Report

Fact Finding Mission
Colombia
March 2018

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Index:

United Nations Economic Commission for Europe

GENERAL INFO

Submitted by:	**Date:**
Michal Drabik	2 July 2017

Mission:

Colombia, 11 – 17 March 2018

Type of mission:

Pre-workshop, fact-finding

Beneficiary country:

Colombia

OBJECTIVES

1. To conduct a fact-finding mission necessary for preparation of a capacity building workshop in Colombia (Summer 2018).

2. To explore the situation on the ground and learn about the actual problems and needs of all relevant stakeholders, i.e. the regulators (the Government and relevant state agencies), mine operators, project developers, and miners in Colombia

MEETINGS AND SITE VISITS

Meetings:

Meetings were held with all relevant Governmental Agencies involved in regulation, exploration, or extraction on Coal Mine Methane in Colombia, i.e.

- the National Hydrocarbon Agency (ANH) (13 March 2018) (see section *2.1.2 ANH*, and Annex I - Presentation ANH),

- the Ministry of Mines and Energy (13 March 2018) (see Annex II - Presentation MINMINAS),

- the Unit for Mining and Energy Planning (UPME) (13 March 2018) (see section *2.1.4 UPME,* and Annex III – Presentation UPME, and Annex IV – Presentation UPME – VAM),

- the Ministry of Environment (13 March 2018) (se section *2.1.5 Ministry of the Environment),*

- the National Geological Service of Colombia (SGC) (13 March 2018) (see section *2.1.1 SGC,* and Annex V - Presentation SGC),

- the National Mining Agency (ANM) (13 March 2018, plus additional meeting on 15 March 2018) (see section *2.1.3 ANM,* and Annex VI - Presentation ANM),

During the meetings problems, needs, as well as ongoing and planned projects related to the field in question in Colombia were discussed.

Meetings were held with relevant private sector stakeholders, such as:

- Durmmond Ltd. (the only company running a CBM project in Colombia) (15 March 2018) (see section *3.4.1 Case study: Drummond),*

- Argos (a cement company managing an abandoned coal mine) (14 March 2018) (see section *3.5.1 Case study: San Martin Mine Project by Argos,* and Annex VIII Pictures section *D. Cementos Argos abandoned mine)*

- Uniminas (an operator of multiple mines across the country) (12 March 2018), providing insight into the private sector's activities, needs, opportunities and difficulties in the field of CMM and AMM in Colombia (see Annex VII - Presentation UNIMINAS).

Site visits:

1. Casablanca coal mine operated by Uniminas (including visits to smaller mines conducting extractive activities based on the same concession) 12 March 2018 (see Annex VII - Presentation UNIMINAS, and Annex VIII – Pictures section *A. Casablanca Mine*);

2. Cementos Argos site in Boyacá, (including visit to the model abandoned mine project run by the company), 14 March 2018 (see section *3.5.1 Case study: San Martin Mine Project by Argos,* and Annex VIII Pictures section *D. Cementos Argos abandoned mine).*

3. SGC laboratory responsible for determining the characteristic of coal (including its methane content, porosity, etc.) (see section *2.1.1 SGC,* and Annex V - Presentation SGC).

All visits featured meetings with the management as well as high- and mid-level technical staff.

OBSERVATIONS AND CONCLUSSIONS

Observations

1. Coal Mining

- Coal mining activities in Colombia depend on the price of coal. If the price goes below 80 USD/tonne many small operators in the country stop production, as they cannot afford bringing coal to the coast (which is necessary for export).
- An average underground mine in Colombia is small (2000-4000 t/month), located in the mountains, and not adequately equipped.
    - Particularly there are large deficiency in ventilation systems, both in terms of their efficiency and design (see below – section *3.2 Ventilation*).
- Oftentimes a single concession is developed by multiple operators under contract to a larger organization (each running a separate mine).
    - Usually the sub-contractors are under obligation to sell the extracted coal to the main operator who is the owner of the concession).
- There is a problem of illegal underground mining.
    - Until detected, illegal mines are beyond control of state authorities, this is critical as they do not adhere to mine safety and health regulations, but mine rescue may still respond to accidents at these mines if needed

2. Regulatory Issues

2.1 Institutional confusion

- There are multiple Governmental agencies, with no clearly defined relative competencies related to CMM regulation and oversight.
    - E.g. Enriching through VAM, being a mining activity, is regulated by ANM, but degassing from the surface through vertical wells, not being consider as mining activity, is in the competence of ANH.
    - It is necessary to clearly establish what is gas recovery from mining activity and what is oil and gas issue.
- Relevant agencies need to coordinate their activities and exchange data.
    - Right now, however, they tend to compete with one another.

2.1.1 Servicio Geologico Colombiano (SGC)

- Works on CMM from 2010.
    - It provides technical information on the issue.
        - It focuses on where methane is located, and how it can be used for energy generation.
    - The SGC works on CMM mostly in the Centre of the Country
        - Since 2011 SGC explored 200 km2
        - The idea of the study is to drill very close to the anticline
        - Program has 4 phases:
            - Diagnosis of the information already possessed.
                - E.g. geological mapping, and evaluation of the coal seams.
            - Socialization (approach civil and military authorities as well as local communities), surface geology, and determination of the coal activity in the area (SGC seeks to drill boreholes 200 m from exploitation)
            - Evaluation of the subsurface geology.
                - The objective is to sample coal from the depth.
                - Some 100 and 200 m deep drills have already been performed.
            - Characterization of the coal potential by the SGC Laboratory
                - The laboratory use a “new” method allows for constant control of gas content in the sample and for keeping it in the “original” reservoir temperature. However, measuring gas at reservoir temperature is not new.
                - Isotherms are developed based on the desorption data by fitting the data to the Langmuir equations, this is a desorption isotherm, but industry standard adsorption isotherms are not performed in the laboratory due to lack of equipment. The current approach does not indicate if the reservoirs are saturated or undersaturated with gas.
                - Calculation of CBM resources and reserves are performed
                    - Measured reserves
                    - Indicated reserves
                    - Potential reserves
                - Fifty 300 to 600 m deep boreholes were drilled over the last 7 years (2011-2017).
                - Results allowed to obtain further data on:
                    - Rank of coal, and
                    - Type of coal.

2.1.2 National Hydrocarbon Agency (ANH)

- Established in 2003.
- Related to the Ministry of Mining and Energy.
- It administers and regulates hydrocarbons (evaluation, exploitation, production).
- Its mission is to optimize the extraction and use of hydrocarbons in Colombia.
- Functions (among others):
    - To identify and evaluate the potential for hydrocarbons in the country.
    - To evaluate, design, and promote investor activities (exploration and production).
    - To promote, negotiate, and conclude contracts for R&D of hydrocarbons in the country.

2.1.3 National Mining Agency (ANM)

- Created in 2011 under the Ministry of Mines.
- Functions (among others):
    - Promoting mining activity.
    - Contracting (gives and authorizes contracts to be exploited).
    - Follow up and control of already titled mines.
    - Calculating and collecting royalties.
- Beyond ANM competence remain:
    - Illegal exploitation of mines.
    - Mine closure/AMM.
        - So far only 3 stages (exploration, exploitation, and construction) are regulated
        - There is a will to create a law on mine closure.
            - It would be the 4th stage determining obligations that need to be followed in the process of mine closure.
            - Cooperation with Ministries of Mines and the Ministry of the Environment is necessary, yet, particularly in the latter case, difficult.
- The only way to exploit mine in Colombia is to have a title that is on a production stage.
- ANM issued 6690 titles for all mineral at all stages of mining process.
- Around 1200 titles were issued for coal in the whole country.
- 3 main issues ANM needs a help with:
    - Ventilation of mines.
        - It is also necessary to raise awareness among miners of how ventilation improves security of work underground.
    - Degasification of mines.
    - Prevention and control of explosions (the most important of the 3).
        - There is a lack of research on how to deal with methane and coal dust in Colombia.
        - There is a necessity for training in this field.
        - There is a lack of capacity to deliver specialized training to miners.
        - There is a general lack of awareness of the broad range of information and data that is available from other coal mining countries and published literature
            - There is a potential for establishing an International Centre of Excellence on CMM in Colombia with focus on training and research.

2.1.4 Unit for Mining and Energy Planning (UPME)

- Function: to plan sustainable development of the country.
- Sub-direction of mines:
    - Brings support to the Ministry of Mines in policy making.
    - Studies on methane are relatively new as before there was no regulation on use and exploitation of CMM.

        - Only the Law 1886 of 2015 provided a framework to do so.
    - First study was conducted in 2016 with the aim to bring information to the stakeholders operating in the field in question.
        - The goal was to gather and consolidate all information on CMM available in the country (from ANH, Ecopetrol, Universities, Geological Service, etc.)
        - The study analyses technologies utilized in other countries as at that time there were none in Colombia.
        - At the time when the study was conducted there was no data on emissions.
            - IPCC emission factor was used to estimate them.
            - With new technology it turned out that the initial estimates were overestimated by 47%
        - Results:
            - The study determined:
                - Quality of coal,
                - Technology utilised in the facilities involved,
                - Methane content in coal.
    - For further studies other organizations will be invited.
    - There is a need for contribution by international experts, due to a lack of local expertise.
    - UPME seeks to develop a project integrating VAM and drilling.
        - As for now it is beyond UPME capabilities due to:
            - Lack of resources, and
            - Lack of expertise.

2.1.5 Ministry of the Environment

- Works to fulfill Colombia's commitments under the Paris Agreement.
- CMM capture and use is a new field for the Ministry.
    - It is seen as an opportunity that could help the country to reduce its emissions.
    - It is important that all CMM activity is in compliance with law and environmental objectives of the country.
    - So far, no studies related to CMM capture and use were conducted by the Ministry.
- Ministry plans to give more attention to unconventional sources of energy, and CMM is a part of this plan.
- There was cooperation with the Ministry of Energy on some issues related coal exploration and exploitation, but it was 20 years ago.
    - There is a need to revive this cooperation.
- No environmental assessment of implementing CMM projects have been so far conducted.
    - There is a conviction that such projects would bring to the sector multiple benefits, such as:
        - GHG emission reduction,
        - Economic use of captured gas a s a fuel,
        - Improvements of the working conditions underground (risk reduction).
- Currently there are no baselines that would indicate what the impact of the CMM projects could be.
    - First step is thus to work on modelling and developing such baselines.
- The ministry sees a need to limit the negative impact of mining at every stage of the coal-mining life cycle.
    - There is an awareness and a concern in the Ministry about abandoned mines that are not properly managed.

2.2 Lack of clarity in CMM definition

- Resolution 180742 of 18 May 2012 does not distinguish between non-conventional resources such as shale gas, oil sands, and CMM.

- A base line distinction between CBM and CMM is necessary.
  - In order to do so art. 59 was inserted to the Directive 1886.
- Technical regulations related to unconventional resources are set by the Ministry of Energy.
  - There are contract forms designed for unconventional resources.
  - In 2014 Ministry of Energy issued ToR on exploration of unconventional resources.
  - There are no ToR, or any other regulation on production of unconventional resources.
    - Such situation effectively inhibits development of any CMM/CBM projects

3. Specific Issues

3.1 Fatalities

- Mining industry causes more fatalities that all other industries combined. There is a very high mortality rate in Colombian underground mines (in 2017 there were 113 accidents that caused 136 deaths. These accidents occurred in both, legal and illegal mines. The distribution was approximately half-half.).
  - While these number have been relatively stable over the last decade (around 100 accidents and 100 deaths per year), over the last 3 years the number of casualties is gradually growing (from 92 to 136).
  - As in 2014 illegal mining activity increased, so did also the number of accidents.
  - From 2005 to 2018 there were 1073 emergency situations (not only accidents) causing death of 1283 people.
  - Causes of emergencies:
    - 13% methane explosions,
    - 15% noxious atmosphere of the mines,
    - 35% landslides.
  - Causes of fatalities:
    - 27% explosions of methane and coal ashes,
    - 16% noxious atmosphere of the mines
      (i.e. 43% of deaths are related to methane).
  - Major causes of safety problems:
    - Illegal exploitation.
    - Most of title holders do not have resources to assure adequate safety conditions (why are the titles given?).
    - Nonfulfillment of obligations.
      - While equipment is oftentimes available, many mines do not technically assume the risk.
    - Lack of technological acknowledgment of safety engineering.
      - Lack of experts on ventilation.
  - According to the standing regulation there are 3 categories of mines in Colombia:
    - With zero to very low methane concentration,
    - With up to 0.3% methane concentration,
    - With over 0.3 % methane concentration (which require special precautions).
  - The above division is difficult to implement.
    - There is a not enough information about methane concentration in the title;
    - Strict adherence to the law and the resulting classification of many mines as category 3 mines would cause closure of many of them;
    - Gas concentration is measured during the follow up procedure for the titles. The procedure is not efficient, as mines specially prepare for it and thus in majority of cases manage to be classified as category 1 mines.

3.2. Ventilation

- There is a substantial deficiency in ventilation systems, in terms of their efficiency and design.
    - In some cases, while the quantity of air moved through the mine conforms with the regulation, not enough methane is removed in the process (due to faulty design of the ventilation system) thus allowing for accumulation of the gas in certain parts of the mine in eddies and blind roadways ("pockets").
    - In some mines there is a twofold problem: on the one hand, the ventilation system is not sufficiently efficient to provide enough air to dilute methane concentration to safe levels (in particular methane is being collected in "pockets" which occur due to faulty design of the ventilation system); on the other hand, when more air is being provided it can cause spontaneous combustion of coal.
    - Companies/mine operators often lack personnel to deal with all the problem that they face (due to accumulation of tasks the personnel oftentimes do not have time to deal with inefficient ventilation).
    - In many cases there is not enough electricity available to secure efficient ventilation (as it is used for extraction purposes).
    - There is not enough data about the "gassiness" of mines. Without knowing how much methane is in the mine it is difficult to properly assess efficiency of the ventilation system.

3.2.1 VAM

- It is estimated that for an auto-generation VAM project is required 500,000 m^3/h with concentration 0.7% of methane.
    - However, in Colombia such numbers are never present, i.e. VAM projects are not viable under the present conditions found at operating mines.
    - Potential alternative: oxidation of VAM.
        - If price of carbon in Colombia reaches the California's level of 14.75 USD, such projects would be viable (carbon market with guaranteed minimum price is necessary).
            - According to local estimates break even cost is 10.31 USD for 10 years of carbon price and 4.36 USD after year 11.

3.3. Emissions

- One of Colombia's international commitments is to lower methane emissions.
- One of the point s of the national strategy is to provide energy from fossil fuels in a cleaner way.
- According to the local estimates there is 200,000 t of CMM emissions per year.
- If CBM is captured, Colombia will be able to register reduction of CMM emissions only with the first extracted tonne of coal, i.e. in 12 years.
    - According to local regulation coal extraction can start only 8 years after CBM gas capture.
- CMM is treated as a fugitive emission.

3.4. CMM/CBM

- There is lack of information about methane resources and reserves.
    - Determination of estimating resource and establishing proven reserves of methane should be a priority.
    - Over the last year UPME has been trying to coordinate activities of various Governmental agencies in order to develop such study.
- In Colombia there are 12 mine zones where CMM is present.
- Some coal seams in the country have good potential for CMM extraction.
- There are multiple regulatory issues preventing development of CMM/CBM projects in Colombia.

    - Directive 1886 of 2015 states that if there is a proven high concentration of methane, operators should drain it either before or during exploitation.
    - Resolution 90325 of 2014 provides a basis for use of CMM, being concerned mostly with security but also allowing for self-generation of energy.
    - According to the current regulation any mine that exceeds its energy capacity will be able to sell the surplus to the grid.
    - At the same time according to law 1715 of 13 May 2014, gases generated by mining industry are not considered as potential alternative sources of energy (art 11-14).
        - There is a will to change it.
        - The goal is to allow companies to capture CBM, assuring at the same time that the benefits of such activity would be distributed also to the miners.
- There is a lack of knowledge and regulation of how to simultaneously exploit conventional and non-conventional resources.
- There is an issue of ownership of methane between the owners of adjacent concessions.
- Mines interested in developing CMM projects (such as Casablanca) lack sufficient data (on volume of methane gas resources contained by the coal seams and surrounding strata, permeability, volatility of gas, gas release rate, etc.) what prevents them from certifying their concessions on international markets.
- Drilling necessary for determining viability of CMM projects is very costly (in Casablanca mine it is estimated to cost up to 3 million USD), thus in most cases beyond the reach of mine operators.
    - Consequently, local mine operators are looking for a support from international organizations and foreign states.
- The obligatory negotiations with indigenous people (Consulta Previa) on whose land a mine or a project is to be developed tend to be very lengthy and difficult.
    - Public hearings with local communities are obligatory.
        - Communities tend to have high demands for job opportunity, financial compensation, etc.

3.4.1 Case study: Drummond

- The company originally applied for a licence that included a large area.
    - The application was rejected.
- Then it applied for a smaller licence. It took 6 years to obtain it.
    - It is a very difficult and time-consuming process.
    - It has not yet obtained an environmental permit.
- The company degasses areas close to their open pit mines and covering part of the adjoining mine owned by Cerrejon, a partially state -owned and international joint venture.
- It is very difficult to develop a stable relation between two operators focused on the one hand on gas and coal and on the other hand with a company that is focused solely on coal extraction.
    - Drummond can do it because it covers both of these areas by itself. However, where there are two separate entities Drummond and Cerrejon, with two different objectives involved, it is very complicated
- Very few companies are still interested in CBM
    - There was much more interest in 1980's.

3.5. AMM

- There are local environmental rules that needs to be follow during the process of mine closure in Colombia.
- New law requires all mines above 3000 m to be closed for environmental reasons (mostly water concerns).

3.5.1 Case study: San Martin Mine Project by Argos

- Argos bought the mine from Sator (which operated it from 2004 to 2012)
    - The company obtained 75 acres of mine title.
- On the basis of the results obtained from 12 drilled wells, Argos estimated production to reach 5000 tonnes/month.
- There were two coal seams – 2.20 m and 4.80m with a 20˚ dip angle.
- According to the study based on the drills, the company decided to build a tunnel parallel to the borderline established by the law.
    - The tunnel had $5m^2$, and was 330 m long. It cut across the seams.
    - There was also another tunnel one built by the previous owner at 3200 m.
    - The company planned to extract coal by going up, in order to connect the tunnels, but the new law prevented such activity.
- Ventilation
    - A gravity ventilation (a natural air flow).
    - A number of 3 to 5 PS fans were installed as an auxiliary ventilation for dead spots.
    - There was also an additional ventilation shaft with 12 PS fan.
    - There were no problems with methane as such.
- Employment
    - 100 people were employed at the time of closure
- Closure
    - Rationale:
        - Licence expired in 2011 and since the large part of the mine was above 3000 m (only 30% of the title were below the limit set by the new law) the full licence could not be extended (the entry was at 3000 m but the majority of the coal deposit was at 3200 m) Consequently, the company decided to close the mine.
            - Program to close the mine started in 2013
    - Environmental issues – necessity to revegetate the area, i.e. to bring it to the environmental state as it used to be before the commencement of mining activities.
        - This requires restoring:
            - Physical and chemical stability;
            - Water situation;
            - Territory situation.
    - Social issues – necessity to take care of the workers and the communities affected by the closure.
    - Technical issues – necessity to fill up the tunnel.
    - In Colombia there is no established procedure of mine closure that needs to be followed.
        - However, there are certain rules and regulations (e.g. environmental) that need to be complied with.
            - Argos did much more than required.
    - Before the closure the company conducted number of studies to assess the cost of the process.
        - It assessed the risk for workers.
        - It assessed the risk of removing equipment.
            - The company removed steal arches from the tunnel and reused them in another mine.
                - In the first 50 m of the tunnel arches were left intact.
    - Physical closure
        - The tunnel, except of the first 50 m that were left intact, was filled with plastic bags filled with rocks.
        - The wall was built to prevent entry to the mine (also at the second entry utilized by the previous owner).
            - The wall is not a seal – it does not prevent gas escape.

