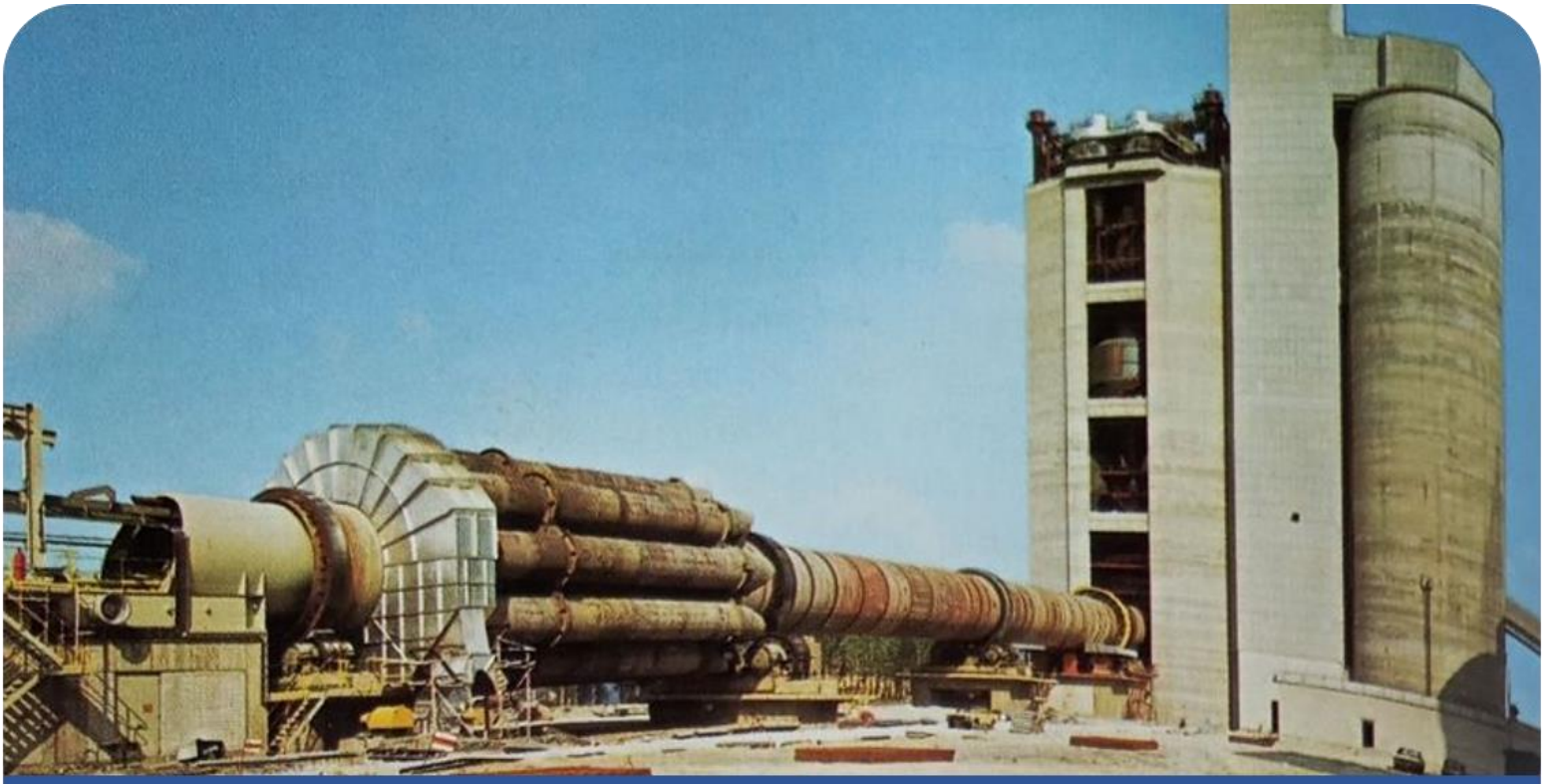

Colombia

Waste plastics, Refuse Derived Fuels (RDF) and Cement kilns

September 2024

red de desarrollo sostenible

IPEN a toxics-free future

Colnodo Uso estratégico de Internet para el desarrollo

30 AÑOS

Colombia,
Plastic waste, Refuse Derived Fuels (RDF) and cement kilns

September 2024

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IPEN is a network of over 600 non-governmental organizations working in more than 120 countries to reduce and eliminate the harm to human health and the environment from toxic chemicals.

www.ipen.org

Colnodo facilitates communications, inter-exchange of information and experiences between Colombian organizations at the local, national and international levels. Colnodo prioritizes human rights, improving the status of women, globalization, democracy and civic participation, sustainable development, democratization of knowledge, digital inclusion, and strategic use of Information and Communications Technology (ICT) for development.

Colnodo is the operator of the Sustainable Development Network in Colombia (www.rds.org.co), and is a member of the Colombian Network of Environmental Education (www.redcolombianafa.org).

https://colnodo.apc.org/, https://rds.org.co/

PHOTOGRAPHY

Cover (top): © Struktur-Material-Reaktion, Diesterweg / Salle Sauerländer, Hans Rudolf Christen, Sauerländer Aarau Verlag, 1974. Abb. 13.8 Moderner Drehrohrofen zur Herstellung von Zement. Seite 268

Contenido

Plastic Waste, Refuse Derived Fuels (RDF) and Cement kilns

Summary:

The use of Refuse Derived Fuels (RDF) and their use in the cement industry is analysed, national policies related to waste management, energy recovery, and current challenges, on waste disposal in landfills are reviewed.

National policies promoting energy recovery from waste as an alternative energy source. The National Energy Plan 2020-2050[1] highlights the importance of diversifying the energy matrix and includes the recovery of solid waste as part of Non-Conventional Energy Sources (NCRE).

The cement industry[2] in Colombia has adopted the use of RDF to reduce the use of fossil fuels. Companies such as Argos[3], Cemex[4], y LafargeHolcim[5] have implemented co-processing processes using waste such as oily sludge derived from hydrocarbon refining processes, used tyres and urban waste to partially substitute coal and other conventional fuels.

The use of RDF and waste incineration pose risks to public health,[6] [7] [8] with recurrent diseases such as bronchitis, skin rashes and diarrhoea, and the environment, especially in vulnerable communities near cement plants. It is important to consider these impacts in the formulation of public policy.

The use of waste as fuel in cement plants generates several harmful pollutants that pose risks to both the environment and health. Major pollutants include dioxins, furans, particulate matter (PM), and heavy metals such as mercury and lead. These pollutants are released into the air during the incineration process, contributing to air quality degradation and health risks for nearby communities.

Dioxins and furans, considered among the most toxic chemicals, are of particular concern as they are linked to serious health problems including cancer, damage to the immune system, and reproductive problems. Particulate matter, another major pollutant, affects the lungs, leading to

[1] https://www1.upme.gov.co/DemandayEficiencia/Paginas/PEN.aspx

[2] How is cement made? Cement is produced by burning mixtures of limestone, minerals and other additives at high temperatures in a special rotary kiln. The hot air mixed with the raw materials creates a chemical reaction and produces 'clinker', a marble-sized product made up of particles the size of sand. The clinker is removed from the kiln, cooled and ground for packaging.

[3] https://argos.co/coprocesamiento-argos/

[4] https://www.cemexcolombia.com/sostenibilidad/gestion-ambiental/estrategia-de-carbono/combustibles-alternos

[5] https://www.holcim.com.co/sites/colombia/files/2023-02/ids2021.pdf page 2

[6] https://onlinelibrary.wiley.com/doi/full/10.1111/1753-6405.12939

[7] https://pubmed.ncbi.nlm.nih.gov/9501632/

[8] https://www.ciel.org/wp-content/uploads/2019/02/Plastic-and-Health-The-Hidden-Costs-of-a-Plastic-Planet-February-2019.pdf

respiratory diseases, heart conditions, and even premature death. Studies have shown that cement plants using waste as fuel often exceed international air quality standards for PM, exacerbating public health risks.

Communities living near such plants may face increased exposure to these pollutants, raising concerns about respiratory illnesses, birth defects, and higher cancer rates. There is also evidence to suggest that local foods such as chicken eggs may become contaminated with dioxins, presenting another route of exposure to harmful chemicals.

In addition to air pollution, generate toxic solid waste (fine ash and heavy ash) contaminated with persistent organic pollutants such as polychlorinated biphenyls (PCBs) and per- and polyfluoroalkyl substances (PFAS). These chemicals are difficult to manage and often unregulated, posing long-term environmental risks. [9] [10] [11]

Incinerators are designed for the destruction of waste by controlled combustion. Their aim is to reduce the volume and hazardousness of waste by converting it into ash and gases. This incineration process is used to generate energy. Incinerator furnaces usually operate at temperatures between 850°C and 1,100°C, depending on the type of waste to be incinerated. These temperatures allow the destruction of organic compounds, but may not be sufficient to decompose some metals or more complex compounds.

Cement kilns are designed for the purpose of producing clinker, a key component of cement, by firing raw materials (such as limestone, clay and other minerals). Cement kilns can use waste as an alternative fuel, but their purpose is to produce clinker, not to destroy waste.

In the kilns, temperatures of up to 1,450°C are reached, allowing materials to be melted to form clinker. These high temperatures also allow the effective destruction of some pollutants present in the waste, therefore they are used without much assessment of the risks of emission of toxic substances.

Cement kilns are a known source of dioxins and furans and other unintentional POPs (UPOPs) and are listed as significant sources of these pollutants in Annex C Part II o the Stockholm Convention[12] on Persistent Organic Pollutants. They produce a fine ash called Cement Kiln Dust (CKD)

[9] Health, environment concerns are raised as Philippine cement plants burn plastic wastes for fuel - PCIJ.org **Health, environment concerns are raised as Philippine cement plants burn plastic wastes for fuel**

[10] ipen.org/sites/default/files/documents/waste_incineration_and_the_environment.pdf Waste incineration and the environment.

[11] https://ipen.org/toxic-priorities/what-are-pops#:~:text=Persistent%20organic%20pollutants%20%28POPs%29%20are%20a%20class%20of,for%20exceptionally%20long%20periods%20of%20time%20%28many%20years%29%3B

[12] See Annex 5 of this document

contaminated with dioxin and other pollutants. Some CKD can be mixed back into the cement production process but too much CKD impacts the quality of the cement. Therefore, CKD must eventually be disposed as a hazardous waste.

For more details on the environmental and health impacts of waste incineration at cement plants, the IPEN https://ipen.org report provides a comprehensive analysis.

The goal of reducing emissions in electricity generation should not be a central objective, which is reasonable given Colombia's situation in this area in the international context and the composition of generation, 70% of energy is generated by hydroelectric sources[13]. In general, the National Interconnected System is not an important generator of Greenhouse Gas emissions, therefore, justifying the use of Refuse Derived Fuels should not be a priority in the context of reducing greenhouse effect emissions since the emissions derived from the use of these fuels will affect the health of the population.

The concept of the ‘backyard’ in waste management refers to the idea that certain communities, often the most vulnerable or marginalised, are used as sites for the disposal of rubbish and hazardous waste. These areas are often far from urban centres or more influential communities, leading to environmental and health problems associated with waste management disproportionately affecting these populations.

This phenomenon is related to ‘environmental injustice’, where less powerful communities are less able to resist or influence decisions on the siting of waste management facilities such as incinerators, landfills or hazardous waste treatment plants. These communities become, in effect, the ‘backyards’ where waste is handled that more privileged areas do not want nearby.

In addition, the lack of adequate regulation and oversight in these areas can lead to dangerous practices, increasing health and environmental risks. The term also highlights power dynamics and inequality in decision-making, where those with the least resources and political representation are most affected by waste management decisions.

This issue is central to discussions on environmental justice and sustainability, as it highlights the need for more equitable and accountable

[13] https://www.minenergia.gov.co/es/sala-de-prensa/noticias-index/colombia-como-uno-de-los-l%C3%ADderes-latinoamericanos-en-energ%C3%ADa-hidroel%C3%A9ctrica-le-apuesta-a-la-aplicaci%C3%B3n-de-un-est%C3%A1ndar-mundial-de-sostenibilidad-con-el-apoyo-de-la-cooperaci%C3%B3n-econ%C3%B3mica-y-desarrollo-seco-de-suiza-y-la-asociaci%C3%B3n-internacional-de-energ%C3%AD/#:~:text=cero%20emisiones%20netas.-,Con%20el%2070%25%20de%20su%20electricidad%20suministrada%20por%20energ%C3%ADa%20hidroel%C3%A9ctrica,la%20e%C3%B3lica%20y%20la%20solar%22.

approaches to waste management that do not sacrifice the health and well-being of vulnerable communities in favour of others.

The hazards associated with Refuse Derived Fuels (RDF) are not publicly disclosed, substantial risks and threats to public health and the environment are imminent, and one of the regions where the population may be most affected is the area of Boyacá where there is a population of approximately 160,000[14] people within 3.11 miles of the plants.

To determine the critical points it is necessary to carry out a study in each region where meteorological information is included, such as wind rose, precipitation and topographic information, characterisation of fuels, combustion systems, among others, to determine the areas with the highest concentration of pollutants[15].

The demand for Refuse Derived Fuels (RDF) in the world is currently increasing, on par with the generation of municipal solid waste, which is expected to grow by 65% by 2050[16].

The Inter-American Cement Federation (FICEM), which represents cement producers, institutes and associations throughout Latin America, the Caribbean, Spain and Portugal, strongly promotes waste incineration and energy recovery as key solutions. These approaches are in line with the principles, promoted in Colombian policies, of the circular economy and contribute to climate change mitigation by generating electricity as an added benefit. Colombia is also adopting these methods to address its solid waste management challenges.

Refuse Derived Fuels produce hazardous pollutants[17], which harm nearby communities and the environment. In many cases, the burden of health costs associated with the production and use of plastics will fall on state and municipal governments, so good monitoring systems must be required and authorities must have the necessary tools to verify emissions.

[14] https://geoportal.dane.gov.co/geovisores/territorio/analisis-cnpv-2018/

[15] Protocolo-Fuentes-Fijas.pdf (minambiente.gov.co) https://www.minambiente.gov.co/wp-content/uploads/2021/06/Protocolo-Fuentes-Fijas.pdf

[16] Aumenta la generación de residuos en América Latina y el Caribe mientras 145.000 toneladas aún se disponen de forma inadecuada cada día (unep.org) https://www.unep.org/es/noticias-y-reportajes/reportajes/aumenta-la-generacion-de-residuos-en-america-latina-y-el-caribe

[17] https://ipen.org/tags/srf

INTRODUCTION

The report is a preliminary analysis based on the information available at industry level and government policy for waste management and the use of Refuse Derived Fuels (RDF) at a time when the waste disposal industry is at a critical juncture in Colombia.

Use of Refuse Derived Fuels (RDF) in the cement industry and its projection, the sources and parallel development of industries to meet the needs of this market, national policies for waste management at a time when landfills have expired licenses and capacity saturation especially in cities with larger populations, and it is proposed from different sectors to advance in multidisciplinary public policies to seek solutions with the use and implementation of other technologies based on the concepts of circular economy and zero waste.

BACKGROUND

Although the use of waste for energy generation has been permitted since before the 1990s, in panel mills[18] in direct combustion processes, etc., today there are numerous proposals for cogeneration and incineration and projects for the transformation of waste into fuels for domestic use and export. When Colombia became part of the Basel Convention in 1989, which was approved by Law 253 of 1996, a process of legislation or strengthening of the existing regulations on the subject began.

Photograph 1 Sugar mill to produce panela source AGROSAVIA https://www.agrosavia.co/

[18] https://youtu.be/EELXc2ZABLw In the 1980s, combustion was optimised by promoting the use of sugar cane residues to reduce the use of tyres and other waste. https://www.agrosavia.co/productos-y-servicios/oferta-tecnol%C3%B3gica/l%C3%ADnea-agr%C3%ADcola/cultivos-transitorios-y-agroindustriales/maquinaria-equipos-instrumentos-y-herramientas/132-hornillas-paneleras-ecoeficientes-tipo-cimpa

In Colombia in 1998, the document 'Policy for the integrated management of waste'[19] was presented in which proposals for incineration with energy recovery of municipal solid waste were evaluated. In 2016 the 'National Policy for the integrated management of solid waste' document CONPES 3874[20], was approved, where the concept of energy recovery already included in Law 1715 of 2014 is taken up again, where the energy content of waste that is not susceptible to reuse and recovery is considered as a Non-Conventional Renewable Energy Source (NCRES), it is important to clarify that in Colombia tyres[21] are considered as non-hazardous waste and are used as the main source for energy recovery; and energy recovery is included in the concept of the circular economy.

On the island of San Andres, between 2010 and 2012, a plant was installed to generate energy with a capacity to process 40 tonnes per day, a plant that has not worked due to difficulties in the process of adapting municipal solid waste to feed the incinerator. [22] [23].

Photograph 2 Solid waste incineration plant 1MW, San Andres Island Colombia, 12 12,554346419528969, -81,72685712588097 fuente Google maps
https://www.google.com/maps/@12.5532358,-

[19] https://archivo.minambiente.gov.co/images/AsuntosambientalesySectorialyUrbana/pdf/Polit%C3%ACcas_de_la_Direcci%C3%B3n/Pol%C3%ADtica_para_la_gesti%C3%B3n_integral_de__1.pdf

[20] https://colaboracion.dnp.gov.co/CDT/Conpes/Econ%C3%B3micos/3874.pdf

[21] https://www.sistemaverde.com.co/servicios/posconsumo-de-llantas?gad_source=1&gclid=Cj0KCQjw28W2BhC7ARIsAPerrcLFinszc-0-tJUgeU6TRIDxAAS8wmW7v6BCtkz0Sgkvcui24DsRy8saAu-mEALw_wcB

[22] CE-ORDENA-PONER-EN-MARCHA-PLANTA-DE-TRATAMIENTO-DE-BASURA-EN-S.-ANDRÉS.pdf (consejodeestado.gov.co) CE-ORDERS-TO-START-UP-WASTE-TREATMENT-PLANT-IN-S.-ANDRÉS

[23] Estudio-de-caso-San-Andrés-final-14-07.pdf (no-burn.org) Case-study-San-Andres-final-14-07.pdf

81.7223471,2706m/data=!3m1!1e3?entry=ttu&g_ep=EgoyMDI0MDkwOS4wIKXMDSoASAFQAw%3D%3D

The increase in waste generation in cities raises public concern about the impacts on the environment because the waste generated continues to be deposited in uncontrolled ways.

