GEOGRAPHICAL REPRESENTATION OF ACIDIFYING EMISSIONS IN THE NETHERLANDS

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ABSTRACT

In this paper the results are presented of the national acidifying emissions in 1990, which have been inventoried and analyzed by the Emission Inventory in The Netherlands. The results are presented of analyses of emission data with respect to the environmental theme 'acidification' and the target groups emitting acidifying emissions of NH[3], NO[x] and SO[2]. The emission density distribution of the acidifying substances, expressed in acid equivalents, is also presented.

As is shown in the paper, agriculture is the most important target group with respect to acidification. The NH[3] emissions are correlated against different soil types. The second large contribution is made by traffic and transport. This concerns NO[x] emissions from inland shipping as well as from road traffic. The third contribution is due to SO[2] emissions from major industrial sources, like oil refineries and power plants, being the biggest emittants of SO[2].

It is also shown that the inventory systems allow geographical presentation of the emissions. To demonstrate the power of this system, maps show the spatial distribution of NO[x] emissions due to inland shipping, showing the main shipping routes within The Netherlands, and the density of SO[2] emissions due to industrial sources. The geographical information of emission densities can be used as input to dispersion models to calculate concentrations in ambient air.

1 INTRODUCTION

The Emission Inventory described in this paper comprises the inventory, analysis and localization of emission data of both industrial and nonindustrial sources in The Netherlands. The objective of the Emission Inventory is to monitor the emissions from sources of air and water pollution on a national scale. This information is used to evaluate the progress of environmental policy and to provide national and international bodies with the official data on emissions within the country. The first inventory cycle started in 1974 and was completed in 1981. Nowadays the Emission Inventory takes place in cycles of one year. This paper summarizes some results of the fifth inventory cycle of the emissions in 1990, as published in *Emission inventory in The Netherlands - Emissions to air and water in 1990. Summary* (1). That report describes the most relevant results of the Dutch Emission Inventory for 1990, carried out in 1992 and 1993. In that cycle the emissions in 1990 to air and water from about 700 major companies have been registered. These 700 companies are the most important contributors to the total industrial emission in The Netherlands. The emissions of these companies are individually registered within the *Individual Emission Inventory system* (IEI). The emissions from the other smaller companies and from

diffuse nonindustrial sources are stored in the *Collective Emission Inventory system (CEI)*. Both systems are described in more detail below. The relation between the several cycles is depicted in chapter 1.3.

In this paper the results are shown for the acidifying emissions of NH[3], NO[x] and SO[2], differentiated for the emitting target groups i.e. source categories as distinguished in the National Environmental Policy Plan (2).

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1.1 INDIVIDUAL EMISSION INVENTORY SYSTEM

For the most relevant industries, the Individual Emission Inventory system (IEI) contains a large number of specific compounds emitted to air and water. Each individual plant, installation and, in most plants, each device is examined and significant data at the different levels are stored in the Individual system. Together with information on the sources (points of release) within the company, each emission is categorized as to the origin, the chemical nature and the location. Figure 1 schematically illustrates the overall structure of the data model for the Individual Emission Inventory system.

The companies concerned provide the data required to estimate emissions on a voluntary basis. This

information is treated as confidential and is administered by the Department for Emission Inventory and Information Management of the Inspectorate General for Environmental Protection. Only a restricted number of persons, the primary environmental authorities included, have access to the data on individual industries. Others may obtain data at an aggregated level only.

However, with respect to the year of emission, from 1990 onwards all emission data are on request available for public, under the restriction of total annual emissions per compound for the whole plant.

The Individual Emission Inventory takes place in cycles. The first inventory cycle started in 1974 and was completed in 1981. During this period about 6,300 companies with approximately 20,000 installations were registered. One important result was that about 100 of the companies caused 97% of the total air pollution. Hence it was decided to use a more efficient selection of companies for the following cycles. This selection is based both on the (expected) contribution of companies to the emission within the country, and on the environmental impact of the emitted compounds.

