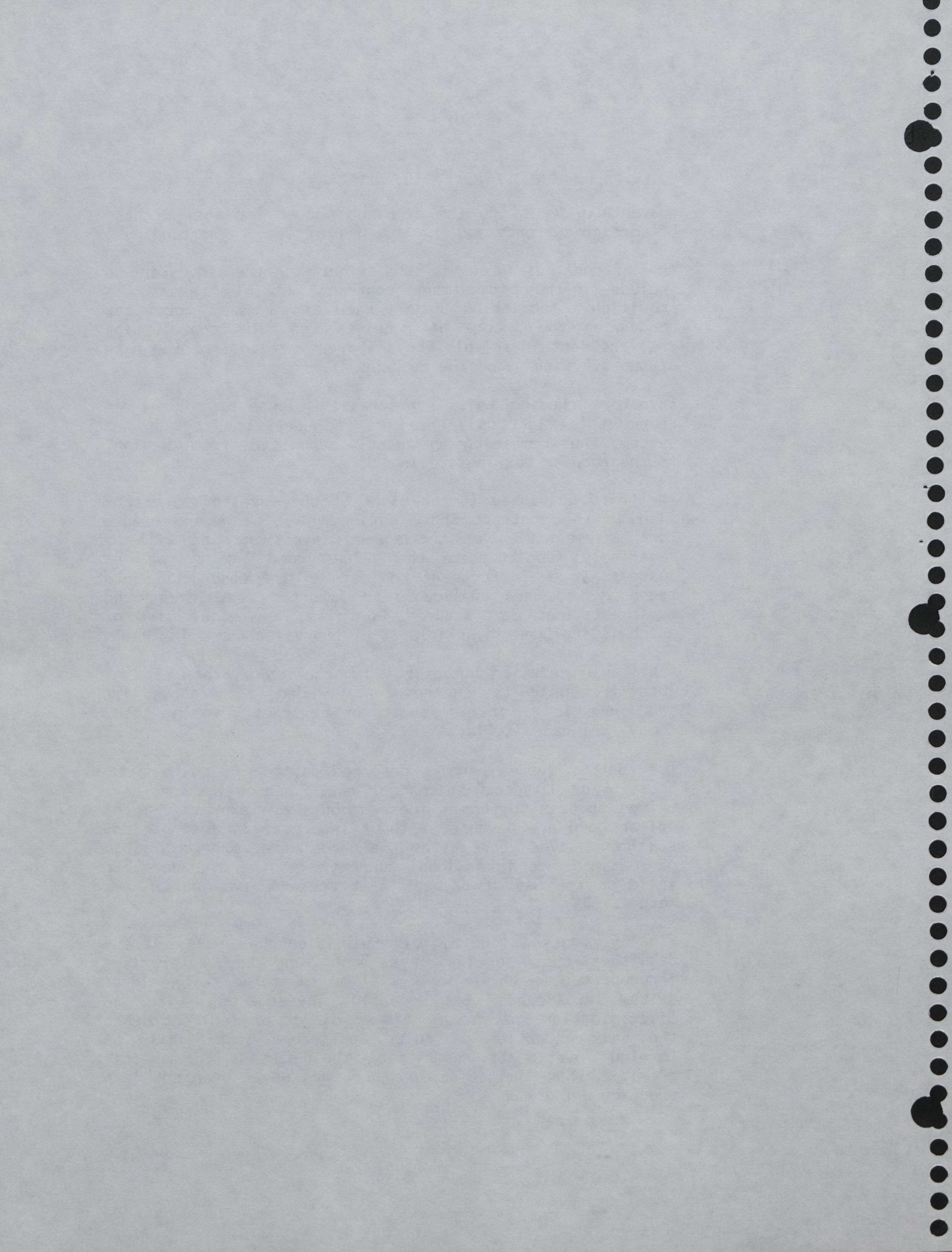
Investors choosing this invariability clause may later renounce this right only one time and adopt the regular tax system, thus remaining permanently submitted, from then on, to the regular tax legislation.

3. The third guarantee is the right of the investor to establish in the contract that, during the time period needed for implementation of the agreed investment, he will be invariably submitted to the Value Added Tax system and customs system in force at the date of the contract. Both these systems are applicable to imports of machinery and equipments not manufactured in Chile, a special list of which is included in Article 12 of the Value Added Tax Law.

Applicable taxation authorizes importation on this kind of goods free of VAT, when they are included in the above list and there is a foreign investment contract covering them. Today, VAT rate is flat a 18%.

The customs system permits deferred payment of customs duties, taxes, dispatching charges, and other obligations perceived through Customs. These amounts are expressed in US dollars and are payable, without interest, in a single installment seven years after the goods were imported. This payment is made in national currency, at the exchange rate valid on the day of payment. At present, Chilean customs rate is 11%.

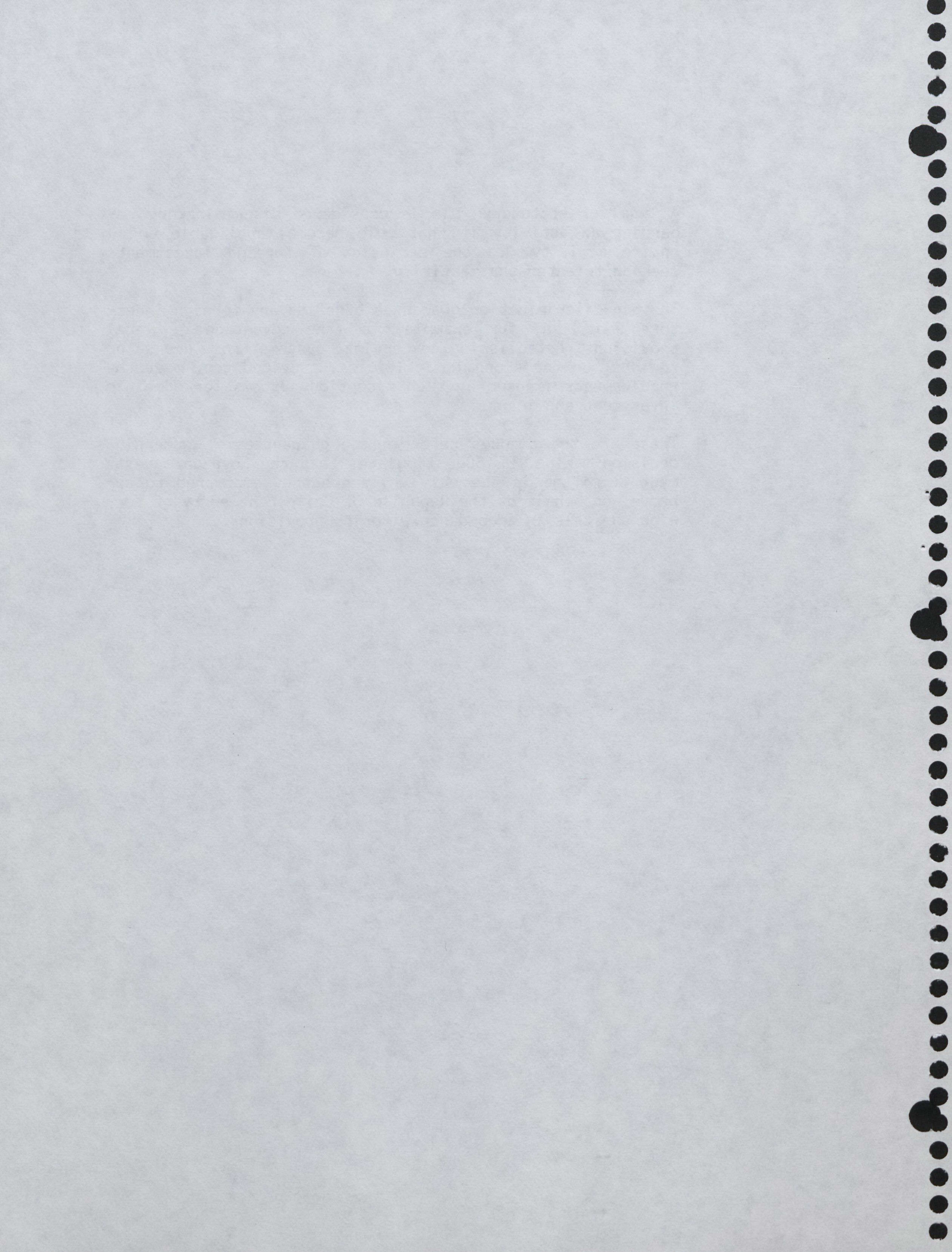
4. Finally, there is the non-discrimination guarantee. It establishes that foreign investments and the enterprises incorporated on their basis will be submitted to the legal system applicable to domestic investments, with no discrimination whatsoever, either direct or indirect, with the only exception of rules applicable specifically to foreign investments restricting their access to domestic credit. This limitation, however, has never been put into practice until now.



A legal or statutory rule is considered discriminatory regarding an activity if that rule becomes applicable to an entire activity, to the exclusion of foreign investments seeking to enter that activity.

The non-discrimination guarantee benefits any foreign investors who wish, for example, to take advantage of legal provisions establishing exception systems for areas or regions, or for economic activities, provided they meet the requirements imposed by such exception systems for domestic investment applicants.

These are the clauses referring to guarantees. Concerning decision-making, DL 600 stipulates that the Foreign Investment Committee is the only Chilean agency empowered to approve, on behalf of the Republic of Chile, the entry of foreign capitals in accordance with its provisions.



ANNEX Nº 2

SPECIAL PETROLEUM-OPERATION CONTRACTS

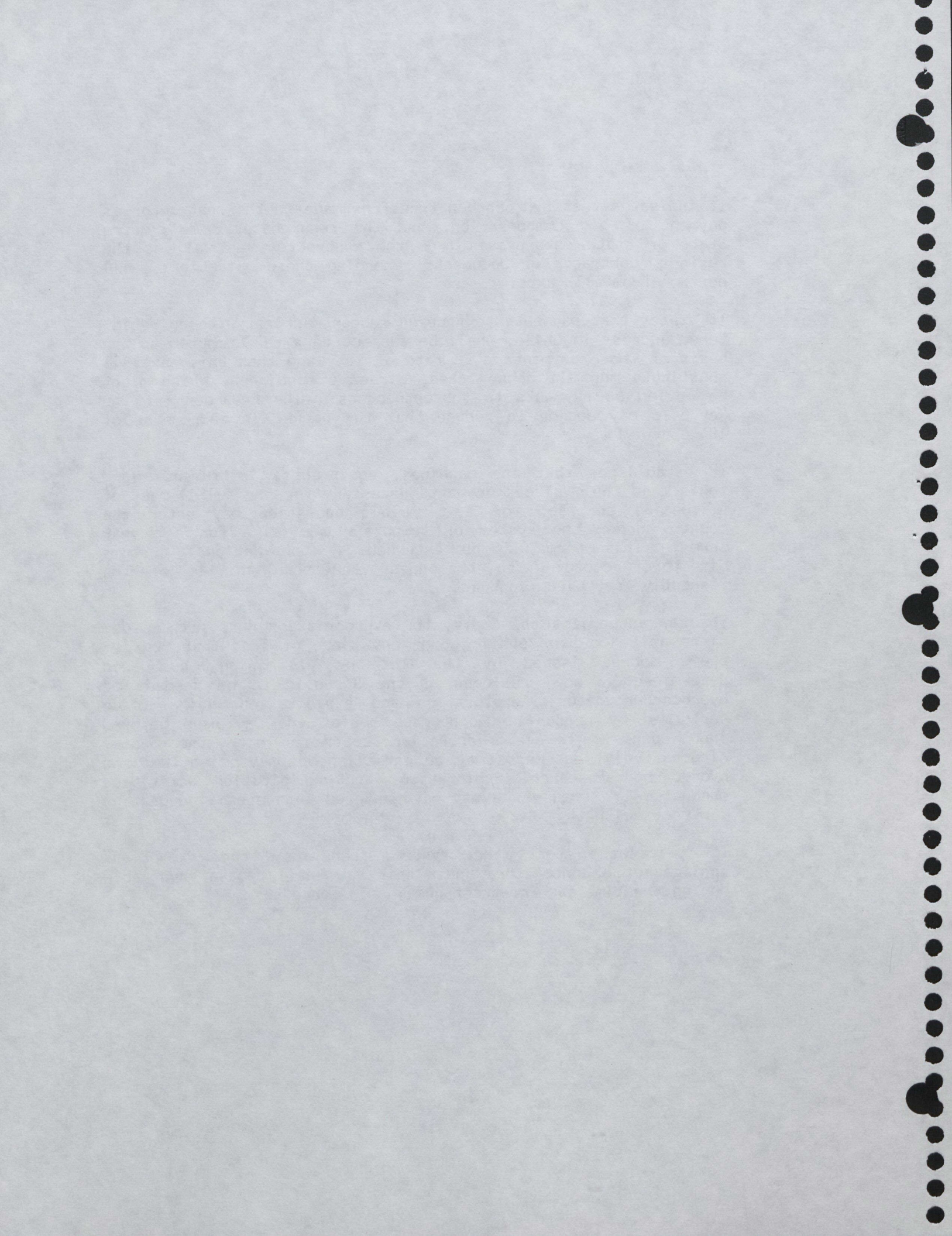
This Annex contains a summary of the law on Special Contracts for Petroleum Operations, Decree-Law Nº 1089.