Currently, waste disposal, energy generation and the circular economy converge and in the search for solutions, technologies for energy recovery are being promoted. These technologies are presented as solutions within the popular concept of the circular economy that will solve waste disposal and energy generation. The underlying assumption is that these approaches will reduce greenhouse gas emissions associated with inadequate waste management and energy production from solid fuels.

According to the National Administrative Department of Statistics (DANE), in 2021 Colombia generated 30.31[24] million tonnes of waste in the year, of which 82.2% corresponded to solid waste and 17.8% to residual products. The latter, although of no value to those who generate them, are marketed to other beneficiaries.

According to the information published in the technical bulletin Environmental and Economic Account of Solid Waste Material Flows, 6,683,809 tonnes of solid waste were used to generate energy, an increase of 6.6% compared to the previous year 2020[25].

Of the waste products, 141,766 tonnes were exported in 2021. [26]

Industries interested in cogeneration, processing, co-processing[27] or energy recovery are the cement industry and in some cases the iron and steel industry, some industries such as sugar mills have used energy generation from crop waste such as the sugar cane industry and the paper industry which has used lignin as a fuel for steam production.

[24] DANE Technical Bulletin Environmental and Economic Account of Solid Waste Material Flows https://www.dane.gov.co/files/operaciones/CAEFM-RS/bol-CAEFMRS-2021pr.pdf

[25] https://youtu.be/EELXc2ZABLw In the 1980s, combustion was optimised by promoting the use of sugar cane residues to reduce the use of tyres and other waste. https://www.agrosavia.co/productos-y-servicios/oferta-tecnol%C3%B3gica/l%C3%ADnea-agr%C3%ADcola/cultivos-transitorios-y-agroindustriales/maquinaria-equipos-instrumentos-y-herramientas/132-hornillas-paneleras-ecoeficientes-tipo-cimpa

[26] DANE Technical Bulletin Environmental and Economic Account of Solid Waste Material Flows https://www.dane.gov.co/files/operaciones/CAEFM-RS/bol-CAEFMRS-2021pr.pdf

[27] https://ficem.org/coprocesamiento-economia-circular/

Photograph 3 Open dumping of Municipal Solid Waste, Hobo Huila 1998 Source: ASD
https://rds.org.co/apc-aa-files/205ec78c9cca6d1850bdca24e20e50bf/rsu_3.jpg

WHAT ARE REFUSE DERIVED FUELS?

Refuse Derived Fuels (RDF) are mixtures of industrial or municipal solid waste that are homogenised, reduced in size to feed a combustion system, and are mainly composed of plastic polymers, wood, paper and textiles (which are often also made of plastic), and other high calorific value wastes that are sorted, especially hydrocarbon sludge, blended, shredded and baled or pelletised for use as fuel. There are currently no standardised specifications for Refuse Derived Fuels (RDF), their quality is established by the calorific content required by industry.

Refuse Derived Fuels (RDF) are named in different ways depending on their origin, industry or processes, such as Process Engineering Fuel (PEF), Solid Recovered Fuel (SRF), Tyre Derived Fuel (TDF) or End of Life Tyres (ELT), Energy Valorisation, Formulated Solid Fuel, Plasticfuels, Pyrolytic Products, Climafuel CEMEX trademark, Alternative Fuels, etc.

Law 1672 of 2013 established Extended Producer Responsibility in Colombia, obliging manufacturers and distributors of tyres or tyres to manage the collection and disposal of disused products. In Bogotá, the lack of proper management of tyres accumulated in unsafe conditions caused a major fire, which prompted the creation and strengthening of the used tyre recovery business. This emerging industry has focused on transforming discarded tyres into alternative fuels, contributing to improved management.

Photograph 4 Used tyre depot fire in Bogotá 2014 Source: https://www.elespectador.com/bogota/continuan-tareas-para-extinguir-incendio-en-deposito-de-llantas-fontibon-article-525908/

PRODUCTION OF REFUSE DERIVED FUELS RDF

The production and processing of solid fuels derived from waste (RDF) uses non-special industrial, commercial and residential waste as raw material.

Agro-industrial waste such as sawdust, wood chips from tree pruning, rice husk, sunflower husk, peanut husk, coffee husk, sugarcane bagasse, waste from the hydrocarbon industry, etc. are also used. These processes are included in the concepts of the Circular Economy as energy recovery through co-processing. These concepts must be reviewed in detail so as not to distort the initial idea of the circular economy. A simple description of a process for manufacturing Refuse Derived Fuels may be first size reduction of untreated waste, separation of ferrous and inorganic metals such as glass, etc. pneumatic classification of heavy materials, secondary crushing or final granulation. One of the main characteristics to consider in Refuse Derived Fuels is humidity, as it affects the calorific value that can be obtained.

More details on the processes can be found in the document on the subject: “The dangers of plastic waste management” Waste to Energy, chemical recycling and plastic fuels by Lee Bell, Professor Hideshige Takada[28]

[28] https://rds.org.co/*es/resultado-busqueda*/los-peligros-de-la-gestion-de-residuos-plasticos

GOVERNMENT INCENTIVES

Colombia's National Energy Plan (PEN) 2020-2050[29] is a strategic roadmap for the country's energy transition. This plan seeks to guide the policies and actions necessary to ensure the supply of energy in a sustainable, efficient and safe manner, taking into account the challenges of climate change and the opportunities offered by new technologies and energy sources.

Main objectives of the PEN 2020-2050:

1. Diversification of the energy matrix: The plan promotes the diversification of energy sources, including a significant increase in the share of non-conventional renewable energies, such as solar, wind and the use of biomass, which includes the energy recovery of solid waste.
2. Reduction of dependence on fossil fuels: Colombia seeks to reduce dependence on fossil fuels (oil, coal and natural gas), encouraging the adoption of other energy sources. This includes the promotion of biofuels and the generation of energy from Municipal Solid Waste (MSW).
3. Energy recovery from solid waste: In relation to Non-Conventional Energy Sources (NCES), the plan recognises the potential of solid waste as an alternative energy source. Energy recovery from solid waste not only contributes to reducing the amount of waste that reaches landfills, but also supports energy generation. The PEN 2020-2050 promotes research and development of technologies to convert solid waste into energy, such as incineration with energy recovery and biogas production through anaerobic digestion processes.
4. Technological development and innovation: The PEN promotes innovation and the development of new technologies to improve energy efficiency and explore new energy sources. In this context, research into the energy recovery of waste and other non-conventional sources is encouraged.
5. Sustainability and climate change: The plan is aligned with Colombia's international commitments on climate change, promoting an energy transition that reduces greenhouse gas emissions. The integration of non-conventional sources, such as solid waste, into the energy matrix contributes to these proposed objectives.

In summary, the PEN 2020-2050 promotes a shift towards a more diversified energy matrix, where solid waste plays a key role as a Non-Conventional Energy Source (NCES). The plan seeks to harness the energy potential of this waste, reducing dependence on fossil fuels and supporting the transition towards a low-carbon economy.

[29] https://www1.upme.gov.co/DemandayEficiencia/Paginas/PEN.aspx

When considering the use of Refuse-Derived Fuels (RDF) for energy generation as a Non-Conventional Energy Source, projects that use them are included and benefit from the incentives of Law 1715 of 2014, amended by Law 2099 of 2021.

These incentives include:

1. Special Income Deduction: Investments in Non-Conventional Energy Sources NCES allow deducting up to 50% of the total value of the investment from the taxpayer's net income, for a maximum period of 15 years, starting from the year following the investment's operation. However, this deduction cannot exceed 50% of net income in each fiscal year.
2. VAT Exemption: National or imported equipment, elements, machinery and services necessary for the generation of electric energy from Non-Conventional Energy Sources NCES are exempt from Value Added Tax (VAT).
3. Exemption from Customs Duties: Imported goods used for the generation of energy from Non-Conventional Energy Sources (NCES) are exempt from the payment of customs duties.
4. Accelerated Depreciation of Assets: Assets used in the generation of energy from Non-Conventional Energy Sources (NCES) can benefit from an accelerated depreciation regime. This allows assets to depreciate in a shorter time than traditionally established, which improves the recovery of the investment.

These incentives recognize Refuse-Derived Fuels as a Non-Conventional Energy Source (NCES) by including them as renewable energies and clean technologies in Colombia, supporting the transition towards a more sustainable and diversified energy system. The Mining and Energy Planning Unit (UPME) encourages the use of Alternative Energy Sources within the rational energy use program, promoting, for example, the use of hydrogen in the cement industry, as well as agricultural and industrial waste.

There are also several private funds that finance the conversion of Solid Waste into Fuels. One of them is the Fondo Acción, which supports projects of the Ministry of Environment and Sustainable Development focused on low-carbon development. A prominent example is the Geofuturo[30] project in Cartagena, which seeks to transform solid waste deposited in landfills into a "Formulated Solid Fuel" to replace fossil fuels used in industry, reducing the environmental impact. Other projects include coal gasification to obtain hydrogen in industry, with initiatives such as those of Carbomax, Cerámica Italia, ANDI Norte de

[30] https://www.geofuturo.com.co/es-co

Santander, Corponor, and various ceramic, brick, textile and food companies in the department of Norte de Santander.

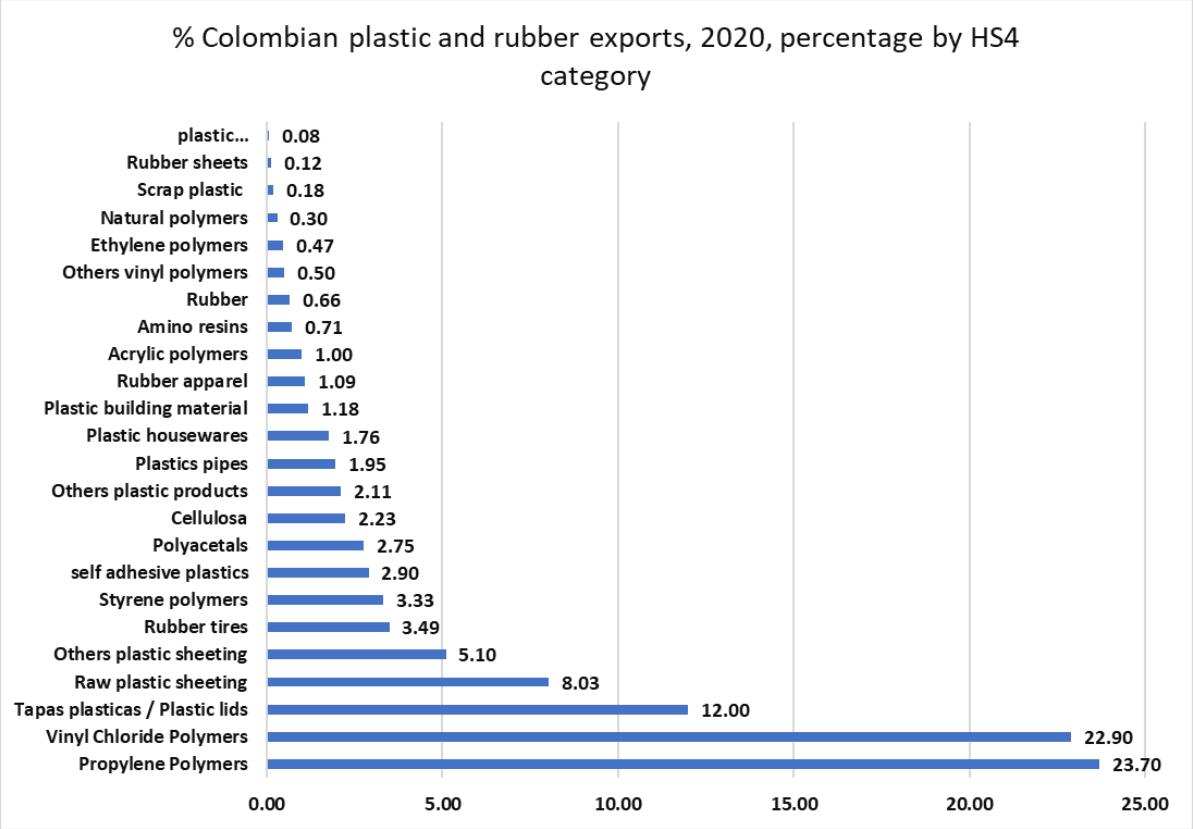
Photograph 5 Geofuturo inaugurated its GEO-PARQUE Circular Economy Plant https://www.geofuturo.com.co/copia-de-gran-inauguracion-de-geo-parque Fuente: Geofuturo https://lirp.cdn-website.com/b436ea96/dms3rep/multi/opt/_DSC0386-1920w.JPG

PLASTIC PRODUCTION

In Colombia, the plastics industry consumes more than one million metric tons of polymers[31] per year. Use is distributed as follows:

- 56% of production is destined for the packaging sector.
- 22% corresponds to inputs for the construction sector.
- 6% is directed to the institutional channel and the consumer.
- 9% to the agricultural sector.

Acoplasticos[32] estimates that 350,000 tons of waste are being used in the last year, and employs approximately 60,000 recyclers. The entity has a program with a website where it reports on the progress of recycling and the circular economy. https://plast-tic.org



Graphic 1 % Colombian plastic and rubber exports, 2020, percentage by HS4 category
https://publications.iadb.org/es/cero-emisiones-netas-en-los-andes-descarbonizacion-de-los-sectores-del-plastico-textil-automotriz-y

An increase in production is expected, which will impact the generation of waste, which is closely related to the use of plastics and depends on the

[31] https://numan.la/industria-plastica-colombia-actualidad-tendencias/#:~:text=En%20Colombia%2C%20la%20industria%20de,subsector%20de%20envases%20y%20empaques.
[32] https://acoplasticos.org/

average useful life of each plastic product and the country's economic growth. Waste can be recycled, incinerated, deposited in landfills or disposed of inappropriately.

> *"In the first production of this pioneering advanced chemical recycling project in Latin America, we seek to recover nearly 500 tons of waste, as a boost to the consolidation of a value chain that uses this type of circular resins for its applications, achieving an increase in the production of recycled material in the future, while achieving the recovery of ecosystems and environments."*
> https://www.pactoglobal-colombia.org/news/colombia-es-pionera-en-latinoamerica-en-producir-polipropileno-circular.html?highlight=WyJwb2xpcHJvcGlsZW5vIl0=

SOLID WASTE GENERATION

According to the National Administrative Department of Statistics (DANE), Colombia produces 30.31 million tons of waste in 2021[33], of which 82.2% correspond to solid waste and 17.8% to residual products, materials that have no value for the generator, but are marketed to other beneficiaries. The use of solid waste for energy cogeneration and other uses in 2021 was 6,683,809 tons, showing an increase of 6.5% compared to 2020[34].

The production of urban solid waste in Colombia in 2017 was 30,081 tons per day[35]. Urban solid waste in the most populated city in Colombia, Bogotá, with approximately 8,000,000 inhabitants, has a production of plastic waste of 17% according to the characterization carried out in 2017, for a daily volume of 6,868 tons, by contract of the Special Administrative Unit of Public Services of Bogotá (UAESP).

In the document Economic and Social Policy Council of the Capital District CONPES 31 "PUBLIC POLICY FOR CLIMATE ACTION 2023-2050" [36] the increase in the use of Non-Conventional Energy Sources NCES is proposed as a solution to waste management and energy generation.

Bogotá has a project for the thermal valorization of urban solid waste with a capacity of 2,300 to 3,000 tons per day, to produce 100 to 128 megawatts per hour. Through the company Biogás Colombia SAS ESP[37], energy generation began using the gas generated in the Doña Juana landfill. The Doña Juna I power plant began operating in 2016 with a capacity of 1.7 MW, with expansion plans at the end of 2024 and 2025 to achieve a total capacity of 26.6 MW.

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[33] DANE Technical Bulletin Environmental and Economic Account of Solid Waste Material Flows https://www.dane.gov.co/files/operaciones/CAEFM-RS/bol-CAEFMRS-2021pr.pdf

[34] Ibidem

[35] https://www.superservicios.gov.co/sites/default/files/inline-files/2._disposicion_final_de_residuos_solidos_-_informe_2017%20%281%29.pdf

[36] https://www.sdp.gov.co/sites/default/files/doc_conpes_31_pp_aclimatica.pdf

[37] https://www.biogas.com.co/index.php/nosotros/

Photograph 6 Doña Juana Central Power Plant Bogotá

Greenpeace says that Bogotá generates more than 9,000 tons daily, of which 3,000 can be used and only 1,600 tons are recovered. [38]

WASTE TRADE

Waste trade is covered by the Basel Convention, which establishes some rules and procedures for cross-border movements and disposal of hazardous waste and other waste at national and international level. Colombia is a party to this treaty that was approved by Law 253 of 1996[39].

The import of plastic waste from Annex 8 of Circular 022 of 2022[40] of the Ministry of Commerce, Industry and Tourism requires the Authorization process for the Transborder Movement of Hazardous Waste and its Disposal. If the waste is classified or meets the express condition in category Y48, the authorization process is required. If it is classified or meets the conditions of B3011, it is not required to carry out said procedure.

COMTRADE

UN Comtrade Database[41] "The world's most comprehensive global trade data platform, the UN database aggregates detailed annual and monthly global trade

[38] https://www.greenpeace.org/colombia/noticia/issues/contaminacion/greenpeace-colombia-realiza-un-sondeo-sobre-la-problematica-del-manejo-de-las-basuras-en-bogota/#:~:text=Bogot%C3%A1%20genera%20diariamente%20m%C3%A1s%20de,toneladas%20son%20material%20potencialmente%20aprovechable.