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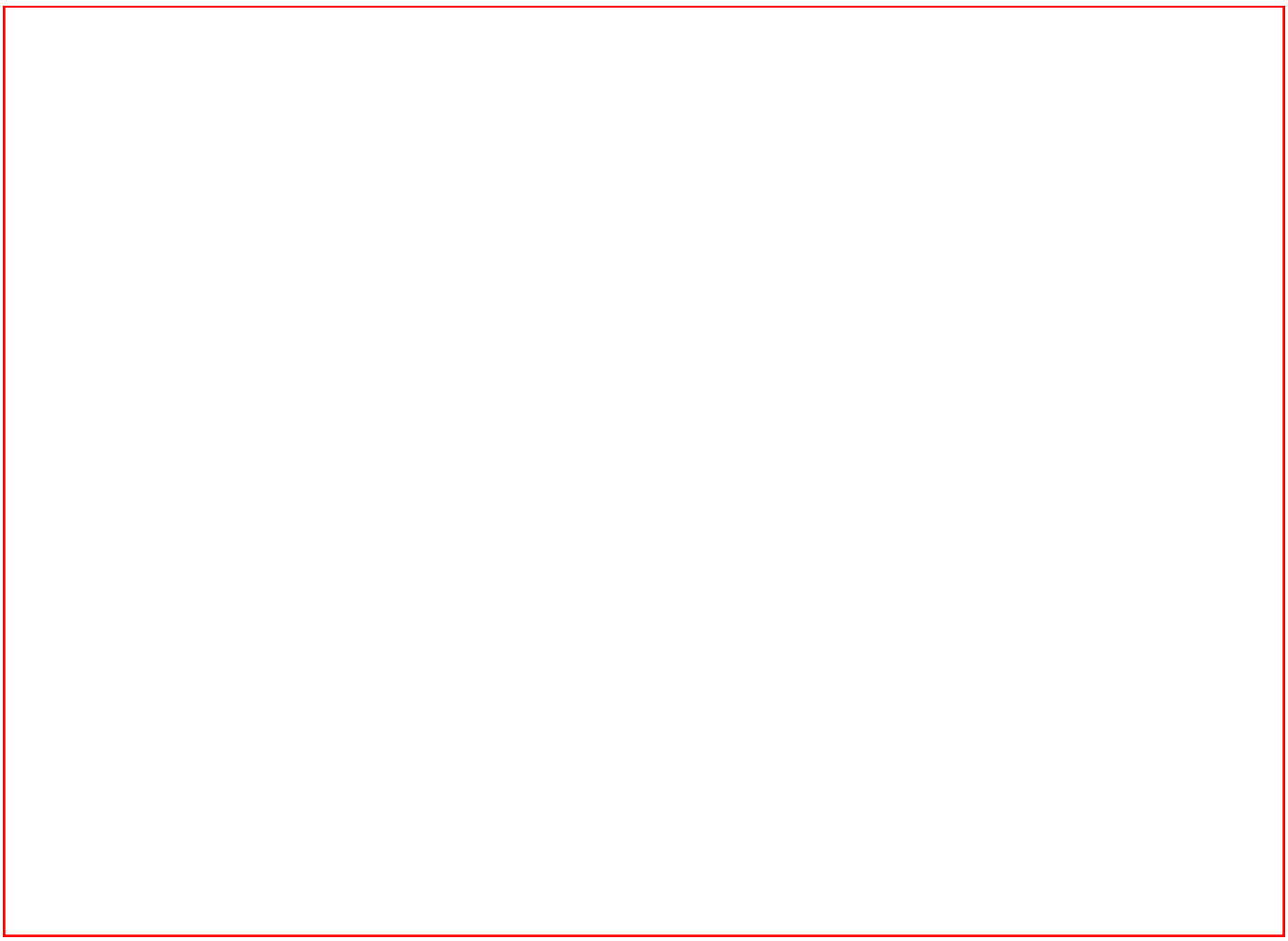
Especially, the emissions from large combustion plants constitute a quantitative important emission source. Therefore, these emissions are inventoried each year. These emissions are reported on a regular basis to the EC (4). Companies which are no longer registered on an individual basis are recorded in the Collective Emission Inventory system in a simplified form. The data set of the fifth cycle of the Individual Emission Inventory of which the results are presented in the report of the fifth cycle, essentially, is a matrix of approximately 900 emitted substances and about 700 companies. Each matrix cell contains a new matrix, in which the emission of a substance is attributed to an installation and an emission point (figure 1). Because of this, a link has been established between an emission and its underlying processes. The inventory of emissions to water is more simple as the link with processes is disconnected in many occasions. In most cases, the total, aggregated emission of a company to water has been recorded.