The main provisions of these regulations are the following:

- It defines the terms "Special Operation Contract," "Contractor," "Compensation," and "Contract for a specific oil job."
- It provides that, if authorized by the Special Petroleum Operation Contract, the contractor may export hydrocarbons received as his compensation without having to meet export regulations, and having guaranteed free disposition of the foreign currency amounts perceived from said export operations.
- It stipulates that the State guarantees the contractor access to the foreign currency market, called the "free banking market," or whichever system may replace it in the future, for conversion and further remittance abroad of incomes perceived from the sale of his own equipments or other goods, in accordance with the terms and conditions stipulated in the contract.
- It establishes that the contractor will be subject to a tax figure calculated directly on the amount of his compensation, which is now 50% of said compensation; or he may be subject to the regular provisions of the Income Tax Law. Notwithstanding this, the President of the Republic may authorize, whatever the applicable tax system, reductions of the payable tax, or of all or any of the taxes established by the Income Law, equivalent to a figure ranging from 10% to 100%, in 10% increments. The applied system substitutes all other direct or indirect taxes that could be levied on the compensation or on the contractor with regard to his compensation, and it remains invariable during the term for which it was granted.
- It authorizes the President of the Republic to condone, in 10% increments up to 100%, the duties, fees, taxes, or contributions and, in general, any other payments or taxes which may directly or indirectly be levied on imports of machinery, equipment, materials, spare parts, and items or goods intended for works of exploration or exploitation of hydrocarbons.



- It indicates that hydrocarbon transfers made to the contractor as payment of his compensation, and the repurchases made by the State or state enterprises from the contractor, as well as the actions, contracts or documents recording these operations, will be free from all taxes.
- It states that payments to foreign subcontractors, with no registered address in Chile, shall be subject to a tax computed on the basis of those payments at a rate of 20%, and that this tax will substitute for all other taxes, direct or indirect, which might be levied on payments to subcontractors. The President of the Republic may decide to reduce that tax amount in increments of 10% up to 70%.
- It establishes that the machines, equipments, instruments, and tools, and their pieces or parts necessary for the fulfillment of a special contract for a petroleum operation may enter the country under the system of temporary admission for a 5-year term. This term may be extended by the National Customs Director, according to the needs and peculiarities of the respective petroleum contract.
- The Law authorizes the State, for expropriation purposes, to declare as being "for public good" any piece of land that, by supreme decree issued by the Ministry of Mining, has been determined by the President of the Republic to be needed for hydrocarbon deposit exploration and exploitation works to be performed by persons or corporate bodies who may have entered into special petroleum operation contracts with the State. Alternatively, easements may be established applying entirely to hydrocarbon research, exploration, and exploitation activities conducted by persons who may have entered into special operation contracts with the State.
- It stipulates that the system, benefits, and exemptions applicable to contractors under this Law shall remain invariable during the time each contract remains in force.



ANNEX N° 3

ELECTRIC SECTOR PRICING POLICIES

1. Pricing Policies

The main purpose of electricity pricing policies is to have prices which reflect the real costs of efficiently generating, transmitting, and distributing power.

The current pricing policy was designed by CNE and it has been in force since 1980. A distinction needs to be made between areas of distribution to consumers, where natural monopolies exist and prices must be regulated, and the areas of generation and transmission, where energy is sold to a few clients, on a competitive basis, so prices are freely set.

1.1 Free prices

For major clients, with an installed demand of over 2 MW, prices and other supply conditions are negotiated directly between client and generating companies. Power is normally supplied in high voltages.

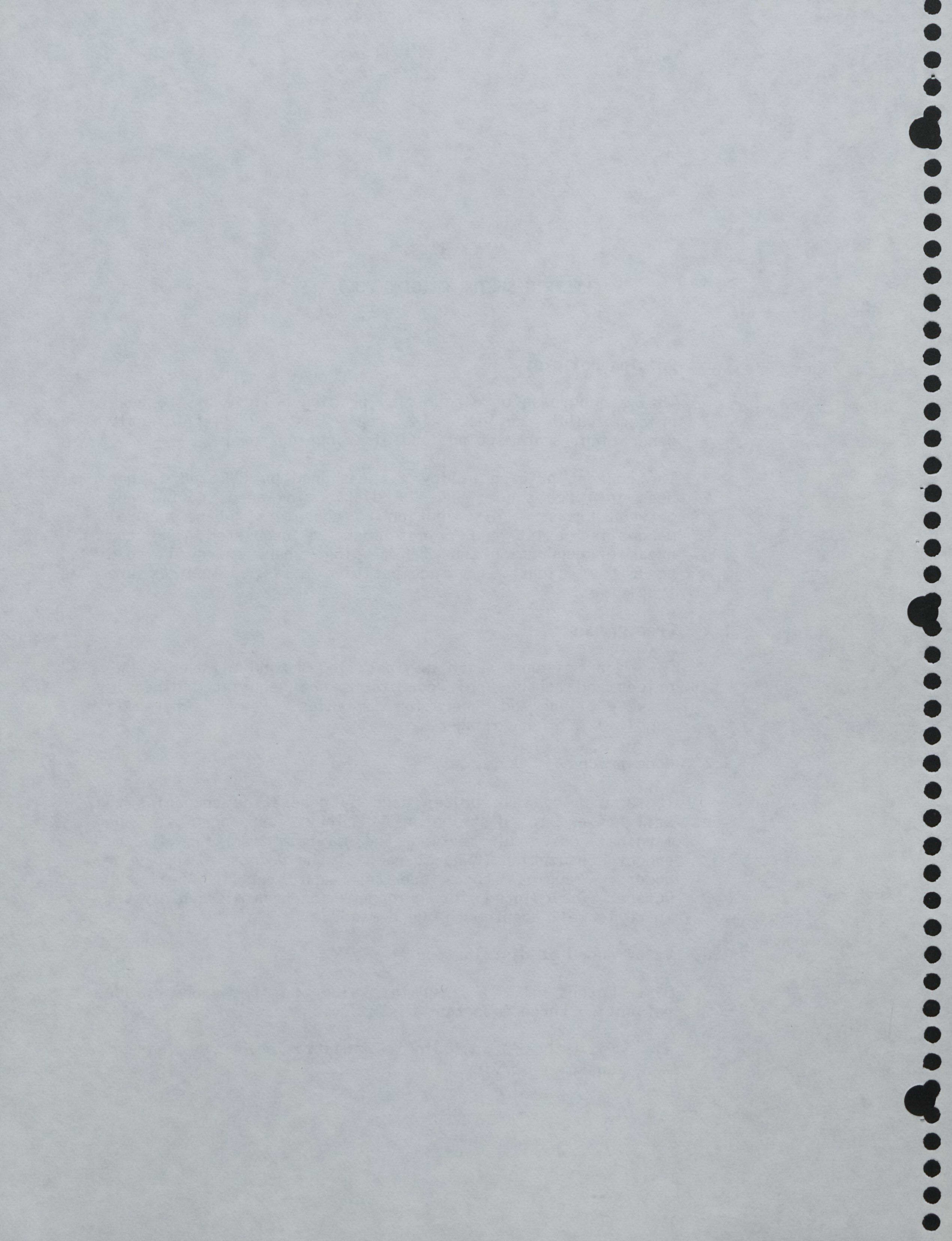
1.2 Node prices

These are the sale prices used by generating companies to sell power to distributors. They correspond to the marginal costs of meeting the maximum demand (kW) and energy consumption (kWh) at each of the points of supply or nodes. Marginal costs are set each year in April and October, calculated for a generation-transmission system which is well adapted to the demand.

1.3 Value added at distribution

Distributors add a certain value to the node price reflecting three important distribution costs:

- a) Fixed costs including administration, invoicing and customer services.



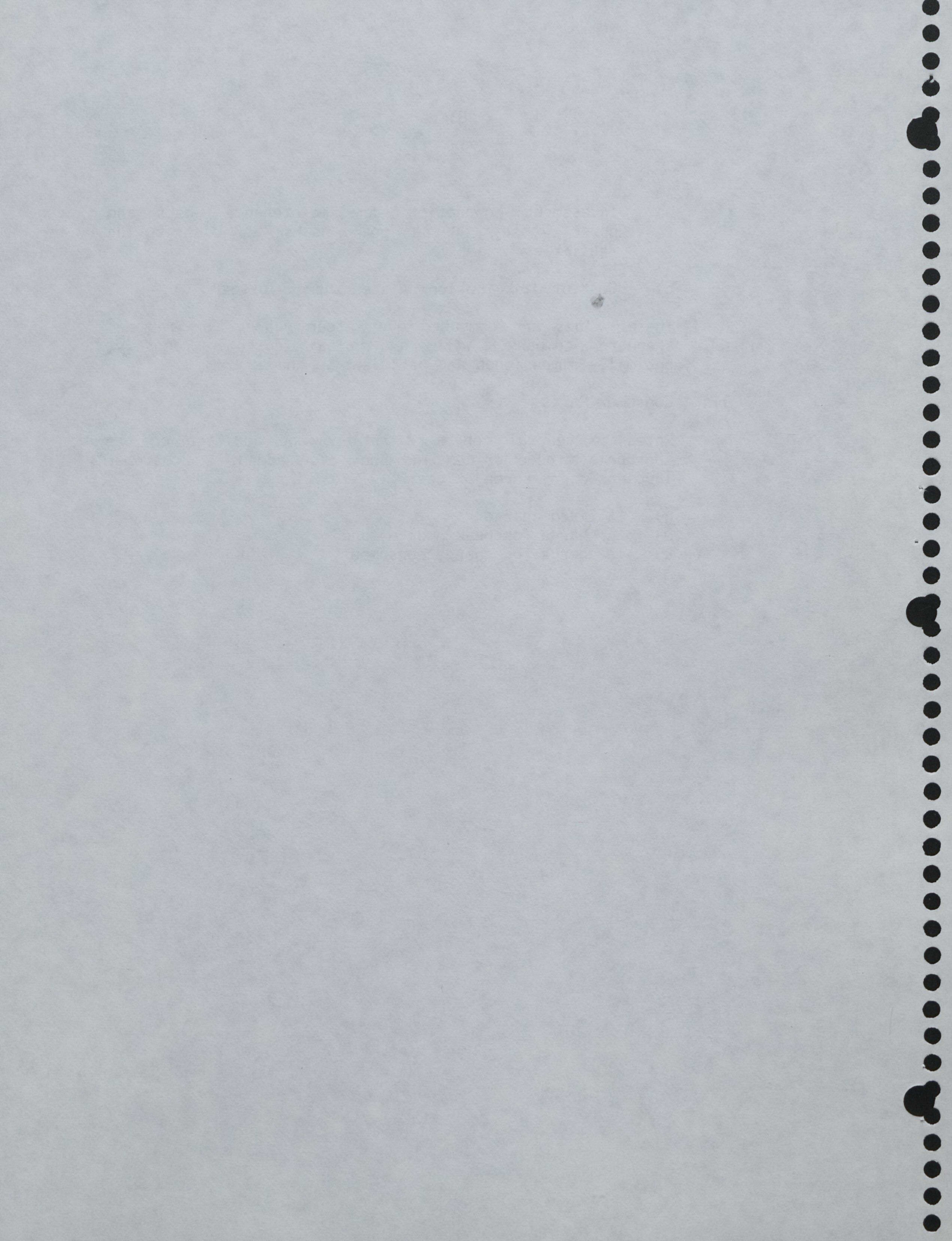
- b) Investment, operation, and maintenance costs and power losses during peak hours at distribution facilities.
- c) Cost of distribution-related energy losses.

These values are computed every four years, for a model standard company, with a typical customer density, optimally dimensioned and efficiently managed.

1.4 Consumer Rates

Rates to general consumers reflect the addition of the appropriate node price plus the value added, so customer invoices carry three prices:

- a) A fixed charge
- b) A charge for peak hour demand
- c) A charge for energy consumed