- There is a pipe in the wall at the main entry to prevent gas accumulation.
- A pipe was built to drain the water.
  - Drained water is now cleaner that at the time when the company bought the mine.
    - There is no residue – no need to treat it any further.
- The ventilation shaft was covered with concrete
  - The fan was removed.
  - 2 m long pipe was left to prevent gas accumulation.
- The equipment was given to the company specialising in its disposal.
- The plants were restored on the terrain in the same proportion as originally encountered
- The terrain was donated to municipality.
  - Before donation, it was agreed what the municipality is going to use the terrain for (multifunctional sport centre).
- Previous owner had a dumping place for debris which Argos also revegetated.
  - The company stabilized it.
  - The company planted plants on it.
  - The company built ducts from cement bags to remove water.
- All exterior infrastructure, including the office building constructed by the previous owner, was removed.
- The terrain is monitored
  - There is a problem of theft of the monitoring infrastructure by the local population.
- Lessons learned:
  - It is necessary to have a detailed plan for mine closure and an adequate budgetary reserve to implement it.
    - Argos underestimated the costs of closure.
    - As it is required in certain states of the USA, Argos now keeps a special earmarked reserve for expenses related to mine closing (a fund for mine closure).
      - The company requires the same from mine operators that it cooperates with.
      - Argos does not have any more underground mines but it has open pit mines

Conclusions

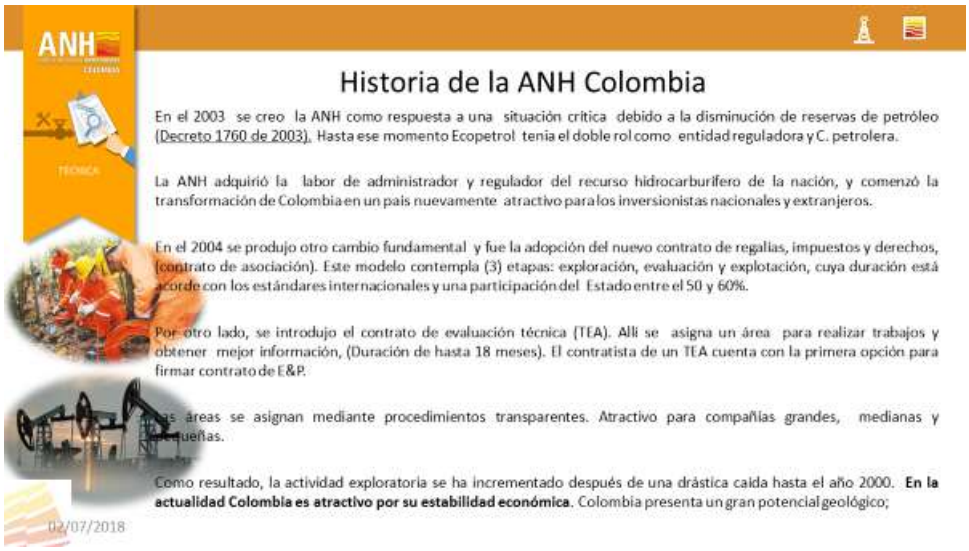
- There is a need for capacity building activities in Colombia, as well as for technology transfer to the country.
- There is a will to improve the situation, which provides the Group of Experts with an opportunity to get actively involved and to share its expertise.
- A two-day-long capacity workshop is to be delivered this summer.
- The workshop is to be directed to policy-makers / regulators, mine operators, project developers and miners.
- There is an interest to host an International Centre of Excellence on CMM in Colombia.
  - A potential ICE-CMM should be focused on training trainers and on best practice dissemination activities

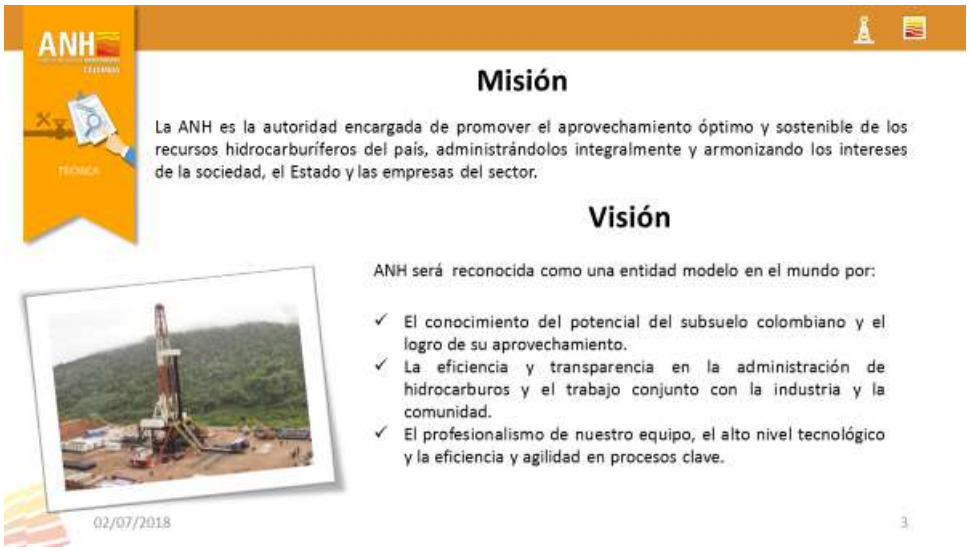
Follow-up

- Follow up with UPME and the Bureau of the Group of Experts to decide the content and logistics of the upcoming workshop in Colombia (Done; event scheduled for 24-25 July 2018; agenda – *see* annex IX).
- Follow up with Durmmond Ltd. on private sector's involvement in the workshop (Done).
- Follow up with ANM on potential establishment of ICE-CMM in Colombia (Done; work in progress).

Annex I

Presentation ANH





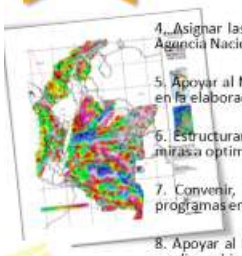
Funciones

Son funciones de la Agencia Nacional de Hidrocarburos -ANH, las siguientes:

1. Identificar y Evaluar el potencial hidrocarburíferos del país.

2. Diseñar, evaluar y promover la inversión en las actividades de E&P, con las mejores prácticas internacionales.

3. Promover, negociar, celebrar y administrar los contratos y convenios de E&P de O&G de propiedad de la Nación, así como hacer el seguimiento al cumplimiento de todas las obligaciones previstas en los mismos.



4. Asignar las áreas para exploración y/o explotación con sujeción a las modalidades y tipos de contratación que la Agencia Nacional de Hidrocarburos -ANH adopte para tal fin.

5. Apoyar al Ministerio de Minas y Energía en la formulación de la política gubernamental en materia de hidrocarburos, en la elaboración de los planes sectoriales y en el cumplimiento de los respectivos objetivos.

6. Estructurar los estudios en las áreas de G&G para generar nuevo conocimiento en las cuencas sedimentarias con miras a optimizar el aprovechamiento del recurso hidrocarburífero y generar interés exploratorio y de inversión.

7. Convenir, en los contratos de E&P los términos y condiciones sociales; los cuales, las compañías adelantarán programas en beneficio de las comunidades ubicadas en las áreas de influencia.

8. Apoyar al Ministerio de Minas y Energía y demás autoridades en los asuntos relacionados con las comunidades, el medio ambiente y la seguridad en las áreas de influencia de los proyectos hidrocarburíferos.

02/07/2018

9. Fijar los precios de los hidrocarburos para efectos de la liquidación de regalías.

Funciones

10. Administrar la participación del Estado, (especie o en dinero), de los vol. de HC que le correspondan en los contratos de E&P y demás contratos suscritos por la ANH, incluyendo las regalías.

11. Recaudar, liquidar y transferir las regalías y compensaciones por la explotación de hidrocarburos.

12. Adelantar las acciones necesarias para el adecuado abastecimiento de la demanda nacional de hidrocarburos.

13. Fijar los vol. de producción de petróleo de concesión que los productores deben vender para la refinación interna.

14. Fijar el precio al cual se debe vender el petróleo crudo de concesión destinado a la refinación interna, y el gas natural que se utilice como materia prima en petroquímica.

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Funciones

15. Administrar y disponer de los bienes muebles e inmuebles que pasen al Estado por finalización de contratos y convenios de E&P, o por reversión de concesiones vigentes.

16. Hacer seguimiento al cumplimiento de las normas técnicas relacionadas con la E&P de hidrocarburos dirigidas al aprovechamiento de los recursos de manera racional e integral.

17. Fijar los precios de exportación de petróleo crudo para efectos fiscales y cambiarios.

18. Dirigir y coordinar las liquidaciones por concepto del canon superficiario en los contratos de concesión.

19. Verificar las especificaciones y destinación del material importado en el sector de hidrocarburos para aplicar las exenciones previstas en el Código de Petróleos o normas que lo modifiquen.

20. Supervisar las especificaciones y destinación del material importado en el sector de hidrocarburos para efectos de aplicar las exenciones previstas en el Código de Petróleos.

02/07/2018

6

Funciones misionales y Objetivos estratégicos en Relación con CBM

La ANH podría llevar a cabo Investigación, estructuración de proyectos de inversión de CBM . Igualmente realizar el seguimiento a contratos.

La ANH es consiente del riesgo de Autosuficiencia en Gas Natural (Domiciliario e Industrial).

Tiene el compromiso de un desarrollo sostenible con el medio ambiente y las comunidades.

Funciones Misionales

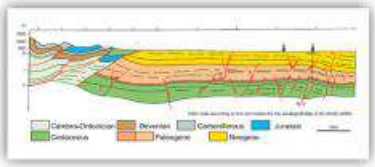
- Conocimiento del potencial de Recursos Hidrocarburíferos
- Promoción de la Inversión
- Seguimiento a Contratos de Hidrocarburos

Objetivos estratégicos

- Autosuficiencia energética y generación de recursos
- Actividad hidrocarburífera amigable con el medio ambiente y respetuosa de los derechos de las comunidades

Proyectos Realizados en la Agencia Nacional de Hidrocarburos – ANH con el CBM

- *«Caracterización Geológica y Geoquímica de las Doce Cuencas Carboníferas de Colombia con Base en Información existente y con Adquisición de Nuevos Datos Geoquímicos de los Carbones Colombianos para el diseño de las Áreas de Exploración de CBM en Colombia».* Agencia Nacional de Hidrocarburos - ANH 2013.



Proyectos a Realizar a corto y mediano plazo por la Agencia Nacional de Hidrocarburos

En los próximos meses la Agencia Nacional de Hidrocarburos - ANH proyecta iniciar su participación en el proyecto de colaboración internacional con el Departamento de Estado de Estados Unidos, el cual utiliza la capacidad operativa de la compañía americana ARI.

La referida compañía ARI, es el enlace operativo que tiene Colombia con el Gobierno de Estados Unidos para ejecutar este importante convenio.

De parte de Colombia, participará el Ministerio de Minas y Energía como cabeza principal y sus entidades adscritas, como la UPME, SGC, ANM y la ANH.

Objetivo principal del convenio: Investigar, estructurar la prefactibilidad, factibilidad y desarrollar un proyecto piloto en Colombia de CBM y CMM en un plazo de tres (3) años.

Principales impedimentos para la realización de proyectos CBM

- Poco interés de los posibles inversores debido a la complejidad minera que presenta el país. (En todos las zonas prospectivas se encuentra en desarrollo minería artesanal.
- Los inversionistas que se encuentran en el pais están enfocados en sus respectivos negocios (Gas y Petróleo convencionales, carbón etc.).
- Alta Complejidad social en zonas mineras.
- Algunas zonas presentan alta complejidad de orden público.
- Legislación enfocada a este tipo de desarrollo no esta clara.

Gracias por su atención.

Hugo Hernán Bultrago.
Geólogo, Magister en Gas y Petróleo.

ANH
AGENCIA NACIONAL DE HIDROCARBUROS
COLOMBIA

Annex II

Presentation MINMINAS

OAAS
Oficina de Asuntos Ambientales y Sociales

Gas Metano Asociando a Mantos de Carbón

MINMINAS

1

CONTENIDO

1. Funciones de la entidad y estructura del sector minero energético.
2. Relación de las funciones con el gas metano de los mantos de carbón CBM/CMM.
3. Proyectos desarrollados relacionados con CMM - PIGCC.
4. Principales impedimentos para la realización de dichos proyectos.

MINMINAS

2

1. Funciones de la entidad y estructura del sector minero energético.

De acuerdo con lo determinado por el Decreto 0381 de 2012, y sobre el subsector "minas". Las siguientes son competencia del Ministerio de Minas y Energía:

1. Articular la formulación, adopción e implementación de la política pública del sector administrativo de minas y energía.

2. Formular, adoptar, dirigir y coordinar la política nacional en materia de exploración, explotación, transporte, refinación, procesamiento, beneficio, transformación y distribución de minerales, hidrocarburos y biocombustibles.

3. **Formular, adoptar, dirigir y coordinar la política sobre las actividades relacionadas con el aprovechamiento integral de los recursos naturales no renovables y de la totalidad de las fuentes energéticas del país.**

MINMINAS

3

1. Funciones de la entidad y estructura del sector minero energético.

4. **Formular políticas orientadas a que las actividades que desarrollen las empresas del sector minero-energético garanticen el desarrollo sostenible de los recursos naturales no renovables.**

5. Expedir los reglamentos del sector para la exploración, explotación, transporte, refinación, distribución, procesamiento, beneficio, comercialización y exportación de recursos naturales no renovables y biocombustibles.

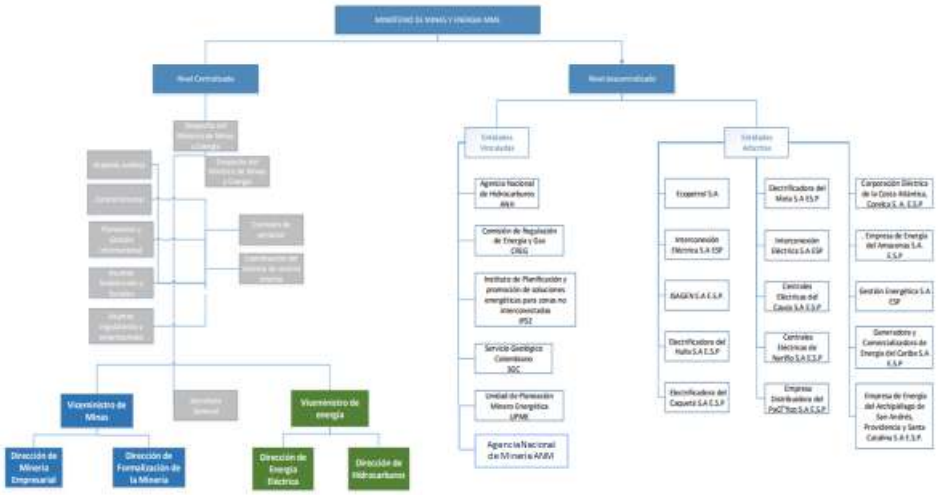
6. Fiscalizar la exploración y explotación de los yacimientos, directamente o por la entidad a quien delegue.

7. Divulgar las políticas, planes y programas del sector.

MINMINAS

4

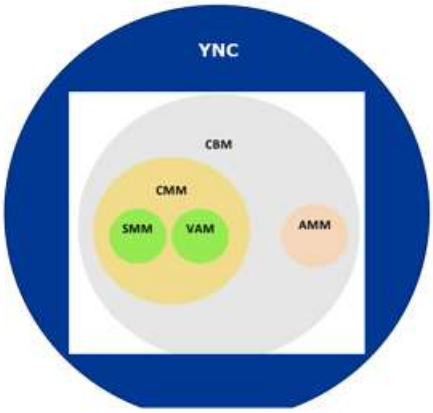
1. Funciones de la entidad y estructura del sector minero energético.



MINMINAS

5

2. Relación de las funciones con el gas metano asociado a los mantos de carbón



- CONPES 3517 de Mayo 12 de 2008.
  - Estructura general GMAC
    - Reglamento técnico
    - Comisión técnica para resolver superposiciones.
- Resolución 180742 de Mayo 18 de 2012. (Parte de la Res. 181495 de 2009)
  - Aspectos técnicos explotación YNC e inclusión GMAC en la categoría YNC.
  - Reglamentación sobre superposiciones de áreas
- Decreto 1886 de 2015 "***Por el cual se establece el Reglamento de Seguridad en las Labores Mineras Subterráneas***"

MINMINAS

6

Regulación

Decreto 1886 de 2015:

Artículo 59. *Extracción del gas Metano.* En aquellos casos que el titular minero compruebe que en el área concesionada donde adelantará su proyecto minero de carbón subterráneo se encuentren volúmenes con altas concentraciones de metano, y considere que es viable su drenaje antes y/o durante el desarrollo de las labores de extracción del mineral, para autogeneración, uso o eliminación del mismo, éstas labores deberán ser incluidas dentro del Plan de Trabajos y Obras (P.T.O.) o Programa de Trabajos e Inversiones (P.T.I.) o modificaciones a estos, presentado ante la autoridad minera para su evaluación y aprobación, ajustándose a las mejores prácticas internacionalmente aceptadas. El gas extraído podrá ser utilizado en el proyecto minero o en caso de no ser utilizado el mismo, deberá ser quemado acorde con las estipulaciones técnicas que para este fin establezca la Autoridad Minera y ambiental.

Parágrafo. El seguimiento a la extracción y posterior uso del gas metano proveniente de la operación minera estará a cargo de la autoridad minera.

MINMINAS

7

3. CMM y emisiones

Estudios sobre potenciales de mitigación:

Cobeneficios cuantitativos	Otros cobeneficios
Millones USD 2015	1/4
0,24	
Ahorro en costo por salud	Facilidad regulatoria
Millones USD 2015	3/5
N/A	

ANÁLISIS GLOBAL DE MEDIDA Y SU POTENCIAL DENTRO DE LA LÍNEA ESTRATÉGICA	
	Posición en ranking de la línea estratégica
	5 de 5 medidas
	Puntaje de priorización
	10,93

MINMINAS

8

3. Proyectos a realizar CMM - PIGCC.

MINMINAS

9

4. Principales impedimentos para la realización de dichos proyectos.

Si el CMM – AMM fue considerado como una actividad que podía reducir emisiones ¿por qué no está considerada dentro del PIGCC?

1) Elementos técnicos
    1) En términos de CMM, y en la medida que el PIGCC tiene un horizonte de 12 años (20 % de reducción de emisiones para 2030), se requiere certificar una tonelada de CO2 reducida para ese año y en la medida que los periodos de desgasificación son de 8 años en promedio, y no se ha iniciado ninguna perforación para CMM, en el mejor de los casos la primera tonelada de carbón "desgasificado" estaría el 2030- 2031.
    2) En cuanto a VAM, los estudios desarrollados hasta el momento no han sido concluyentes y sólo han llevado a un mejor conocimiento de los factores de emisión. Asumiendo el inicio de proyectos piloto, para 2018, hay mucho camino por recorrer antes de que las emisiones reducidas tengan un impacto en el sector.
2) Elementos regulatorios:
    1) Falta regulación de la ANM respecto a las condiciones de explotación del CMM – VAM)
    2) Prevalece la falta de acuerdo sobre las superposiciones entre minas y HC. Esto impide hacer un efectivo uso de los derechos.
3) Elementos políticos:
    1) No hay una línea clara por parte del sector privado sobre su interés en el desarrollo de este tipo de proyectos.
    2) No hay "masa crítica" para el desarrollo informado de regulación.

MINMINAS

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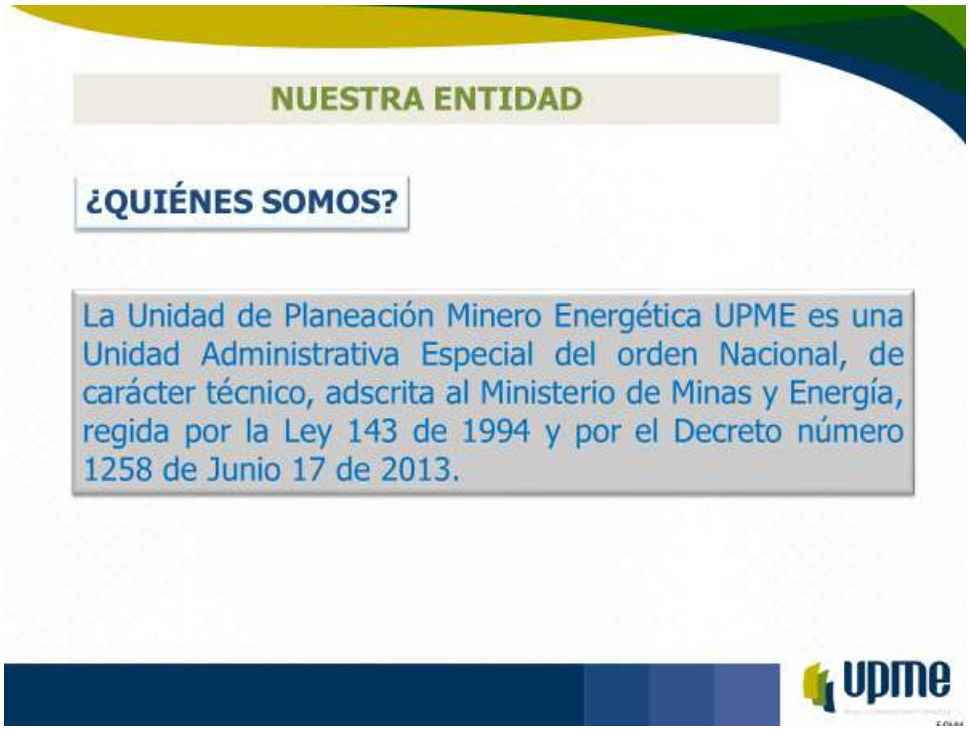
Annex III

Presentation UPME



NUESTRA ENTIDAD

MISIÓN

Planear de manera integral el desarrollo minero energético, apoyar la formulación de política pública y coordinar la información sectorial con los agentes y partes interesadas

VISIÓN

"Consolidarnos como un referente internacional de innovación para la planificación integral del desarrollo y aprovechamiento de los recursos minero energéticos, a través de estudios, análisis y proyecciones, brindando información de alto valor agregado para la formulación de políticas públicas y la toma de decisiones de sus grupos de interés, con criterios de sostenibilidad económica, social y ambiental".