1.2 COLLECTIVE EMISSION INVENTORY SYSTEM

The Collective Emission Inventory system (CEI) does not take place in cycles. The underlying data are yearly updated. The Collective system stores the emission data of other (smaller) companies and of diffuse emissions from road traffic and other mobile sources, from households and from land use related sources as agriculture and nature. The emissions are estimated with statistical data such as number of inhabitants, houses, jobs etc. and by use of emission factors.

Furthermore, the Collective Emission Inventory system contains all kind of basic data related to the infrastructure of The Netherlands, such as geographical information about houses, traffic roads, railway roads, airports, shipping routes and smaller companies. Also general data are incorporated such as the type of soil, the nationwide sewer system and the drainage system for waste water. Figure 2 presents an overview of the data structure of the Collective Emission Inventory system.



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The right part of the scheme in figure 2 indicates that individual emissions are also introduced in the data structure of the Collective system. Linking the Collective Emission Inventory system to a Geographical Information System enables spatial presentation of the emission per area. No restrictions are imposed on the use of data from the Collective Inventory system. The data bases are administered by the Department for Emission Inventory and Information Management and requests concerning use of the data are to be addressed to this Department.

1.3 RELATION BETWEEN THE CYCLES OF THE EMISSION INVENTORY

Differences in numbers of companies

The first three cycles of the Individual Emission Inventory have been realized between 1974 and 1990. The first cycle has been performed and reported for each province individually. From the second cycle on, the inventory and reporting has been carried out for the country as a whole. The Collective Emission Inventory, as mentioned before, is actualized on a yearly basis and, consequently, does not take place in cycles. As the perception of the way to perform an emission inventory has changed over the years, the applied methodology changed as well during the subsequent cycles. These changes are of great importance for a good understanding of trends in the registered emissions. This paragraph will discuss this in more detail.

The number of registered companies in the first cycle was much larger than in the more recent cycles (table 1). In the fifth cycle some 700 companies have been registered individually.

During the first cycle all companies were selected employing more than 10 persons. A number of these companies were selected for the second and third cycle inventory based on their contribution to the total national industrial emission and on the environmental impact of the emitted compounds. The selection for the fifth cycle was done similarly.

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2. ACIDIFICATION

The environmental theme acidification is related to the deposition of the acidifying substances SO[2], NO[x] and NH[3]. The Emission Inventory, however, does not contain information on deposition. However, there is a clear relationship between emission and deposition of acidifying substances. Also, environmental policy has formulated emission objectives as well. Therefore, it was decided to admit this environmental theme as well.

The emissions of NH[3], NO[x], and SO[2] are expressed in acidification equivalents [3]. The emission data in ton/year are multiplied by a correction factor, shown in table 2. Dutch environmental policy employs the unity of Aeq, being equal to 1 ton of acidification equivalents.

For 1990 the total emission of acidifying substances in The Netherlands amounted to 30,800 Aeq, indicating a decrease with 8.5% compared to the 1988 emission data. This reduction was partly caused by the use of an improved method to estimate NH[3] emissions from agriculture. The decrease of SO[2] emission resulted from a further decline of industrial emissions.

The total Aeq emission for 1990 was about 2.5 times higher than the policy objective for this environmental theme for the year 2000. This factor does not differ very much for the three individual substances involved. The contribution of the three substances to total Aeq emission in 1990 was 39% NH[3], 41% NO[x] and 20% SO[2].

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The contribution of the several target groups to Aeq emissions is presented in table 2. The largest contribution is caused by NH[3], emission from agriculture, while NO[x], emissions from traffic also is a major contributor. The third contribution is due to the SO[2] emissions of the large industrial point sources like oil refineries and power plants.