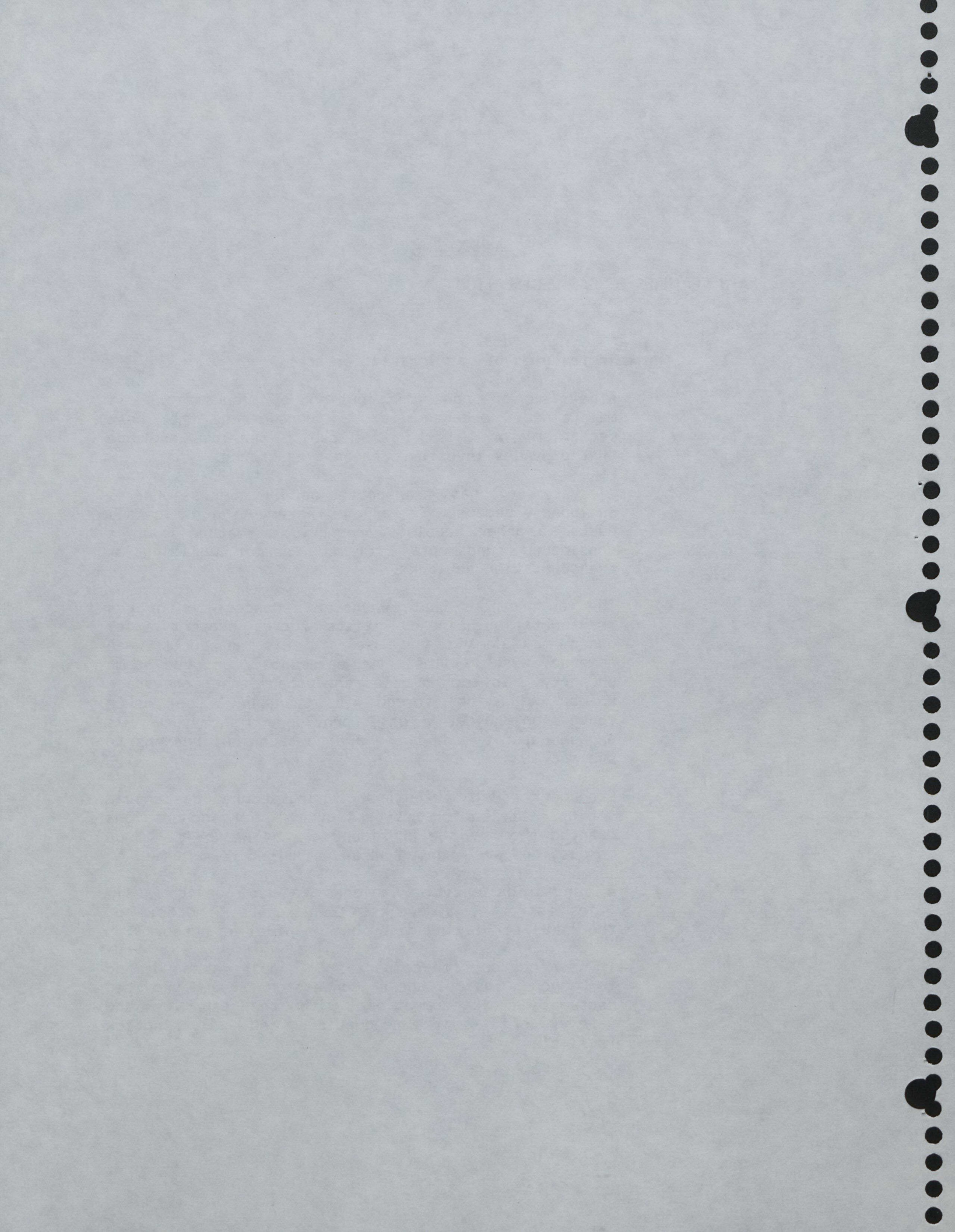


ANNEX Nº 4

MAIN FEATURES OF GAS LEGISLATION

1. The main features of gas legislation are:

- a) A system of gas distribution by concessions is maintained, because it is considered the best mechanism for this kind of public service, and one that provides investors the best assurance.
- b) A system of gas transportation by concessions is included, because it allows easements to install ducts in other people's property, a feature that is considered fundamental for the prompt building of transportation networks.
- c) The law provides that, whenever a concession for gas transportation already exists for a property, its owner may demand the use of existing ducts when someone else claims new easements for the same property. In such a case, the established concession holder will be forced to transport the other concession holder's gas, provided his system has enough capacity and there are no technical reasons to prevent it.
- d) Producers and distributors of manufactured gas should set up distribution networks according to concessions granted them by the President of the Republic. Such concessions are granted on an unlimited term basis.
- e) A concession entitles holders to use public facilities (streets, sidewalks, town squares, roads, and the like) for laying distribution pipeline networks.
- f) It is mandatory for companies to supply gas on demand to anyone inside their concession area, provided consumption is compatible with the capacity and safety of their production and distribution facilities.



- g) Concession holders are allowed to dispose of and pledge any or all of their assets, rights, and concessions, as well as to mortgage and encumber them.
- h) The control and supervision of concession holders' compliance with their obligations is exercised by the Office of the Superintendent of Electricity and Fuels.

2. Pricing Policies

2.1 Mechanism for computing natural gas prices in the 12th Region

Natural gas distributed in the 12th Region has clear monopolistic connotations, because ENAP is the only supplier of this product in the area, and its opportunity cost is much lower than that of substitutes.

Public sale prices in Punta Arenas, Puerto Natales, and Puerto Porvenir include a base wholesale price (ENAP's) plus a distribution surcharge. In this case, both the gas price, at the production level, and the distribution surcharge need to be regulated.

This surcharge is calculated every 3 or 4 years, as a function of costs and investments imputable to a fictitious company. The resulting value, made up of a fixed monthly charge to customers plus a variable charge per cubic meter, is automatically escalated every month, according to cost-related indexes.

Regulations, guarantees, and other topics regarding foreign investments in Chile are discussed in Annex I.

2.2 Rate setting according to the new Gas Law (1989)

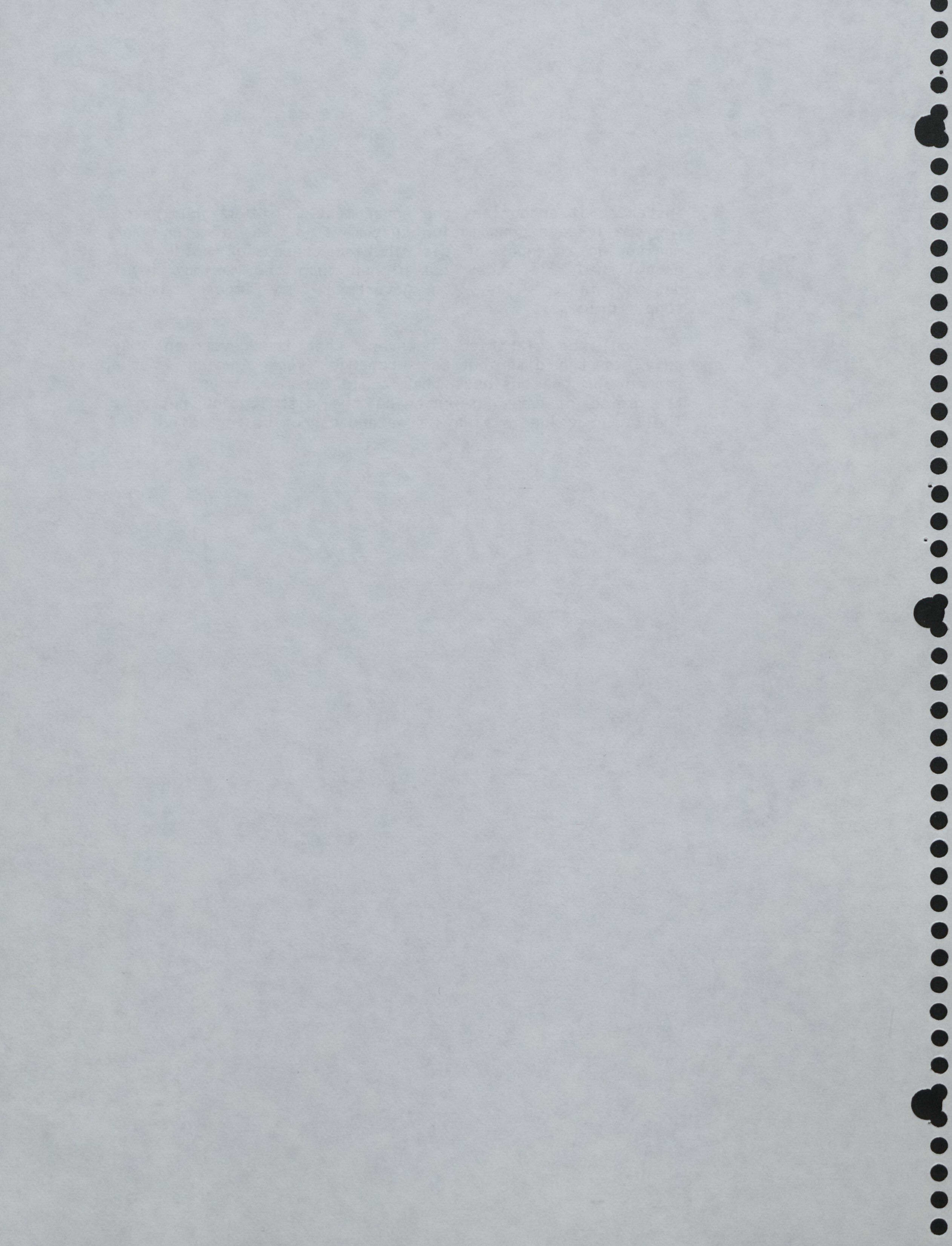
This law provides that manufactured gas companies supplying gas directly to consumers or to other gas companies, shall set prices or rates for the supply of gas and related services. The rate schedule each distributor sets must determine distribution sectors, where selling prices to consumers with similar characteristics must be the same, so as not to discriminate against them.

In order to have clearly defined "rules of the game" in the long run, and to prevent possible monopolistic gains, Decree-Law N° 323 sets forth some definitions. For



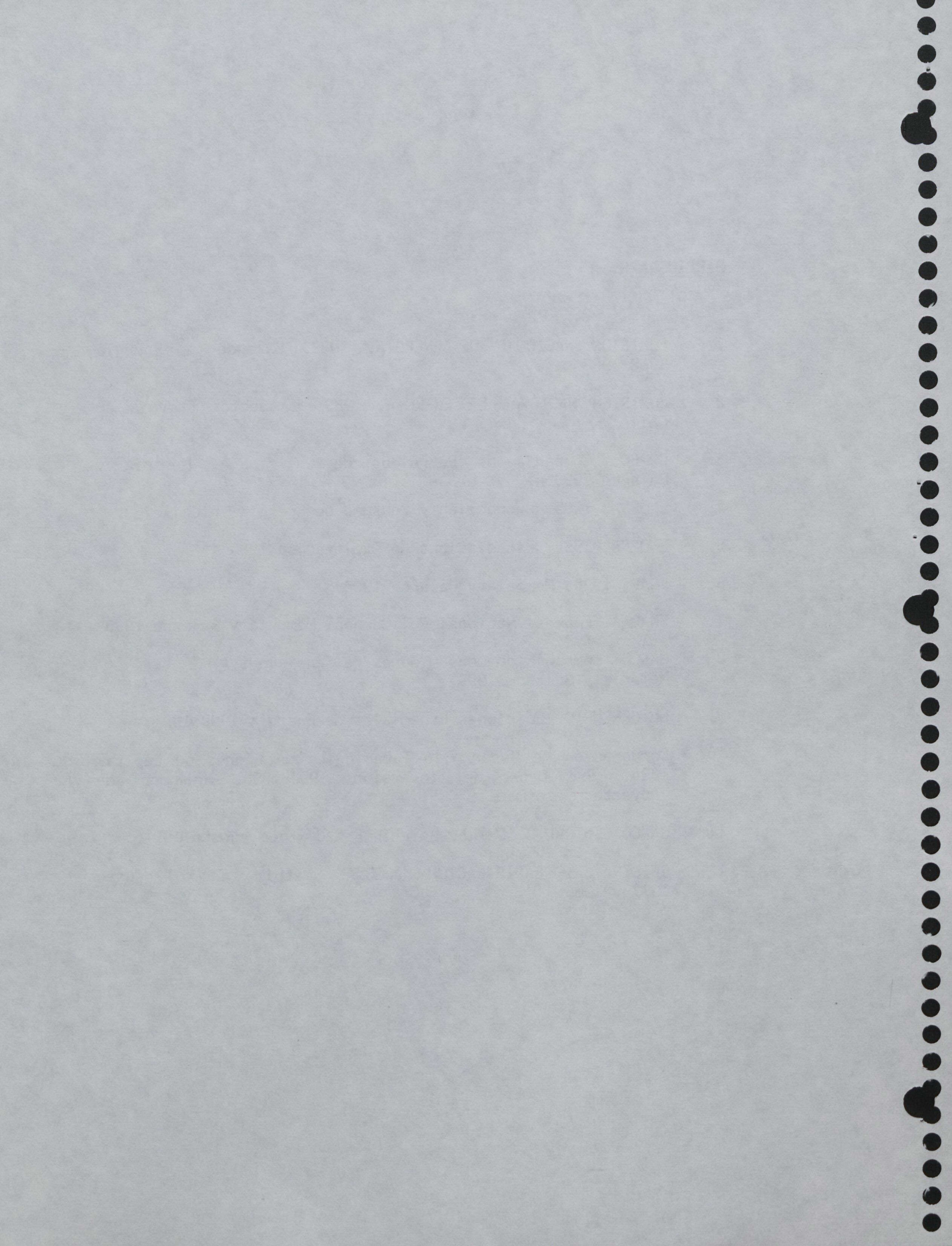
instance, it authorizes the government to set maximum rates for small-scale consumption customers. Also, a method for monitoring revenues of distribution concession holders is established. If they are higher than the maximum level defined in the law, the government may impose maximum supply prices.

It should be clarified, however, that the government may only set the distribution surcharge figure, which is the segment of the business that could become a monopoly, not the price of the gas entering the distribution network. The latter value is always free and cannot be regulated.