[39] https://archivo.minambiente.gov.co/images/normativa/leyes/1996/ley_0253_1996.pdf

[40] https://www.mincit.gov.co/getattachment/6a61409a-9f4d-4304-954e-d0449c5ef0dc/Circular-022-del-20-de-octubre-de-2022.aspx

[41] https://comtradeplus.un.org/

statistics by product and trading partner for use by governments, academic institutions, research institutes and businesses.

Data compiled by the United Nations Statistics Division cover approximately 200 countries and represent over 99% of global merchandise trade.

The Comtrade system uses the Harmonized System classification which is a standardized numerical method of classifying traded products. They are commonly and universally used throughout the merchandise export process.

Let's look at an example, which has HS code 39,15,10:[42]

HS3915
• The first two digits of the HS code are the chapter, i.e. the general categorization of your product. In our case, it would be Plastics and articles thereof (chapter 39).

• The second two digits are the heading, which provides another layer of separation. In this case, it refers to plastic waste, scrap and scrap (15).

• The last two digits are the subheading, which provides a final layer of clarification. In the case of our example, there is a specific subheading for ethylene polymers, which adds two final digits (10); Styrene polymers 20; Vinyl chloride polymers 30; Other plastics (90).

HS 3825
For residual products from the chemical or allied industries, not elsewhere specified or included; municipal waste; sewage sludge. Again, there is a whole range of different categories of waste products classified under this base code. 3825.10 - Municipal waste 3825.20 - Sewage sludge 3825.30 - Clinical waste 3925.90 Residual products of the chemical or allied industries, not elsewhere specified or included; n.e.c. in 3825 or 27.10.

HS 3606
For ferrocerium and other pyrophoric alloys in all their forms; metaldehyde, hexamethylenetetramine and similar products in tablets, rods or similar forms, for use as fuel; alcohol-based fuels and prepared fuels of a similar type, solid or in paste form; liquid gases and liquid fuels for lighters or igniters, igniters and the like.

[42] https://www.wcotradetools.org/en/harmonized-system/2022/en/073915?q=3915%20#073915

Comercio 2020-2024
Trade 2020-2024
kg/year

	Export	Import
3915	20,949,789	27,764,105
3825	160,883	788
3606	15,087	144,834
Total	21,125,759	27,909,727

access Sept 9, 2024 https://comtradeplus.un.org/Trac

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Table 1 exports imports HS3915 HS3825 HS3606

Analyzing the totals of the detailed products, table 1, HS3915, HS3825, HS3606, we could suggest that there is a dependence on raw materials for the production of Residue-Derived Fuels, where 75.7% of the imported material would be exported with a higher value.

There is a possibility that the import of these polymers is an industrial necessity, to revalue the waste in the form of fuels and sell them to neighboring countries seeking to take advantage of trade treaties and special economic zones to maximize re-export opportunities.

Below, we present detailed information on the trade for the three chapters of the harmonized system that we are analyzing:

HS3915.10 ethylene polymers
Colombia reported to the United Nations COMTRADE system for the years 2020 to 2023 the total import of 20,162,238 kg of material registered with the HS code 3915.10 ethylene polymers. Venezuela being the largest supplier with 15,000 tons during the 4 years.

391510	Ethylene polymers; waste, parings and scrap
reporterDesc	Colombia
altQtyUnitAbbr	kg

Suma de qty	Etiquetas de columna	
Etiquetas de fila	Export	Import
2020	340,926.00	4,423,984.70
Aruba		43,894.00
Ecuador		72,000.00
Free Zones		298,316.00
Mexico	24,000.00	
Morocco	261,926.00	
Pitcairn		26,610.00
Poland	55,000.00	
USA		256,704.70
Venezuela		3,726,460.00
2021	14,940.50	7,558,344.90
Aruba		25,600.00
Free Zones		275,335.50
Guatemala		7,880.00
Panama		302,937.00
USA		1,075,949.40
Venezuela	14,940.50	5,870,643.00
2022	1,581,508.00	5,894,418.80
Ecuador	808,639.00	
Free Zones		379,309.10
Germany	181,638.00	
Guatemala		7,759.00
Panama		412,577.00
Peru	117,100.00	
Portugal	474,131.00	
Spain		183,480.00
Trinidad and Tobago		13,278.00
USA		961,545.70
Venezuela		3,936,470.00
2023	2,041,561.00	2,285,490.41
Argentina		4,000.00
Ecuador	758,292.00	
Free Zones		518,600.91
Germany	31,310.00	
Mexico		2,105.00
Panama		107,543.00
Peru	294,534.00	
Portugal	886,425.00	
USA		185,891.50
Venezuela	71,000.00	1,467,350.00
Total general	**3,978,935.50**	**20,162,238.81**

access August 30, 2024 https://comtradeplus.un.org/TradeFlow

Archivo: 1Exp Imp TradeData 2024 08 30 391510.xls

Table 2 HS3915,10 Ethylene polymers, export import

391510	Ethylene polymers; waste, parings and scrap
reporterDesc	Colombia
altQtyUnitAbbr	kg

Suma de qty	Etiquetas de columna
Etiquetas de fila	Import
2020	3,726,460.00
Venezuela	3,726,460.00
2021	5,870,643.00
Venezuela	5,870,643.00
2022	3,936,470.00
Venezuela	3,936,470.00
2023	1,467,350.00
Venezuela	1,467,350.00
Total general	**15,000,923.00**

access August 30, 2024 https://comtradeplus.un.org/Trade

Archivo: 1Exp Imp TradeData 2024 08 30 391510.xls

Table 3 HS3915,10 ethylene polymers export to Venezuela

In the same period, it is reported that 3,978,935.5 kg of the same product were exported, registered with the HS code 3915.10 ethylene polymers. Exports were concentrated in Ecuador, followed by Portugal.

391510	Ethylene polymers; waste, parings and scrap
reporterDesc	Colombia
altQtyUnitAbbr	kg

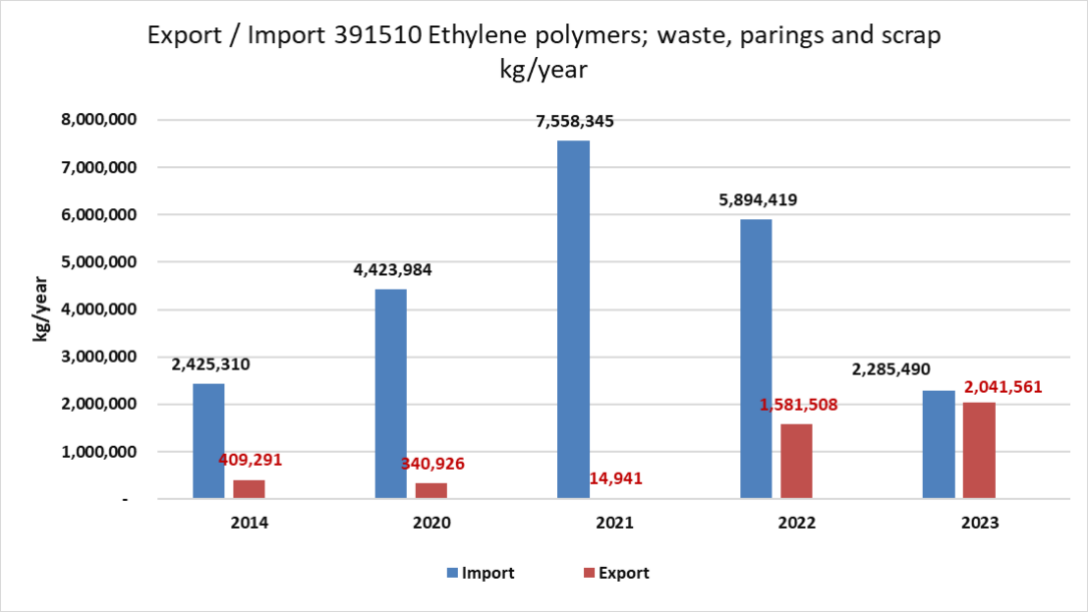
Suma de qty	Etiquetas de columna
Etiquetas de fila	Export
2020	340,926.00
Mexico	24,000.00
Morocco	261,926.00
Poland	55,000.00
2021	14,940.50
Venezuela	14,940.50
2022	1,581,508.00
Ecuador	808,639.00
Germany	181,638.00
Peru	117,100.00
Portugal	474,131.00
2023	2,041,561.00
Ecuador	758,292.00
Germany	31,310.00
Peru	294,534.00
Portugal	886,425.00
Venezuela	71,000.00
Total general	**3,978,935.50**

access August 30, 2024 https://comtradeplus.un.org/TradeFlow

Archivo: 1Exp Imp TradeData 2024 08 30 391510.xls

Table 4 HS3915,10 ethylene polymers major export destinations

It is important to mention that in 2014, imports of 2,425,310 kg and exports of 409,292 kg were reported, without indicating the origin or destination. In the following graph we can see the dynamics of the market, where we can see the substantial increase in exports in 2022 and 2023 compared to 2014.



Graphic 2

391510	Ethylene polymers; waste, parings and scrap				
reporterDesc	Colombia				
altQtyUnitAbbr	kg				
	2014	2020	2021	2022	2023
Import	2,425,310.00	4,423,984.00	7,558,344.90	5,894,418.80	2,285,490.41
	100%	182%	312%	243%	94%
Export	409,291.00	340,926.00	14,940.50	1,581,508.00	2,041,561.00
	100%	83%	4%	386%	499%

Table 5 HS3915.10 Ethylene polymers percentages of trade variation

Imports from free zones in this period amount to 1,471,562 kg. This may be national production in a free zone that re-enters the market.

HS3915.20 Styrene polymers

One of the most common uses in Colombia after polystyrene has been discarded has been the manufacture of adhesives or rubber solutions.

Imports of styrene polymers; waste, scraps and remnants in the last 4 years amounted to 1,709,059.90 kilos, with the country of origin with the largest amount sent from the USA, followed by Mexico. And 151,982 kilos were exported to Spain and Venezuela in the same period.

391520 Styrene polymers; waste, parings and scrap

reporterDesc Colombia

altQtyUnitAbbr kg

Suma de qty	Etiquetas de columna	
Etiquetas de fila	Export	Import
2020	127,482.00	55,397.00
Dominican Rep.		20,790.00
Panama		3,291.00
Spain	47,410.00	
USA		31,316.00
Venezuela	80,072.00	
2021		835,789.90
Mexico		180,256.90
USA		655,533.00
2022		379,283.00
Mexico		254,850.00
USA		124,433.00
2023	24,500.00	438,590.00
Spain	24,500.00	
USA		438,590.00
Total general	**151,982.00**	**1,709,059.90**

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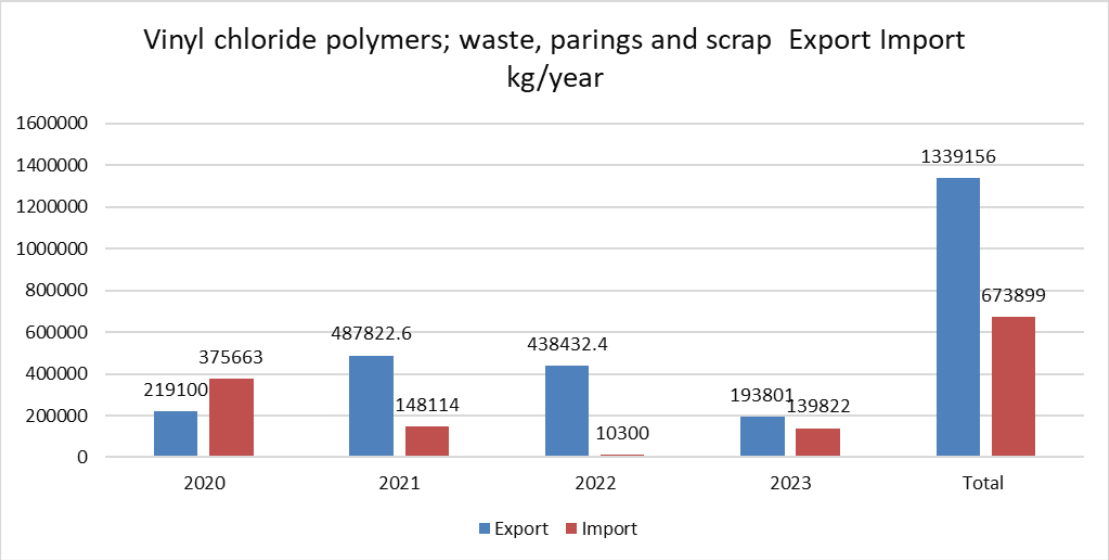
Table 6 HS3915.20 Styrene polymers main exports and imports origin/destination

In 2014, only 254,354 kilos of exports were reported in the COMTRADE system.

HS3915.30 Vinyl chloride polymers

Reported imports of vinyl chloride polymers from 2020 to 2023; waste, trimmings, amounted to 673,899 kg, with the largest supplier being the United States; and the main export destination was Malaysia, followed by Ecuador.



Graph 3 vinyl chloride polymers; scrap, offcuts Exports Imports

391530	Vinyl chloride polymers; waste, parings and scrap
reporterDesc	Colombia
flowDesc	Export
altQtyUnitAbbr	kg

Suma de qty	Etiquetas de columna	
Etiquetas de fila	Export	Import
2020	219,100.00	375,663.00
Ecuador	219,100.00	
Free Zones		73,623.00
Netherlands		10,040.00
Panama		10,802.00
USA		281,198.00
2021	487,822.60	148,114.00
Ecuador	178,035.60	
Free Zones		24,000.00
Malaysia	296,381.00	
Netherlands		11,600.00
Thailand	13,406.00	
USA		112,514.00
2022	438,432.40	10,300.00
Areas, nes		10,300.00
Chile	4.20	
Ecuador	235,692.00	
Malaysia	202,734.00	
Panama	2.20	
2023	193,801.00	139,822.00
Areas, nes		89,085.00
Free Zones		50,737.00
Malaysia	193,801.00	
Total general	**1,339,156.00**	**673,899.00**

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Table 7 HS3915.30 Vinyl chloride polymers exports and imports

In 2014, 778,287 kilos of vinyl chloride polymers, waste and scraps, were imported from Venezuela, Mexico and the USA.

HS3915.90 Of other plastics: propylene polymers, ethylene terephthalate polymers (e.g. PET), Other
This material is the largest volume reported in COMTRADE, 5,218,909 kg have been imported to Colombia in the period from 2020 to 2023, with China being the largest supplier with 58%, and 15,479,716 kg have been exported, with the largest shipment destinations being the USA (48%) followed by Brazil (14%) and Thailand (9%).

391590	De los demás plásticos: polímeros de propileno, polímeros de tereftalato de etileno (por ejemplo, PET), Los demás
reporterDesc	Colombia
qtyUnitAbbr	kg
Suma de qty	Etiquetas de columna

	Export	Import
2020	3116840	2043011
2021	5,632,604	1,397,340
2022	4,388,967	928,345
2023	2,341,305	850,212
Total general	15,479,716	5,218,909

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Archivo: TradeData (11)_391590.xls

Table 8 HS3915,90 Of other plastics

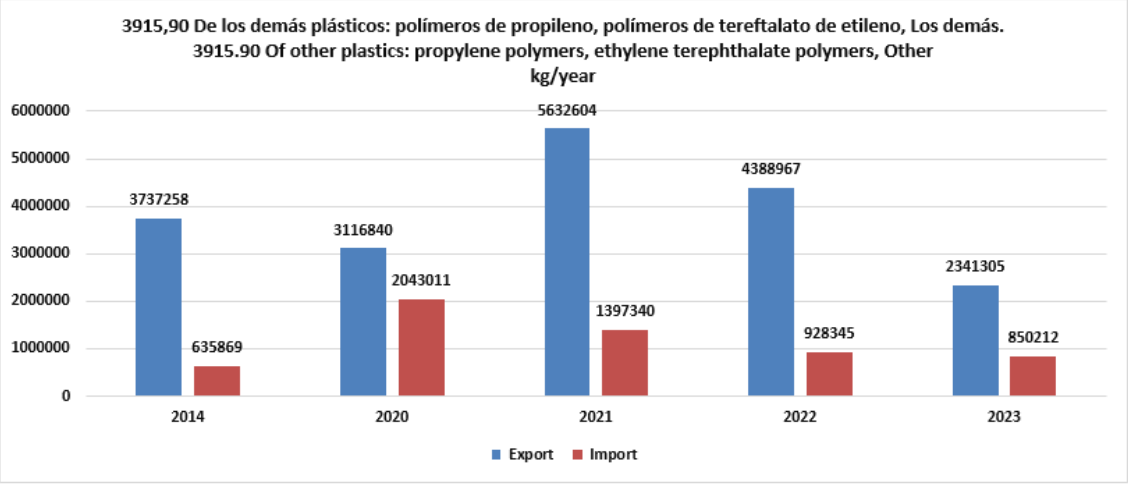
The main countries participating in the trade are shown in the following table.

391590	De los demás plásticos: polímeros de propileno, polímeros de tereftalato de etileno (por ejemplo, PET), Los demás
reporterDesc	Colombia
qtyUnitAbbr	kg

Suma de qty	Etiquetas de columna	
Etiquetas de fila	Export	Import
2020	2,763,229	1,390,970
Brazil	994,200	
China		783,387
Ecuador	13,072	154,739
Honduras	150,830	
Latvia	1,312,219	
Mexico	20,000	209,010
Thailand	114,009	
USA	158,899	243,834
2021	5,166,381	1,179,754
Brazil	1,120,000	85
China		825,952
Ecuador	60,634	
Mexico	57,339	
Thailand	324,628	
USA	3,603,781	353,717
2022	3,774,271	799,468
China		749,590
Ecuador	137,791	21,668
Honduras	56,062	
Latvia	42,000	
Mexico	104,219	21,911
Thailand	323,423	
USA	3,110,776	6,300
2023	1,565,202	789,703
Brazil	19,000	
China		669,613
Ecuador	644,590	
Honduras	119,110	
Mexico	18,507	79,880
Thailand	217,058	
USA	546,937	40,209
Total general	**13,269,083**	**4,159,894**

Table 9 HS3915.90 Of the other main plastics trade destinations

In 2014, HS3915.90 was exported to 3,737,258 kg and imported to 635,869 kg.