3 GEOGRAPHICAL ANALYSES OF ACIDIFYING EMISSIONS

The Collective Inventory system allows geographical presentation of the emissions. To demonstrate some of the possibilities of the analyzed information, the following maps show the spatial distribution of the emissions of some components from the important acidifying sources in The Netherlands.

The spatial distribution of the emission of all acidifying substances is presented in figure 4. The important industrial areas can be recognized, as well as the areas of diary farming. NH[3] emissions in The Netherlands for about 93% are the result of agricultural activities, namely, production and utilization of animal manure. Figure 5 illustrates the NH[3] emission pattern due to agriculture in relation with the location of sandy soils. It shows that the most important emissions are on the sandy soils. Figure 6 shows the main shipping routes within The Netherlands and the NO[x] emissions related to inland shipping. The map of the density of industrial SO[2] emissions, as presented in figure 7, shows the important industrial areas in The Netherlands: the Rotterdam and Amsterdam harbour areas, the chemical industry in Limburg and in Groningen.

The geographical information as presented here can be used as input in dispersion models to calculate ambient air concentrations. This is shown in figure 8. Comparison with actual measured concentrations in ambient air shows that the calculated concentrations are in the order of 10 µg/m^3 lower than the measured ones. This difference can be attributed to SO[2] emitted by sources abroad.

4 REFERENCES

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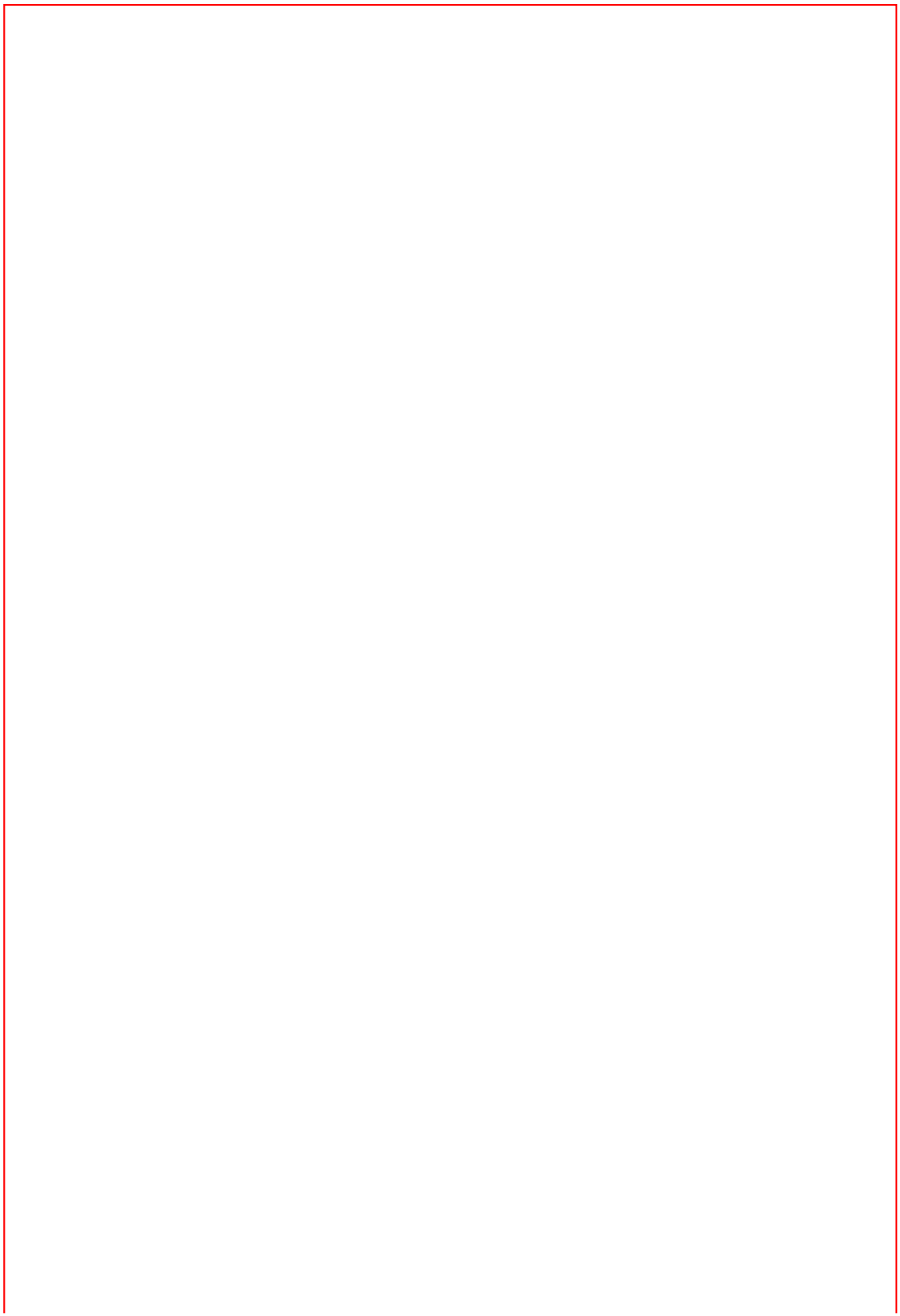
Geographical representation of acidifying emissions in the Netherlands