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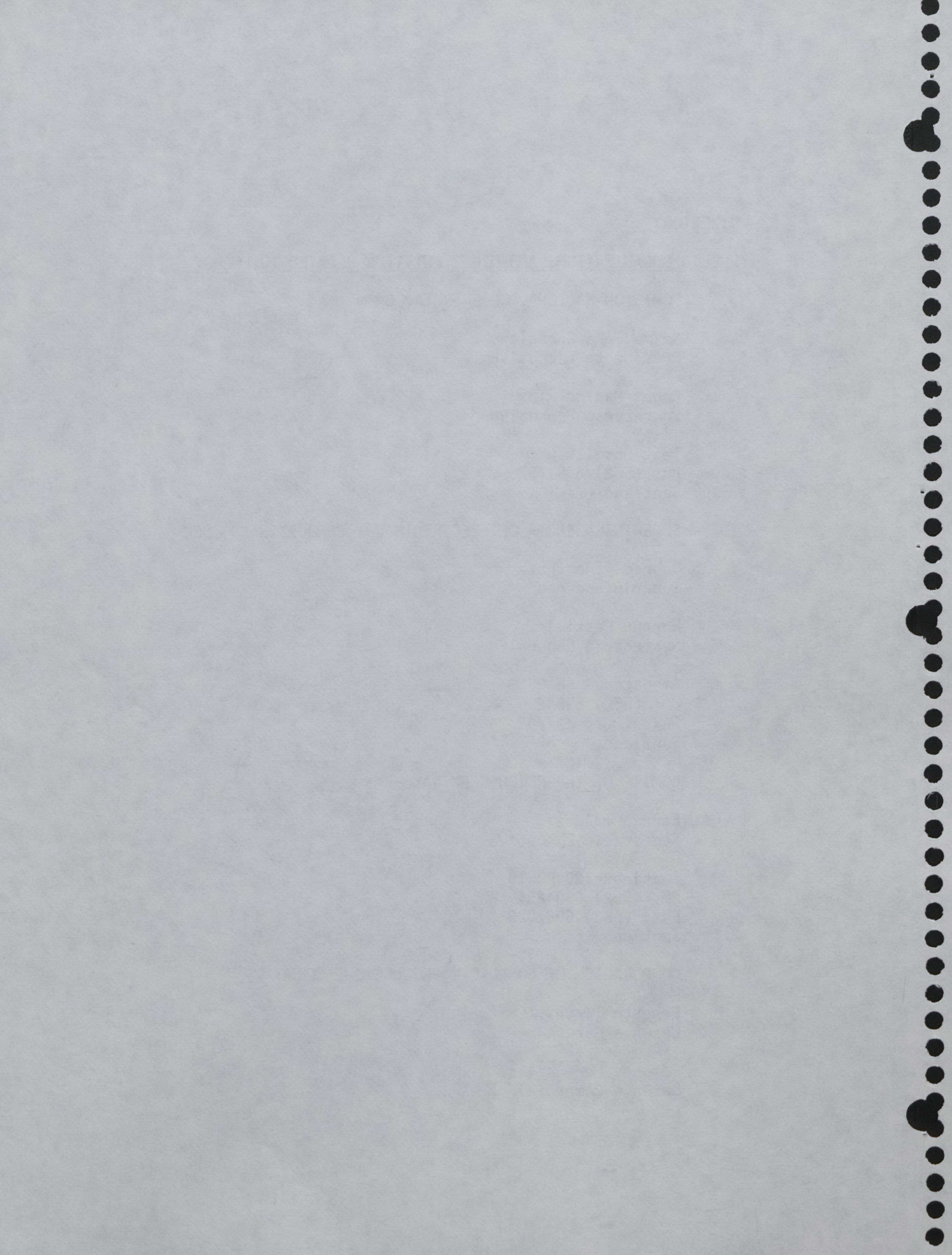
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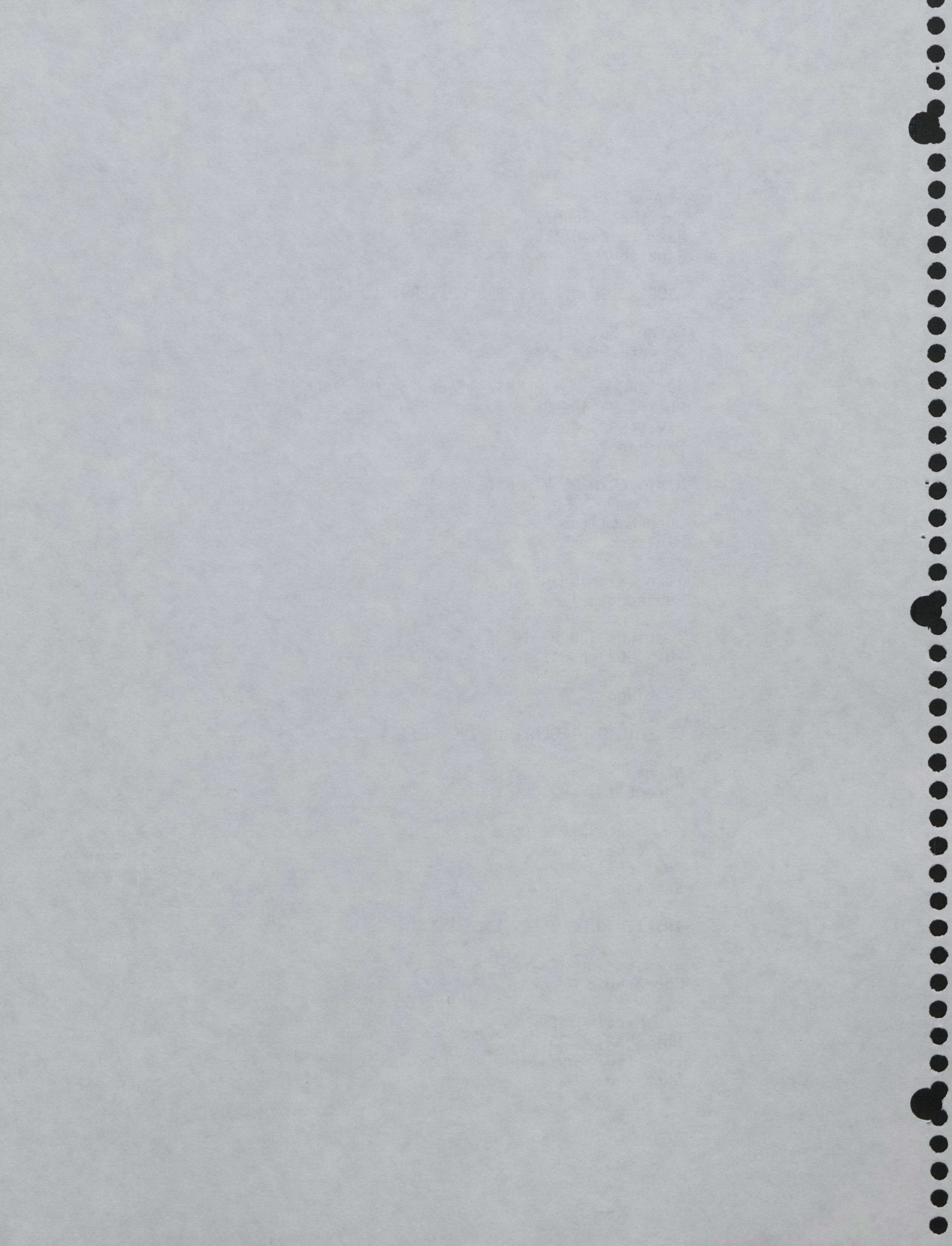
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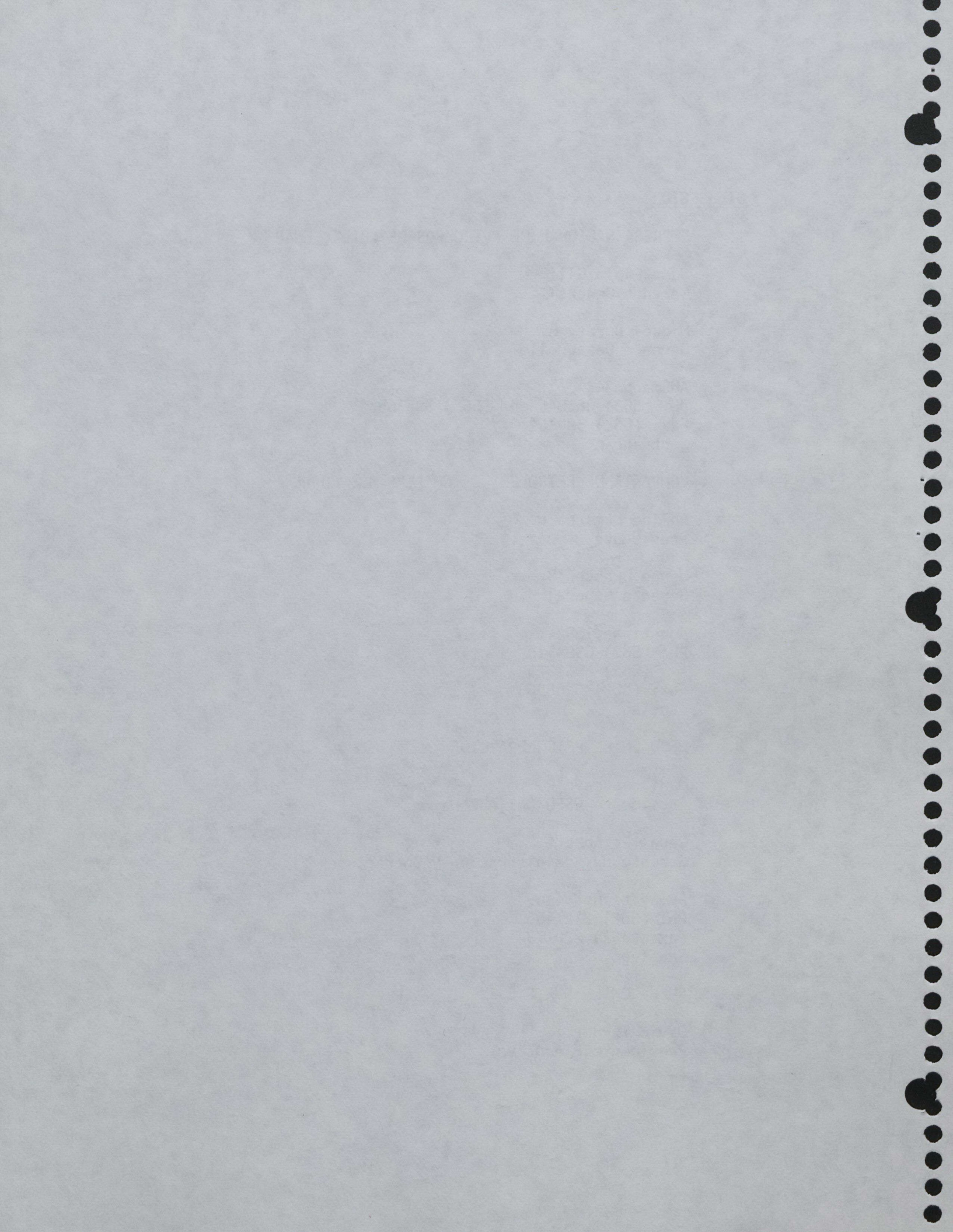
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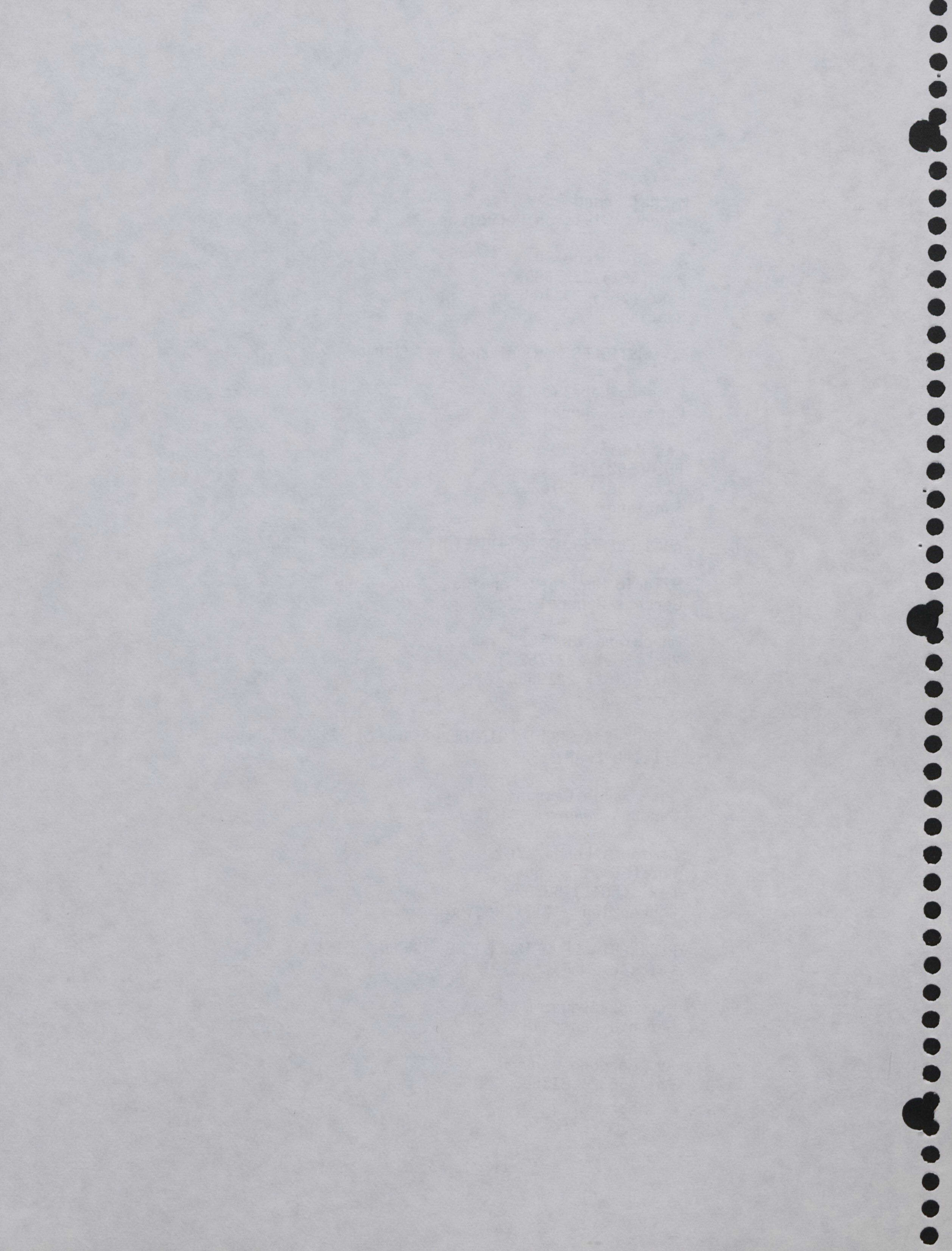
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ELECTRIC SECTOR