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Graph 4

3915,90 De los demás plásticos: polímeros de propileno, polímeros de tereftalato de etileno, Los demás.

3915.90 Of other plastics: propylene polymers, ethylene terephthalate polymers, Other. kg/year

	2014	2020	2021	2022	2023
Export	3737258	3116840	5632604	4388967	2341305
Import	635869	2043011	1397340	928345	850212

Table 10 HS3915.90 Of other plastics exports imports

The highest export volume corresponds to the HS3915.90 code of “Other plastic polymers”, and the highest imports correspond to the HS3915.10 code.

Comercio HS3915 2020-2024
Trade HS3915 2020-2024
kg/year

	Export	Import
391510	3,978,935	20,162,238
391520	151,982	1,709,059
391530	1,339,156	673,899
391590	15,479,716	5,218,909
Total	20,949,789	27,764,105

Table 11 HS3915 trade summary

HS3825 Residual products of chemical or allied industries
Residual products of chemical or allied industries, not elsewhere specified or included; municipal waste; sewage sludge; other wastes specified in note 6 to this chapter.

This material has been the source of exports to Ecuador.

382590	Residual products of the chemical or allied industries, not elsewhere specified or included; n.e.c. in 3825 or 27.10
reporterDesc	Colombia
altQtyUnitAbbr	kg

Suma de qty	Etiquetas de columna	
Etiquetas de fil.	Export	Import
2020		698.10
USA		698.10
2021	1,118.50	
Guatemala	1,118.50	
2022	5.00	90.00
Aruba	5.00	
Spain		90.00
2023	159,760.00	
Ecuador	159,760.00	
Total general	**160,883.50**	**788.10**

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Archivo: TradeData_3825.xls

Table 12 HS3825 Residual products from chemical or related industries

HS3606 ferrocerium and other pyrophoric alloys in all their forms
The largest quantity of this product has arrived from China. And the main destination of this material is Ecuador.

360690	Ferro-cerium and other pyrophoric alloys in all forms; articles of combustible materials n.e.c. in chapter 36
360610	Fuels; liquid or liquefied-gas, in containers, of a kind used for filling or refilling cigarette or similar lighters and of a capacity not exceeding 300cm3
reporterDesc	Colombia
altQtyUnitAbbr	kg

Suma de qty	Etiquetas de columna	
Etiquetas de fila	Export	Import
2020	633.50	49,054.54
Austria		40.35
China		41,180.33
Curaçao	440.00	
Ecuador	183.70	
India	9.80	
Spain		2,959.50
Türkiye		2,585.40
USA		2,288.96
2021	13,400.00	17,210.97
Austria		11.32
China		7,835.39
Ecuador	13,400.00	
Germany		4.00
Spain		995.77
Switzerland		20.00
Türkiye		2,981.33
USA		5,363.16
2022	295.00	49,131.29
Austria		106.27
China		33,333.77
France		31.90
Mexico		0.10
Panama	50.00	
Spain		831.25
Türkiye		8,106.20
United Kingdom		225.41
USA		6,496.39
Venezuela	245.00	
2023	758.86	29437.62
Austria		3.44
China		23263.94
Guyana	758.86	
Panama		802.93
Rep. of Korea		147.09
Spain		182.34
Türkiye		2957.58
USA		2080.3
Total general	**15087.36**	**144834.42**

access Sept 2, 2024 https://comtradeplus.un.org/TradeFlow
Archivo: TradeData_3606.xls

Table 13 HS3606 Ferrocerium and other pyrophoric alloys in all their forms

CEMENT INDUSTRY

The cement industry is grouped together in the Inter-American Cement Federation (Federación Interamericana del Cemento FICEM), where the industry is concentrated to develop projects for the development of new technologies considering the new trends of the world market; Currently, 60% of cement manufacturers in Latin America work to use Residue-Derived Fuels.

FICEM has conducted a detailed study using the classification of alternative fuels from the World Resources Institute (WRI - WBCSD) Greenhouse Gas (GHG), differentiating the origin:

Alternative Fuels	
Alternative fossil fuels	**Biomass fuels**
End-of-life oil	Dehydrated sewage sludge
End-of-life tyres	Wood, unimpregnated sawdust
CDR including plastics	Paper and cardboard
End-of-life solvents	Animal meals
Impregnated sawdust	Animal bone meals
Mixed industrial waste	Animal fats
Other waste-based fossil fuels	Agricultural, organic, end-of-use diapers and charcoal
	Other biomass

Table 14 Alternative fuels

According to information from the Federation in Latin America, the percentage of co-processing is 15%, calculated with information for the years 2014 and 2015.

Cement production in Colombia began in the first decade of the 20th century, with great development in the first 50 years of the last century, where several companies were consolidated and acquired by multinationals at the end of the 20th century. In 1998, 42 kilns were operated with an installed capacity of 14.3 million tons. At the beginning of the 21st century, this was reduced to 36 kilns and the installed capacity to 12.8 million tons.

In Colombia, the industry is associated with the Colombian Chamber of Cement and Concrete (PROCEMCO) and together with the Inter-American Cement Federation (FICEM) they have established roadmaps “Towards a low-carbon economy”; which include several lines of work such as co-processing and energy efficiency, including fuels derived from waste.

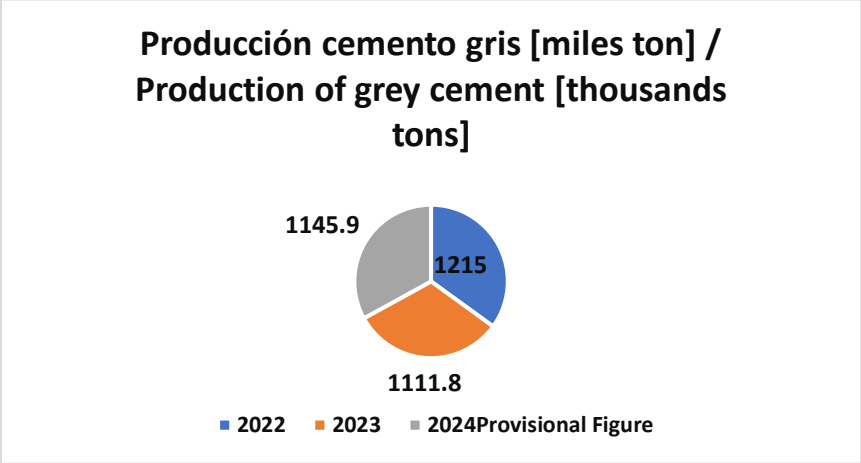
> *“In July 2024, the production of gray cement at the national level was 1,155.7 thousand tons, which represented a variation of -5.4% compared to the same month in 2023.”*

DANE Gray Cement Statistics (ECG) July 2024pr
https://www.dane.gov.co/files/operaciones/ECG/bol-ECG-jul2024.pdf

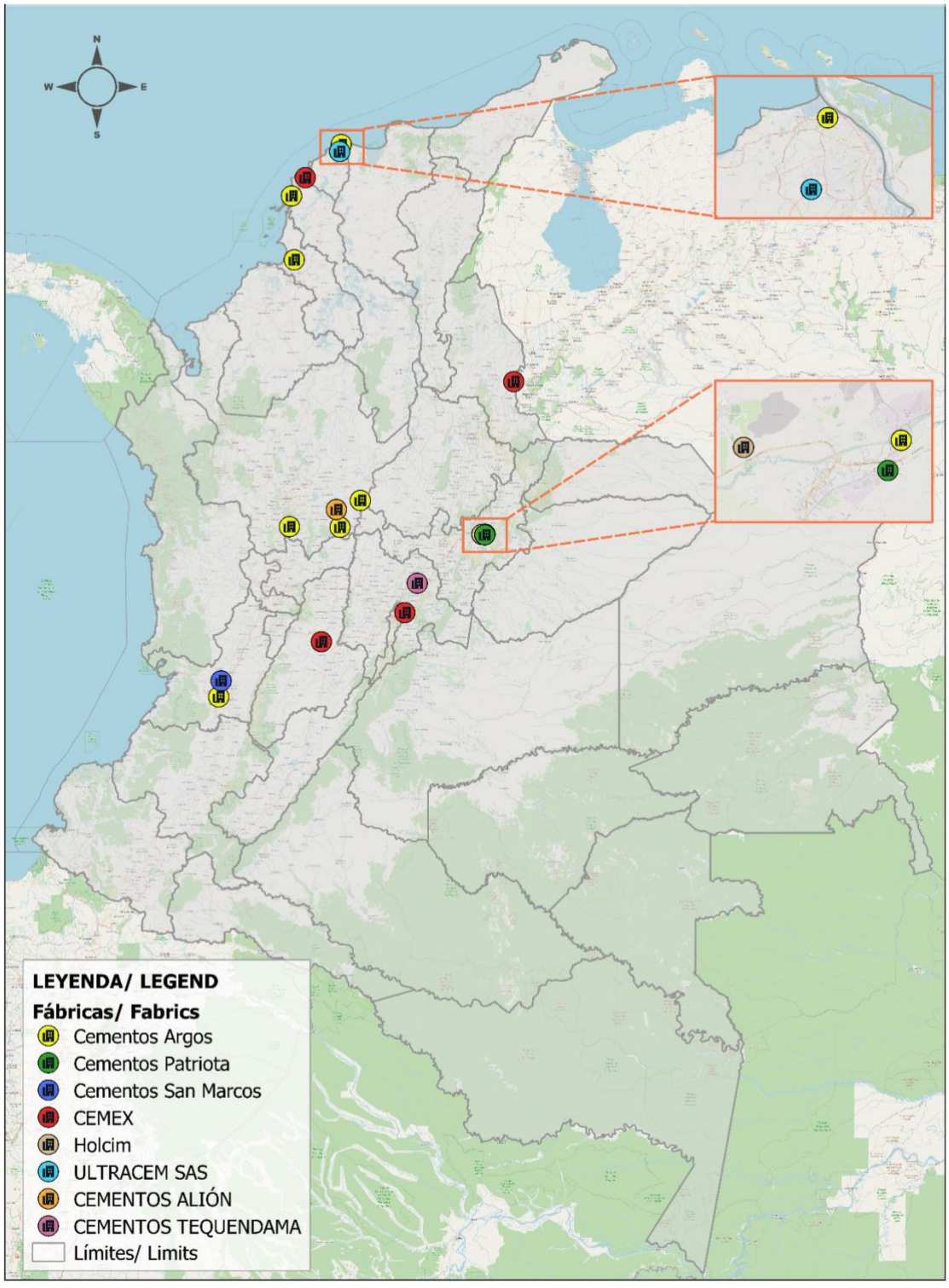
Co-processing is a clear objective in the cement industry since they consider it an essential mechanism in the circular economy, although they are aware of the loss of thermal efficiency due to the lower calorific value of Refuse Derived Fuels.

There are three large groups in Colombia that dominate the cement market: LafargeHolcim, Cemex Latam Holdings and Argos, and other producers such as Cementos Patriota, Cementos Ultracem, Cementos Alión and Cementos San Marcos.

FICEM reports that the co-processing factor is 7.5% below the world average reported by GNR, which is 16%, which is why they have requested support from the state to reach 15% by updating the waste management policy.



Graph 5 Source: DANE PR technical bulletin provisional figure



Map 1 Location of cement plants in Colombia

Cement ALIÓN

Company owned by the Corona group in alliance with Cement Molins with a capacity of 1.3 million tons per year. In Colombia, they report the use of alternative fuels, without specifying the origin and quantity. The Spanish company Cement Molins uses Refuse Derived Fuels.

Cement ARGOS

Cement Argos is owned by the Argos business group, and is present in 16 countries. In Colombia, being the industry leader for more than 86 years, it has the following cement production plants with an installed capacity of 8.7 million tons per year:

1. Cartagena Plant
2. Sogamoso Plant
3. Cairo Plant
4. Nare Plant
5. Rio Claro Plant
6. Toluviejo Plant
7. Yumbo Plant

The Argos group in its Integrated Report 2023 reports having taken advantage of 105,000 tons of urban waste, reducing the use of coal. At the Cartagena plant, 2,500 tons of urban and industrial waste are used in the co-processing process. And following this line established in the roadmap on the subject of climate change, it has an alliance with Ecopetrol and Veolia to co-process 7,000 tons of waste, oily sludge derived from hydrocarbon refining processes, each year replacing 5% of the fuel used.

At the Rio Claro plant, used tires have been used as fuel[43] since 2015. The result of these processes has been the issuance of carbon credits.

In 2023, they achieved a replacement of 7.2% of fuels using Refuse Derived Fuels, using tires[44], biomass, urban waste and hydrocarbons; and they plan to increase the use of alternative fuels with an investment of USD 46.1 million by 2030, to achieve the replacement of 33% of conventional fuels.

Cementos Argos at the Sogamoso plant has been sued for the contamination caused to water sources[45].

[43] https://argos.co/coprocesamiento-argos/

[44] https://www.sistemaverde.com.co/servicios/posconsumo-de-llantas?gad_source=1&gclid=Cj0KCQjw28W2BhC7ARIsAPerrcLFinszc-0-tJUgeU6TRIDxAAS8wmW7v6BCtkz0Sgkvcui24DsRy8saAu-mEALw_wcB

[45] https://www.infobae.com/america/colombia/2022/03/15/acusan-a-cementos-argos-de-contaminar-recursos-ambientales-en-boyaca/

Cementos CEMEX LATAM HOLDINGS

A Mexican company that bought cement plants in Colombia and today has 4 production centers. It has a presence in Colombia, Panama, Costa Rica, Nicaragua, Guatemala and El Salvador. CEMEX is one of the main construction materials companies worldwide, with a presence in Mexico, the United States, Europe, the Middle East, Africa and Asia.

The history of CEMEX in Colombia began in 1996 with the acquisition of Compañía Colombiana de Clinker S.A. and Cement Diamante S.A. These purchases included cement plants in Bucaramanga, Ibagué and La Calera, as well as ready-mixed concrete assets, aggregate quarries and distribution terminals.

Today, CEMEX is one of the leading producers of cement and ready-mix in Colombia, with a solid network of plants, distribution centers and customers throughout the country, and owns the following plants:

1. Santa Rosa Cement Plant, La Calera,
2. Caracolito Cement Plant, Payandé, San Luis
3. Los Patios Cement Plant
4. Clemencia Cement Plant

Since 2005, the company has integrated the use of Non-Conventional Energy Sources in its operations. By 2012, 36% of the fuels used by the company were considered "Alternative Fuels." These included agricultural waste generated in the department of Tolima, where it operates one of its plants, specifically fuels derived from the rice industry, such as rice husks. The Caracolito plant implements a process aligned with the Clean Development Mechanism[46],, a procedure established in the Kyoto Protocol. In addition, the company continues to develop initiatives in other plants to take advantage of waste from the coffee industry.

Within Cemex's sustainability goals for the year 2030, based on the result of the year 2021 in the use of alternative fuels of 29.2%, they aspire to achieve the goal of a greater use of 55%.

Regenera is a subsidiary of Cemex for the management and handling of waste recycling processes and waste adaptation processes for the substitution of fuels, such as Climafuel™ registered in the United Kingdom.

Cement LAFARGEHOLCIM

It is a company of the Swiss group Holcim since 1969 when it bought the company Cementos Boyacá. In Colombia, it focuses on the production and

[46] https://www.cemexcolombia.com/sostenibilidad/gestion-ambiental/estrategia-de-carbono/combustibles-alternos

marketing of cement and concrete, it has a plant in Nobsa Boyacá; in 2015 it merged with Lafarge, a French group.

At the Nobsa plant in the department of Boyacá, they have been co-processing or using alternative fuels since 2006.

Currently, 19%[47] [waste co-processing in 2021, 40,000 tons] of the fuels used by the company come from Alternative Fuels. The company plans to increase this proportion, reaching 37% use of Refuse Derived Fuels (RDF) by 2030."

Geocycle is a company of the cement group that carries out adaptation and management work on solid waste to deliver it to the cement production process; it offers certified final disposal services[48].

Photograph 7 Guidelines on Pre- and Coprocessing of Waste in Cement Production geocycle.com/sites/geocycle/files/2023-04/coprocem_2020_esp_lowres.pdf

In 2010, the Holcim company (now LAFARGEHOLCIM) was sued by the ASONOBSA association, made up of residents of an urban settlement near the cement plant in the municipality of Nobsa, an urbanization created in 1987, with approximately 70 houses built at a distance of 400 meters from the boundaries of the plant, it also affects the rest of the residents in Nobsa, Boyacá and has had a significant impact on the surrounding populations.

In 2015, the municipality of Nobsa had a population of 16,271 inhabitants; This impact also extends to the neighboring towns of Sogamoso, which had 121,396 inhabitants, as well as Iza, whose population was 2,015 inhabitants in that same year 2015. There is also the popular action brought by the inhabitants of Iza, Boyacá against the Ministry of Mines and Energy - INGEOMINAS - Department

[47] https://www.holcim.com.co/sites/colombia/files/2023-02/ids2021.pdf

[48] https://www.procem.co/economiacircular/presentaciones-economia-circular/5.Avances-y-experiencias-en-el-tratamiento-de-residuos.pdf

of Boyacá - Municipality of Iza - Corpoboyacá and the company Holcim S.A. (today LAFARGEHOLCIM), for environmental contamination.

May 31, 2019,

State and criminal liability of legal entities for environmental damage. Case study: Holcim Colombia in Nobsa, Boyacá

https://revista-investigare.uexternado.edu.co/responsabilidades-estatal-y-penal-de-las-personas-juridicas-por-danos-ambientales-estudio-de-caso-holcim-colombia-en-nobsa-boyaca/

The document addresses the state and criminal liability of legal entities for environmental damage, focusing on the case of Holcim in Nobsa, Boyacá. It exposes how the cement industry, by incinerating waste to obtain energy, generates pollution that affects the environment and human health. The lack of criminal liability of companies is criticized, which falls on legal representatives instead of corporations. The work proposes changes in the assignment of responsibilities, suggesting a new legal approach for both companies and the State.