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ESTRUCTURA ORGANIZACIONAL
DECRETO 1258 Y 1259 DE 2013

upme

ESTRUCTURA ORGANIZACIONAL
DECRETO 1258 Y 1259 DE 2013

SUBDIRECCIÓN DE MINERÍA

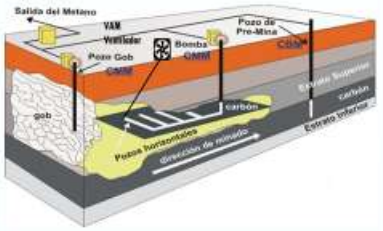
1. Asesorar al MME en la fijación de las políticas públicas y analizar las incidencias de las mismas en la competitividad del sector, teniendo en cuenta los factores ambientales, técnicos y económicos que influyen en estas.
2. Proponer al MME planes, programas y proyectos integrales y sostenibles para el desarrollo del sector.
3. Identificar procesos productivos innovadores y sostenibles que generen valor agregado.

SUBDIRECCIÓN DE HIDROCARBUROS

1. Realizar estudios y análisis tendientes a determinar el potencial para suministro de FNCH por regiones, fuentes y usos, como estrategia para mejorar la matriz de consumo de energía en el país.
2. Promover estudios conjuntos con los diferentes agentes del sector para la formulación de planes de desarrollo de FNCH.
3. Identificar y analizar precios y costos de producción, de FNCH y su incidencia en la competitividad del sector para su integración en la matriz energética del país.
4. Realizar estudios tendientes a la evaluación de temas relacionados con la incidencia del sector hidrocarburos en el cambio climático.

¿QUÉ SE HA HECHO?

1. ESTUDIO QUE DEFINA ESTRATEGIAS PARA EL APROVECHAMIENTO DE GAS METANO ASOCIADO A LOS MANTOS DE CARBÓN EN EXPLOTACIONES BAJO TIERRA

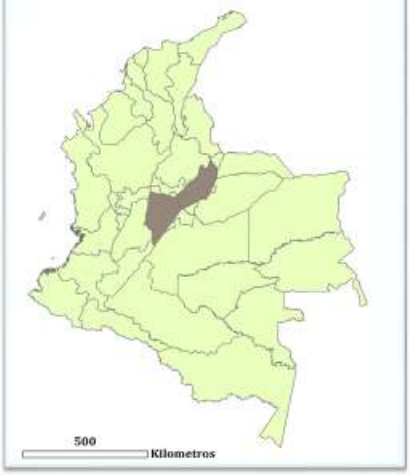


RESULTADOS

1. Línea base de CBM para el país
2. Avances internacionales sobre aprovechamiento de gas metano
3. Nueva metodología para cálculo de emisiones de gas metano - IPCC nivel II
4. Identificación de 4 áreas potenciales para proyecto piloto

¿QUÉ SE HA HECHO?

AREAS POTENCIALES PARA PROYECTO PILOTO



CONCLUSIONES

1. GUACHETA – Uniminas/Promincarg
2. CUCUNUBA-SUTATAUSA – Minminer
3. SOCHA-SOCOTÁ – Colombiana de minerales Ltda.
4. CHINAVITA-ÚMBITA– Intercontinental de Carbones

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¿QUÉ SE HA HECHO?

JUSTIFICACION

1. Área estructuralmente ubicada en el sinclinal Checua- Lenguazaque, donde afloran hasta 14 mantos de carbón.
2. Espesores entre 0,4 y 1,2 metros, buzamiento entre los 45 y 65 grados, calidades que alcanzan el rango bituminosos – coquizables
3. Estructuras geológicas amplias y con baja complejidad tectónica especialmente en el flanco occidental
4. Primer Estudio Regional – ANH/EAFIT

PROYECTO GUACHETA

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¿QUÉ SE HA HECHO?

JUSTIFICACION

1. El área del Contrato de Concesión No 2505, tiene una extensión de 807 hectáreas, actualmente se extraen 26.000 toneladas de carbón mensuales con 750 personas vinculadas

2. El área del Contrato de Concesión No 867T, tiene una extensión de 293 hectáreas, se extraen 15.000 toneladas de carbón mensuales con 420 personas vinculadas a la operación

PROYECTO GUACHETA

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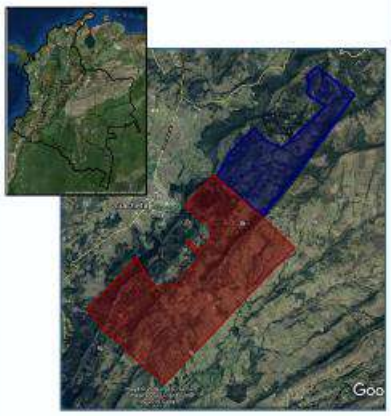
¿QUÉ SE HA HECHO?

JUSTIFICACION

1. Las mayores cantidades de gas metano se encuentra en la parte norte del área del contrato de Concesión No 2505 y hacia las parte sur y centro del área del Contrato de Concesión No 867T.

2. Las mediciones muestran que las minas mas grisutuosas de la Concesión 867T en el año 2015 emitieron 373 toneladas de gas metano, es decir aproximadamente 7.850 tonCO2e.

PROYECTO GUACHETA



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¿QUÉ SE HA HECHO?

2. CONSTRUIR UN MODELO PARA COLOMBIA DE APROVECHAMIENTO U OXIDACIÓN DE GAS METANO DE LOS DUCTOS DE VENTILACIÓN (VAM) DE LAS MINAS SUBTERRÁNEAS DE CARBÓN.

CONCLUSIONES

1. En las minas piloto no es viable implementar un proyecto de aprovechamiento VAM no se cumplen las condiciones :
   - ✓ volumen de aire de los ductos de ventilación de al menos de 500.000 m3/h
   - ✓ porcentaje de metano mínimo de 0,7%.

2. se propone un proyecto de oxidación del metano producido en las minas piloto

3. Lo más recomendable para posibilitar la implementación de proyectos VAM en Colombia, es hacer un proceso de reingeniería de los sistemas de ventilación

4. los costos de inversión son similares para los dos proyectos ya que los equipos deben tener las mismas características técnicas, igual sucede con los costos de mantenimiento, de transporte y de nacionalización. Esto podría ser aplicado otras minas colombianas similares.

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¿QUÉ SE HA HECHO?

OTRAS CONCLUSIONES

5. Los VPN's resultante para todos los escenarios son negativos, esto debido a que no hay fuentes de ingresos para un proyecto de destrucción de VAM en Colombia

6. El valor mínimo que debería tener un bono de carbono por abatir una tonelada de CO_2 equivalente para minas con una producción de metano cercano a 18 mil toneladas de CO_2 por año es de USD$ 8.70.

   Para el caso de Colombia se sugiere que el bono de carbono sea igual o similar al de California, es decir USD$14.75.

7. El costo de abatir una tonelada de CO_2 equivalente mediante tecnología VAM y bajo los costos actuales de la tecnología, para una mina que produzcan cercan a 18 mil toneladas de CO_2 por año es variable hasta que se logra el punto de equilibrio, iniciando en USD$ 10.31 en el primer año, estabilizándose después de lograr el punto de equilibro al año 11 a USD$4.36.

2. CONSTRUIR UN MODELO PARA COLOMBIA DE APROVECHAMIENTO U OXIDACIÓN DE GAS METANO DE LOS DUCTOS DE VENTILACIÓN (VAM) DE LAS MINAS SUBTERRÁNEAS DE CARBÓN.

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¿QUÉ SE PIENSA REALIZAR?

AÑO 2017

1. Calcular factores de emisión para cuencas, que no lo poseen y actualizar la emisión de gas metano por la extracción de carbón.
2. Continuar con la gestión para realizar pozos de prueba para definir la viabilidad de realizar CBM/CMM en Colombia.

AÑOS 2018 Y 2019

1. Determinar la viabilidad de realizar un proyecto de aprovechamiento de gas metano CBM/CMM en el país.

2. CONSTRUIR UN MODELO PARA COLOMBIA DE APROVECHAMIENTO U OXIDACIÓN DE GAS METANO DE LOS DUCTOS DE VENTILACIÓN (VAM) DE LAS MINAS SUBTERRÁNEAS DE CARBÓN.

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GRACIAS

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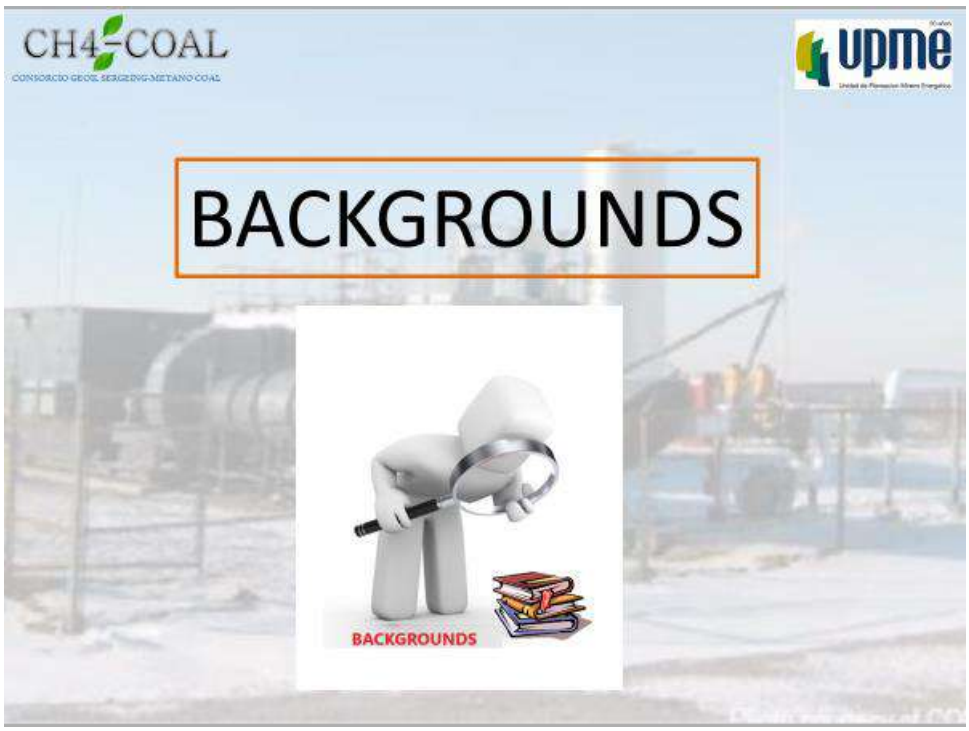
MINMINAS upme TODOS POR UN NUEVO PAÍS

Annex IV

Presentation UPME – VAM



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CONSORCIO GEOIL SERGEING-METANO COAL

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LAW 1753 OF 2015 – National Development Plan 2014-2018

Art 170 Formulation of a green growth policy (Low Carbon Development) in the long term: BY MINISTRIES.

They Will formulate and implement sectoral climate change adaptations plans.

Sectoral mitigation action plans of the Colombian Low Carbon Mitigation Strategy, which will have quantitative sectoral targets for reducing greenhouse gas emissions in the short (year 2020) and médium term (2025 or 2030).

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CONSORCIO GEOIL SERGEING-METANO COAL

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Act 1886 of 2015- ART 59 – Methane Gas Extraction.

When volumes with high methane concentrations are found in the mining project area and it is considered feasible to drain them before and/or during the development of the extraction of the mineral. For self-generation, use or elimination of the same, these tasks must be included in the Work Plan (P.T.O.) or Work and Investment Program (P.T.I.) or modifications to them.

Resolution 90325 of 2014

The Ministry of Mines and Energy adopts the criteria for mitigation plans in the Energy , Mining and Hydrocarbon sector…. For the mining sector one of the two lines of the proposed emission reduction policy is the " pormotion of the use of methane gas from mining operations, managed for safety reasons, for self-generation purposes".

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CONSORCIO GEOL SERGEING-METANO COAL

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PROJECT STRUCTURE

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DELIVERABLE 1

- Methodology and aschedule activities

DELIVERABLE 2

- Diagnosis of oxidation exploitation Project in different countries.
- Mining diagnosis of the pilot área.
- Strategies that facilitate the start-up of a Project to use or burn CH4.

DELIVERABLE 3

- Two proposals to use methane gas from the ventialtion ducts in Self-generation or oxidation adapted to the technical conditions of the selected mines.
- Proposal regulation of greyout mines and methane gas recovery from VAM ventilation ducts.
- Integral Document.
- Utilization guide for Self-generation or oxidation.

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DIAGNOSIS OF METHANE GAS EXPLOITATION PROJECTS IN DIFFERENT COUNTRIES

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CONSORCIO GEOSIL SERGEING-METANO COAL

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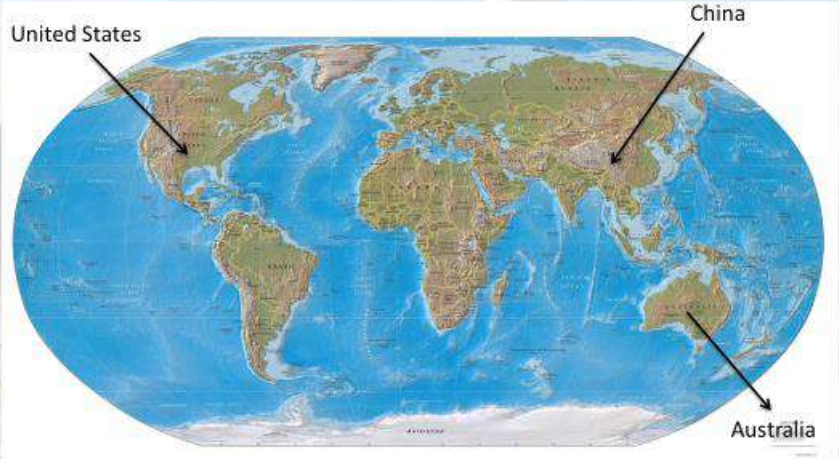
SUCCESFUL PROJECTS
INTERNACIONAL.xlsx



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CONSORCIO GEOSIL SERGEING-METANO COAL

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COSTS OF VAM PROJECTS ACCORDING TO SOME COMPANIES IN THE WORLD

License		Install Capacity	Invesment by Unit (Millon USD)	Proportion: Annual Operating Cost/Total Investment	Invesment by Unit (USD)
Yima (Group) Co.Ltd.	Utilization Project of CMM (UNFCCC ref. 1613)	11MW	7.96	9.16%	$ 1.194.000
		1 VAM oxidizer	15.106		$ 2.250.000
Pingdingshan Coal (Group) Co.,Ltd. Province Henan, China	Utilization Project of Methane, (UNFCCC ref.1614)	19MW	5.71	10.07%	$ 856.500
		4 VAM oxidizers	15.106		$ 2.250.000
Zhengzhou (Grupo) Co., Ltd.	Utilization Project of Methane (UNFCCC ref. 1603)	8MW	8.91	9.59%	$ 1.336.500
		7 VAM oxidizers	14		$ 2.100.000
Jiada Coal Mine CMM and VAM Utilization Project	Utilization Project of CMM y VAM	3MW	7.66	10.90%	$ 1.149.000
		3 VAM oxidizers	6.79		$ 1.050.000

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CONSORCIO GEOSIL SERGEING-METANO COAL

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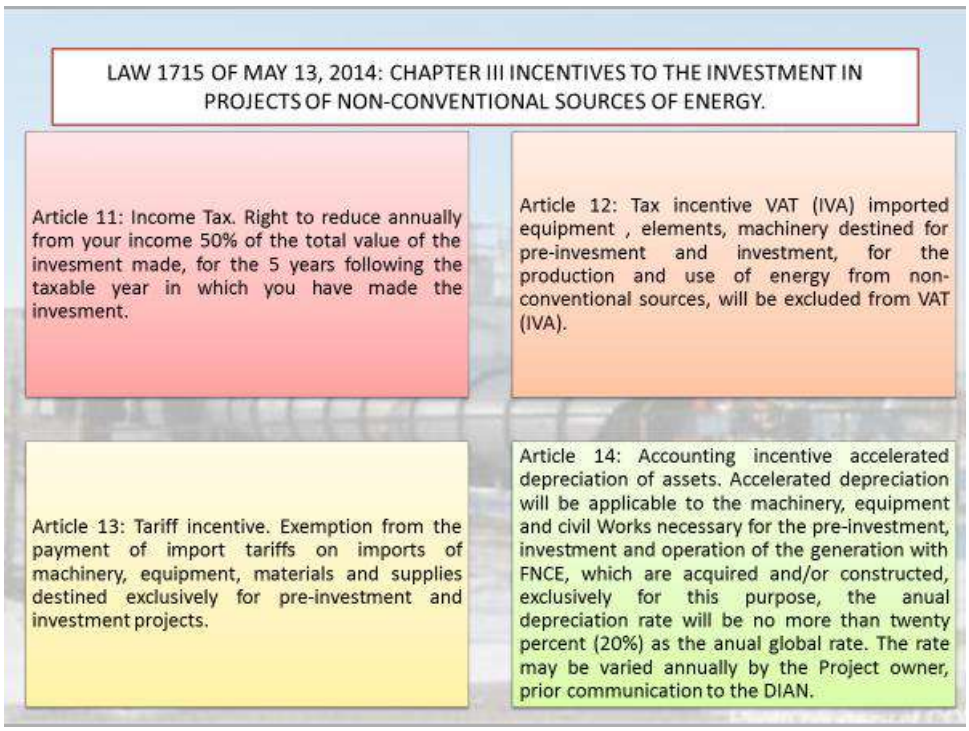
POLICIES


CH4COAL
INTERNATIONAL POLICIES
upme
Study on Legislation on Climate Change 2015
99 Countries
93% (GEI)
In 2014, 46 new laws and policies were enacted by 34 of the 99
17 developed countries and 17 developing countries
21 were legislative (approved by the parliaments) and 25 were executive (promulgated by the governments).
Approvved Laws and policies related to climate in 2014.


LAW 1715 OF MAY 13, 2014: CHAPTER III INCENTIVES TO THE INVESTMENT IN PROJECTS OF NON-CONVENTIONAL SOURCES OF ENERGY.
Article 11: Income Tax. Right to reduce annually from your income 50% of the total value of the invesment made, for the 5 years following the taxable year in which you have made the invesment.
Article 12: Tax incentive VAT (IVA) imported equipment , elements, machinery destined for pre-invesment and investment, for the production and use of energy from non-conventional sources, will be excluded from VAT (IVA).
Article 13: Tariff incentive. Exemption from the payment of import tariffs on imports of machinery, equipment, materials and supplies destined exclusively for pre-investment and investment projects.
Article 14: Accounting incentive accelerated depreciation of assets. Accelerated depreciation will be applicable to the machinery, equipment and civil Works necessary for the pre-investment, investment and operation of the generation with FNCE, which are acquired and/or constructed, exclusively for this purpose, the anual depreciation rate will be no more than twenty percent (20%) as the anual global rate. The rate may be varied annually by the Project owner, prior communication to the DIAN.