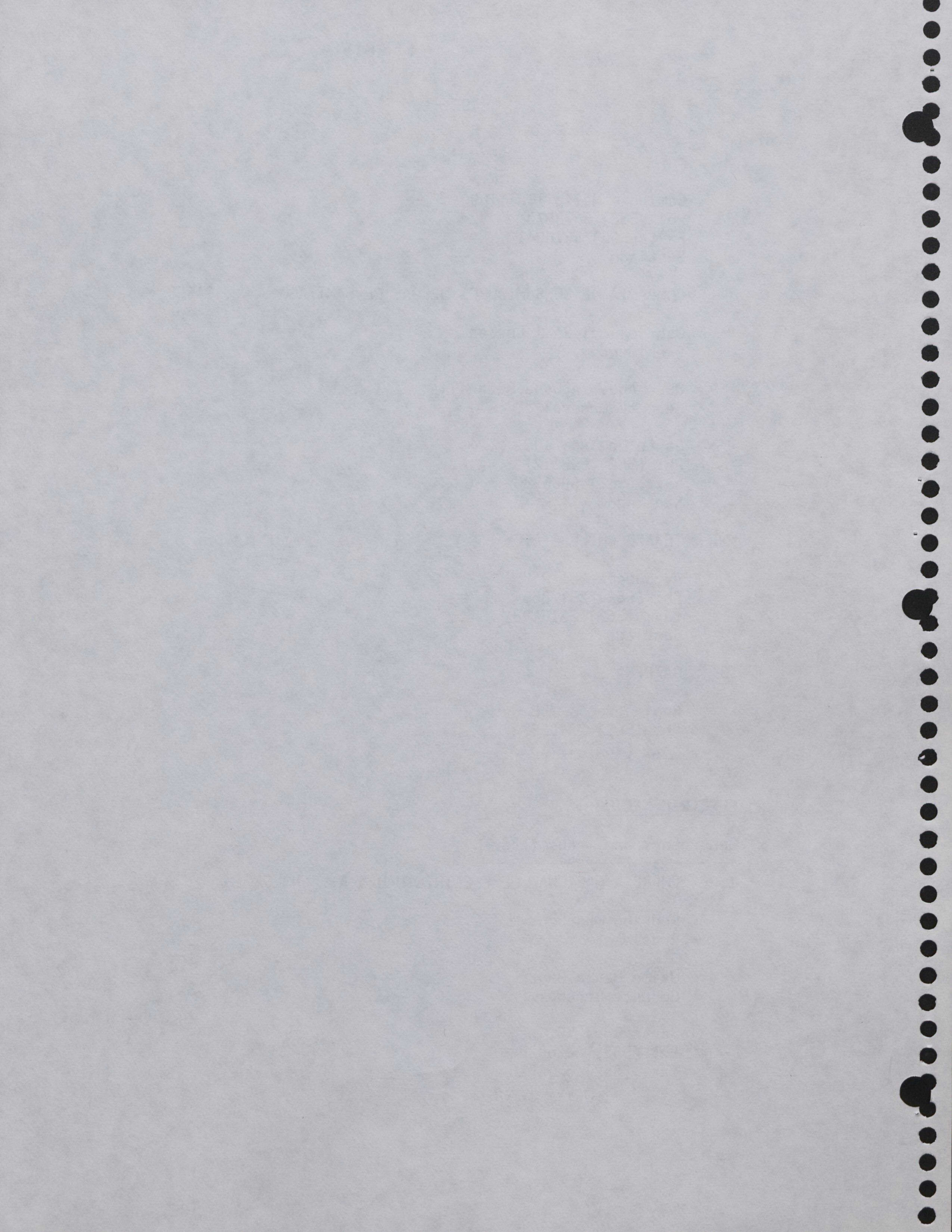
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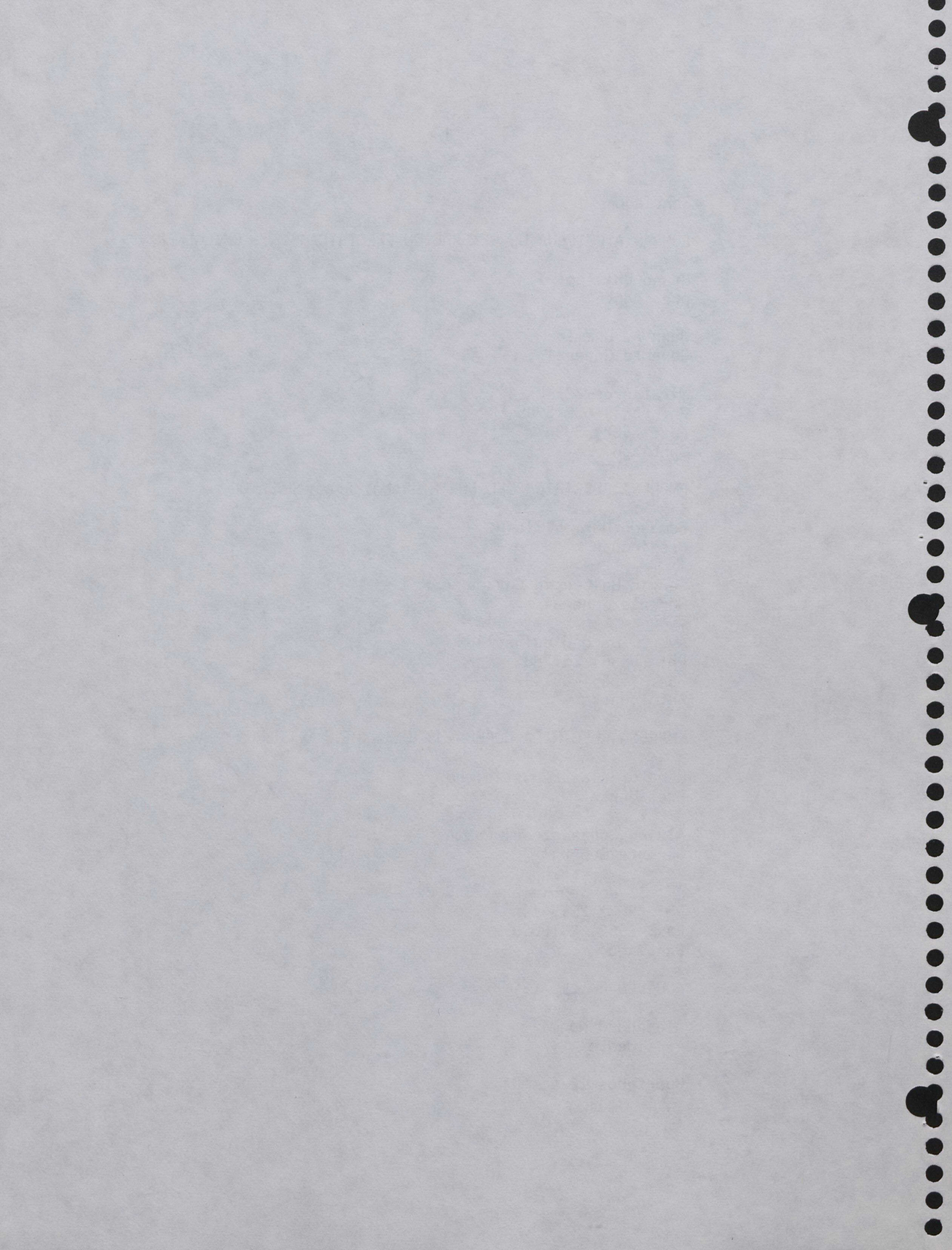
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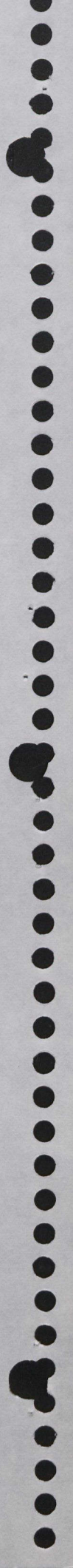
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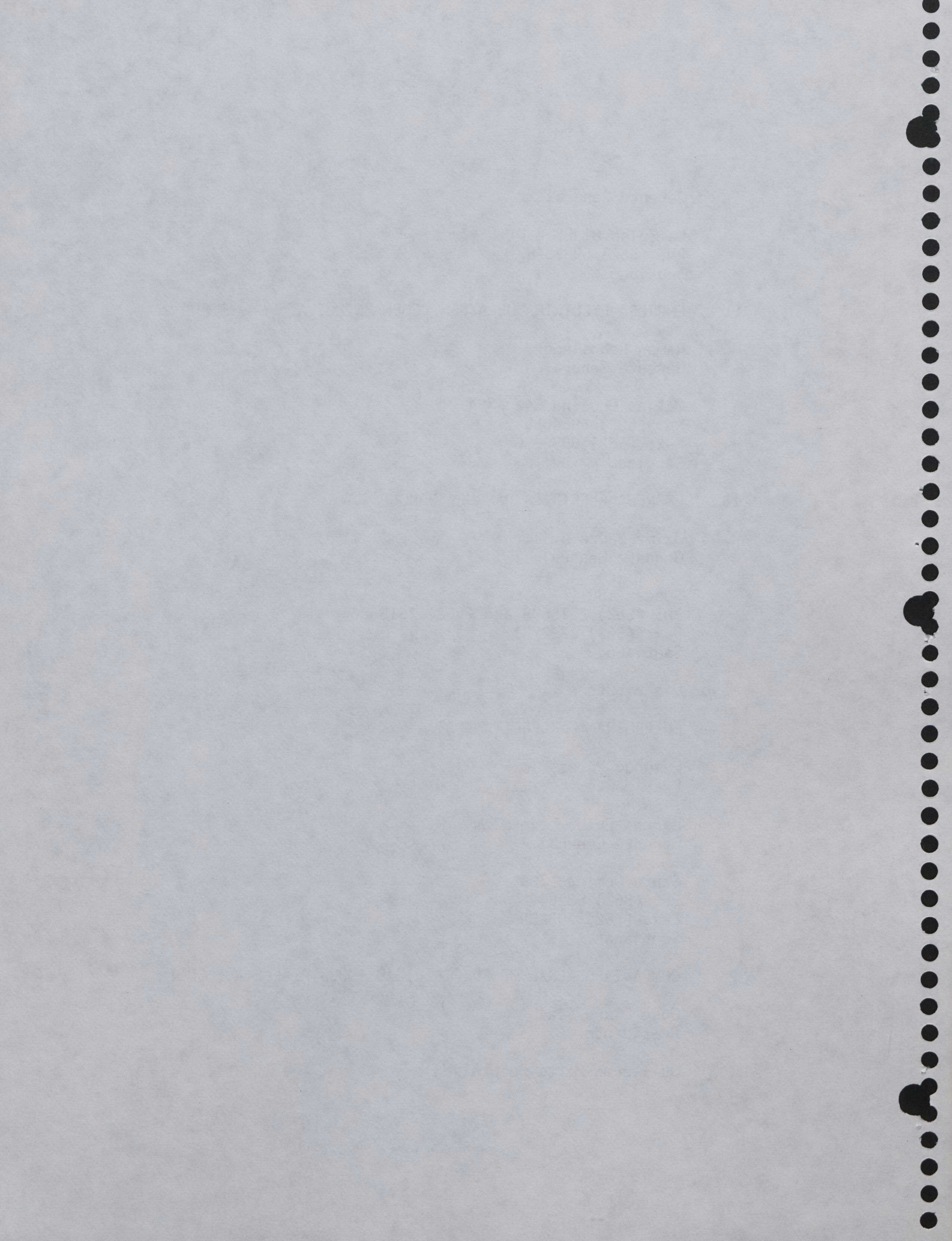
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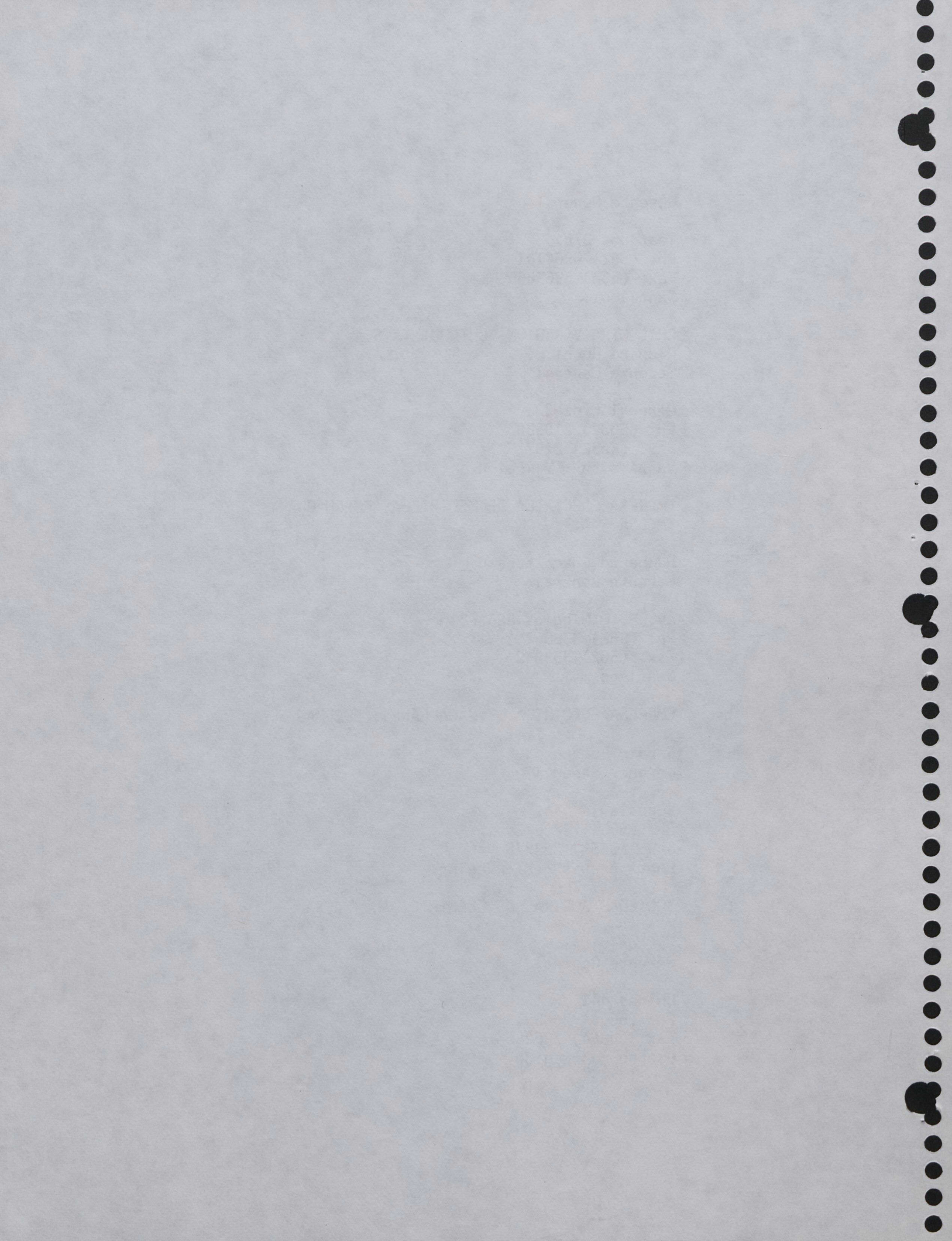