Photograph 7 Location ASONOBSA and the LAFARGEHOLCIM Cement Plant, Nobsa Boyacá Source: Google Earth

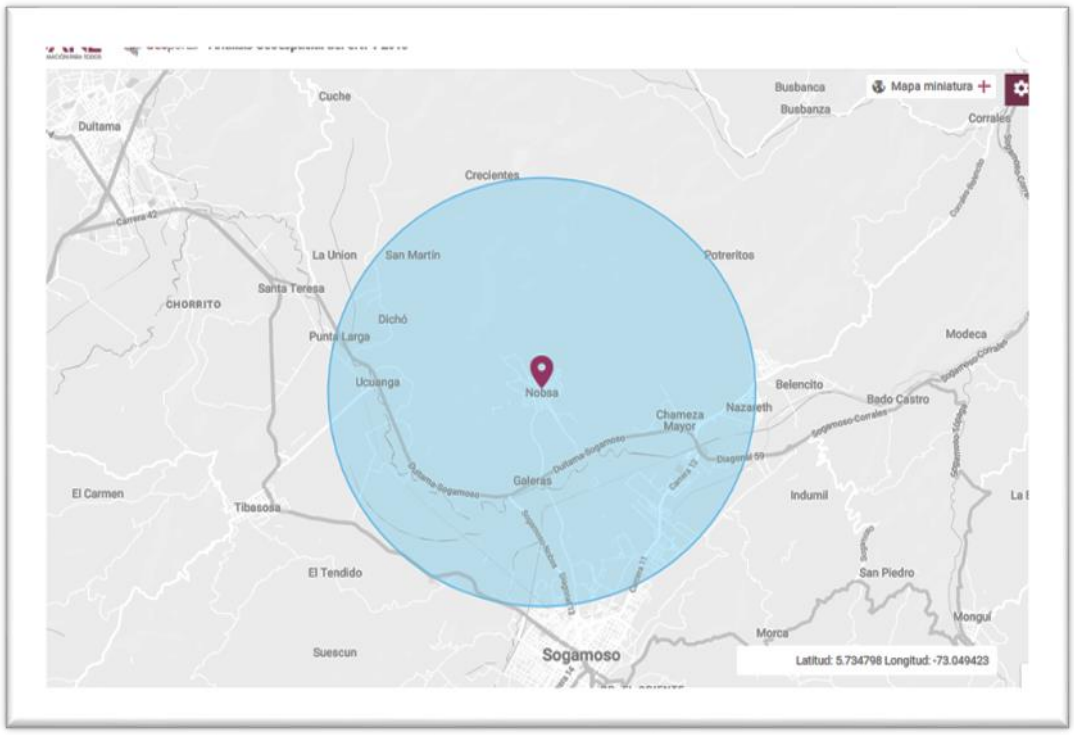
The Holcim company has been sued in other regions of the country such as Chocontá[49], for the exploitation of quarries, Bogotá for mining on the banks of

[49] https://www.holcim.com.co/nuestra-empresa/ultima-edicion/latest-release/article/holcim-respetuosa-de-la-ley-defendera-sus-actuaciones-en-su-planta-de-choconta-y-su-licencia-de

the Tunjuelo River, this conflict is an environmental liability that was acquired when it bought Boyacá cement.

There is also a popular action brought by the inhabitants of Iza, Boyacá against the Ministry of Mines and Energy – INGEOMINAS – Department of Boyacá – Municipality of Iza – Corpoboyacá and the company Holcim S.A., for environmental pollution; in this, the Administrative Court of Boyacá determined that Holcim has not complied with the law regarding emissions.

There have been lawsuits by farmers for damage to crops in the Nobsa area against the factory.



Map of the population density of Nobsa Boyacá Source: https://geoportal.dane.gov.co/geovisores/territorio/analisis-cnpv-2018/?lt=4.646075&lg=-74.088605&z=20

Cementos PATRIOTA

Cement company located in the municipality of Nobsa with a cement production of 100,000 tons per year, does not report the use of alternative fuels or Refuse Derived Fuels.

Cement SAN MARCOS

Cementos San Marcos, located in the municipality of Yumbo, department of Valle del Cauca, with a production capacity of 550,000 tons per year; does not report the use of refuse derived fuels.

Cement TEQUENDAMA

Located in the municipality of Suesca in Cundinamarca, it has a production capacity of 540,000 tons per year.

Cement ULTRACEM

Multinational with presence in Panama, Guatemala, Honduras and Colombia with a plant in Galapa Atlántico, with a production capacity of 1,300,000 tons per year.

Company	production capacity million tons/year
CEMENTOS ALIÓN	1,500,000
CEMENTOS ARGOS	5,800,000
CEMENTOS CEMEX LATAM HOLDINGS	5,500,000
CEMENTOS LAFARGEHOLCIM	3,300,000
CEMENTOS PATRIOTA	100,000
CEMENTOS SAN MARCOS.	550,000
CEMENTOS TEQUENDAMA	540,000
CEMENTOS ULTRACEM	1,300,000

Table 15 Cement production capacity

REFUSE DERIVED FUELS RDF, INCLUDING PLASTICS

The National Circular Economy Strategy[50] projected to the year 2022, with the indicator called “Percentage (%) of used lubricating oils collected and treated for energy recovery”: using 69% of used lubricating oils should be energy recovered, which was equivalent to 64,505 tons of used oils in the country. (calorific value of used oils 43.61 MJ/kg, density at 40°C 0.882 g/ml).

Small and medium-sized companies have used lubricating oils as cheap fuels. With Law 430 of 1998 "By which the use of waste lubricating oils is permitted, in order to produce energy" the use of oils for energy generation was legalized

Through resolution 1457 of 2010, the Ministry of Environment, Housing and Territorial Development established the selective collection system for Out-of-Use Tires (NFU) and with resolution 1326 of 2017[51] of the Ministry of Environment and Sustainable Development, coverage was expanded to all types of tires, having a collection and utilization coverage in 2024 of 80%. According to data from the ANLA[52], in the period from 2012 to 2017, 10,879,853 tires were collected through the post-consumer program that were used in co-processing[53] processes. Already in 2018, a consumption of 17,924,194 tires equivalent to 143,737 tons that can potentially be converted into fuel through appropriate reverse logistics.

Refuse Dervide Fuel generators are establishing alliances with urban solid waste collectors to strengthen the supply chain.

The cement industry in Colombia plans to increase the use of Rfuse derived Fuels (RDF) to 17.5% in the entire cement industry by 2030. By business group, the projections can be seen in the following table:

[50] https://acoplasticos.org/wp-content/uploads/2024/02/economia_circular_01.pdf

[51] https://www.sistemaverde.com.co/fotos/Image/archivos/Res%201326%20de%202017%20llantas%20usadas.pdf

[52] ANLA https://www.anla.gov.co National Authority for Environmental Licensing

[53] Co-processing: is the process of converting waste into a material with such characteristics that it can be considered an alternative fuel or raw material for a specific industrial process. [source reference 15]

Projections of the use of Refuse-Derived Fuels (RDF)

Company	Using 2024	2030 projection
CEMENTOS ALIÓN	Yes	Not available
CEMENTOS ARGOS	7%	33%
CEMENTOS CEMEX LATAM HOLDINGS	36%	55%
CEMENTOS LAFARGEHOLCIM	19%	37%
CEMENTOS PATRIOTA	Not available	Not available
CEMENTOS SAN MARCOS.	Not available	Not available
CEMENTOS TEQUENDAMA	Not available	Not available
CEMENTOS ULTRACEM	Not available	Not available

Table 16 Projections of RDF use for the year 2030

Refuse Derived Fuel RDF Producers

Waste valorization has been promoted through the circular economy and to encourage this type of process, a model called “Environmental Technology Parks” [54] has been designed in Colombia, which are designed and have permits for waste management, where they are supposed to carry out the integral management for the production of fuel. These parks are included in the National Circular Economy Strategy and are promoted with support from the United Nations Industrial Development Organization - UNIDO and the United Nations Environment Program - UNEP. [55].

Some companies that are visible in the market that offer waste valorization processes are:

ATICA

Ática processes approximately 120,000 tons of waste annually, recycling it to valorize materials for recycling and also adapting it as fuel to produce energy in thermal processes. It has 7 incineration furnaces in Colombia. These wastes are used in its energy utilization plant to produce thermal energy.

ECOLOGISTICA

It is one of the so-called “Environmental Technology Parks” located in the city of Medellin with a license to process hazardous, biological, medicinal, organic, sludge, etc. And through thermal valorization processes they produce a fuel called Ecofuel.[56]

GEOCYCLE

A company of the LafargeHolcim group, it is one of the main providers of industrial, agricultural and municipal waste management services worldwide; it is the company in charge of the pre- and co-processing of waste in the cement industry. [57]

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[54] https://economiacircular.minambiente.gov.co/index.php/transicion-a-la-economia-circular/parques-industriales-ecoeficientes/ https://youtu.be/2tWXq2R2qUM **GEIPP Colombia:** Programa Global de Parques Eco-Industriales

[55] https://www.minambiente.gov.co/wp-content/uploads/2021/06/Estrategia-Nacional-de-Economia-Circular-2019-Final.pdf

[56] https://ecologistica.com.co/ (25 mayo 2022 https://youtu.be/VbbIUipzitI)

[57] https://www.geocycle.com.co/

GEOFUTURO
Geofuturo, a Colombian company dedicated to the integral management of waste, is developing a project called 'Geopark' in the city of Cartagena, which has as its main front the manufacture of Refuse Derived Fuels. [58]

PLASTICOMBUSTIBLES
Business project for the pyrolysis of plastic waste, Plastic waste in Bogotá[59]

PYRCOM
Pyrcom[60] is an allied company of the Colombian Petroleum Company S.A. Ecopetrol[61] for the pyrolysis of plastics purchased from recyclers, especially polypropylene. The plant is located in the Barrancabermeja refinery and once processed and an oil called "Polypropylene Oil" is obtained, it is transported 399 miles to the Essentia plant in Cartagena. It is a 100% Colombian company of the Ecopetrol Group, whose main plant is located in Cartagena, Colombia. It is dedicated to the production and marketing of raw materials for the plastics industry such as polypropylene, polyethylene and masterbatch.

Essentia supports some composting plants in Colombia:

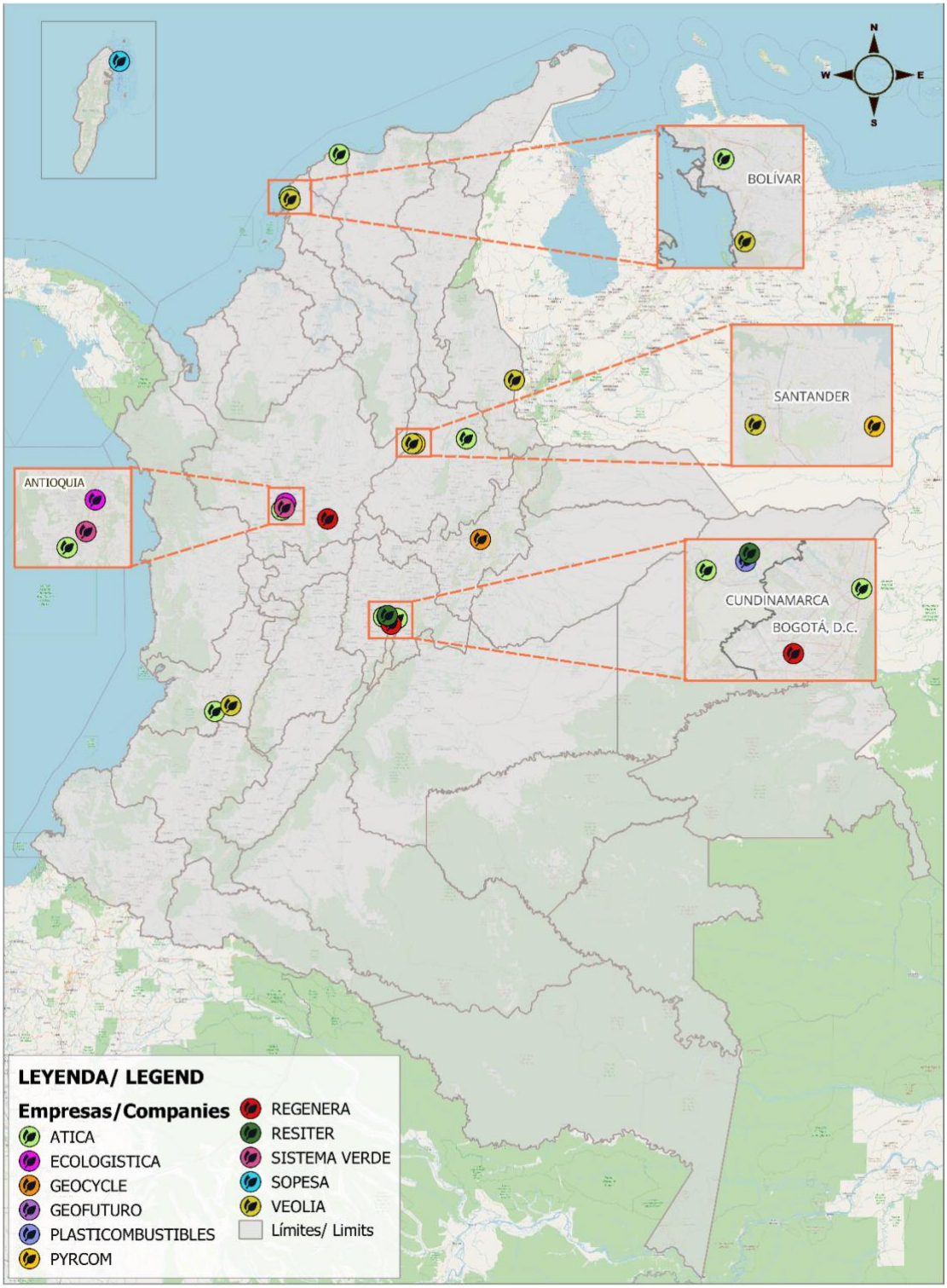
1. Antioquia, Earthgreen, Gestión y Desarrollo Ambiental S.A.S.
2. Atlántico: Compost Baladi, Orgánicos del Caribe.
3. Cundinamarca: Más Compost Menos Basura, Grupo Terra Zan, Biotecnología Ambiental Terranova.

REGENERA
Cemex subsidiary for the management and handling of rubble recycling processes and waste adaptation processes for fuel substitution[62].

RESITER
Multinational company that provides industrial waste management services[63].

SOPESA
Company dedicated to the management of public services on San Andrés Island, for the management of urban solid waste and with it the production of electric energy with a capacity of 14,400,000 tons, installed in 2012, it has not been possible to operate[64].

[58] https://www.geofuturo.com.co/es-co/geoparque (11 enero 2023 https://youtu.be/IAGxxzbFBmM)
[59] http://www.drcalderonlabs.com/Plasticombustibles/Index%20Plasticombustibles.htm (https://www.youtube.com/watch?v=NqfgDbzaM9E)
[60] http://pyrcom.com.co/
[61] Grupo Ecopetrol
[62] https://www.cemexcolombia.com/regenera
[63] https://www.resiter.com/resiter-colombia/
[64] https://sopesa.com/



Map 2 Plants producing Refuse Derived Fuels

SISTEMA VERDE
Transforms solid waste into Refuse-Derived Fuels (RDF) and Tire-Derived Fuel (TDF) Medellín 2024[65].