CLIMATE CHANGE NATIONAL POLICY

THE OBJECTIVE of the National Climate Change Policy is to incorporate climate change management into public and private decisions to advance a climate-resilient and Low-Carbon development path that reduces the risks of climate change and takes advantage of the opportunities that climate change generates. The aspiration for the long term, and to which this general objective contributes, is to makes the country carbón neutral.

Figura 3. Componentes de la *Política nacional de cambio climático*

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PROJECT OF THE LAW NUMBER 73 OF 2017 SENATE, whereby guidelines for the managament of climate change are established.

It is part of the instruments that will guide the necessary actions to manage the adaptation to the climate change of the territories and the mitigation of emissions of greenhouse gases according to the a PDN.

Through this Law, new institutional arrangements are also defined and different existing instruments are articulated that will allow to expand and strengthen the institutional design of the State, which will be responsible for the management of climate change, defining functions and creating instruments for this purpose..

This Law defines the recently established Climate Change Policy as the national reference and also locates national strategies within the instrument landscape.

It institutionalizes the Integrated Climate Change Management Plans, both territorial and sectoral, and makes them the guide to be followed by territorial entities, autonomous regional corporations and national level entities for the implementation of their actions.

It provides for the creation of economic and financial instruments for the management of climate change. (national program of tradable quotas, an emissions market will be generated)

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TECHNICAL DIAGNOSIS OF THE MINES LOCATED IN THE PILOT AREAS.

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CONSORCIO GEOL SERGEINGMETANO COAL

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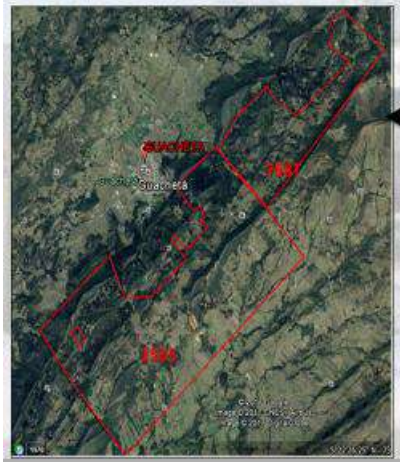
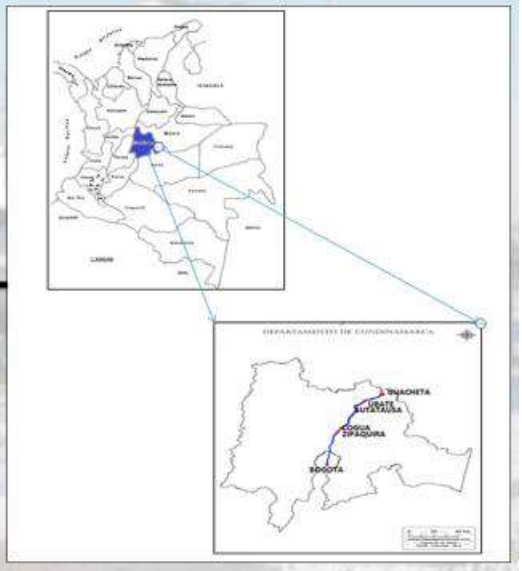
LOCATION

The two (2) areas are contiguous, the Promincarg (Title 867T) to the north and the Uniminas (Title 2505) to the south.





DIAGNOSIS – MINES DESCRIPTION

The highest concentrations of methane gas occur in the adjoining areas (mines) of the two (2) titles, the northern area of the title that houses Uniminas and the central area - south area of the title that houses Promincarg.

ZONE	UNIMINAS S.A.S	PROMINCARG S.A.S
NOTH ZONE	Carbones GyD	Bocamina la Joya
	Mina L a Ceci	Mina el Roble
	Mina El Roble	Bocamina Forigua Cisquera 2
	Mina L a Virgen BM1 Y BM2	Bocamina Cisquera de a 66
	Futuro 2	Bocamina El Roble Piedro 2
	San Miguel	Bocamina Vidriosa
	Mina Esperanza 6 (Recuperacion)	Bocamina El Zuncho
	Jabonera 1 y 2	Bocamina Buenavista
	Mina El Rubi Callejón	Bocamina Bellavista 2
CENTRAL ZONE	Rinconcito	Bocamina Las Tapias
		Mina el Porvenir
	Mina Tierra Alta	Mina el Manzano
	Mina Los Pinos	Mina Siete Bancos-Nelson Gil (cerrada definitivamente)
	Carboquality Ltda.	Mina El Volcán
		Mina El Mortiño
	Sociedad González	
SOUTH ZONE	BM Zuncho 2 Cisquera2	Mina Diamante 7
	La Esperanza 3	Mina La Mana
	BM Siete Bancos	
	Esperanza 2	
	Túnel Casa Blanca	Mina Bocatoma
	Mina L a Mejia	

UNIMINAS S.A.S

TECHNICAL DESCRIPTION UNIMINAS S.A.S

PERSONEL	PRODUCTION	MINING WORK	TRANSPORTATION SYSTEM	SGSST	VENTILATION PLAN
442	19.250 Ton/mONTH	At a general level, the mines in the area, such as development and access work, perform slopes and levels, such as drilling repairs, the exploitation method is by cut.	in the pit, the charred coal falls by gravity to the unload key where a 1 Ton wagon is located, the transportation level is manually pushed to the hopper located inside the level and by means of unloading keys it is loaded to the Skip located on the incline and from there it goes to surface	have a professional engineer in Mines specialist in Health and Safety at work and technicians responsible for implementing the SG-SST, the general staff is trained in issues of mine safety, accidents at work and conduct safety talks of 6 minutes each day ; machinery and equipment operators are trained and certified for work skills, as well as workers who handle explosives and work at heights	They have a ventilation plan, a person responsible for ventilation in each work shift, continuous gas measurement, control boards under ground and on the surface, the ventilation circuit is forced.

CH4-COAL
CONSORCIO GEOIL SERGENG METANO COAL

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FLOWS AND VOLUME OF METHANE UNIMINAS S.A.S

MINES NAME	%CH4	Q (outflow) m³/hour	CH4 PRODUCTION (m³/Hour)
YACIMIENTO SAN MIGUEL	0,57	18780	106,5
INVERSIONES SIATOBA	0,6	9140,4	62,8
MINA LA CECI	0,4	16132,56	59,9
LA VIRGEN	0,7	5371,2	36,9
RINCONCITO S.A.S	0,2	14940	29,5
FUTURO DOS	0,4	5616	22,2
EL CURUBO	0,15	7642,8	22,1
RUBI EL CALLEJON	0,25	2912,4	10,1
TIERRA ALTA	0,2	4363,2	8,6
ESPERANZA 3	0,05	10764	5,3
LOS PINOS	0,05	7128	1,6
JABONERA 1	0,6	11188,8	0,6
JABONERA 2	0	6350,4	0
ESPERANZA 2	0	3733,2	0

CH4-COAL
CONSORCIO GEOIL SERGENG METANO COAL

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PROMINCARG S.A.S

TECHNICAL DESCRIPTION

PRODUCTION	MINING WORK	TRANSPORTATION SYSTEM	SGSST	VENTILATION PLAN
13976 Ton/month	At a general level, the mines in the area, such as development and access work, perform slopes and levels, such as repairing drums, the exploitation method is cut by cut and some mines widening of drums.	The transport system at a general level works in the following way: the started coal falls by gravity to the unloading key where a trolley is located in the guide, this is pushed manually until the main inclined from there is pulled to the surface, by means of	In SG-OSH issues, all mines have a safe procedure system and personnel trained in these matters. They have a technician in SST who carries the SG-SST of the mine. The continuous measurement of gases is carried out (O2, CH4, CO, CO2 and H2S), it has control boards under ground and on the surface, the ventilation circuit is forced	It is in the process of development.

CH4-COAL
CONSORCIO GEOEL SERGEING METANO COAL

upme

FLOWS AND VOLUME OF METHANE PROMINCARG S.A.S

MINE NAME	%CH4	Q (outflow) m³/hour	CH4 PRODUCTION (m³/Hour)
MINA EL VOLCAN-EL MORTIÑO	0,7	13392	92,5
LA MANA	0,25	16020	49,7
PIEDRO Y BOLAS	0,3	4860	14,4
CANALES	0,35	3339	11,6
BOCATOMA	0	3240	0

CH4-COAL
CONSORCIO GEOEL SERGEING METANO COAL

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METHANE GAS EMISSSION BASE LINE IN THE PILOT AREA

The calculation of methane emissions is made according to the amount of coal produced and an emission factor that depends on the amount of CH_4 coming from the activity.

To determine the CH4 emissions, the following equation is used:

$$\text{Emissions } CH_4 = \text{Coal production} * FEm * FConv$$

Where:
Emissions CH_4: emission of CH_4 x (Gg)
Coal production: Coal production (Ton)
FEm: Emission factor for coal (m^3CH4 / t coal)
FConv: conversion factor (0.67 Gg / 10^6 m3).

Fuente: El Capítulo 2 del Módulo de energía publicado por el IDEAM.

CH4-COAL

CONSORCIO GEOIL SERGEING-METANO COAL

METHANE GAS EMISSIONS BASE LINE IN TH EPILOT AREA

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COMPANY	MINE	CH4 PRODUCTION (m^3/year)	Coal Production Ton per year	Emission Factor $FECH_4$ (m^3CH_4/TON coal)	Conversion Factor (0,67Gg CH4 /10^6 m3 CH4)	Total Emission Gg/Año FEec	TON EMITTED EMISSIONS $GgCO_2Eq$ /Año	TON EMITTED EMISSION $TonCO_2Eq$ /Año
UNIMINAS SA	YACIMIENTO SAN MIGUEL	932.662,77	14592	63,92	0,00000067	0,62	15,62	15.622,10
	EL CURUBO	637.976,00	3600	177,22	0,00000067	0,43	10,69	10.686,10
	CARBONES GYD	549.887,62	10560	52,07	0,00000067	0,37	9,21	9.210,62
	MINA LA CECI	427.991,04	11520	37,15	0,00000067	0,29	7,17	7.168,85
	JABONERA 1 Y 2	405.984,96	4728	85,87	0,00000067	0,27	6,80	6.800,25
	LA VIRGEN	322.921,73	4080	79,15	0,00000067	0,22	5,41	5.408,94
	RINCONCITO S.A.S	258.163,20	28080	9,19	0,00000067	0,17	4,32	4.324,23
	FUTURO DOS	194.088,96	4488	43,25	0,00000067	0,13	3,25	3.250,99
	LOS PINOS	119.367,00	2400	49,74	0,00000067	0,08	2,00	1.999,40
	RUBI EL CALLEJON	88.070,98	7920	11,12	0,00000067	0,06	1,48	1.475,19
	TOTAL UNIMINAS S.A	3.937.114,26	91968	42,81	0,00000067	2,64	65,95	65.946,66
PROMINCARG S.A.S	BOCATOMA	1.175.731,00	10.284,00	114,33	0,00000067	0,79	19,69	19.693,49
	MINA EL VOLCAN-EL MORTIÑO	503.884,80	1644	306,50	0,00000067	0,34	8,44	8.440,07
	LA MANA	423.263,23	14400	29,39	0,00000067	0,28	7,09	7.089,66
	CANALES	190.356,48	1236	154,01	0,00000067	0,13	3,19	3.188,47
	TOTAL PROMINCARG	1.117.504,51	27.564,00	40,54	0,00000067	0,75	18,72	18.718,20
TOTAL UNIMINAS S.A.S+ PROMINCARG S.A.S		5.054.618,77	83,35	83,35	0,00000067	3,39	189,02	189.023,22

CH4-COAL

CONSORCIO GEOIL SERGEING-METANO COAL

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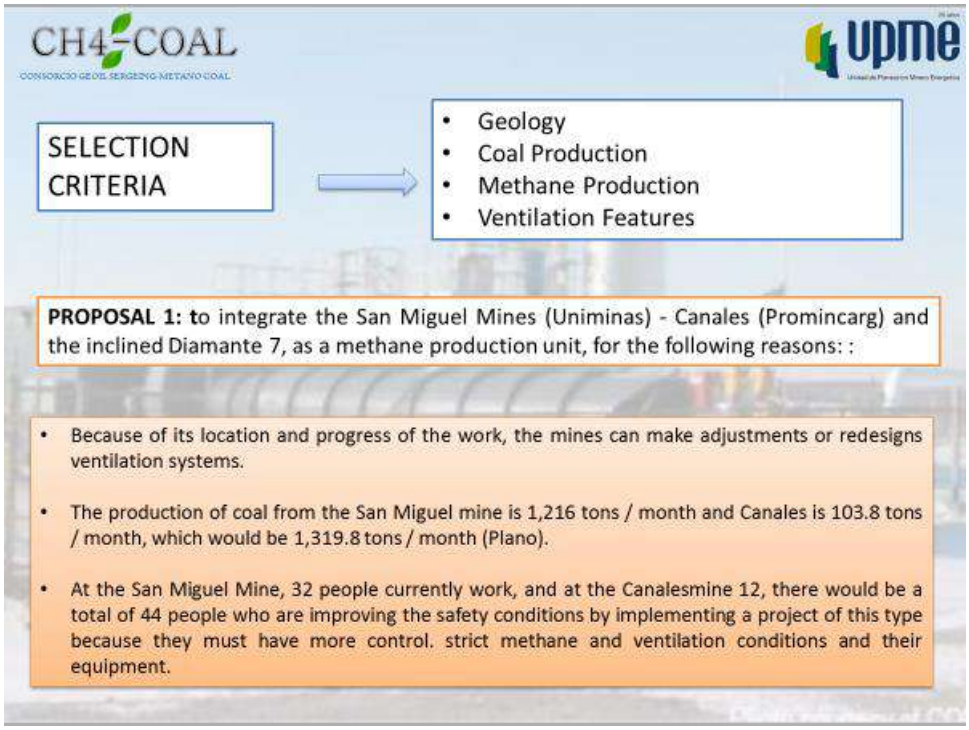
PROPOSALS FOR USE OR OXIDATION OF METHANE GAS.


CH4-COAL
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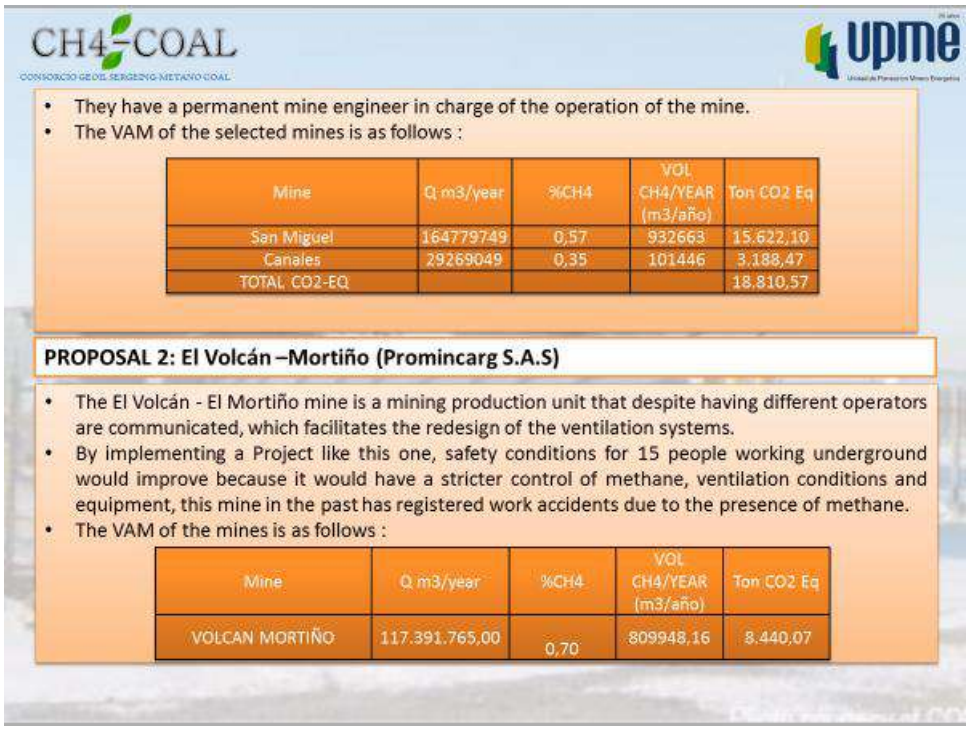
SELECTION CRITERIA
Geology
Coal Production
Methane Production
Ventilation Features
PROPOSAL 1: to integrate the San Miguel Mines (Uniminas) - Canales (Promincarg) and the inclined Diamante 7, as a methane production unit, for the following reasons: :
Because of its location and progress of the work, the mines can make adjustments or redesigns ventilation systems.
The production of coal from the San Miguel mine is 1,216 tons / month and Canales is 103.8 tons / month, which would be 1,319.8 tons / month (Plano).
At the San Miguel Mine, 32 people currently work, and at the Canalesmine 12, there would be a total of 44 people who are improving the safety conditions by implementing a project of this type because they must have more control. strict methane and ventilation conditions and their equipment.


CH4-COAL
CONSORCIO GEOIL SERGENG METANO COAL
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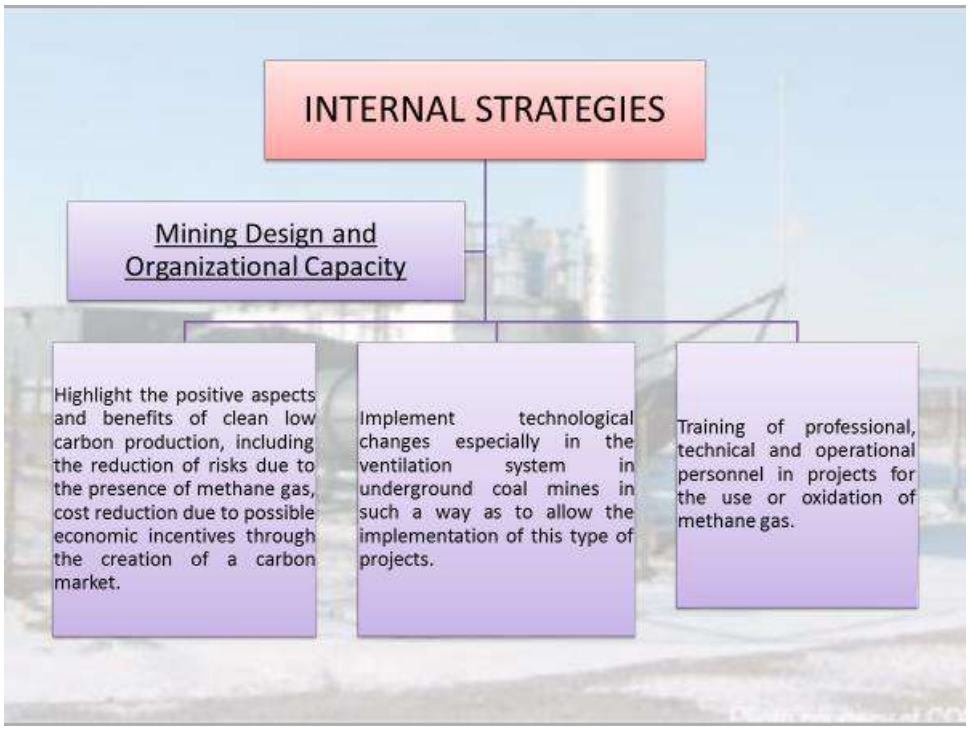
They have a permanent mine engineer in charge of the operation of the mine.
The VAM of the selected mines is as follows :
Mine | Q m3/year | %CH4 | VOL CH4/YEAR (m3/año) | Ton CO2 Eq
San Miguel | 164779749 | 0,57 | 932663 | 15.622,10
Canales | 29269049 | 0,35 | 101446 | 3.188,47
TOTAL CO2-EQ | | | | 18.810,57
PROPOSAL 2: El Volcán –Mortiño (Promincarg S.A.S)
The El Volcán - El Mortiño mine is a mining production unit that despite having different operators are communicated, which facilitates the redesign of the ventilation systems.
By implementing a Project like this one, safety conditions for 15 people working underground would improve because it would have a stricter control of methane, ventilation conditions and equipment, this mine in the past has registered work accidents due to the presence of methane.
The VAM of the mines is as follows :
Mine | Q m3/year | %CH4 | VOL CH4/YEAR (m3/año) | Ton CO2 Eq
VOLCAN MORTIÑO | 117.391.765,00 | 0,70 | 809948,16 | 8.440,07