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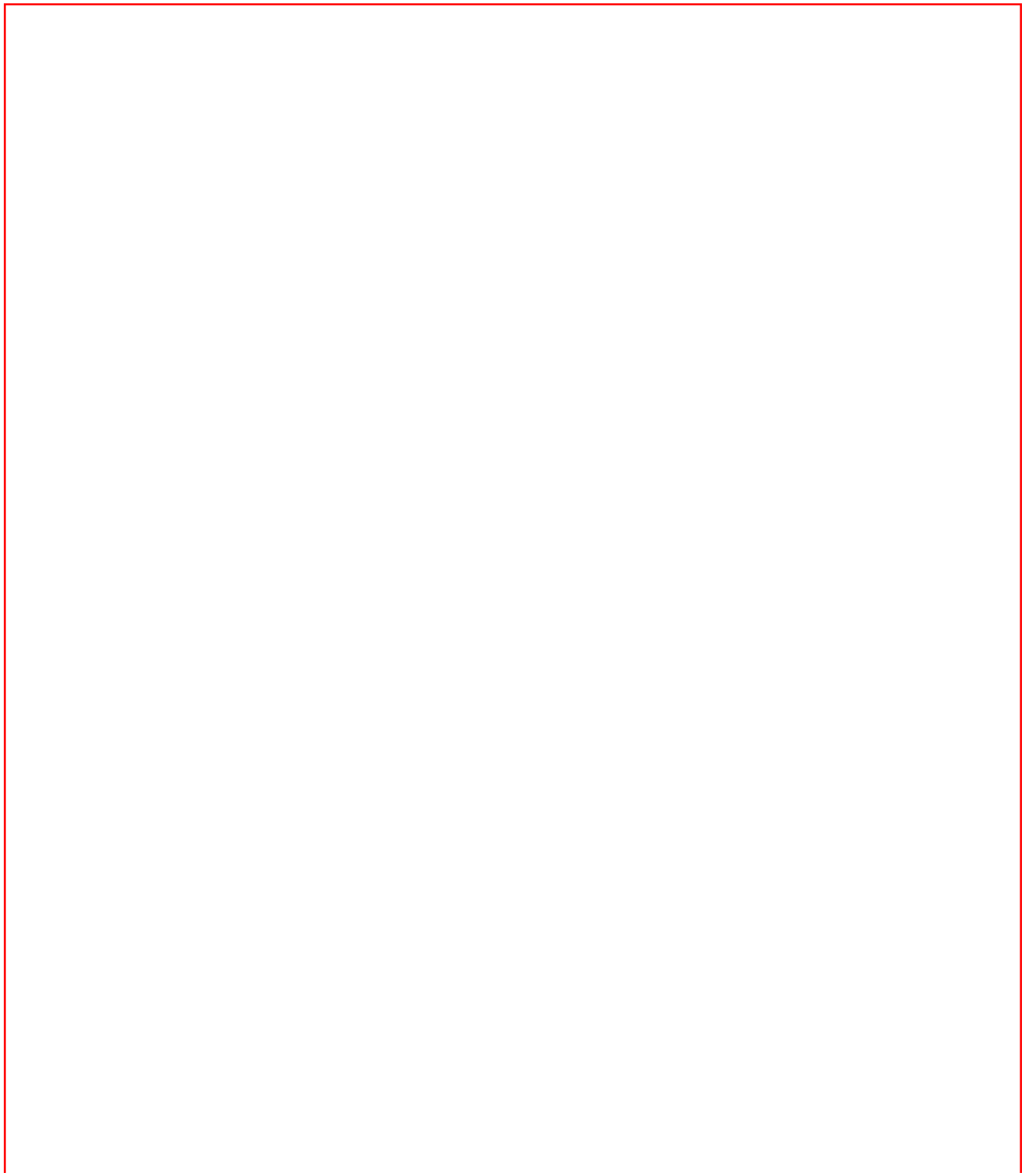