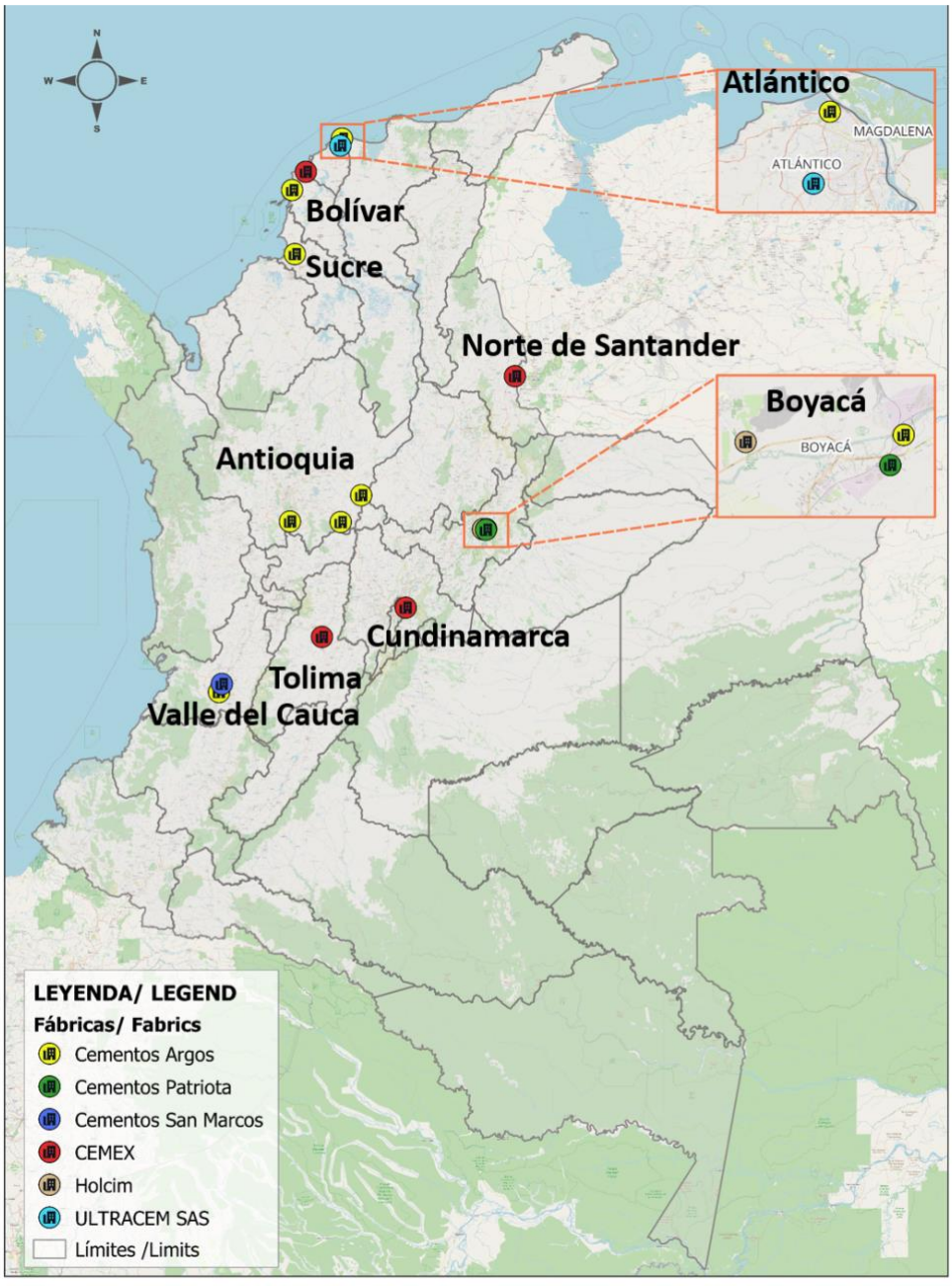
VEOLIA
French multinational company, which provides waste management services in some municipalities and has permits for the management of hazardous waste from the industry. They offer a wide portfolio of services such as waste recovery and valorization, transforming waste into resources through material valorization operations (recycling) as well as energy valorization (Thermovalorization). Hazardous waste. They offer solutions in the management of hazardous waste, from collection services, on-site testing, classification, collection to its treatment. Thermal destruction of industrial waste Final disposal - Sanitary landfills, services, treatment and final disposal of solid waste and hazardous waste. Elimination of medical and hospital waste

Unión Temporal, Argos, a cement company of the Argos Group, and Veolia, the main waste manager in the country, presented a joint solution for the use of oily sludge derived from the hydrocarbon refining processes carried out at the Ecopetrol Refinery in Barrancabermeja. This type of waste is managed by the specialized personnel of the Veolia Argos Temporary Union and transported in sealed dump trucks to the facilities of the Caribbean Environmental Technology Park, and is transported 399 mile to the plant where it is transformed into Refuse Derived Fuel (RDF).

[65] https://www.sistemaverde.com.co/puntos-de-acopio

POPULATION IN THE AREA OF INFLUENCE

Cement plants are located in industrial and mining areas, close to communities that vary in size. The proximity of these communities to cement plants can have implications in terms of environmental impact, public health and economic development.

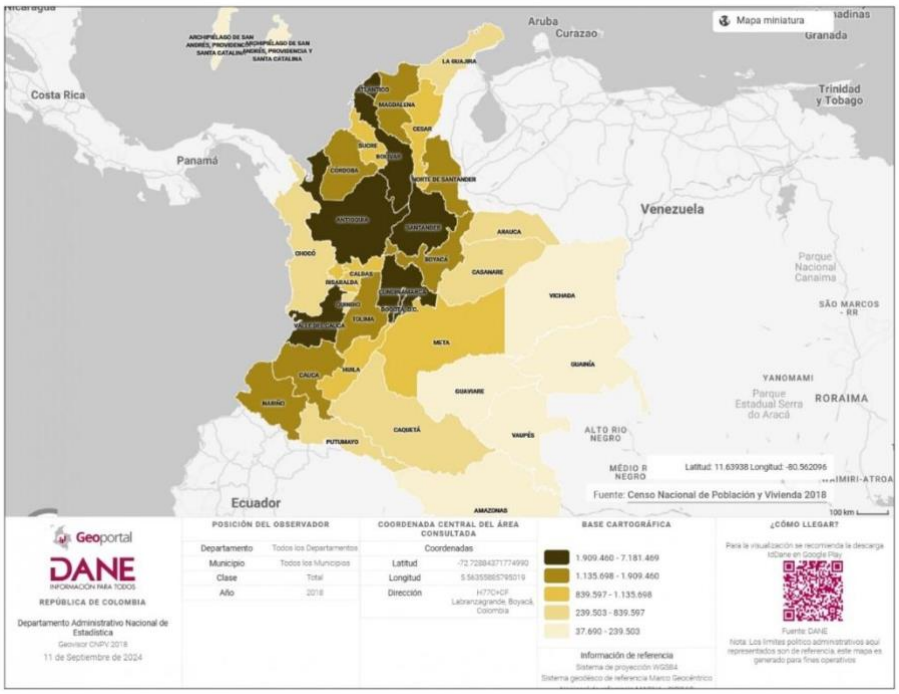


Map 3 Location of cement plants in Colombia

The assumption that pollution effects decrease with distance from the source is valid in many cases, there are multiple factors that can influence the dispersion and concentration of pollutants. Factors such as wind direction and speed, atmospheric stability conditions, terrain topography, and fuel and emissions characteristics play a key role in how pollutants are distributed in the environment.

According to our experience and arbitrarily, a 6.21 miles radius to analyze the potentially exposed population is a valid strategy for a preliminary analysis. It is important to adjust this distance with specific studies, such as atmospheric dispersion models that consider local conditions. These studies will allow us to estimate more accurately the extent of the affected area and the concentration of pollutants as a function of distance.

The next step could be to obtain local meteorological data and use dispersion models, such as AERMOD[66] or CALPUFF[67], to simulate how emissions behave in the area. Once this data is obtained, you could check if the 6.21 miles radius is representative or if it is necessary to adjust it according to the results.



Map 4 Population distribution in Colombia

[66] AERMOD View is a complete and powerful air dispersion modeling package which seamlessly incorporates the U.S. EPA's preferred regulatory air dispersion model into a robust, easy-to-use interface. https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models#aermod

[67] CALPUFF Modeling System is an advanced non-steady-state meteorological and air quality modeling system. https://calpuff.org/

In the area of influence of the cement plants in Colombia, 6.21 miles around, 9,173,217 people live, according to the 2018[68] census. This population may be potentially at risk due to emissions that may be generated by the cement production process, a situation that may increase with the use of waste-derived fuels without adequate control measures.

In order to effectively determine the impacts on the environment, it is necessary to carry out studies where sufficient information is available, meteorological, such as wind rose, temperature data, etc., quality and composition of the fuels, heights of chimneys,

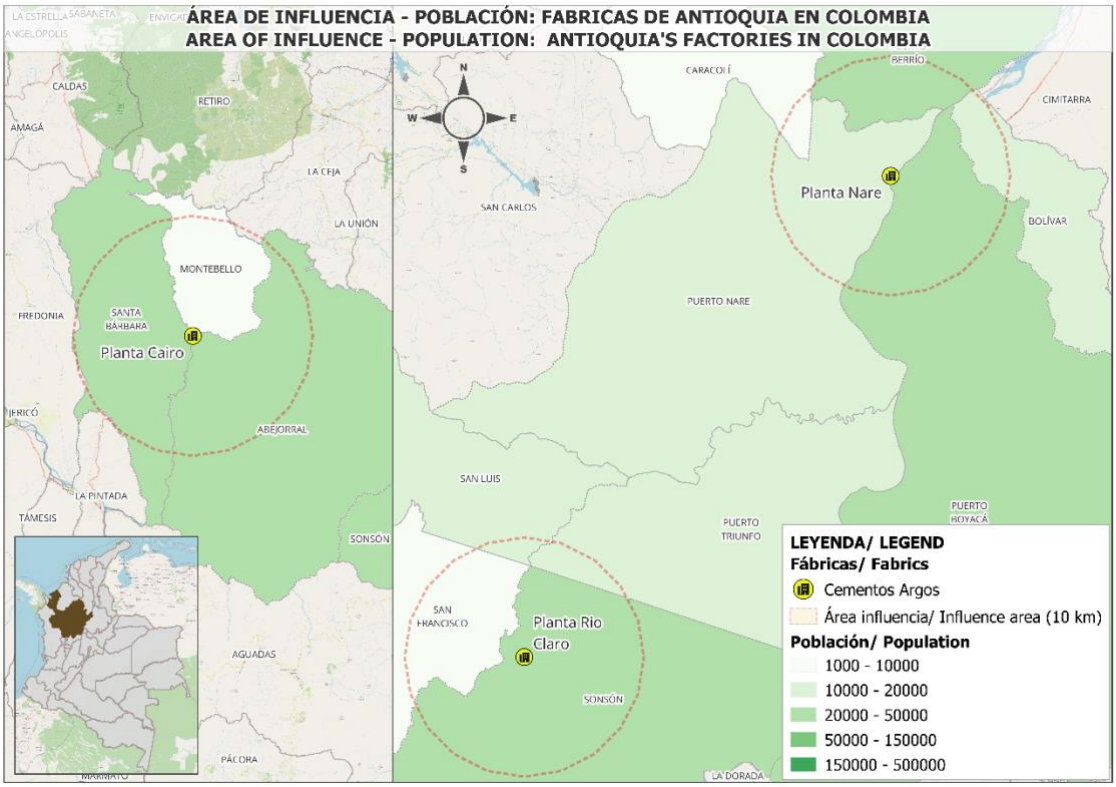
To ensure that emissions remain within the permitted standards and do not affect public health or the environment, detailed studies are required. For studies, sufficient meteorological information must be available, such as wind direction and speed (wind rose), local temperatures, chimney heights, topography data, fuel composition and quality, operating temperatures of the furnaces used. Once this information is available and the appropriate dispersion models have been applied, critical pollution points can be determined.

Industry Department Antioquia

There is no clear or documented evidence of major conflicts in Antioquia associated with the Río Claro, Nare and El Cairo plants. However, there may be unformalized concerns, especially in relation to air quality and health, issues that should be monitored more closely by the authorities and the company to prevent future conflicts.

The Rio Claro plant has been a pioneer in the use of used tires as fuel since 2015. Although this process is aligned with circular economy practices and aims to reduce the use of coal.

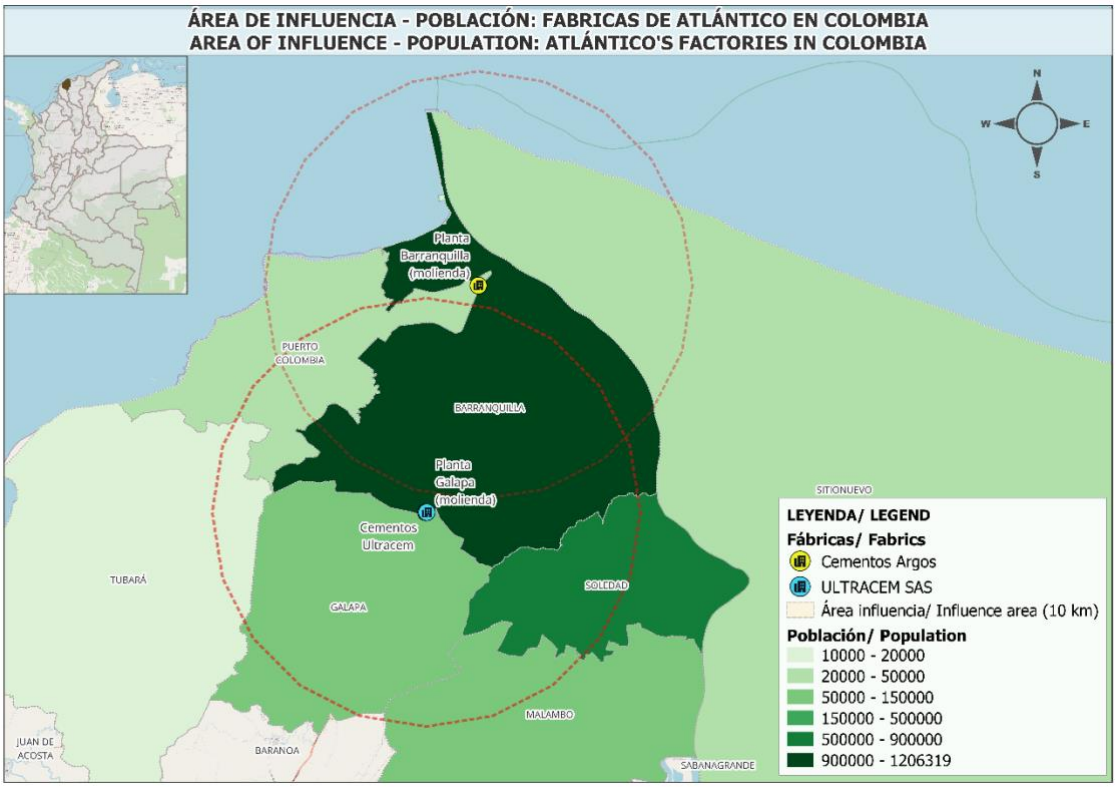
[68] DANE - Censo Nacional de Población y Vivienda 2018
https://www.dane.gov.co/index.php/estadisticas-por-tema/demografia-y-poblacion/censo-nacional-de-poblacion-y-vivenda-2018



Map 5 Area of influence

Industry Department of Atlántico

In the department of Atlántico, cement production has been associated with some environmental concerns and conflicts related to pollution, especially due to the operations of cement plants that generate emissions into the atmosphere. The most notable case is that of the Ultracem plant, located in Galapa, near Barranquilla, which has been the subject of concerns by the community regarding air pollution and its impact on public health; according to the 2018 census, 1,836,624 people live in the area of influence of the cement plant. . However, no significant conflict with the communities in terms of health or air quality has been publicly recorded.



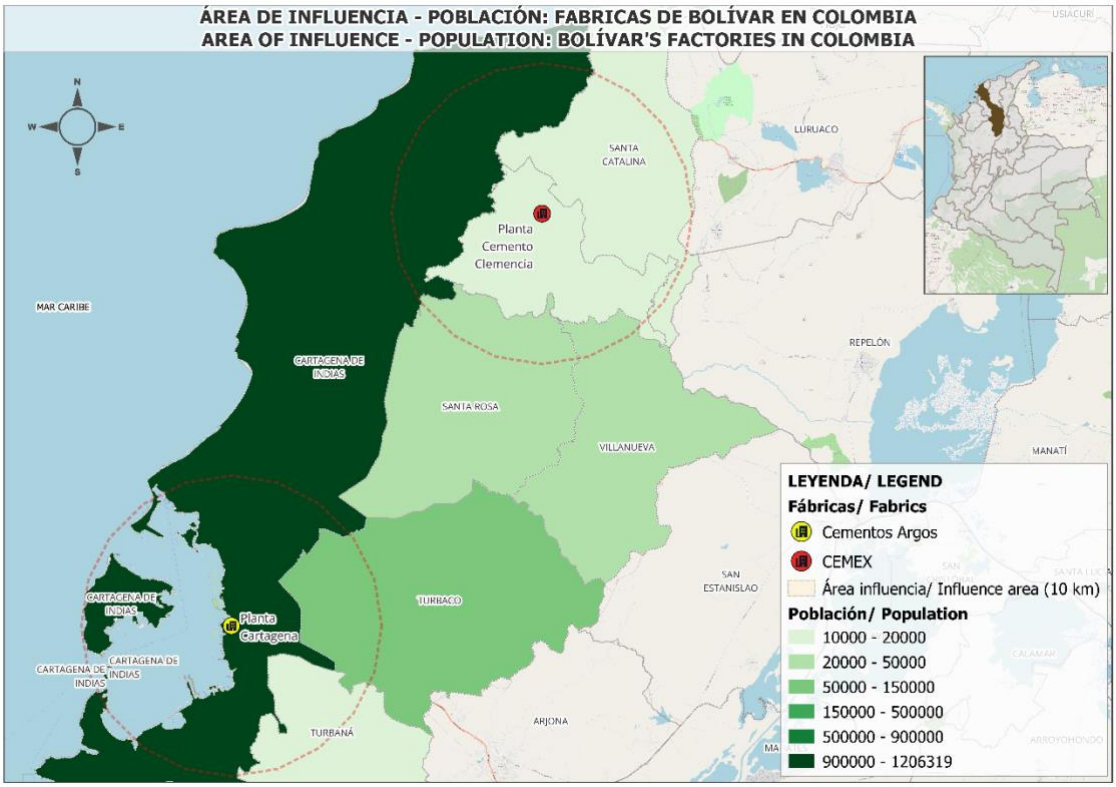
Map 6 Area of influence

Industry Department of Bolívar

In the department of Bolívar in the towns of Turbaco Turbaná, approximately 100,000 inhabitants reside in the area of influence of the Argos cement plant. The Argos Cartagena plant is one of the company's largest and most modern in Colombia, and has implemented waste co-processing as part of its strategy to reduce the use of fossil fuels, using oily sludge and urban waste.