STRATEGIES THAT FACILITATE THE COMMISSIONING OF THE PROJECT

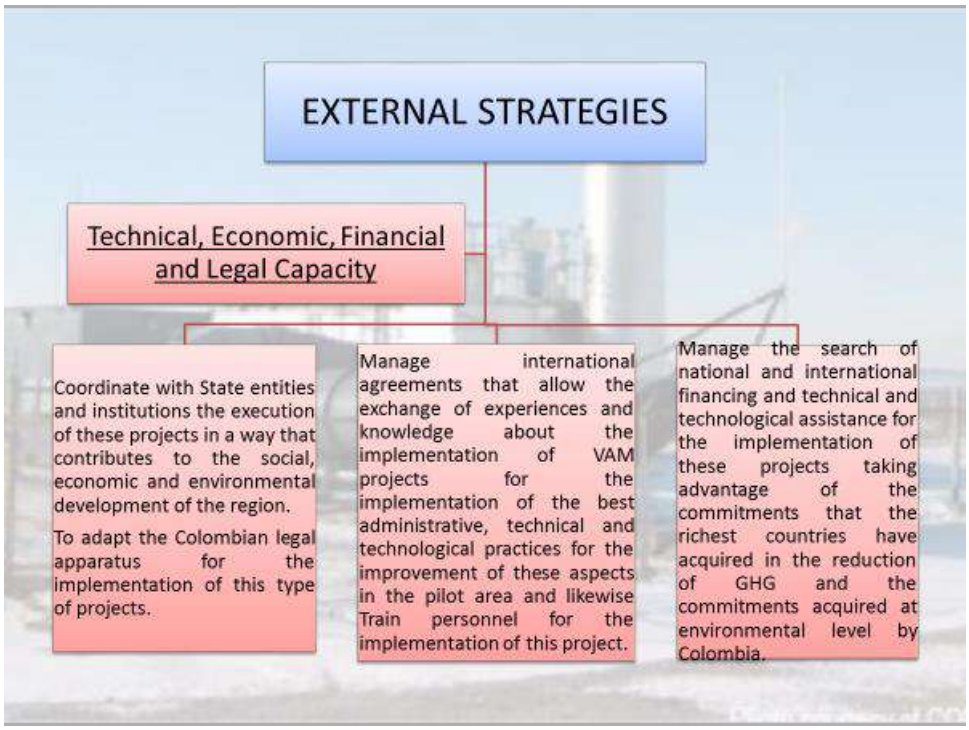
INTERNAL STRATEGIES

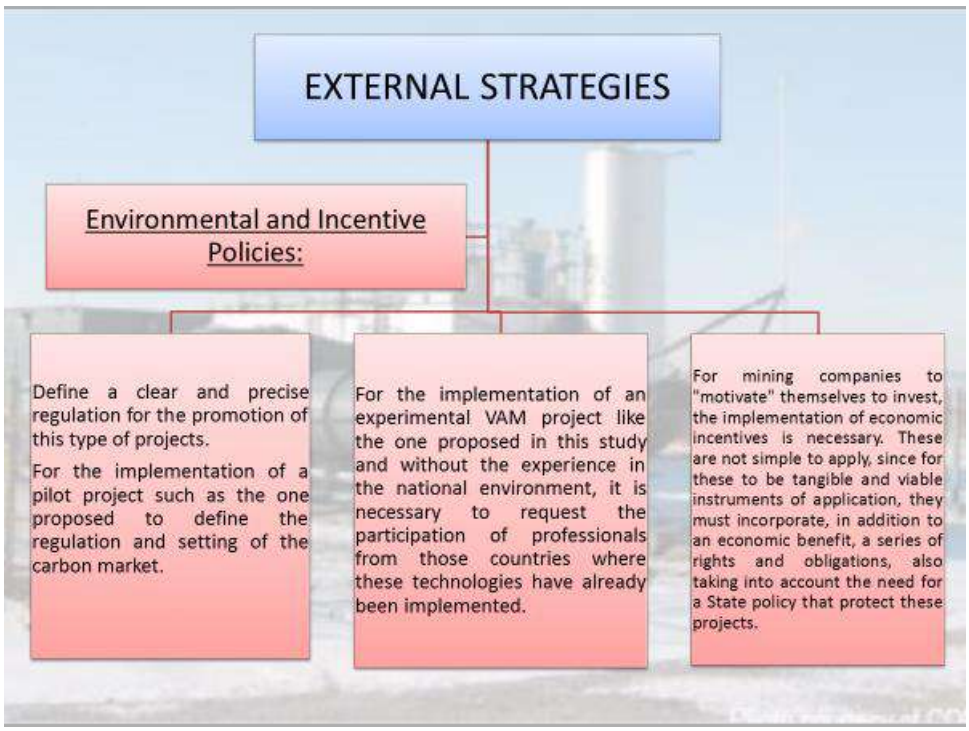
Mining Design and Organizational Capacity

- Adapt the ventilation systems of the pilot mines according to the technologies to be implemented, so that the ventilation ducts conduct the air without losses to the oxidation equipment.
- For the pilot proposal of San Miguel-Canales-Diamante 7 it is proposed as a strategy to establish, as much as possible, commitments between the two companies in order to establish and execute the proposed design, unify economic, technical, technological, administrative and financing criteria to carry out the project.
- It is necessary to establish new business perspectives, towards new goals and objectives (clean low carbon production) that will ensure the operational continuity of the company along with the implementation of these projects.


INTERNAL STRATEGIES
Mining Design and Organizational Capacity
Highlight the positive aspects and benefits of clean low carbon production, including the reduction of risks due to the presence of methane gas, cost reduction due to possible economic incentives through the creation of a carbon market.
Implement technological changes especially in the ventilation system in underground coal mines in such a way as to allow the implementation of this type of projects.
Training of professional, technical and operational personnel in projects for the use or oxidation of methane gas.


INTERNAL STRATEGIES
Mining Design and Organizational Capacity
Promote good international practices related to GEI within underground coal mining.
Promote the use or oxidation of methane gas as a new business alternative (based on the proposal to create a national carbon market).


EXTERNAL STRATEGIES
Technical, Economic, Financial and Legal Capacity
Coordinate with State entities and institutions the execution of these projects in a way that contributes to the social, economic and environmental development of the region.
To adapt the Colombian legal apparatus for the implementation of this type of projects.
Manage international agreements that allow the exchange of experiences and knowledge about the implementation of VAM projects for the implementation of the best administrative, technical and technological practices for the improvement of these aspects in the pilot area and likewise Train personnel for the implementation of this project.
Manage the search of national and international financing and technical and technological assistance for the implementation of these projects taking advantage of the commitments that the richest countries have acquired in the reduction of GHG and the commitments acquired at environmental level by Colombia.


EXTERNAL STRATEGIES
Environmental and Incentive Policies:
Define a clear and precise regulation for the promotion of this type of projects.
For the implementation of a pilot project such as the one proposed to define the regulation and setting of the carbon market.
For the implementation of an experimental VAM project like the one proposed in this study and without the experience in the national environment, it is necessary to request the participation of professionals from those countries where these technologies have already been implemented.
For mining companies to "motivate" themselves to invest, the implementation of economic incentives is necessary. These are not simple to apply, since for these to be tangible and viable instruments of application, they must incorporate, in addition to an economic benefit, a series of rights and obligations, also taking into account the need for a State policy that protect these projects.

CH4-COAL
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TECHNOLOGIES APPLICABLE TO PROPOSED PROJECTS

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SELF-GENERATION

- The minimum air volume of the ventilation ducts should be: 500,000 m3 / h.
- The methane concentration should be 0.7%

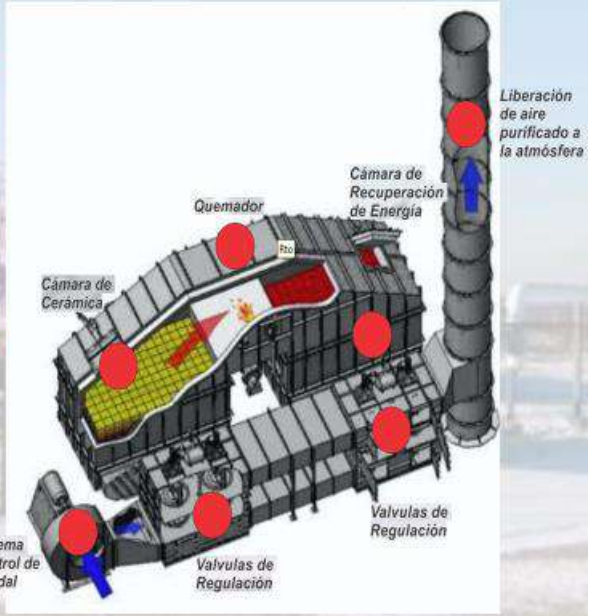
OXIDATION

According to the characteristics of the VAM of the pilot mines, a methane oxidation project is proposed.

In the opinion and recommendation of the international experts, the Regenerative Thermal Oxidants - RTO - (for its acronym in English) are the most appropriate for this type of project.

SCHEME AND OPERATION RTO

All RTOs work in a similar way, using an auxiliary fuel (such as natural gas) to initially heat the ceramic chambers where methane oxidation will occur; Depending on the heat generated by the methane, the process can be continued without the addition of auxiliary fuel.

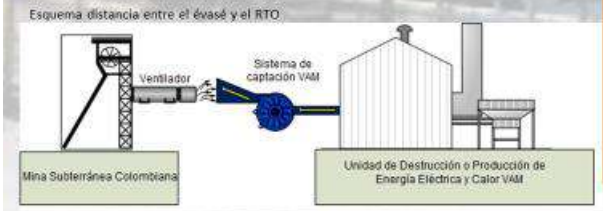


OPERATION

The RTOs are operated as independent units, in general they are installed near the ventilation, or evasion (bell output-capture air -VAM).

The aevase is an integral part of the ventilation system of the mine and should not be obstructed by any part of the RTO system. The evasé is an element that can become a high risk due to its proximity to the main surface fans and the high speed of the air that comes out of it to reach the RTO.

The main risk if the connection between the évassé and the RTO is direct, is that of causing an obstruction in the ventilation, just as the direct connection could also cause a pressure drop and reduce the extraction efficiency of the ventilation system.



OPERATIONAL RISK

- Methane gas is an explosive gas and represents a permanent hazard at the time of capture, storage and use.
- Overheating of the chambers is possible, if unexpected higher than normal concentrations of methane are emitted into the VAM destruction unit. However, technologies such as the one developed by ANGUIL allow through internal controls to stabilize the equipment when these unexpected increases occur.

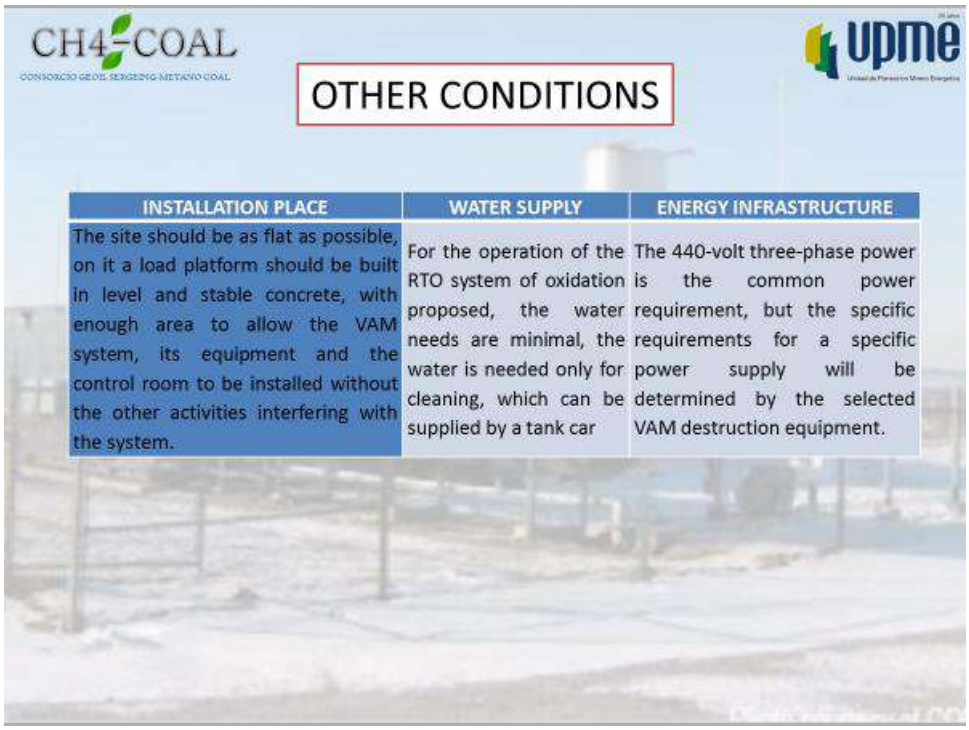
SECURITY MEASURES IN OPERATION

A "risk zone" or zone of exclusion of (for) security must be established around the point of discharge and smoking prohibited, use of unsafe equipment, use of flameproof equipment, prohibition of open flame equipment and all personal equipment such as telephones, watches and others with similar characteristics and that use batteries that can generate some kind of spark.

Visits to the area where the RTO system is located should be prohibited, except for those that are related to prolonged shutdowns of fans or equipment maintenance or due to a serious underground emergency, that is, by a significant gas explosion.

The area where the system is located must be protected and a fence must be installed and an exclusion zone must be delimited with their respective "danger" warning notices for visitors around the area.

To avoid these unexpected increases in methane concentrations, it is necessary to perform periodic and rigorous measurements and monitoring of methane concentrations, especially in the final sections of the ventilation system (in the mine).


CH4-COAL
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OTHER CONDITIONS
INSTALLATION PLACE
WATER SUPPLY
ENERGY INFRASTRUCTURE
The site should be as flat as possible, on it a load platform should be built in level and stable concrete, with enough area to allow the VAM system, its equipment and the control room to be installed without the other activities interfering with the system.
For the operation of the RTO system of oxidation proposed, the water needs are minimal, the water is needed only for cleaning, which can be supplied by a tank car
The 440-volt three-phase power is the common power requirement, but the specific requirements for a specific power supply will be determined by the selected VAM destruction equipment.


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PILOT
PROJECT

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POSSIBLE VAM TECHNOLOGIES FOR COLOMBIAN CONDITIONS

Company	Minimum requirement for ventilation airflow (m^3/hr)	Minimum methane concentration requirement in Ventilation ducts (%)
CANMET	900	0.15
DÜRR	6.287	0.20
DÜRR	101.952	0.20
GULF COAST ENVIRONMENTAL SYSTEMS	8.496	0.25
SHENGLI SHANDONG	60.000	0.25
BIOTHÉRMICA	16.992	0.20
MEGTEC	125.000	0.20
ENER-CORE	6.796	1.50
ANGUIL	5.000	0.2

Of these technologies, compared with their technological peers, the ANGUIL has the capacity to process the lowest amounts of VAM (5000m3 / h, with percentages of around 0.2% methane). This means that the production of VAM and the methane concentration of the selected mines meet the minimum operating conditions of ANGUIL

CH4COAL

CONSORCIO GEOIL SERGENG METANO COAL

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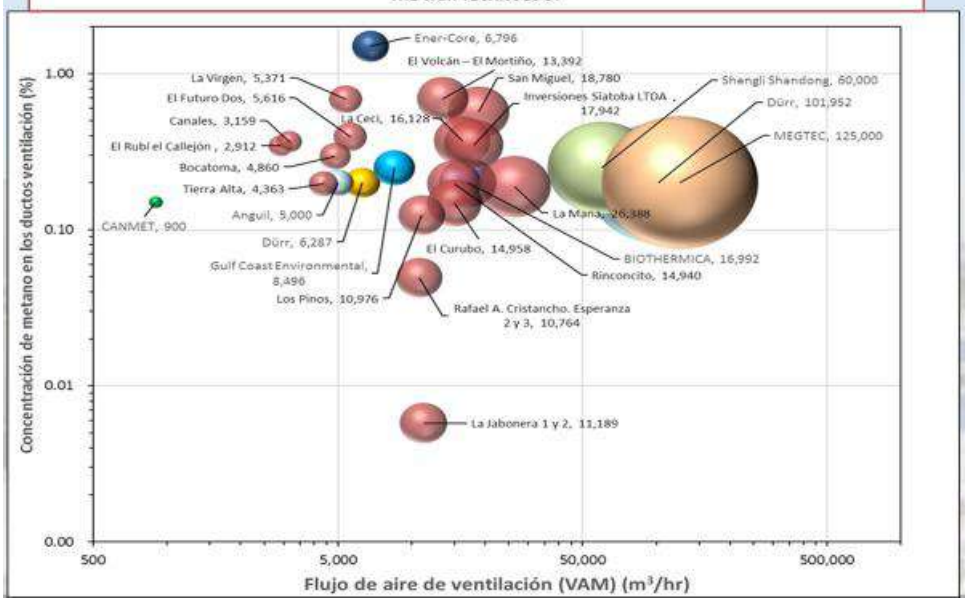
COMPARISON OF THE VENTILATION PARAMETERS OF THE CARBON MINES WITH THE FUNCTIONING SPECIFICATIONS OF THE VAM TECHNOLOGY



DESCRIPTION OF THE PROPOSED EQUIPMENT

ANGUIL ENVIRONMENTAL SYSTEMS, INC., Based in Milwaukee, Wisconsin, USA., Delivered the main features of its RTO system that is listed below :

Standard base system of the RTO model 50.

- Design flow - 5,000 SCFM
- 98% destruction efficiency
- 95% thermal energy efficiency
- Oxidation temperature design of 1550□F
- Skate-mounted design
- Two-chamber carbon steel reactor
- High temperature ceramic fiber insulation
- Ceramic heat transfer media structured at high temperature
- Two (2) vertical pneumatic seat valves with compressed air accumulation tank
- Forced draft system fan
- System motor (TEFC, 460V / 3ph / 60Hz)
- Variable frequency unit
- Burner (natural gas or propane ignited) and fuel train (FM design)
- Exhaust stack
- Digital data recorder and data logger
- Remote communication via modem and Ethernet connectivity
- Execution and factory quality test before shipment
- Operation and maintenance manuals

Additional features and capabilities.

- Start-up and operator training services
- Improvement to a higher thermal energy efficiency
- Upgrade to a higher destruction efficiency rating
- Supplementary fuel injection (SFI)
- Hot or cold side bypass
- Induced draft systems
- Halogenated systems with customized metallurgy
- Methane monitoring
- Evasé capture hood
- Installation of the system (turnkey or only supervision)
- Preventive maintenance programs
- Recommended spare packages

ADEQUACY NECESSARY FOR THE SELECTED PROJECTS

The resistance of the mine increases due to a more extensive development, the heat and the gases of the mine increase, which makes it difficult to keep the mine ventilated. In these mines, the volumetric efficiency of the ventilation system is often low, and high pressure main fans with large volumetric flow capacity are needed to achieve adequate air flow.

In Colombian mines, even with good technical conditions, current ventilation systems could be overwhelmed by sudden gas flows from coal beds, fires or explosions, for this reason the pilot project should include a ventilation system more reliable to ensure safety and allow the VAM destruction unit to demonstrate its effectiveness.

Proposal 1. San Miguel-Canales-Diamante 7
Proposal 2. Volcán Mortiño

TECHNICAL ASPECTS TO TAKE INTO ACCOUNT

It is recommended to exercise the maintenance plan, making a strict control of the cavities to prevent the VAM from escaping there. Adequate lining of the tracks is recommended in order to generate less air resistance.

the exploited areas and abandoned roads must be hermetically sealed leaving pipe for measuring methane and draining if necessary.

The ventilation routes must be maintained under constant maintenance and free of obstacles that may generate resistance to the flow of air circulating in the mine.

carry a continuous methane monitoring system with several control stations with surface communication and a monitoring system for fans that measure at least pressure, temperature, vibrations with surface control. These controls are essential to identify shortcomings in the amount of air flow and correct them in time.

It is recommended that the electrical expert of the mine design an electrical system in such a way that in case of shorts or overloads it is ensured that the fans continue to function correctly.

ECONOMIC EVALUATION

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the cash flow model for coal mine methane projects designed by the US-EPA was used, which uses data specific to the methane industry, and was also compared to a financial cash flow based on the quotes requested for the VAM projects of the pilot areas of the ANGUIL and GCES companies and data estimated by the consultant.