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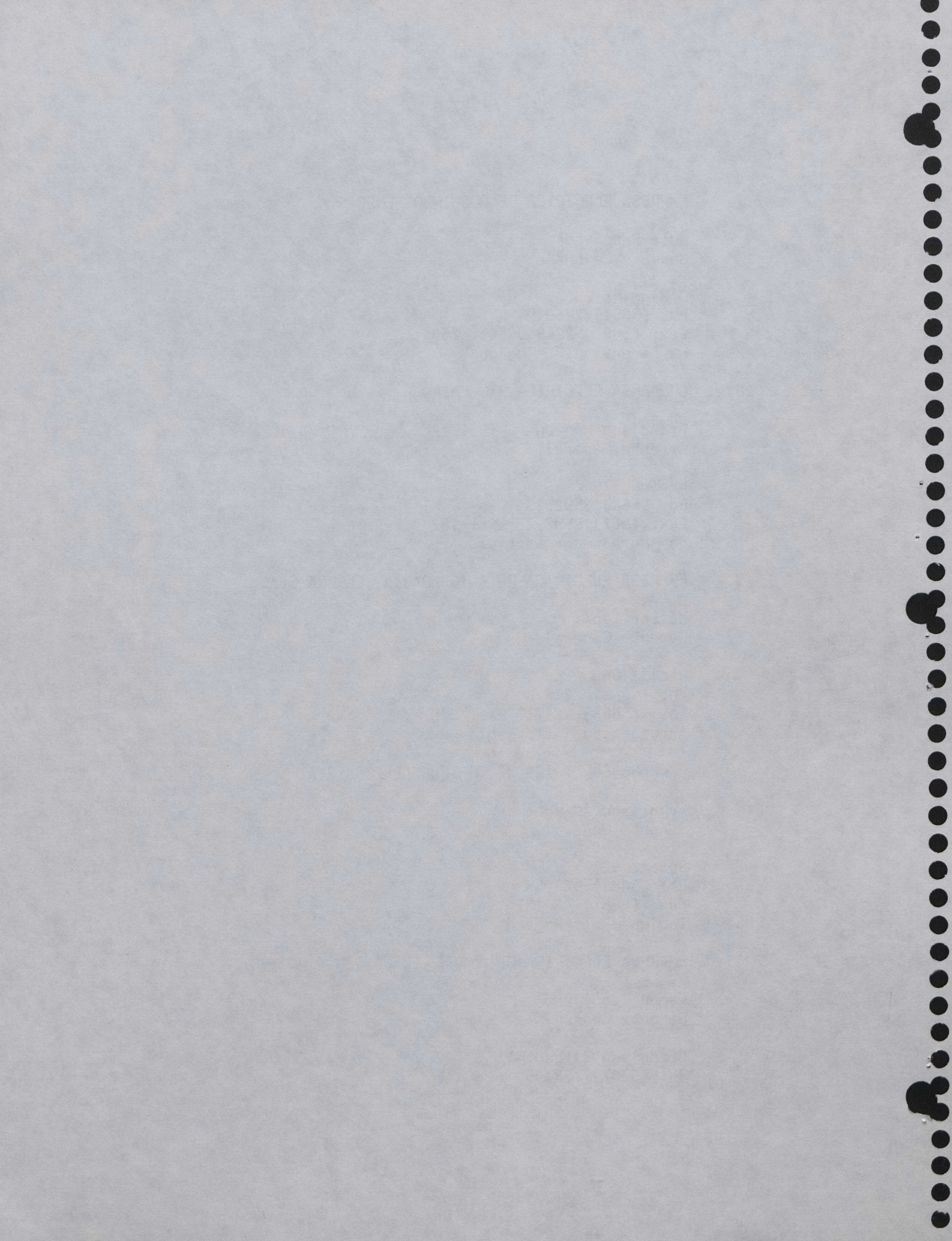
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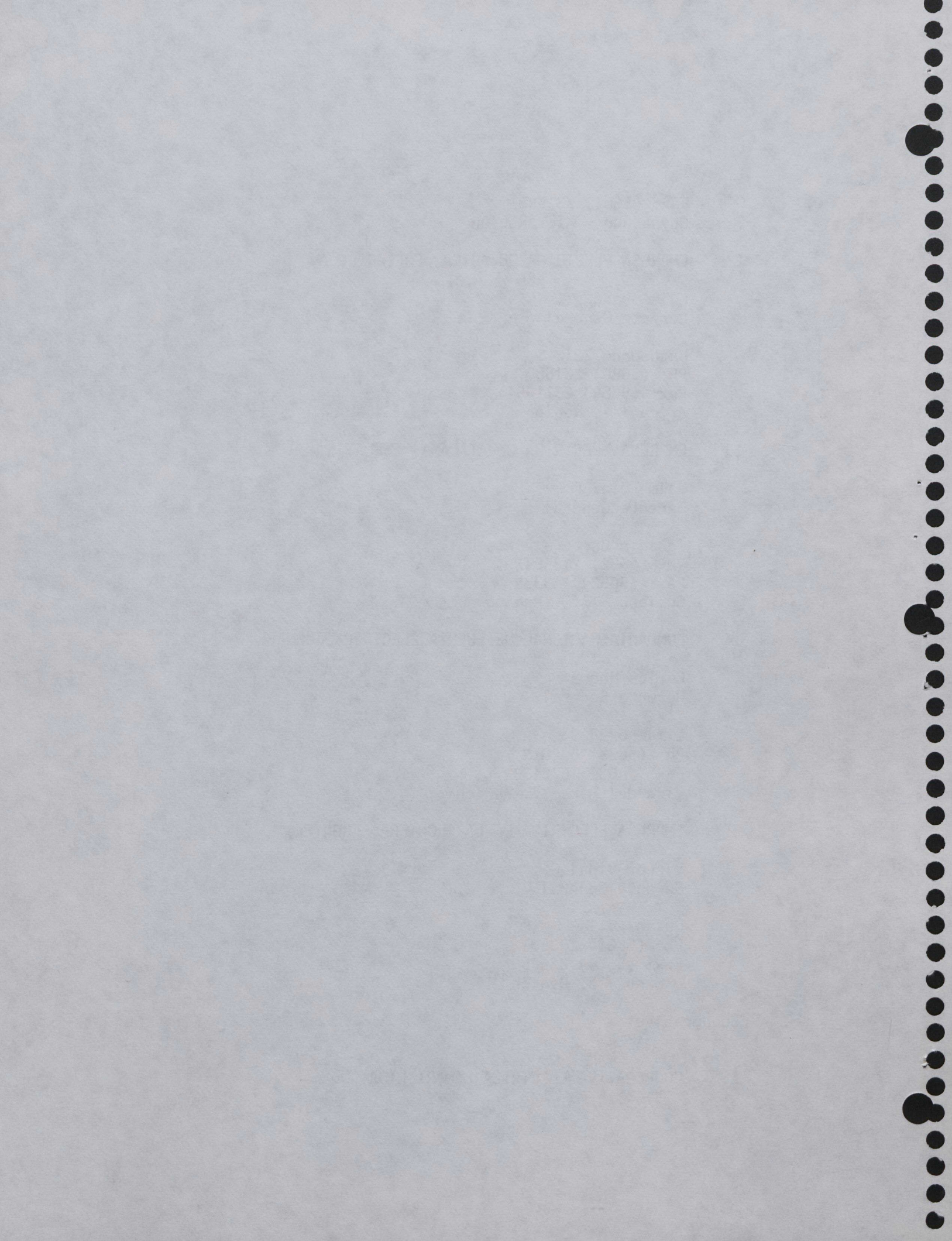
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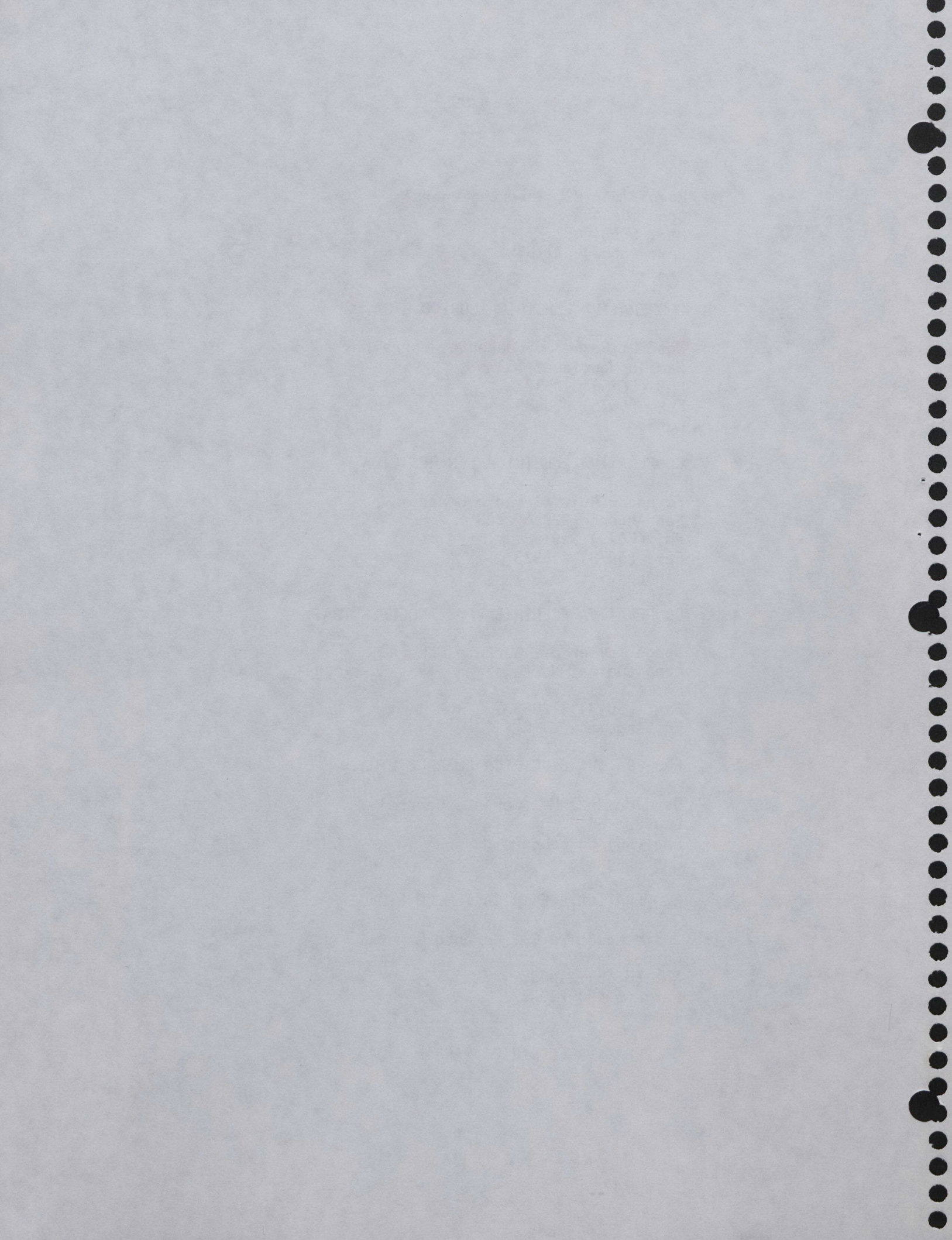
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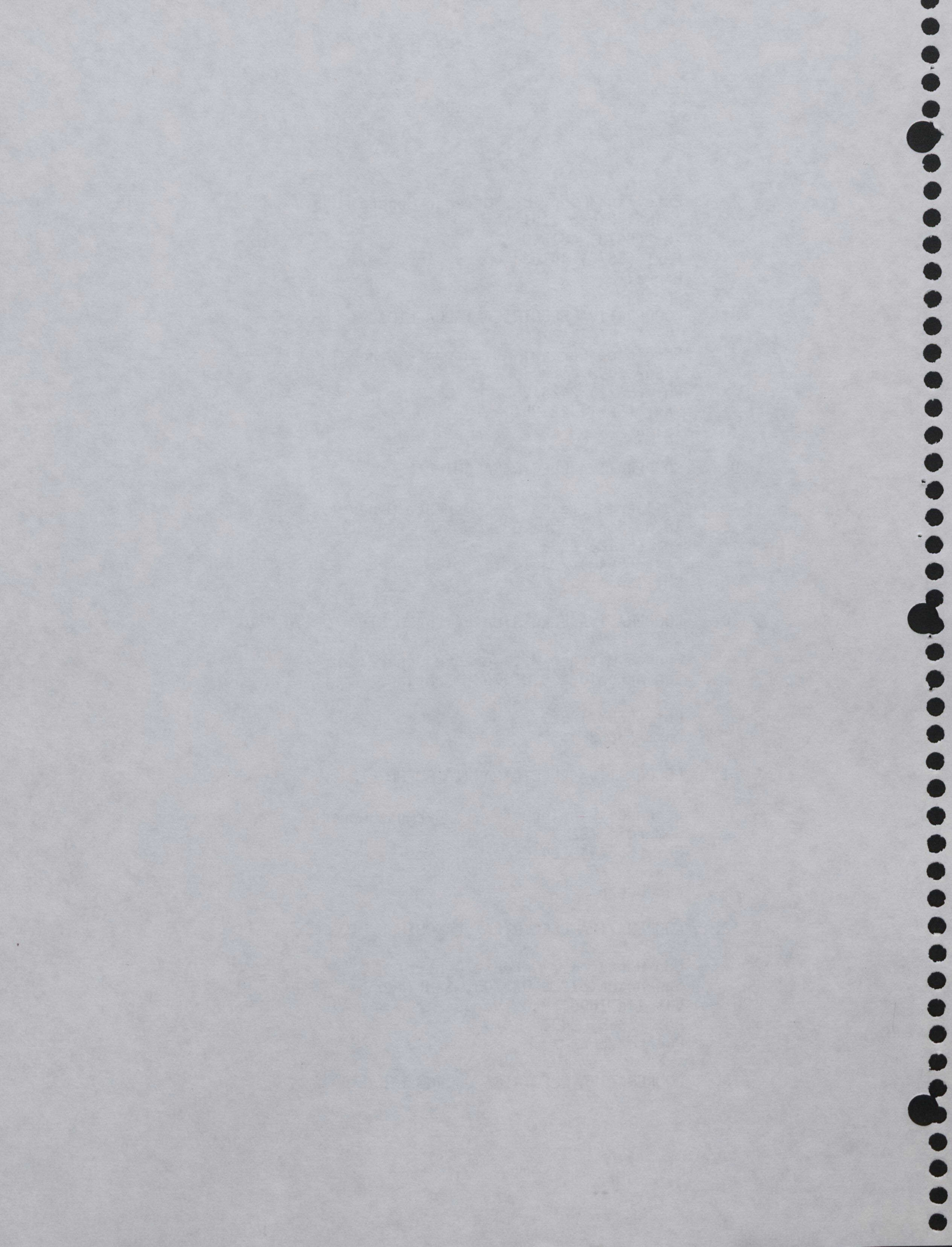