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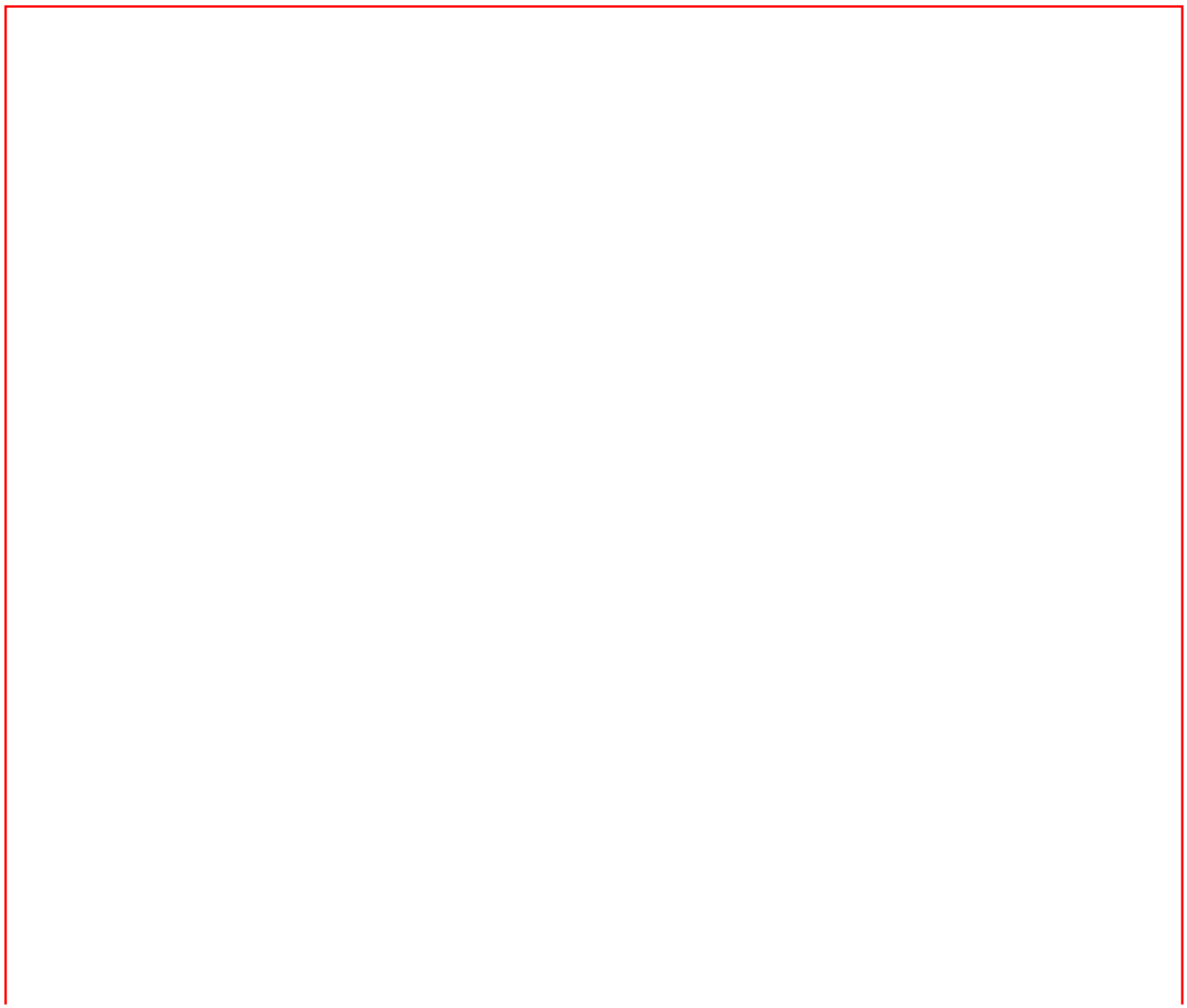