GAS AVAILABILITY	UNITS
What is the methane concentration in the ventilation air?	(%)
What is the ventilation air flow you expect to recover?	1000 m^3/m
ENTRY DATA DEFINED BY THE USER	UNITS
What is the operational life time planned for the project?	year
What term is the loan?	year
What is the interest rate applied to the loan?	(%)
What is the capital share of the Project promoter?	(%)
What is the sale price of the carbon credit unit?	US $/Ton CO2E
What is the installed capital cost of the VAM oxidation system?	US $/$m^3/m$
What is the annual operation and maintenance cost of the VAM oxidation system?	US $/$m^3$/m-year
What is the frequency with which the VAM oxidation system will be relocated?	years
What is the relocation cost of the VAM Oxidation System (Including the preparation of the new site)	US $/$m^3/m$
What is the electric charge of the fans?	kWh/1000 m^3
What is the cost of the electric power used by the Project?	US $/MWh
DEFAULT PARAMETERS	UNITS
What is the inflation rate?	(%)
What is the actual discount rate?	(%)
What are the royalties and severance taxes?	(%)
What is the contingency factor?	(%)
How many hours per year will the VAM Oxidation System be in operation?	hour/year
What are the indirect costs of the Project?	(%)
What is the cost of validation, verification and transaction to monetize the carbon credits?	US $/Ton CO2E

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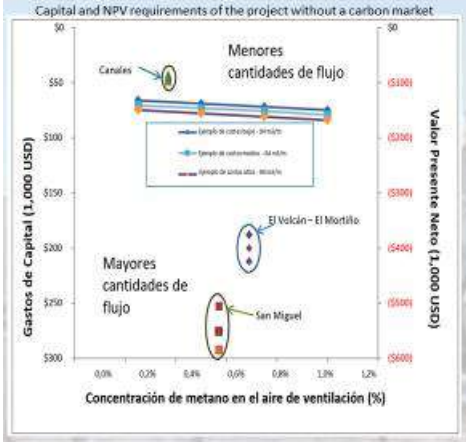
The information of the ventilation flow and methane concentration collected for each of the three mines, Canales, San Miguel and El Volcán, as well as a hypothetical mine were used as inputs in the model.

Flow parameter (of mine), capital expenditure (RT CAPEX) and economic indicators.

Mine	Scenario	CH4 Conc.	Total Flow (m3/m)	CAPEX - Low Case (1,000 USD)	CAPEX - Mid Case (1,000 USD)	CAPEX - High Case (1,000 USD)	Net Present Value - Low Case (1,000 USD)	Net Present Value - Mid Case (1,000 USD)	Net Present Value - High Case (1,000 USD)
San Miguel	Base Case	0.57%	0.313	$267	$301	$334	($505)	($551)	($584)
San Miguel	GCES prices	0.57%	0.313		$350			($759)	
Canales	Base Case	0.37%	0.053	$45	$51	$57	($85)	($90)	($96)
El Volcán – El Mortiño	Base Case	0.69%	0.223	$190	$215	$238	($376)	($400)	($424)
El Volcán – El Mortiño	with CARB Price @$14.75	0.69%	0.223	$190			$490		
N/A	Base Case	0.25%	0.084	$72	$81	$90	($131)	($141)	($149)
N/A	Base Case	0.50%	0.084	$72	$81	$90	($137)	($146)	($155)
N/A	Base Case	0.75%	0.084	$72	$81	$90	($143)	($151)	($161)
N/A	Base Case	1.00%	0.084	$72	$81	$90	($149)	($158)	($167)

Non-Carbon Market Scenario

Capital and NPV requirements of the project without a carbon market



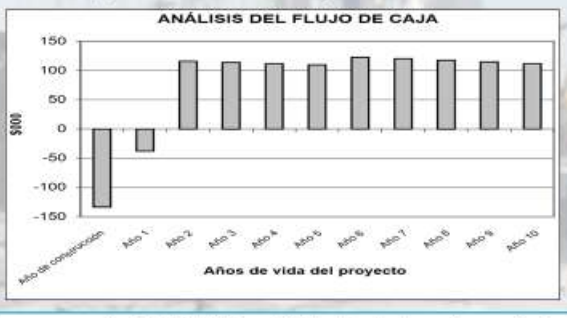
Analysis of cash flows for the VAM-RTO project, without source of income

The economic exercises carried out for a scenario in which there is no carbon market (or government incentive) that allows income to the project, show negative VPN results in all cases, as it will not have any income. The resulting NPVs for all scenarios are negative, this is because there are no sources of income for a VAM destruction project in Colombia.

Scenario With Carbon Market

The exercise was done for the Volcan - Mortiño mine, in a market that traded carbon equally or under similar conditions (for example), with the "California Air Resources Board" market, this exercise resulted in Net Present Values (VPN) positive. A value of carbon bonds between US $ 14 and 15 dollars would be ideal for VAM projects in Colombia, allowing a positive cash flow in year 3.

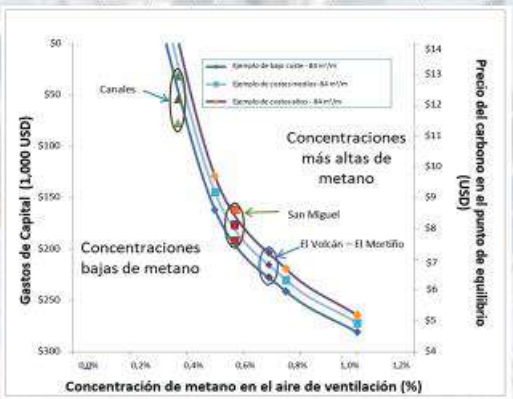
Flow analysis for the VAM-RTO project - carbon sales at US $ 14.75 / ton CO2e. The Volcan - El Mortino



if the carbon price were set at 14.75 USD, which is the last auction price in the Cap and Trade market in California (CARB), an RTO project at the El Volcán - El Mortiño mine would result in a Net Present Value VPN of 490,000 USD and an internal TIR return rate of 48%.

Based on the value of the carbon credits, the exercise was done to find the value that the carbon credits must have to reach the breakeven point. The Figure shows the price of carbon (expressed in USD per tonne of CO2e) for each of the scenarios evaluated for a ten-year profitability project (where the internal rate of return TIR would be equal to the discount rate, which in these analysis is 10%).

Precio de carbono requerido por un proyecto de 10 años para alcanzar pinto de equilibrio



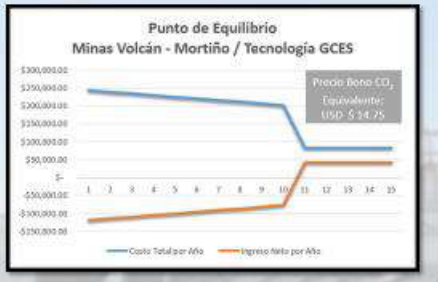
EVALUACIÓN ECONÓMICA Y FINANCIERA (DATOS COLOMBIA)

For each of the proposals, two scenarios are proposed based on the quotes delivered by the companies ANGUIL and Gulf Coast Environmental Services (GCES), including the information provided by the contractor.

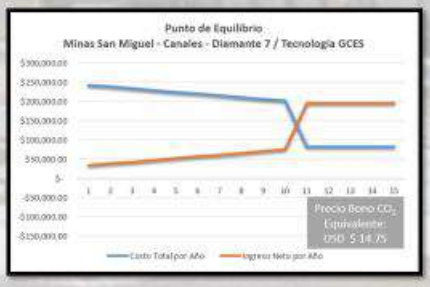
For the development of the scenarios, it was taken into account that:

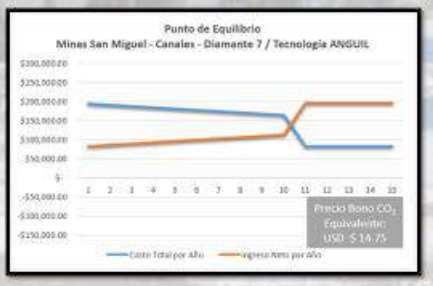
- The duration of the project was arbitrarily set for fifteen (15) years of operation.
- The cost of Capital includes: a minimum of ventilation ducts, fans of the ventilation ducts and the VAM oxidation system.
- Annual costs include, the operation and maintenance of the VAM oxidation system, electricity for the duct fans, and a periodic relocation of the VAM oxidation system.
- The fans work 24 hours a day, seven days a week for 8,000 hours a year, with minimal setbacks.
- IF there are costs in the model associated with the purification of the ventilation air.
- IF there are costs in the model associated with making the necessary modifications to the existing ventilation systems to accommodate the RTO systems.
- IF are included import tariffs and taxes of nationalization and additional expense.
- If local operational expenses are included.
- Capital interest of 4% was taken.
- The amortization costs are 10% per year of the total loan.
- The destruction efficiency of the VAM oxidation systems for the purpose of carbon credits is 100%.

Breakeven Point Volcán-Mortiño Mine

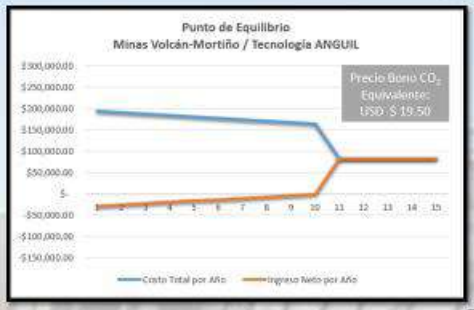


Breakeven Point San Miguel-Canales-Diamante 7





Minimum Price Necessary Carbon Credit



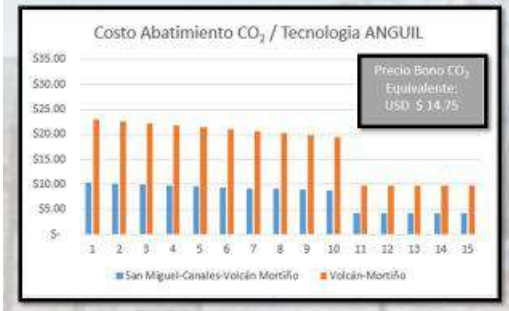
Minimum Carbon bonus price needed to reach breakeven point in the Mortiño Volcano Mine implementing ANGUIL technology, being the most economically viable.

Minimum carbon bonus price necessary to reach equilibrium point at the San Miguel - Canales - Diamante 7 Mine, implementing the ANGUIL technology, being the most economically viable.

Cash Flow - ANGUIL Technology

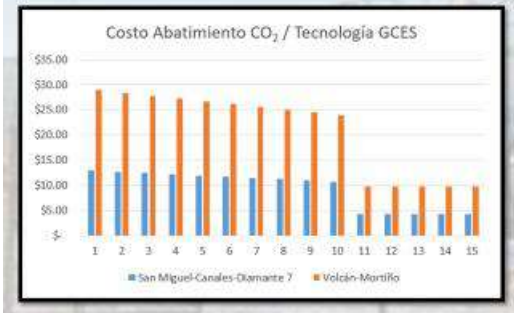
Cash Flow - Technology GCES

Costs of ton CO2e / Year Technology ANGUIL



ton CO2e/año	Proyecto 1: San Miguel-Canales-Diamante 7	Proyecto 2: Volcán - Mortiño:
	18810.57	8440.07
AÑO	USD/ ton CO2e/año	
1	10.3134	22.9856
2	10.1432	22.6064
3	9.9731	22.2273
4	9.8030	21.8482
5	9.6329	21.4690
6	9.4628	21.0899
7	9.2926	20.7107
8	9.1225	20.3316
9	8.9524	19.9524
10	8.7823	19.5733
11	4.3593	9.7156
12	4.3593	9.7156
13	4.3593	9.7156
14	4.3593	9.7156
15	4.3593	9.7156

Costs of ton CO2e / Year Technology GCES



ton CO2e/año	Proyecto 1: San Miguel-Canales-Diamante 7	Proyecto 2: Volcán - Mortiño:
	18810.57	8440.07
Año	USD / ton CO2e/año	
1	12.9469	28.8551
2	12.7016	28.3082
3	12.4562	27.7614
4	12.2108	27.2146
5	11.9655	26.6677
6	11.7201	26.1209
7	11.4748	25.5740
8	11.2294	25.0272
9	10.9840	24.4803
10	10.7387	23.9335
11	4.3593	9.7156
12	4.3593	9.7156
13	4.3593	9.7156
14	4.3593	9.7156
15	4.3593	9.7156

CONCLUSIONS

In the pilot mines, it is not feasible to implement a power generation project because the VAM production does not meet the required minimum requirements:

- ✓ Air volume of the ventilation ducts is at least 500,000 Nm3 / h
- ✓ minimum methane percentage of 0.7%.

Consequently, a methane oxidation project produced in the pilot mines is proposed since they are insufficient to implement a power generation project.

The most advisable to enable the implementation of VAM projects in Colombia, is to do a reengineering process of the ventilation systems that allows an uninterrupted flow and where a continuous methane gas monitoring system and a continuous monitoring system of the fans with connection to surface.

Because the two proposed projects have similarities in their mining characteristics and although they present differences in the production of VAM, the investment costs are similar for the two projects since the equipment must have the same technical characteristics, the same happens with the costs of maintenance, transport and nationalization. This could be applied to other similar Colombian mines.

The economic exercises carried out for a scenario in which there is no carbon market (or government incentive) that allows income to the project, show negative NPV results in all cases, due to the fact that there are no sources of income for a project. destruction of VAM in Colombia.

According to the economic simulation exercises to implement the VAM technology in Colombia, the minimum value that a carbon bonus should have for reducing one tonne of CO2 equivalent for mines with a methane production close to 18 thousand tons of CO2 per year is of USD $ 8.70.

However, taking into account that mines with methane production close to 18 thousand tons of CO2 per year are scarce in Colombia. It is strongly suggested that the carbon bonus for reducing one ton of CO2 equivalent is equal to or similar to that of California, ie USD $ 14.75.

The cost of reducing a tonne of CO2 equivalent through VAM technology and under current technology costs, for a mine that produces close to 18,000 tons of CO2 per year is variable until the breakeven point is reached, starting in USD $ 10.31 in the first year, stabilizing after achieving the equilibrium point at year 11 to USD $ 4.36.

CH4-COAL
CONSORCIO GEOIL SERGEING-METANO COAL

upme

In order to evaluate the technical and economic feasibility to implement a VAM project, it must have a mine that complies with all the technical and safety features required by Colombian legal regulations, and must have certain minimum conditions that guarantee the stability of the methane content and air flow.

One of the main risks is that the ventilation is obstructed, which will cause a variability in the flow and concentration of VAM which can significantly impact the efficiency of the oxidation systems; In addition, these systems can not start quickly or have unscheduled stops, which means, the mining operator must keep in mind that the equipment must operate almost 24 hours a day.

The collection and recording of methane data must be systematic, underground coal mines must improve these aspects and the mining authority must be strict in these inspections. This is important for mining safety and for making decisions about future projects for the use or disposal of methane gas.

CH4-COAL
CONSORCIO GEOIL SERGENG-METANO COAL

upme

The ventilation systems must have the best technical conditions, they must have a maintenance plan, speed measurement, fault identification (mechanical, electrical and general operation) and with intrinsically safe switches. Ventilation must be systematized to know its status in real time. In the same way, the plan must have specified what to do in case any element of the system fails.

If the country wants to advance in the implementation of the use or elimination of the methane gas inherent in coal, it is necessary to define a regulation and an incentive system that allows reducing the costs of this implementation and generates not only environmental benefits, but also, an economic returns that make this sector have a development (growth) low in carbon.

It is recommended that the Colombian government create agreements with international financial institutions to provide Colombian mining companies with access to financing options for oxidation or methane development projects.

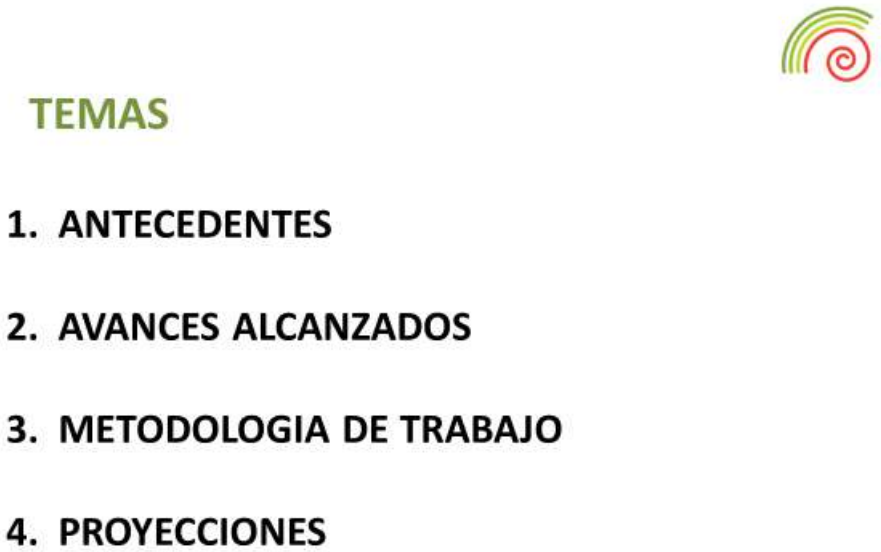
CH4-COAL
CONSORCIO GEOIL SERGENG-METANO COAL

upme

THANK YOU

Annex V

Presentation SGC



1. ANTECEDENTES

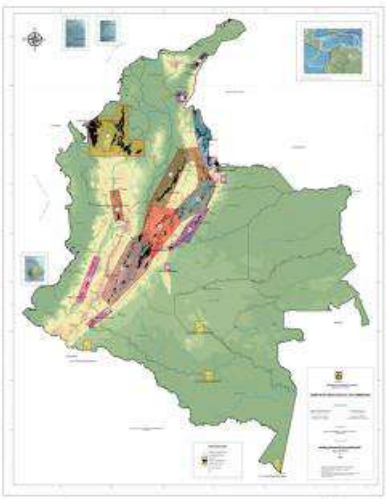
- **LEGAL:** EN EL DOCUMENTO CONPES 3517 DE MAYO12/2008, CUYO OBJETIVO ES FIJAR "LINEAMIENTOS DE POLÍTICA PARA LA ASIGNACIÓN DE LOS DERECHOS DE EXPLORACIÓN Y EXPLOTACIÓN DE GAS METANO EN DEPÓSITOS DE CARBÓN Y EL DESARROLLO DE LAS NORMAS TÉCNICAS PARA SU EXPLOTACIÓN", SE RECOMIENDA QUE EL MINISTERIO DE MINAS Y ENERGÍA APOYADO POR LA ANH E INGEOMINAS (HOY SGC) EXPIDA NORMAS TÉCNICAS PARA LA EXPLORACIÓN Y PRODUCCIÓN DE ESTE RECURSO Y COORDINE EL MANEJO Y SUMINISTRO DE LA INFORMACIÓN TÉCNICA.

- **SEGURIDAD MINERA:** ACCIDENTES REGISTRADOS EN MINAS DE CARBÓN OCASIONADOS POR EXPLOSIÓN DE GAS METANO, ESPECIALMENTE EN LOS DEPARTAMENTOS DE BOYACÁ, CUNDINAMARCA, NORTE DE SANTANDER Y ANTIOQUIA

- **MEDIO AMBIENTE:** EL GAS METANO SE CONSIDERA UN GAS DE EFECTO INVERNADERO, 21 VECES MÁS POTENTE QUE EL CO_2 Y A LA VEZ UN GAS QUE INFLUYE EN EL CALENTAMIENTO GLOBAL DEL PLANETA.

- **CONOCIMIENTO GEOCIENTÍFICO:** EL SGC, DESDE EL AÑO 2010, ADELANTA ESTUDIOS DE EXPLORACIÓN DE CBM, PARA OBTENER INFORMACIÓN SOBRE EL ORIGEN, ACUMULACIÓN Y POTENCIALIDAD DE ESTE RECURSO, COMO OTRA FUENTE DE ENERGÍA PARA EL PAÍS, CARACTERIZANDO MANTOS DE CARBON EN CUANTO A SU CONTENIDO DE CBM.

Potencial Carbonífero de Colombia



En el país se han definido 12 zonas carboníferas

Boyacá, Cundinamarca y Santander representan el 38% del potencial del país

Potencial carbonífero de Colombia .

Potencial 16.569 MT (SGC, 2016)

Consideraciones

- El carbón, es considerado como roca generadora y reservorio del gas metano.

- Las grandes reservas de carbón con que cuenta Colombia, indican que puede existir un buen potencial de CBM.

- Aportar información que pueda brindar conocimiento para proyectar usos del gas metano presente en mantos de carbón y reducir las emisiones de gases de efecto invernadero

- Contribuir con información para planear proyectos mineros que minimicen accidentes ocasionados por concentración de metano en las minas de carbón.