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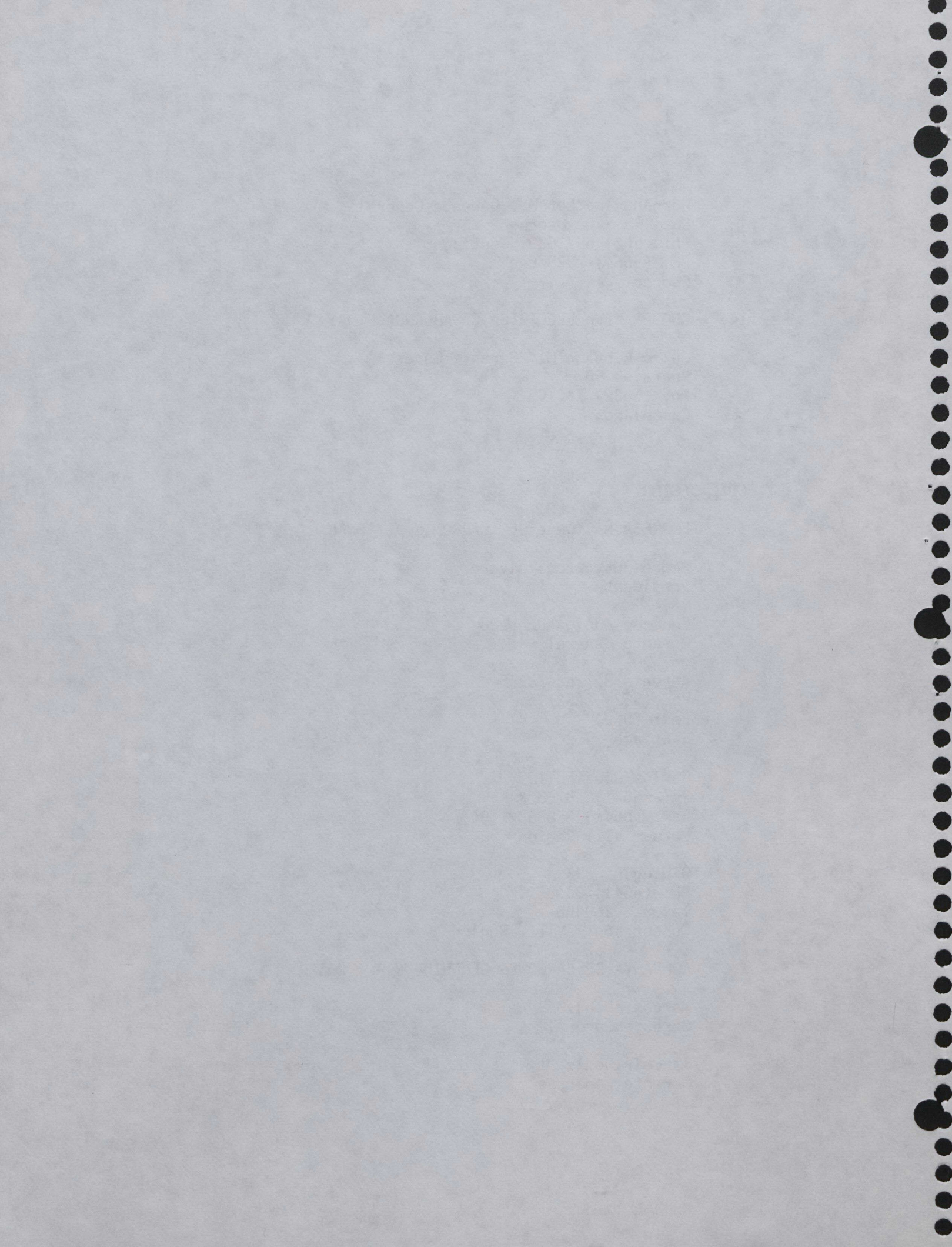
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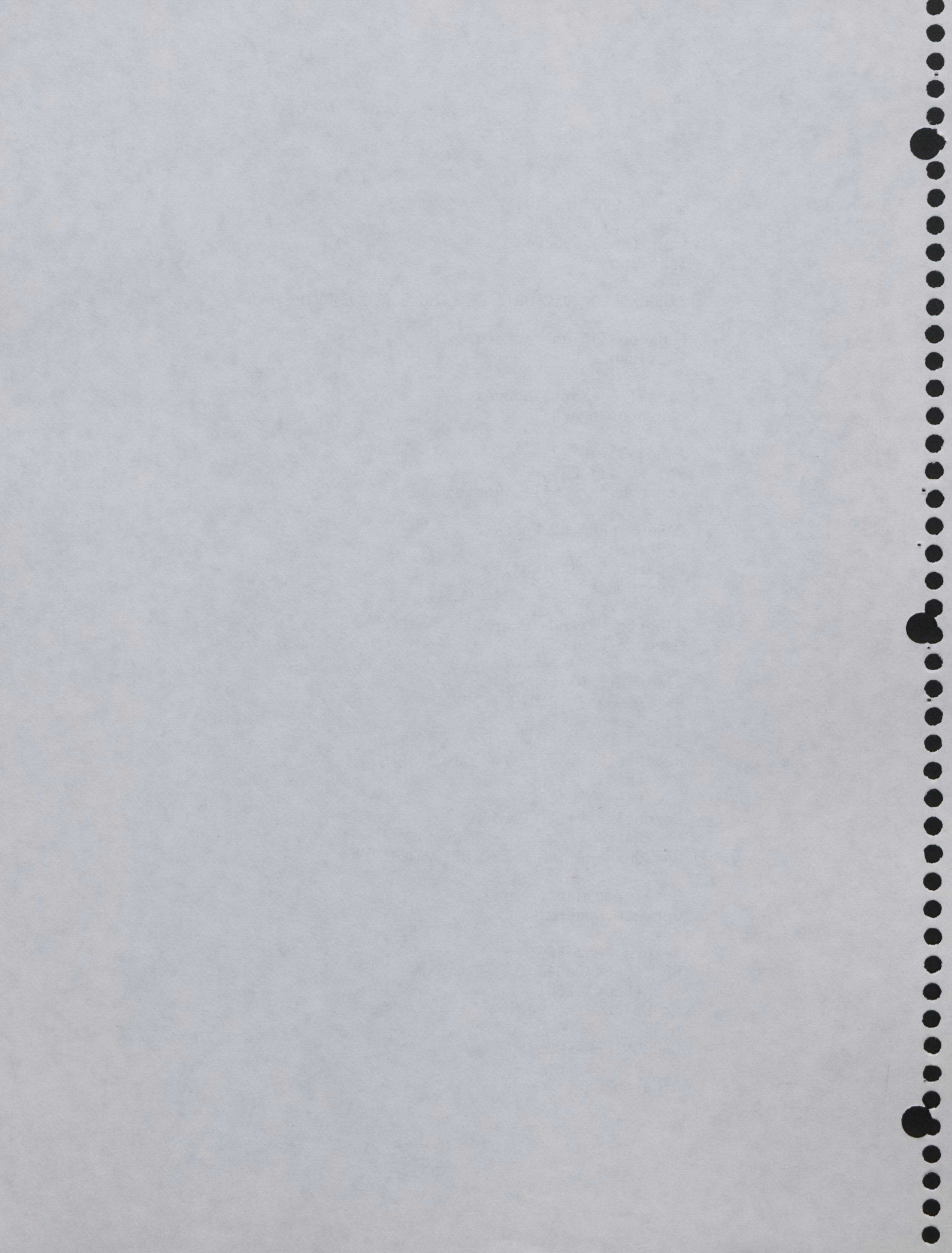
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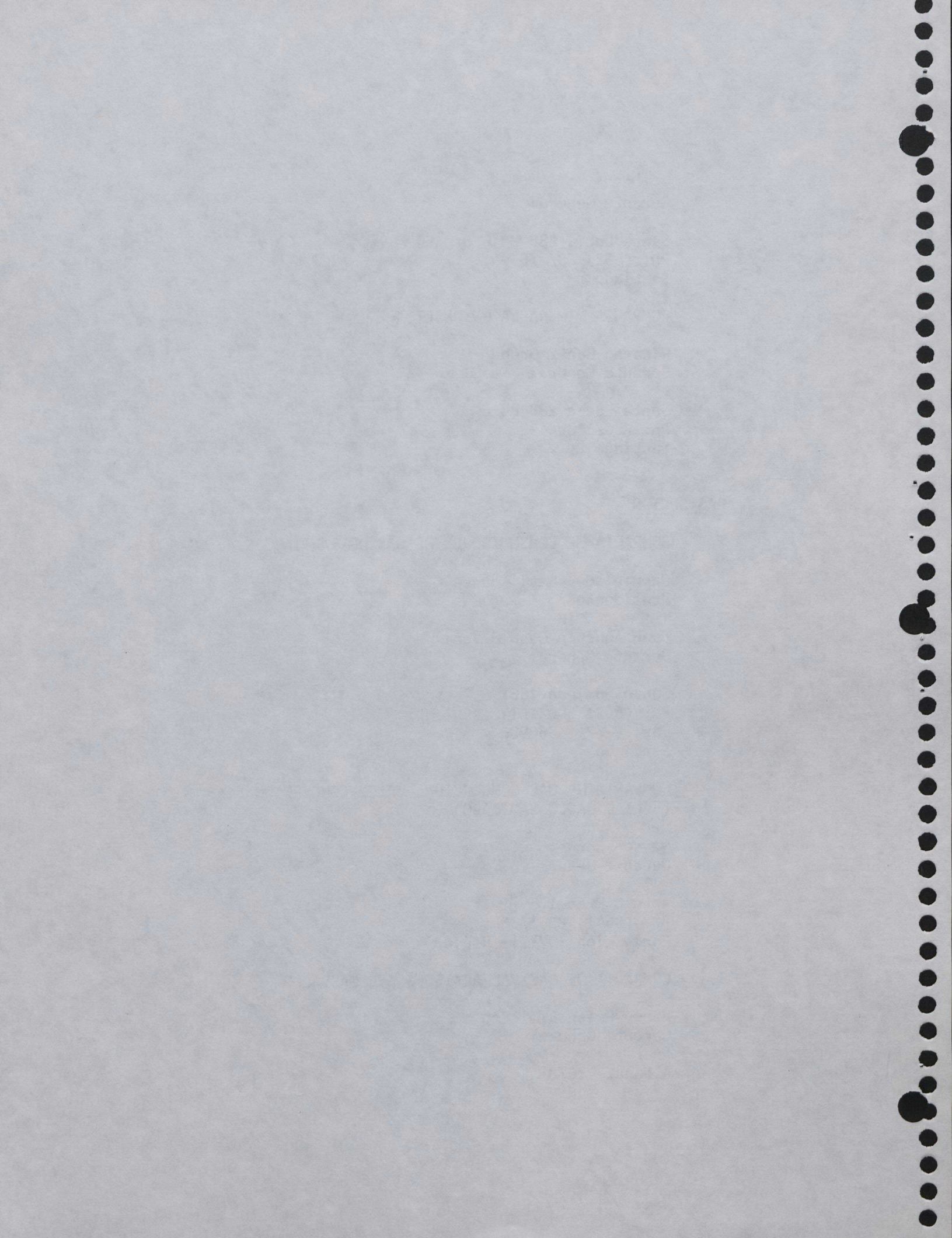
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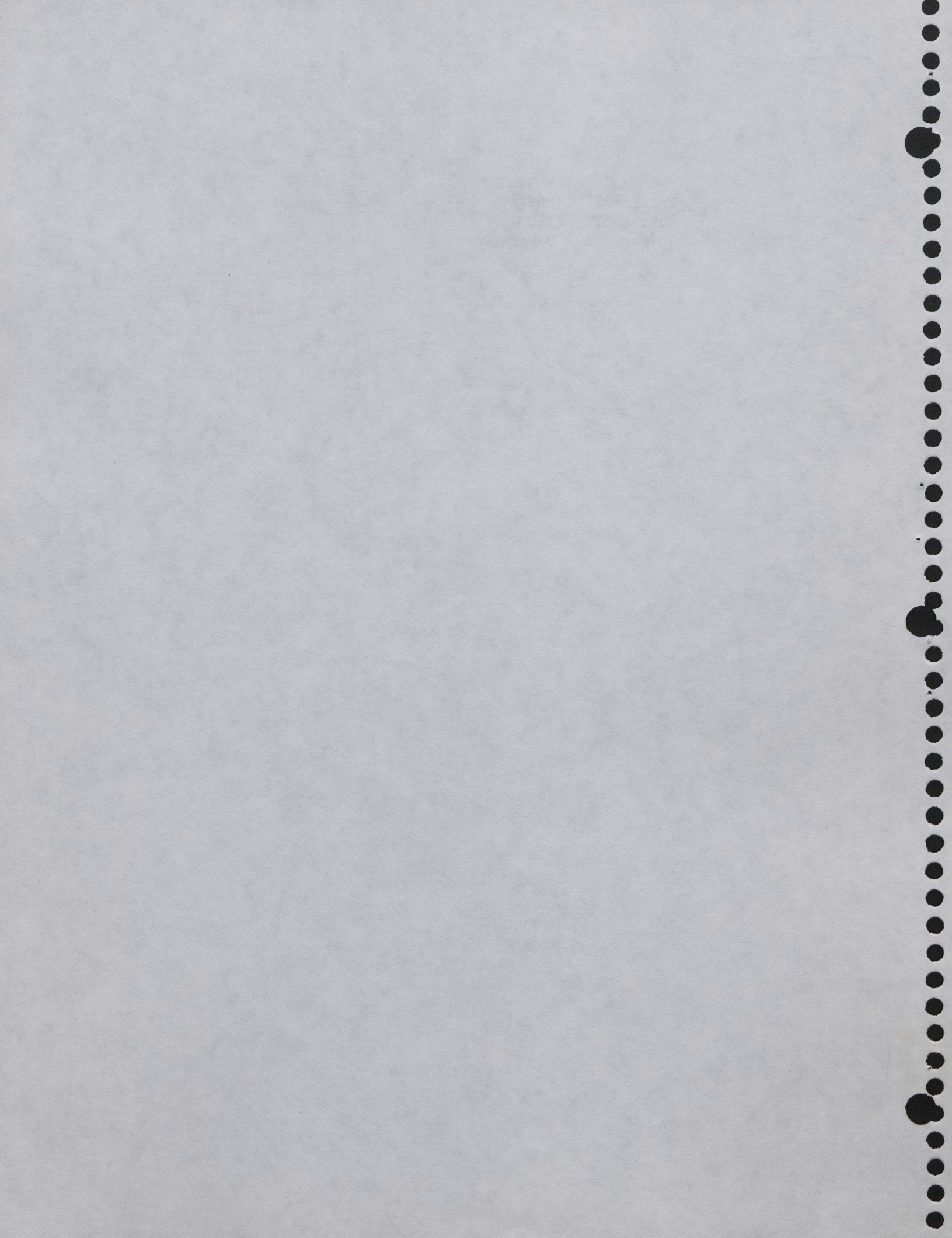