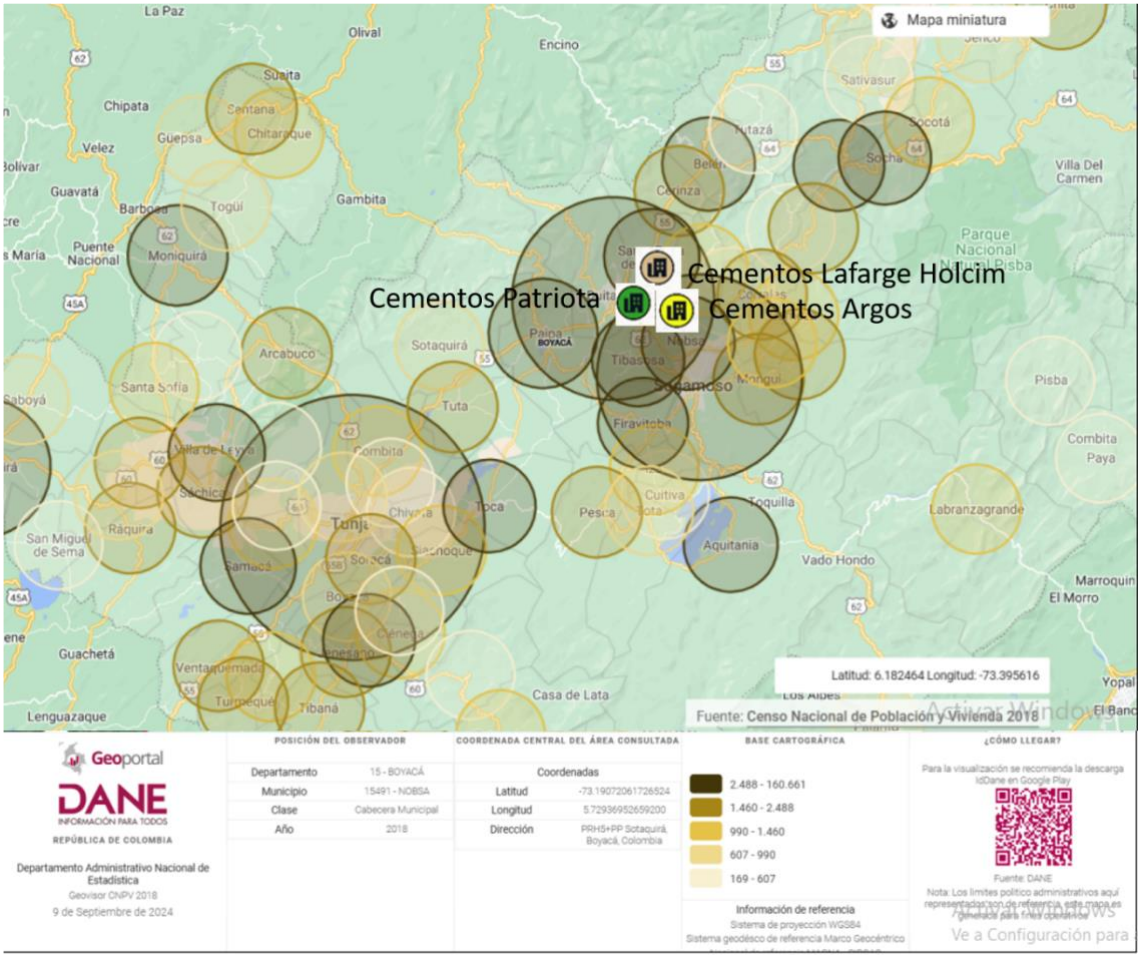
Although the plant has been praised for its focus on sustainability and efficiency, emissions from the use of Residue-Derived Fuels (RDF), such as used tires and other industrial waste, can cause concern in the nearby population. However, no significant conflict with the communities in terms of health or air quality has been publicly recorded.

Cemex Latam Holdings' La Clemencia plant, also located in Bolívar, has an approximate population of 1,000,000 people in the area of influence. As in the case of Argos, there have been no reports between the community and Cemex regarding contamination. However, the use of waste in cement production can pose potential risks to the environment and health, which requires constant monitoring.



Map 7 Area of influence

Industry Department Boyacá



Map 8 Population density in Boyacá area of influence

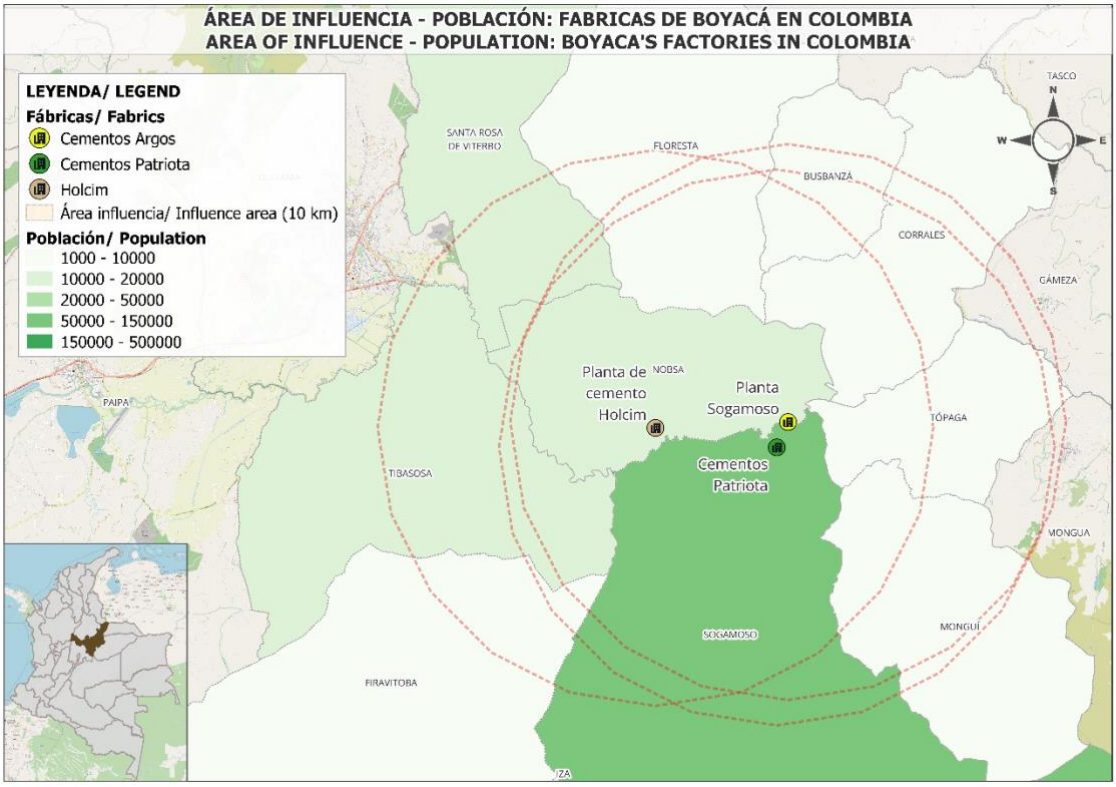
In the Boyacá department, in the towns of Nobsa and Sogamoso, there are approximately 334,000 inhabitants and three cement production plants, Cementos LAFARGEHOLCIM, Cementos PATRIOTA, Cementos ARGOS.

The LafargeHolcim plant has implemented, through Geocycle, a specialized co-processing service in its kilns, which includes the elimination of hazardous products, incineration of industrial waste, plastics and pharmaceutical products in its cement kilns in a controlled manner. This practice, although aligned with sustainability initiatives for waste reduction, has generated concerns in some sectors of the population. As a result, several lawsuits have been filed, requesting detailed studies on the possible environmental and public health effects.

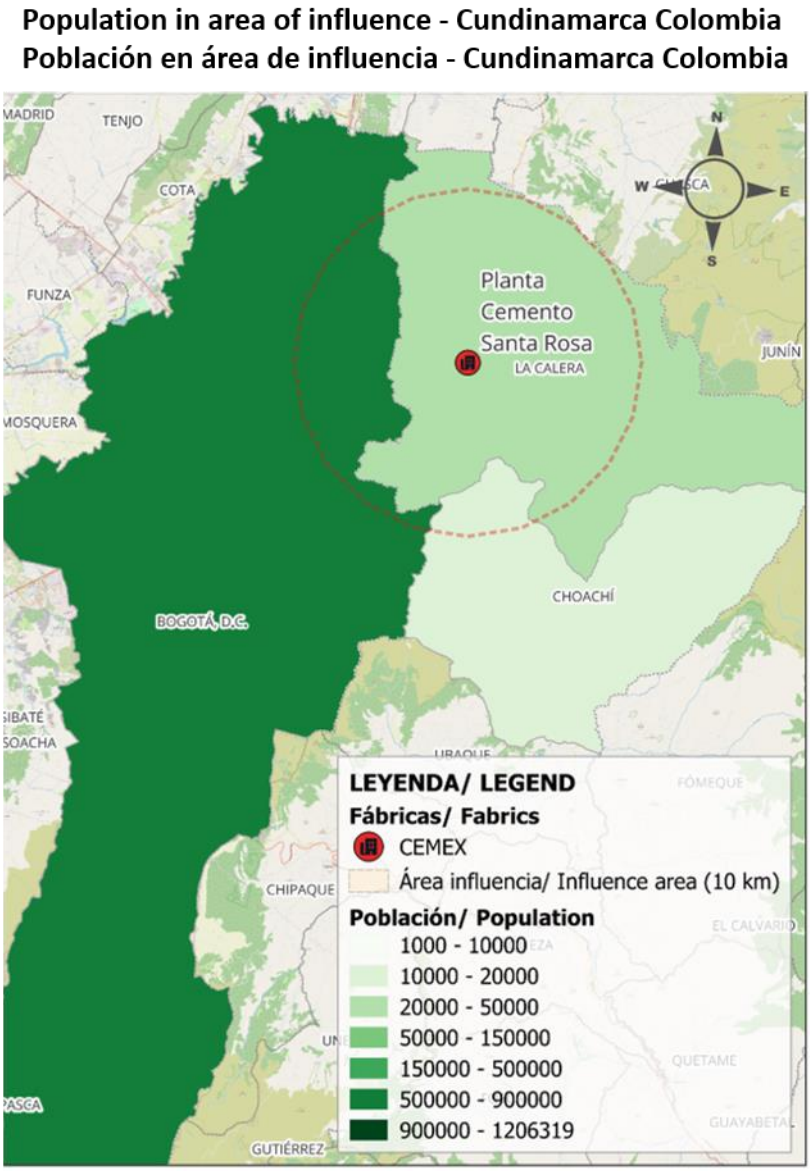
In Colombia, cement companies such as Holcim have faced several lawsuits and controversies related to their environmental practices, especially around the use of alternative fuels, such as the burning of toxic waste. In Nobsa, Boyacá, Holcim is involved in a conflict with environmental activists due to the incineration of industrial waste, plastics and pharmaceuticals in its cement kilns

and mining production. Concerns focused on the effects of these practices on public health and the environment.

Following pressure from these campaigns, Holcim announced that it would stop burning toxic waste at the Nobsa plant. However, the use of other waste as alternative fuels, including industrial and agricultural waste, was also subject to criticism.



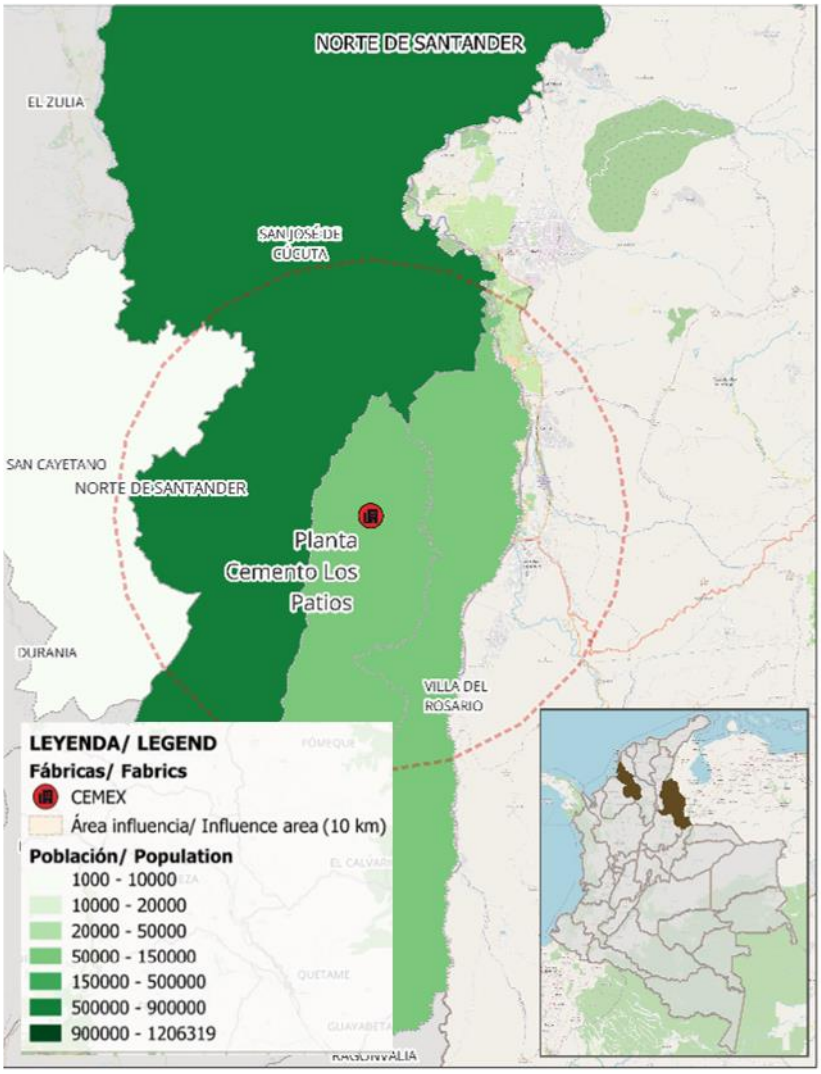
Map 9 Area of influence



Map 10 Area of influence

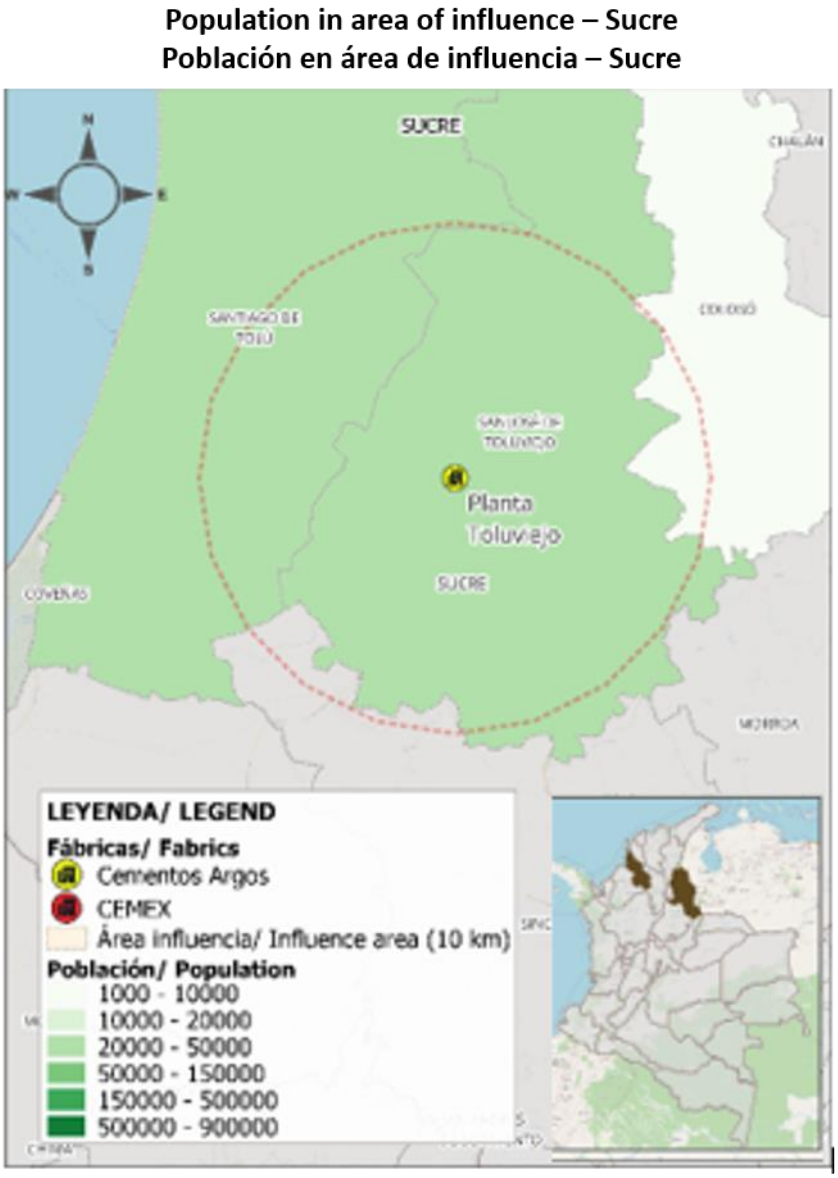
In La Calera, Cundinamarca, Cemex LatamHoldings' Santa Rosa cement plant has been a focus of environmental concerns related to pollution. The plant, which plays a crucial role in cement production due to its proximity to Bogotá, the capital of Colombia, has raised concerns about its impact on air quality, water resources and the health of local communities. La Calera has a population of 28,500 inhabitants, but can influence pollution in the capital, which has approximately 7,500,000 inhabitants according to the 2018 census; this influence can aggravate the pollution produced by the city's vehicle fleet.