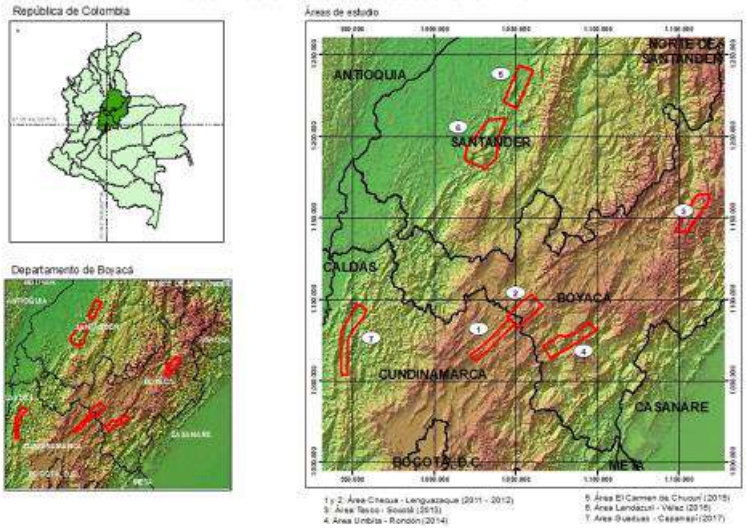
2. AVANCES ALCANZADOS

Áreas evaluadas para CBM

- 2011 Checua – Lenguazaque (Cundinamarca)
- 2012 Checua – Lenguazaque (Boyacá)
- 2013 Tasco – Socotá (Boyacá)
- 2014 Umbita – Rondón (Boyacá)
- 2015 Carmen de Chucurí (Santander)
- 2016 Landázuri – Vélez (Santander)
- 2017 Guaduas Caparrapí (Cundinamarca)

Exploración

Localización áreas de estudio GMAC



Localización áreas de estudio en Exploración de Gas Metano Asociado al carbón por parte del Servicio Geológico Colombiano.

Localización áreas de estudio GMAC.
Estructuras geológicas de interés.

Áreas 1 y 2. Sinclinal Checua-Lenguazaque (2011 - 2012)

Área 3. Sinclinal Rucú (2013)

Área 3. Anticlinal Socotá (2013)

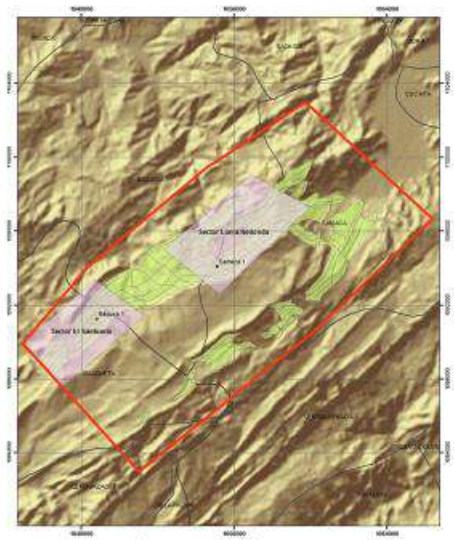
Área 4. Sinclinal Úmbita (2014)

Metodología de trabajo

1. Diagnóstico de información geológica de carbones

Revisión de estudios geológicos de exploración de carbones en los sectores de interés.

- Cartografía geológica
- Estratigrafía
- Mantos de carbón
- Calidades



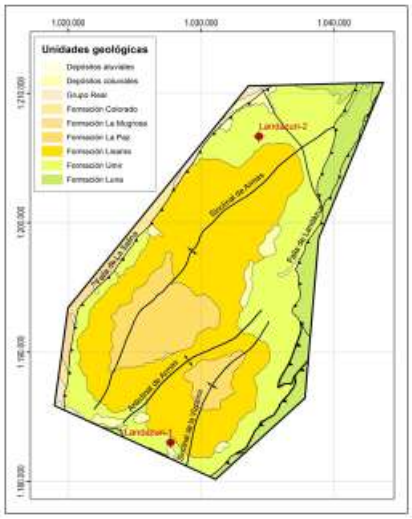
Determinación de sectores área de trabajo GMAC Guachetá-Samacá.

2. Socialización del proyecto

- Autoridades civiles
- Autoridades militares
- Comunidades

2. Geología de superficie y Minería

- Revisión cartográfica en campo. (continuidad en los mantos, ángulos de inclinación de las capas).
- Actualización de inventario minero. (mediciones de CH4 (%) en frente de mina). Avance de explotaciones mineras
- Evaluación de las características topográficas del sector (vías de acceso, fuentes hídricas presentes, etc).
- Determinación de puntos de perforaciones

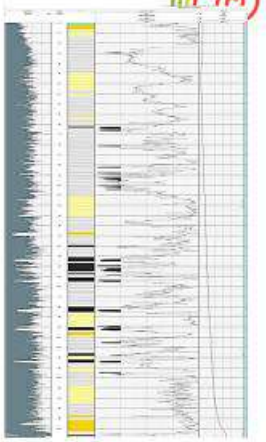


3. Geología del subsuelo

- Realización de perforaciones con recuperación de núcleos
- Muestreo para mediciones y análisis fisicoquímicos

Pozo Carmen de Chucurí-1. Santander

Pozo Landázuri-1. Santander



Registros de pozo

- Gamma Ray
- Resistividad
- Densidad
- Temperatura

4. Caracterización y Cálculo del Potencial

Muestreo y mediciones de contenidos de CBM

a. Preparación de canister

b. Muestreo

c. Sellado, cierre hermético

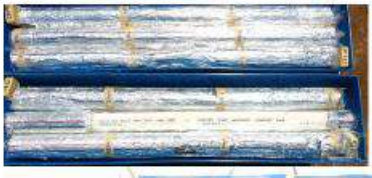
d. Medición gas perdido y desorbido en campo

e. Mediciones de gas desorbido y residual en laboratorio

Muestreo y mediciones de contenidos de CBM

f. Preservación y almacenamiento de núcleos

Recuperación de núcleos para muestreo



Empacado y protección de núcleos

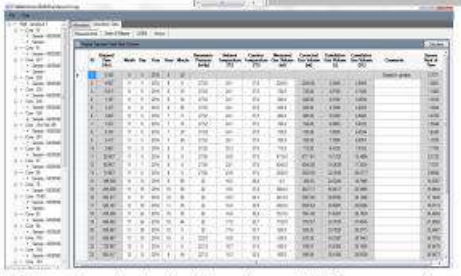
Almacenamiento de cajas para traslado

El destino final de los núcleos es la litoteca del SGC

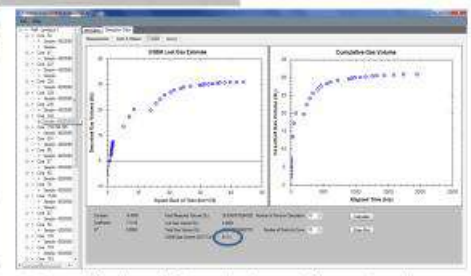
Muestreo y mediciones de contenidos de CBM

g. Procesamiento de información - software Terragam

Introducción de datos básicos sobre el pozo y las muestras



Diligenciamiento de datos de medición para cada muestra, Gas perdido y desorbido.



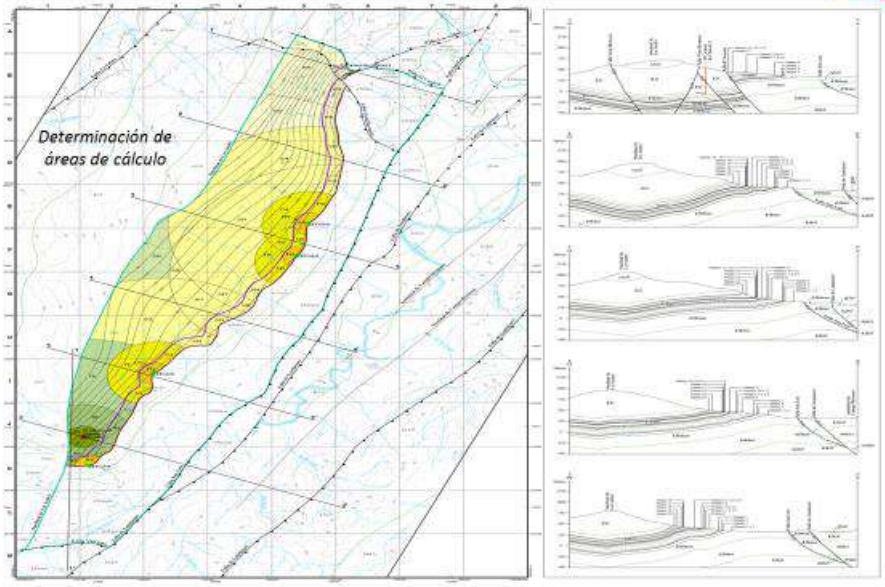
Obtención de gráficas de desorción y valor de gas perdido más desorbido.

Caracterización fisicoquímica de carbones

- Análisis próximo (humedad residual, materia volátil, cenizas y carbono fijo).
- Análisis elemental (carbono, hidrogeno, nitrógeno y azufre total).
- Químico de cenizas (diez elementos mayores).
- Elementos menores.
- Poder calorífico.
- Mercurio
- Índice de Hinchamiento
- Plastometría
- Petrografía
- Cromatografía

- Termocronología - huellas de fisión e isotopos estables (grupo de investigación y aplicaciones nucleares y geocronológicas)

Cálculo de Recursos de CBM



Mapa de Contornos Estructurales. Sector GMAC Carmen de Chucurí. 2015

Resultados Principales

- Realización de 15 perforaciones exploratorias en Cundinamarca, Boyacá y Santander, con profundidades entre 300 a 600 m. En total se han perforado 7235 m con recuperación de núcleos
- Caracterización de carbones y evaluación de potencial de CBM.
- Obtención de muestras de carbón con contenidos de gas metano de hasta 350 pies3/ton. Los mayores valores de CBM se registraron hacia el área de Tasco –Socotá y Umbita-Rondón, en carbones tipo Subbituminosos a Bituminoso con alto volátil A, B, C.

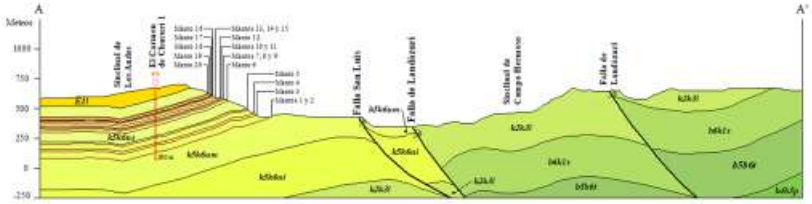
AÑO	AREA	POZOS	Metros	POTENCIAL (Bcf)
2011	Checua – Lenguazaque (Tausa – Cucunubá)	Sutatausa 1 Cucunubá 3	400 300	3.46
2012	Checua Lenguazaque (Gachetá – Samacá)	Ráquirá 1 Samacá 2	400 300	1.92
2013	Tasco – Socotá	Socotá 1 Socotá 2	425 510	8.15
2014	Umbita – Rondón	Umbita 1 Chinavita 1	520 580	122.7
2015	El Carmen de Chucurí	Carmen de Chucurí 1 Carmen de Chucurí 2	600 600	17.3
2016	Landázuri – Vélez	Landázuri 1 Landázuri 2	600 600	305.2
2017	Guaduas – Caparrapí	Caparrapí 1 Caparrapí 2 Guaduas 1	500 400 500	

Fuente: Datos del estudio

Resultados obtenidos

A partir del análisis realizado a los diferentes estudios de GMAC, adelantados por el SGC, en relación a las variables que controlan la generación de gas metano en los mantos de carbón en zonas con buenas perspectivas, se considera hasta el momento, que:

- Rango del carbón ← Mayor importancia
- Tipo de carbón. Análisis Maceral.
- Contenido de materia mineral. Determinación de Cenizas y azufre.
- Espesor de la cobertera e historia del enterramiento. ← Mayor importancia



Corte geológico. Sector Landázuri - Vélez, 2015

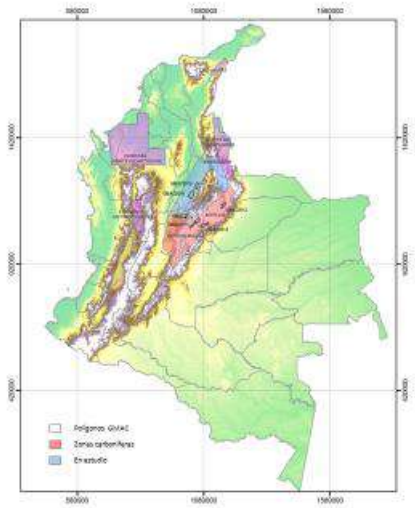
Productos

- Metodologías y estándares (compartidos con ANH y UPME)
- Informes técnicos y cálculos de recursos de CBM
- Mapas geológicos
- Mapas de contornos estructurales
- Columnas estratigráficas
- Informes de perforaciones
- Registros eléctricos y de temperatura
- Entrega de núcleos de perforación a Litoteca SGC

INFORMACIÓN:

- ✓ **Almacenada en base de información EXPLORA de la DRM**
- ✓ **Disponible para consulta en línea WWW.SGC.GOV.CO**

3. PROYECCIONES

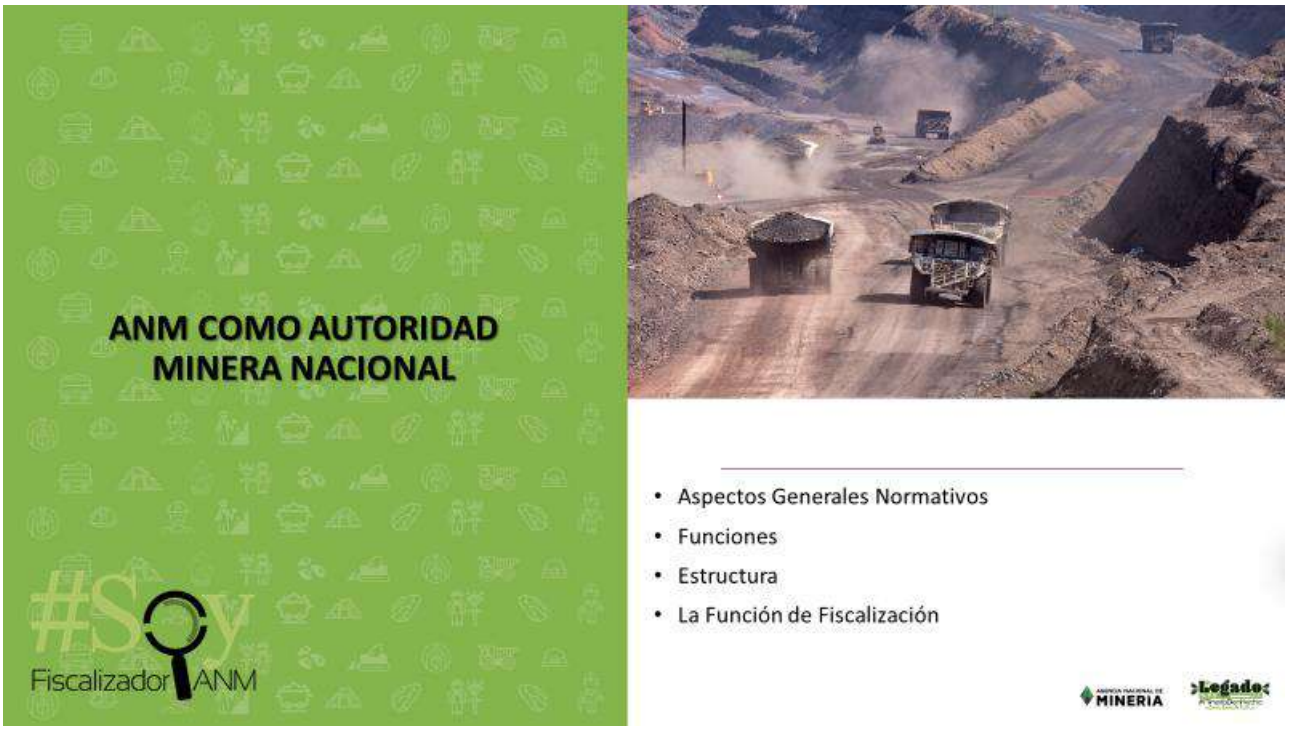


No	ZONA CARBONIFERA	AREA CARBONIFERA
1	CUNDINAMARCA	MACHETA – VILLA PINZON
		TABIO-RIO FRIO
2		
3	BOYACA	
4		CHITA-LA UVITA-EL ESPINO
6		NUEVO COLON-RAMIRIQUI
7		CATATUMBO
8	NORTE DE SANTANDER	TASAJERO
9		ZULIA-CHINACOTA
10	ANTIOQUIA	AMAGA-ANGELOPOLIS
12	LA GUAJIRA	SAN JUAN-VILLANUEVA
13	CORDOBA-NORTE DE ANTIOQUIA	ALTO SAN JORGE

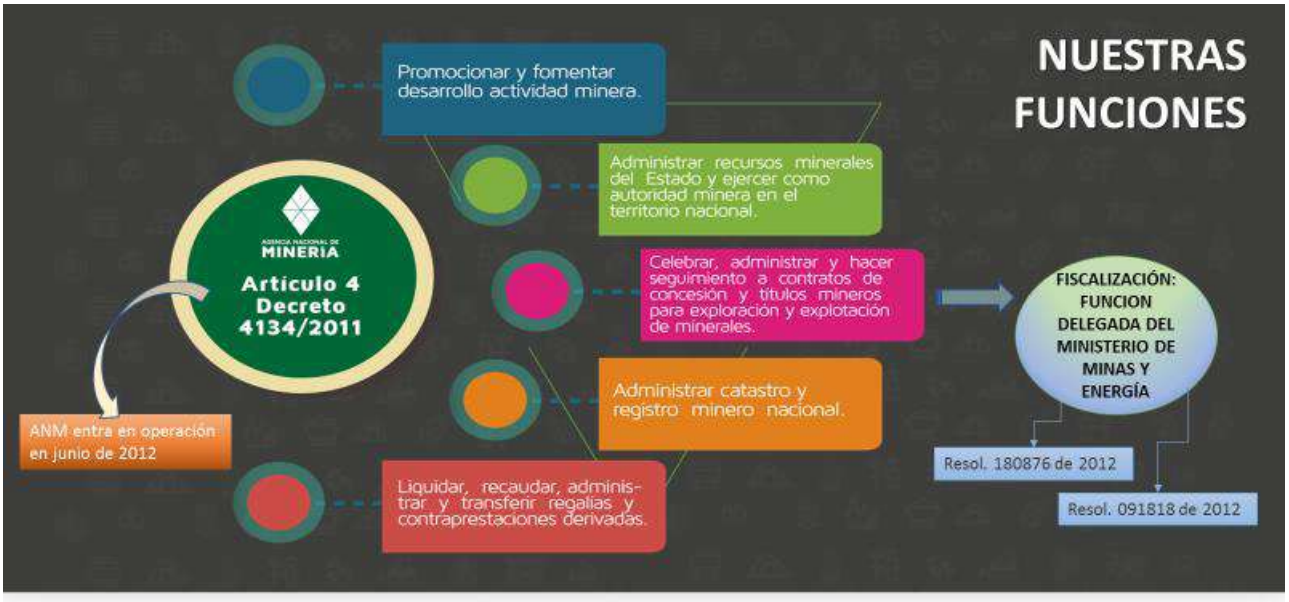
Áreas proyectadas para estudio de CBM.