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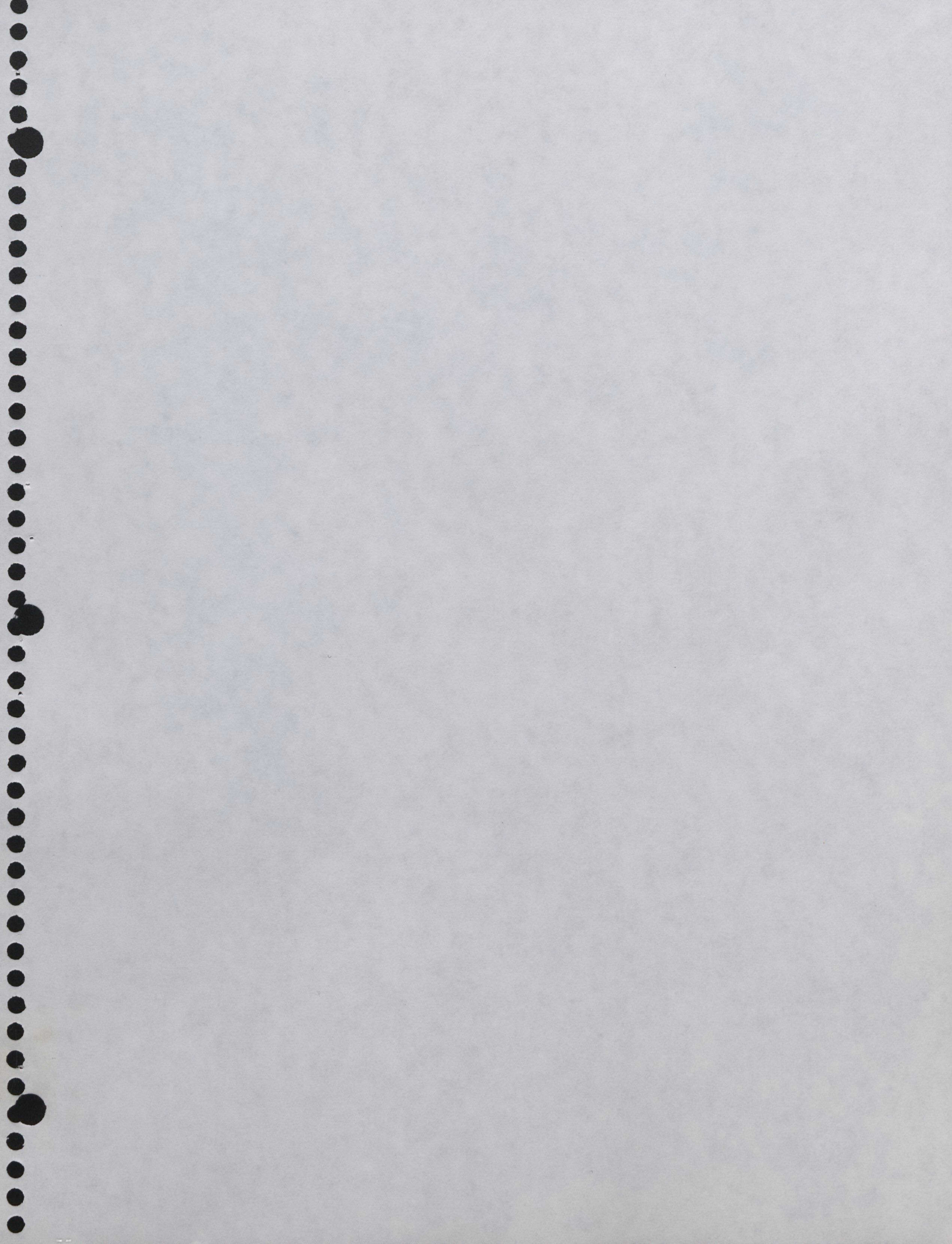
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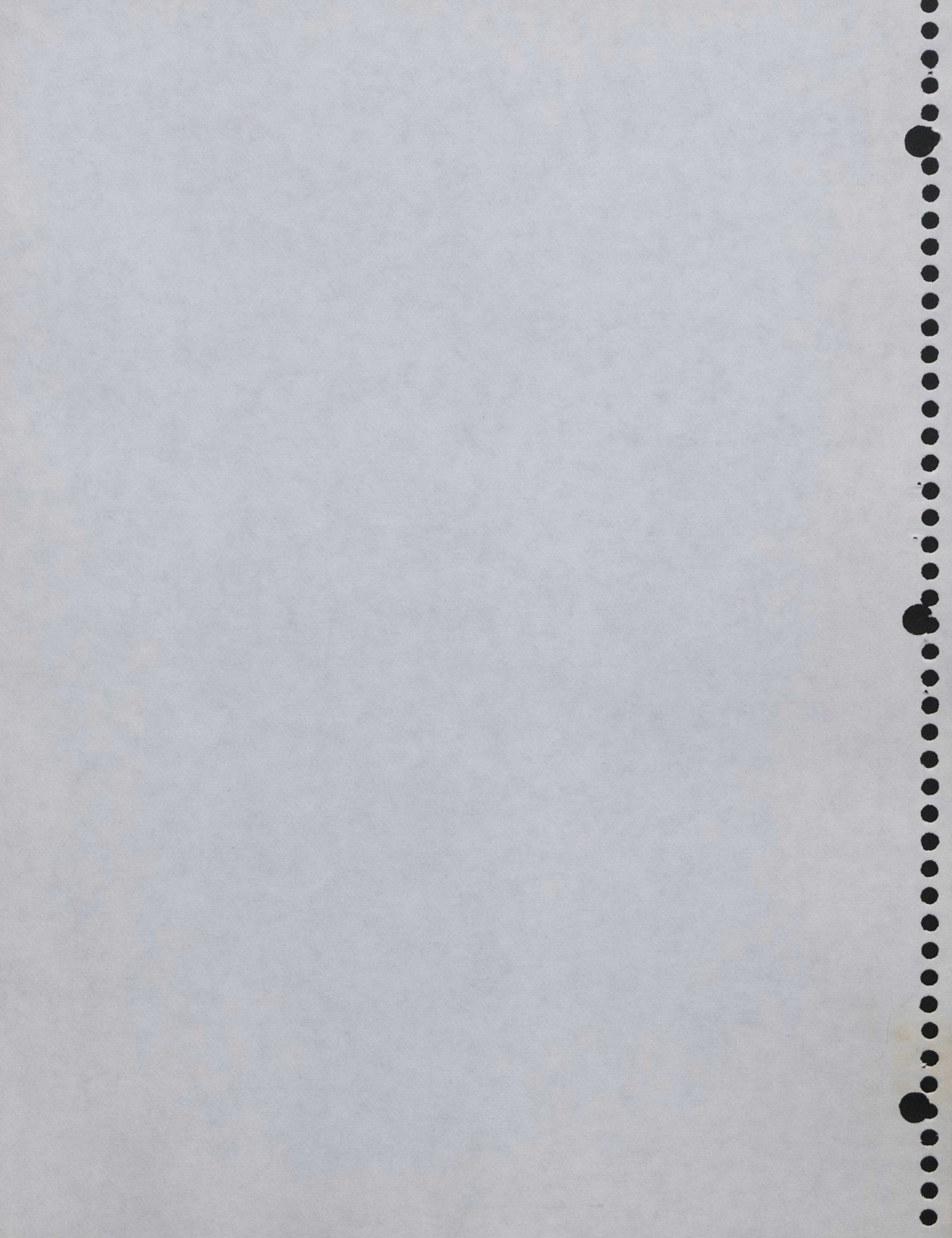
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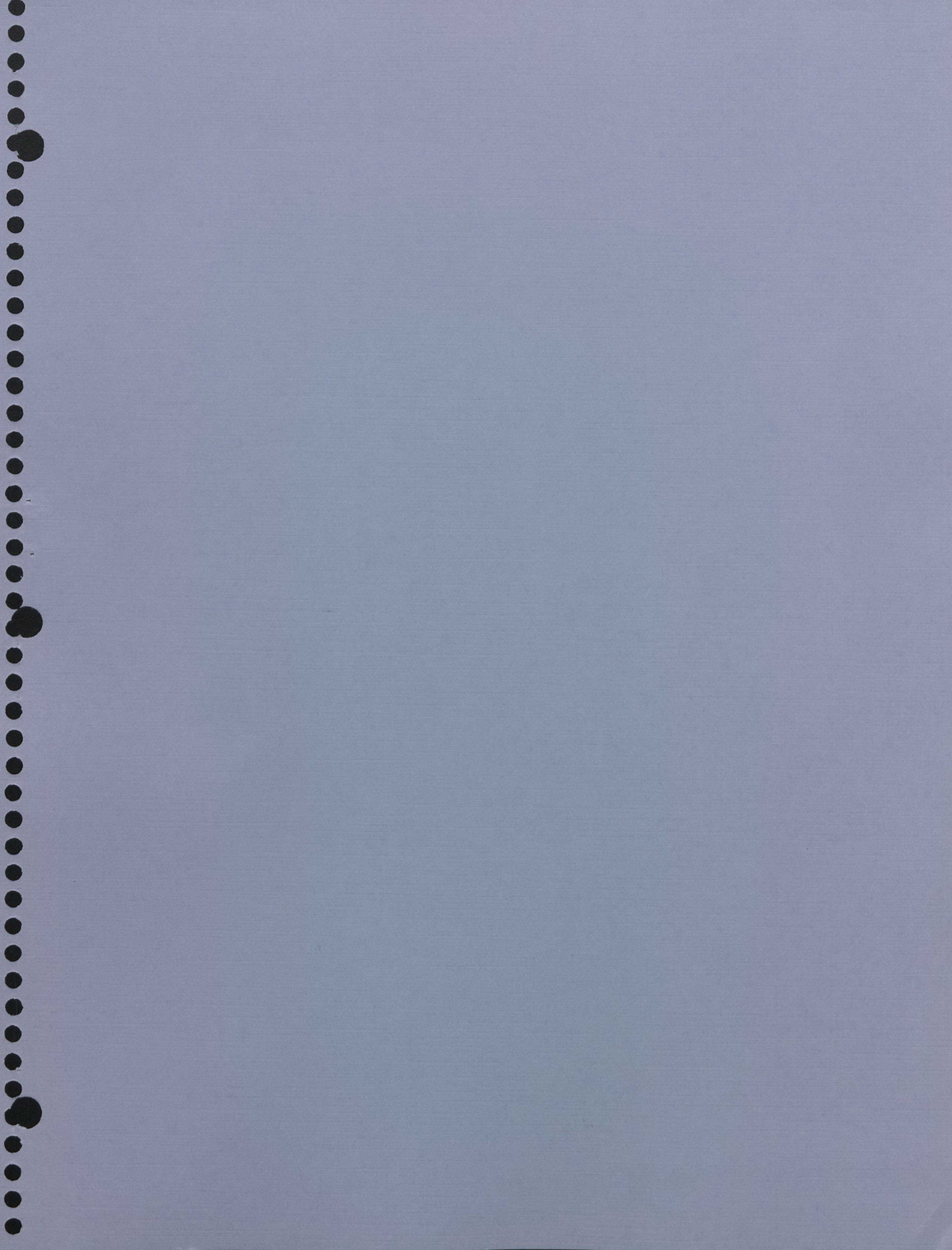


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