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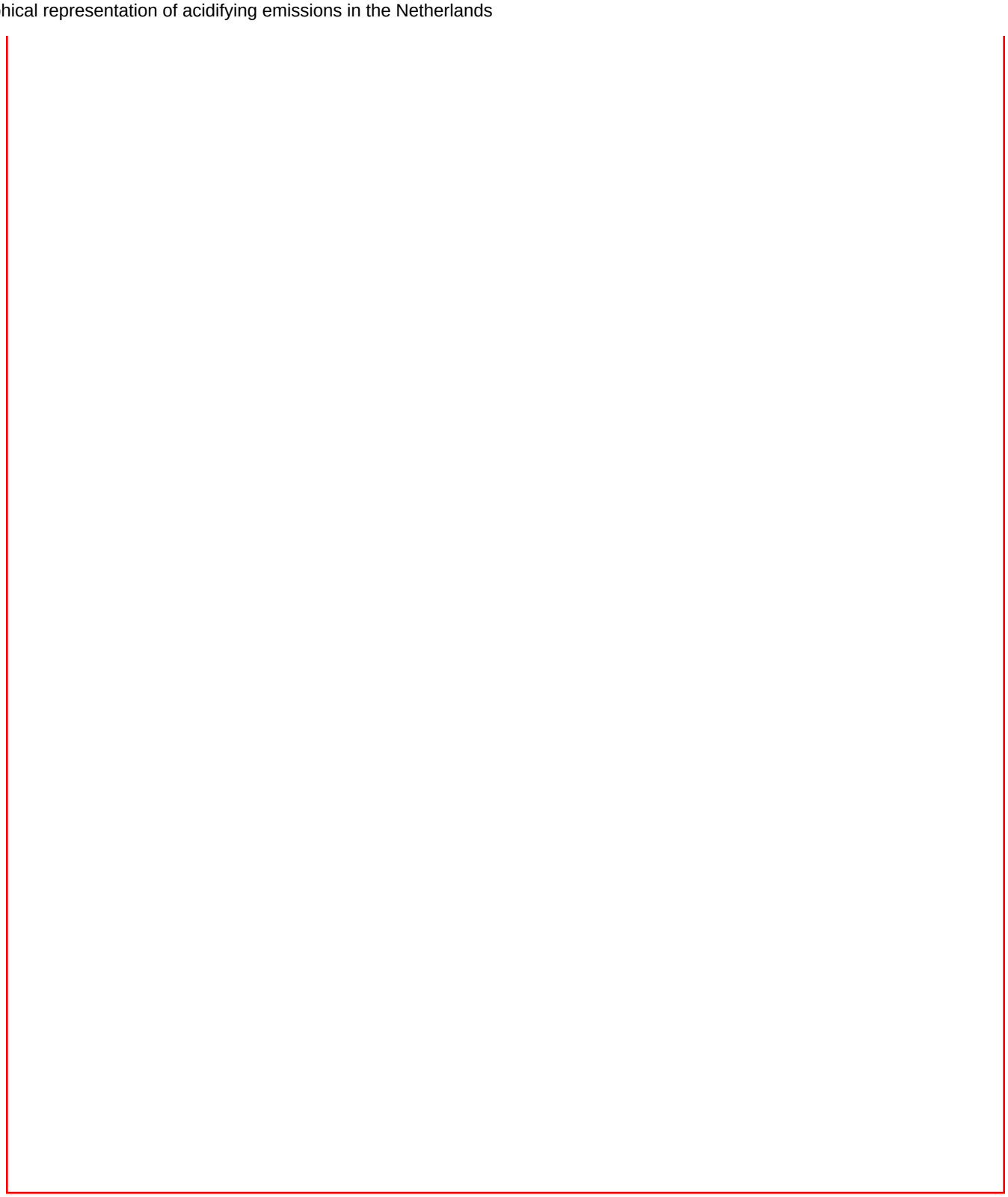