Population in area of influence – Norte de Santander
Población en área de influencia – Norte de Santander



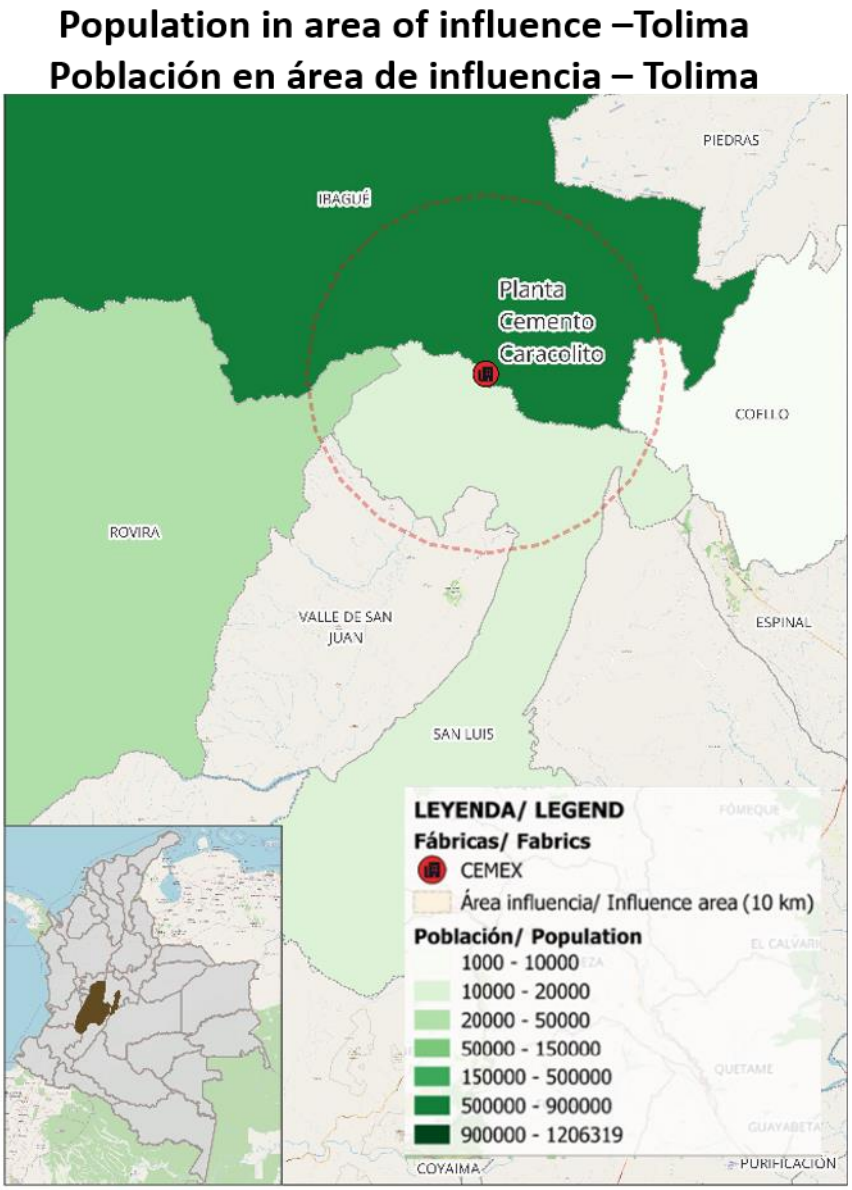
Map 11 Area of influence

The population in the area of influence is approximately 800,000 inhabitants and there are no reports of conflicts with the community.



Map 12 Area of influence

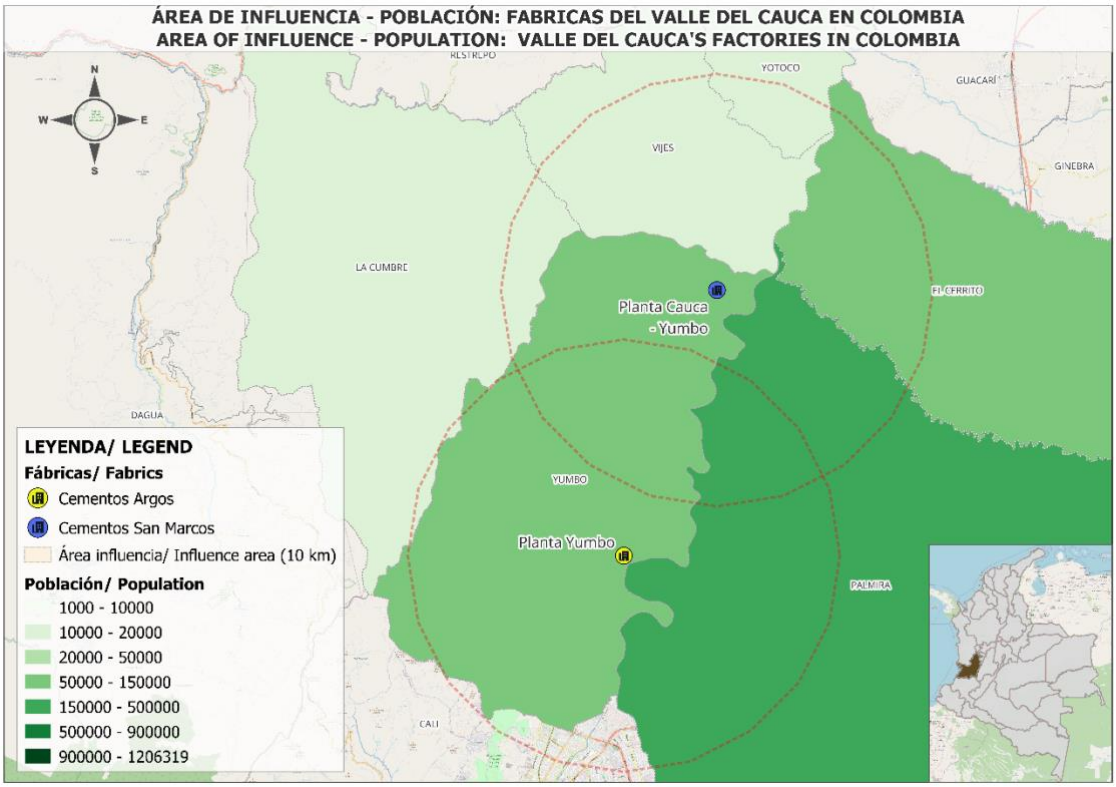
Local environmental authorities, such as the Regional Autonomous Corporation of Sucre (CARSUCRE), have monitored the plant's activities and carried out inspections to ensure that the plant complies with current environmental regulations. However, residents continue to demand greater intervention by the authorities to protect their rights to a healthy environment. According to the 2018 census, 380,000 people live in the area of influence of the cement plant.



Map 13 Area of influence

Cemex Latam Holdings operates one of the largest cement plants in the department of Tolima, called Caracolito, in the municipality of San Luis near Ibagué, in this plant, which uses rice husks as fuel. This plant, like many others in the industry, has faced concerns and controversies regarding its environmental impact, particularly in terms of air pollution, water use and the health of nearby communities, whose population amounts to 500,000 inhabitants.

Industry Department Valle del Cauca



Mapa 14 Área de influencia

In this region of Colombia, the Cementos Argos and Cementos San Marcos plants operate, located in the municipality of Yumbo. Approximately 380,000 inhabitants live in the region, which is directly influenced by the company, although the inhabitants of the city of Cali could be affected. Currently, there are no reports of environmental conflicts in the area due to cement production.

Population in the area of influence

cements company	Department	Town/City	population	Factory/Plant	Area of influence 10 km radius	population
ALIÓN	1 Antioquia	Sonson	31,861	Alión	Puerto Triunfo,	17,231
ARGOS	1 Antioquia	Puerto Nare	12,161	Nare	Caracoli, Puerto Berrio, Puerto Boyaca	85,552
ARGOS	2 Antioquia	Montebello	5,881	Cairo	Santa Bárbara, Abejorral	39,629
ARGOS	3 Antioquia	Sonsón	31,861	Rio Claro	San Francisco, San Luis, Puerto Triunfo	33,716
ARGOS	4 Bolivar	Cartagena	887,946	Cartagena	Turbaco Turbaná	100,217
ARGOS	5 Boyacá	Sogamoso	120,462	Sogamoso	Tópaga, Mongui,Tibasosa, Nobsa, Floresta, Busbanza, Corrales	39,668
ARGOS	6 Sucre	Tolú Viejo	20,033	Toluviejo	Santiago de Tolú, Coloso, Sincelejo, Corozal	380,787
ARGOS	7 Valle del Cauca	Yumbo	95,040	Yumbo	Vijes, Palmira, Cali, La Cumbre	2,149,156
CEMEX LATAM HOLDINGS	1 Bolivar	Clemencia	13,821	La Clemencia	Santa Catalina, Villanueva, Santa Rosa, Cartagena	941,495
CEMEX LATAM HOLDINGS	2 Norte de Santander	Los Patios	81,411	Los Patios	Cucuta, Villa del Rosario, San Cayetano	729,826
CEMEX LATAM HOLDINGS	3 Tolima	San Luis	12,139	Caracolito	Valle de San Juan, Ibague, Coello	512,683
CEMEX LATAM HOLDINGS	4 Cundinamarca	La Calera	28,501	Santa Rosa	Choachi, Bogotá	7,191,866
LAFARGEHOLCIM	1 Boyacá	Nobsa	14,651		Tópaga, Mongui,Tibasosa, Nobsa, Floresta, Busbanza, Corrales, Sogamoso	160,130
PATRIOTA	1 Boyacá	Nobsa	14,651	Patriota	Tópaga, Mongui,Tibasosa, Nobsa, Floresta, Busbanza, Corrales, Sogamoso	160,130
SAN MARCOS.	1 Valle del Cauca	Yumbo	95,040	San Marcos	Vijes, El Cerrito, Palmira, La Cumbre	380,270
TEQUENDAMA	1 Cundinamarca	Suesca	15,401	Tequendama	Gachancipa, Sequile, Nemocón	59,723
ULTRACEM	1 Atlántico	Galapa	55,123	Ultracem	Barranquilla, Soledad, Malambo, Tubará, Puerto Colombia	1,836,624.0
Total			1,535,983			14,818,703

Conclusions

The use of Refuse-Derived Fuels (RDF) in the industry in Colombia is becoming widespread, addressing national policies and environmental and public health challenges related to this process. Some key points are:

1. Use of Refuse-Derived Fuels (RDF) in the cement industry has been adopted in the roadmap prepared by FICEM and PROCEMCO, including in the clean development mechanisms the concept of replacing fossil fuels with alternative fuels.
2. The National Energy Plan 2020-2050 promotes the diversification of the energy matrix, including energy recovery from solid waste. This is aligned with tax incentives to encourage the use of non-conventional energy sources.
3. The use of RDF is presented as a solution aligned with the circular economy and climate change mitigation, greater control and monitoring of negative impacts must be exercised, especially in nearby communities.
4. The use of RDF generates health risks, especially in communities close to cement plants.
5. Environmental control authorities need to improve their capacity to exercise control and surveillance in the areas of influence of the industry.

Annexes

Annex 1 other names for Refuse Derived Fuels

- Climafuel registered trademark of CEMEX
- Alternative fuels
- Tire Derived Fuels (TDF)
- Waste Derived Fuels (WDF).
- Process Engineered Fuels (PEF)
- Solid Recovered Fuel (SFR)
- Formulated Solid Fuel
- Plastic fuels
- Pyrolytic products
- Energy recovery

Annex 2 Waste Management Standards

- Law 9 of 1979, the National Health Code, establishes the health standards in relation to human health and the procedures and measures that must be adopted for the regulation, legalization and control of the discharge of waste and materials that affect or may affect the sanitary conditions of the environment.
- Decree 1713 of 2002 and its amendments, which establishes standards aimed at regulating the public sanitation service within the framework of the comprehensive management of ordinary solid waste, in matters relating to its components, levels, classes, modalities, quality, and other similar matters.
- Law 1672 of 2013 establishes Extended Producer Responsibility: “Post-consumer waste management is essentially based on the concept of Extended Producer Responsibility – EPR, which can be defined as an instrument that obliges manufacturers and importers of certain consumer products to organize, develop and finance the comprehensive management of waste derived from their products, once the final consumer discards them.
- The objectives of the EPR policy in Colombia are the following:
- That post-consumer waste does not continue to be managed together with other domestic waste, generating impacts on the environment and health.
- Influence the change in consumption patterns of Colombian society and in production patterns (efficient use of resources, reuse of materials, recycling).
- Promote the use and valorization of waste.”
- Regarding tires, Resolution 1326 of the Ministry of Environment and Sustainable Development, which establishes the Selective Collection and Environmental Management systems for Used Tires, states:

"Article 12…, the use of used tires in the national territory must be encouraged through recycling and valorization of their energy component.

Specific standards for the cement industry

Co-processing in Colombia is regulated by Resolution 802 of 2014 of the Ministry of Environment and Sustainable Development, which in its recital states:

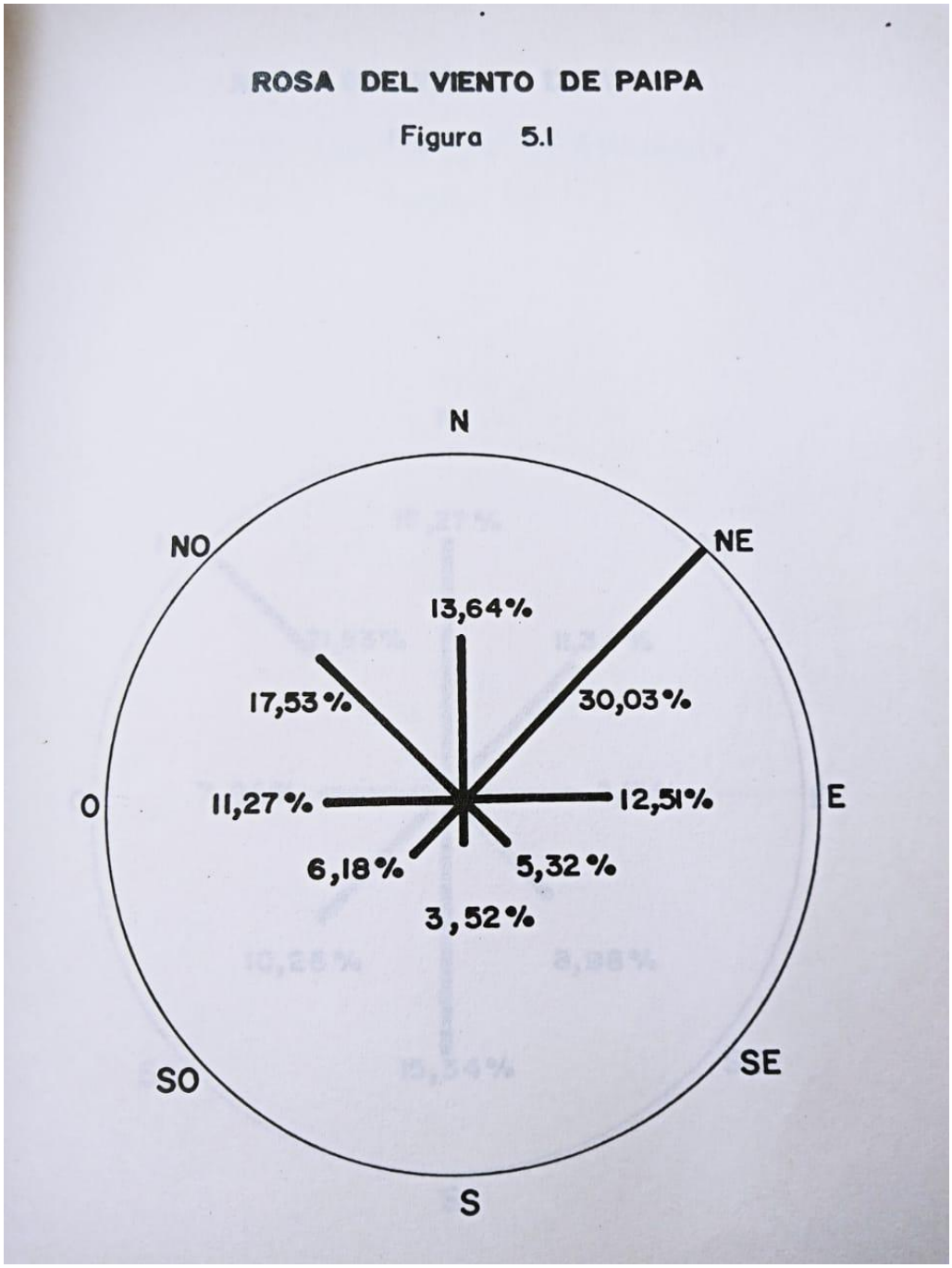
"That the co-processing of non-hazardous waste is an activity that offers an additional alternative to conventional processes of final disposal of waste in landfills and incinerators;" adding in its "ART. 60.—. Thermal treatment of non-hazardous waste will be allowed in cement kilns that carry out co-processing, as long as the emission standards established in table 33A are met."

Annex 3: Paipa wind rose

TABLA 5.3 Resumen de las corridas del subprograma Norma de Emisión *

	Unidad	Zipaquirá	Amagá	Yumbo	Tasajero	Paipa
Norma calidad a/	gr/m^3	77,22	92,26	91,00	96,72	76,13
Norma calidad b/	gr/m^3	308,88	369,05	364,04	386,89	304,55
Norma emisión	Kg/hr.	318,59	598,19e/	136,77	554,38	355,42
Eficiencia equipo c/	%	97,73	81,74	97,10	85,53	93,08
Partículas retenidas d/	Kg/hr.	13.764,90	2.931,59	4.588,50	3.276,98	4.785,03
Total partículas	Kg/hr.	14.083,50	3.586,17	4.725,30	3.831,37	5.140,45
Número unidades		4	1	3	1	3

* Sin equipos de control.
a/ Promedios anuales para partículas y óxidos de azufre.
b/ Promedios en 24 horas para partículas y óxidos de azufre.
c/ Eficiencia mínima requerida para el equipo de control.
d/ Cantidad mínima que se debe retener.
e/ Para una altura de descarga de cien metros.



Annex 4 Geospatial Analysis CNPV 2018
Fuente https://geoportal.dane.gov.co/geovisores/territorio/analisis-cnpv-2018/?lt=4.646075&lg=-74.088605&z=20

Annex 5 Annex C Part II of the Stockholm Convention on Persistent Organic Pollutants.
Part II: Source categories

Polychlorinated dibenzo-p-dioxins and dibenzofurans, hexachlorobenzene and polychlorinated biphenyls are unintentionally formed and released from thermal

processes involving organic matter and chlorine as a result of incomplete combustion or chemical reactions. The following industrial source categories have a comparatively high potential for formation and release of these chemicals to the environment:

a) Waste incinerators, including co-incinerators of municipal, hazardous or medical waste or sewage sludge;
b) Cement kilns burning hazardous waste;
c) Pulp production using elemental chlorine or chemicals generating elemental chlorine for bleaching;
d) The following thermal processes in the metallurgical industry:
    i. Secondary copper production;
    ii. Sinter plants in the iron and steel industry;
    iii. Secondary aluminium production
    iv. Secondary zinc production.