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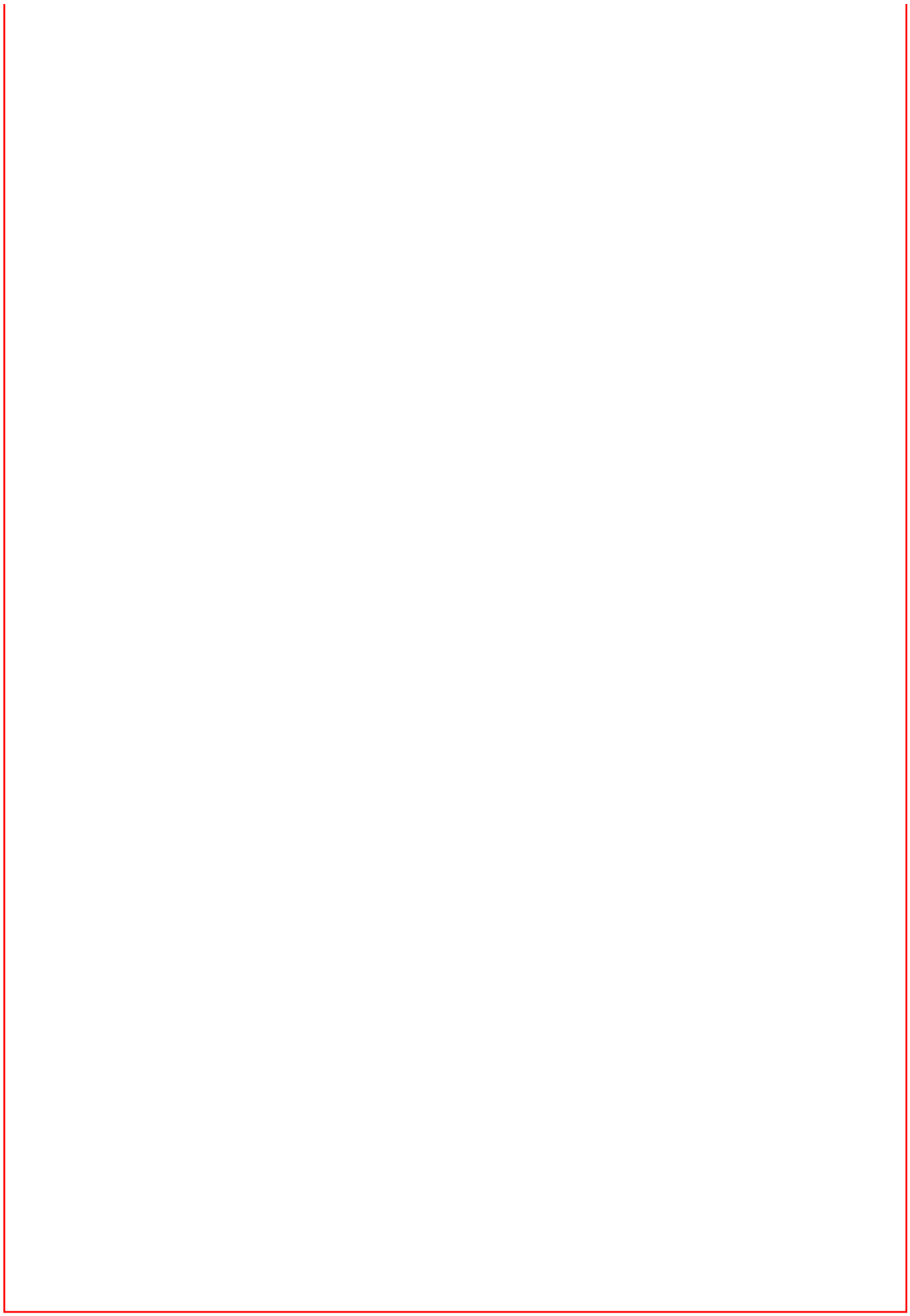

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