Annex VI

Presentation MINERIA




INSTITUCIONALIDAD DEL SECTOR MINERO EN COLOMBIA
MINISTERIO DE MINAS Y ENERGÍA
VICEMINISTERIO DE MINAS Y ENERGÍA
Función Delegada
GOBERNACIÓN DE ANTIOQUIA
Función Delegada
DIRECCIÓN DE MINERÍA EMPRESARIAL
DIRECCIÓN DE FORMALIZACIÓN MINERA
AGENCIA NACIONAL DE MINERÍA
SERVICIO GEOLÓGICO COLOMBIANO
UNIDAD DE PLANEACIÓN MINERO ENERGÉTICA


NUESTRAS FUNCIONES
Promocionar y fomentar desarrollo actividad minera.
Administrar recursos minerales del Estado y ejercer como autoridad minera en el territorio nacional.
Celebrar, administrar y hacer seguimiento a contratos de concesión y títulos mineros para exploración y explotación de minerales.
Administrar catastro y registro minero nacional.
Liquidar, recaudar, administrar y transferir regalías y contraprestaciones derivadas.
MINERIA
Articulo 4 Decreto 4134/2011
ANM entra en operación en junio de 2012
FISCALIZACIÓN: FUNCION DELEGADA DEL MINISTERIO DE MINAS Y ENERGÍA
Resol. 180876 de 2012
Resol. 091818 de 2012

COMPETENCIAS QUE NO LE PERTENECEN A LA ANM

No tiene competencia sobre minería ilegal

No cumple funciones de carácter policivo (Cierre de minas)

No tiene injerencia en la enajenación de predios o uso de los mismos

LA GERENCIA DE SEGUIMIENTO Y CONTROL

Vicepresidencia de Seguimiento, Control y Seguridad Minera

- GERENCIA DE SEGUIMIENTO Y CONTROL
  - Grupo de Estudios Técnicos
  - Grupo Proyectos de Interés Nacional
  - Zona Norte 4 PARES
  - Zona Centro 2 PARES
  - Zona Occidente 6 PARES
- GERENCIA SEGURIDAD Y SALVAMENTO MINERO
- GERENCIA REGALIAS Y CONTRAPRESTACIONES ECONÓMICAS

1. Bogotá - Sede central
   Calle 26 No. 59-51 Torre 4 Pisos 8, 9 y 10
2. Punto de Atención Regional Medellin
   Calle 75 No. 79A-51
3. Punto de Atención Regional Cali
   Carrera 98 No. 16-00
4. Punto de Atención Regional Ibagué
   Carrera 8 No. 19-31, Barrio Interlaken
5. Punto de Atención Regional Bucaramanga
   Carrera 20 No. 24-71
6. Punto de Atención Regional Valledupar
   Calle 15 No. 14-33 oficina 203
7. Punto de Atención Regional Cúcuta
   Avenida 5 No. 11-20, piso 9
8. Punto de Atención Regional Nobsa
   Kilómetro 5, vía Sogamoso
9. Punto de Atención Regional Cartagena
   Calle de la Cruz No. 9-110
10. Punto de Atención Regional Pasto
    Calle 27 No. 9E-25 Barrio La Carolina
11. Punto de Atención Regional Manizales
    Carrera 21 No. 20-58 oficina 504
12. Punto de Atención Regional Chocó
    Carrera 6 No. 28-01 Piso 2 - Quibdó

LA AGENCIA NACIONAL DE MINERIA TIENE COMO OBLIGACIÓN

RETOS:

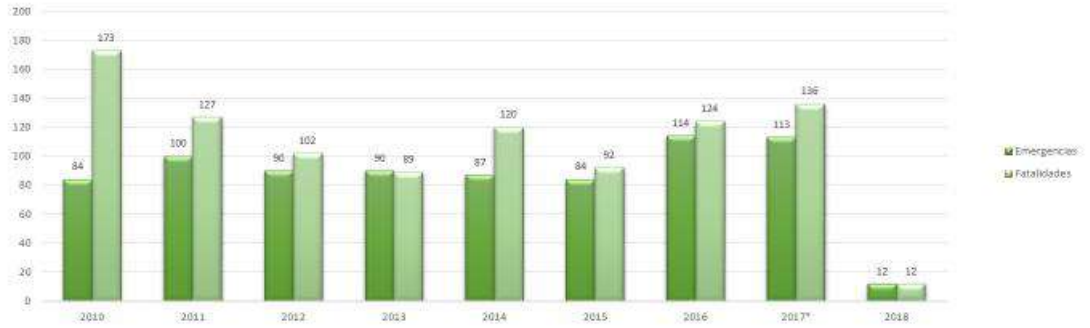
De acuerdo con Artículo 58 de 2015 la Agencia Nacional de Minería tiene a su cargo la Clasificación de las labores mineras subterráneas de carbón. Para todos los aspectos relacionados con el presente Reglamento, las labores mineras subterráneas de carbón se clasifican en tres (3) categorías:

CATEGORÍA	DESCRIPCIÓN
I. Minas o frentes de trabajo no grisutuosos.	Son aquellas labores o excavaciones subterráneas para las cuales la concentración de metano en cualquier sitio de la mina no alcanza el cero por ciento (0%).
II. Minas o frentes débilmente grisutuosos.	Son aquellas labores o excavaciones subterráneas para las cuales la concentración de metano en cualquier sitio de la mina sea igual o inferior a cero
	coma tres por ciento (0,3%).
III. Minas o frentes fuertemente grisutuosos.	Son aquellas labores o excavaciones subterráneas para las cuales la concentración de metano en cualquier sitio de la mina sea superior a cero coma tres por ciento (0,3%).

Parágrafo. La clasificación de las labores mineras subterráneas de carbón será realizada por la autoridad minera, encargada de la administración de los recursos mineros.

EMERGENCIAS MINERAS OCURRIDAS ENTRE LOS AÑOS 2005-2018*

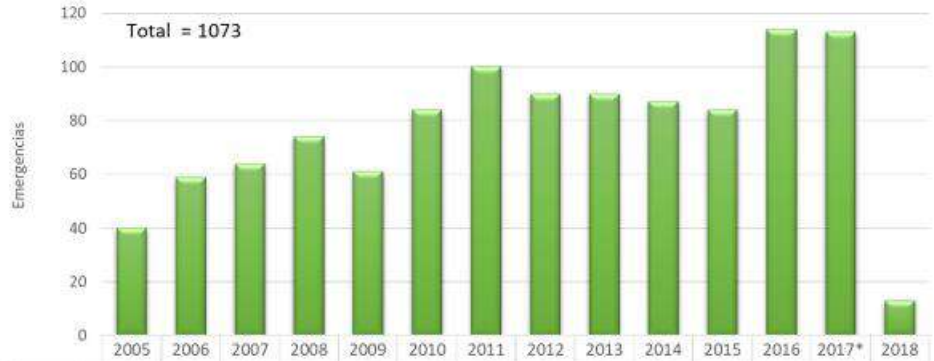
FATALIDADES Y EMERGENCIAS MINERAS OCURRIDAS ENTRE LOS AÑOS 2005 - 2018*



*Datos a 28 de febrero de 2018

EMERGENCIAS MINERAS OCURRIDAS ENTRE LOS AÑOS 2005-2018*

EMERGENCIAS MINERAS OCURRIDAS ENTRE LOS AÑOS 2005 - 2018*



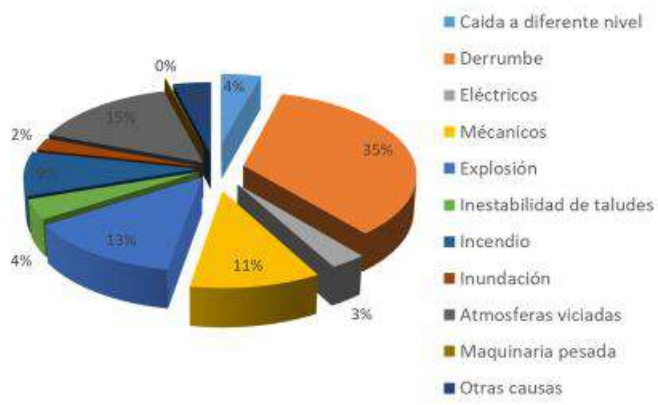
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017*	2018
Emergencias	40	59	64	74	61	84	100	90	90	87	84	114	113	13

*Datos a 28 de febrero de 2018

FATALIDADES EN EMERGENCIAS MINERAS OCURRIDAS ENTRE LOS AÑOS 2005-2018*

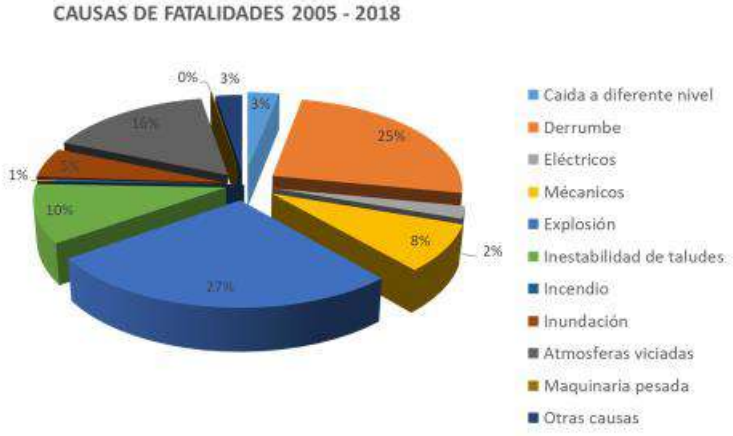
*Datos a 28 de febrero de 2018

CAUSAS DE EMERGENCIA 2005-2018*



*Datos a 28 de febrero de 2018

CAUSAS DE FATALIDADES 2005-2018*



*Datos a 28 de febrero de 2018

Annex VII

Presentation UNIMINAS

QUIENES SOMOS

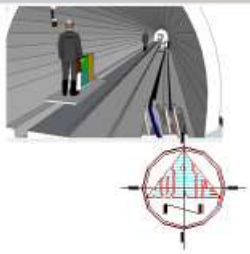
Uniminas S.A.S., titular del contrato de concesión 2505 es una sociedad comercial e industrial creada en el año 1998 con el objeto de realizar la extracción de minerales en todas sus fases; especialmente el aprovechamiento de carbón coquizable.

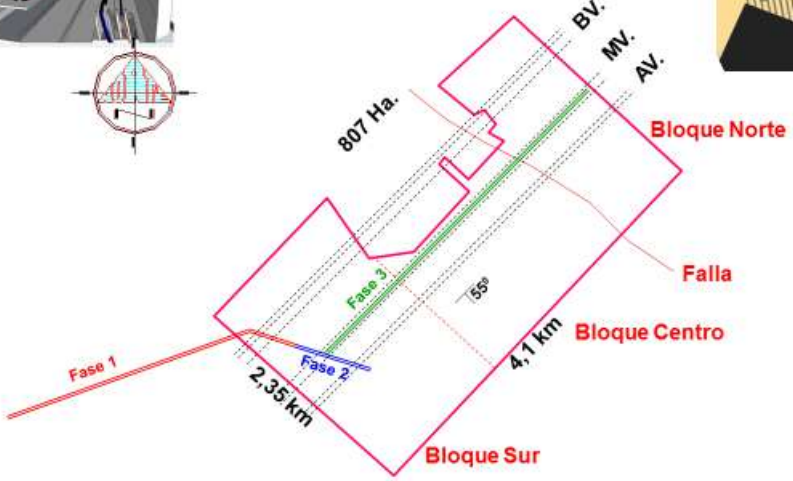
NUESTRA OPERACION

Uniminas realiza la operación minera de extracción del carbón mediante labores subterráneas cumpliendo con los parámetros de seguridad establecidos y comprometidos con la calidad de nuestro producto y con el medio ambiente.
El desarrollo de esta actividad se realiza directamente y a través de contratos de asociación.

C.I. MILPA S.A. – UNIMINAS S.A.S.

CONTRATO DE CONCESIÓN 2505

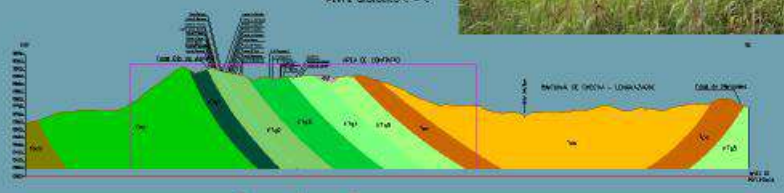




C.I. MILPA S.A. – UNIMINAS S.A.S.

GEOLOGÍA CONTRATO DE CONCESIÓN

Rumbo predominante N45E
Buzamiento 55 SE



Carbón
Bajo Volátil

Carbón
Medio Volátil

Carbón
Alto Volátil

C.I. MILPA S.A. – UNIMINAS S.A.S.

RESERVAS CONTRATO CONCESION

CARBONES BLOQUE SUR	R. MEDIDAS (Ton.)	R. INDICADAS (Ton.)	R. INFERIDAS (Ton.)
Bajo Volátil	3´299.725	8´679.181	22´171.720
Medio Volátil	2´561.903	8´286.496	10´541.146
Subtotal	5´861.628	16´965.677	32´712.866
TOTAL RESERVAS	**55´540.171 Toneladas**		

CARBONES BLOQUE NORTE	R. MEDIDAS (Ton.)	R. INDICADAS (Ton.)	R. INFERIDAS (Ton.)
Bajo Volátil	1´391.394	4´679.849	6´095.168
Medio Volátil	938.598	1´645.699	2´424.642
Subtotal	2´329.992	6´325.548	8´519.810
TOTAL RESERVAS	**17´175.350 Toneladas**		

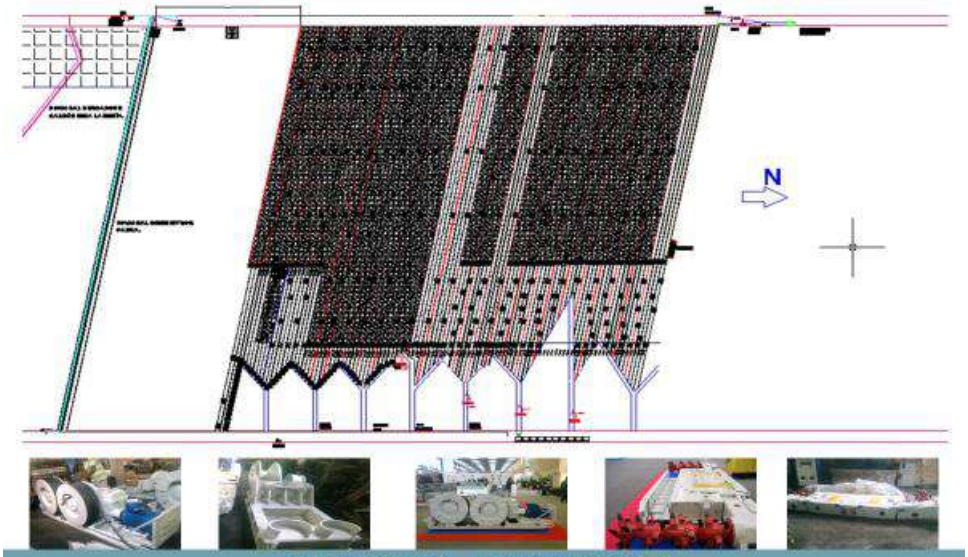
TOTAL RESERVAS CONCESIÓN 2505	**72,715,521 ton**

C.I. MILPA S.A. – UNIMINAS S.A.S.

MARCO PRODUCTIVO UNIMINAS

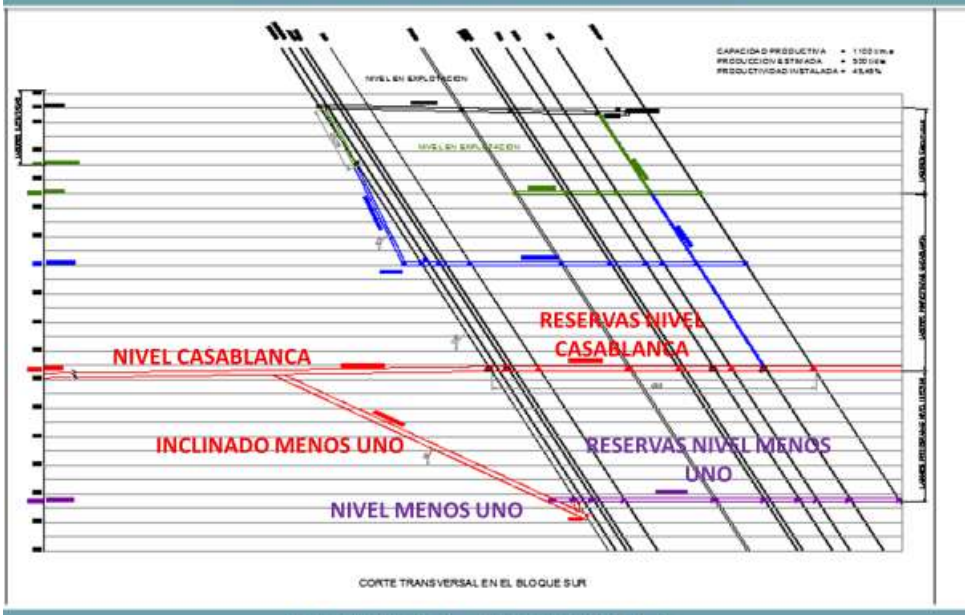
C.I. MILPA S.A. – UNIMINAS S.A.S.

TECNIFICACIÓN EXPLOTACIÓN MINERA



C.I. MILPA S.A. – UNIMINAS S.A.S.

HACIA DONDE VAMOS



C.I. MILPA S.A. – UNIMINAS S.A.S.

INCLINADO MENOS UNO

Se está realizando la construcción del Inclinado menos uno con el fin de habilitar 2.152.180 ton de carbón bajo y medio volátil, que permite garantizar la actividad económica de la compañía para los próximos 10 años.

C.I. MILPA S.A. – UNIMINAS S.A.S.

INCLINADO MENOS UNO

Con este proyecto se busca optimizar el medio de transporte, pasando a un transporte continuo (bandas transportadoras) facilitando la operación minera, mejorando costos de producción y permitiendo producciones mayores a 15.000 Ton/mes.

C.I. MILPA S.A. – UNIMINAS S.A.S.

INCLINADO MENOS UNO

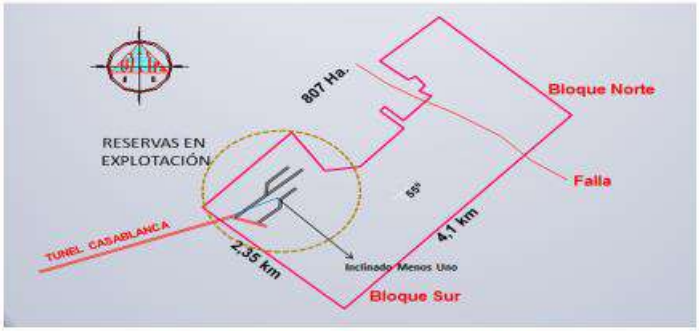
C.I. MILPA S.A. – UNIMINAS S.A.S.

INCLINADO MENOS UNO

C.I. MILPA S.A. – UNIMINAS S.A.S.

PARAMETROS INCLINADO MENOS UNO

PARÁMETROS TÉCNICOS DE AVANCE		
VARIABLES	ESPECIFICACIÓN	UNIDAD
INCLINACIÓN	16	Grados
LONGITUD TOTAL	509	m
RESERVAS A HABILITAR	1.764.000	Ton
PRODUCCIÓN PROYECTADA AÑO	180.000	Ton



C.I. MILPA S.A. – UNIMINAS S.A.S.

CONTRATO DE CONCESIÓN No. 2505 PROCESO DE FORMALIZACIÓN MINERA

C.I. MILPA S.A. – UNIMINAS S.A.S.

OPCIONES

EJECUTAR AMPARO ADMINISTRATIVO Y CIERRE CON EL CONFLICTO SOCIAL QUE SE GENERA

LEGALIZAR UTILIZANDO LAS HERRAMIENTAS JURIDICAS ESTABLECIDAS EN EL CODIGO DE MINAS

C.I. MILPA S.A. – UNIMINAS S.A.S.

LOS MAYORES LOGROS

C.I. MILPA S.A. – UNIMINAS S.A.S.

LOGROS: ASPECTOS SOCIALES Y CALIDAD DE VIDA

ASPECTOS SOCIALES

- ***Empleos directos:*** ***768***
- ***Empleos indirectos:*** ***3.500***
- ***Población área influencia:*** ***11.200 habitantes Guachetá***
- ***Sistema de vida:*** ***Agropecuaria y minera***
- ***Educación:*** ***Primaria y Básica***
- ***Municipios de influencia:*** ***Guachetá, Lenguazaque, Ubaté, Cucunubá***

MEJORAMIENTO CALIDAD DE VIDA

- ***Sistema de potabilización de agua***
- ***Área de ducha y vestieres con agua caliente***
- ***Casino para el suministro de alimentación***
- ***Sistema de monitoreo por Biométrico***
- ***Capacitación a todo nivel y validación primaria y bachillerato personal operativo***

C.I. MILPA S.A. – UNIMINAS S.A.S.

LOGROS OBTENIDOS




C.I. MILPA S.A. – UNIMINAS S.A.S.

LOGROS OBTENIDOS




C.I. MILPA S.A. – UNIMINAS S.A.S.

LOGROS OBTENIDOS

C.I. MILPA S.A. – UNIMINAS S.A.S.

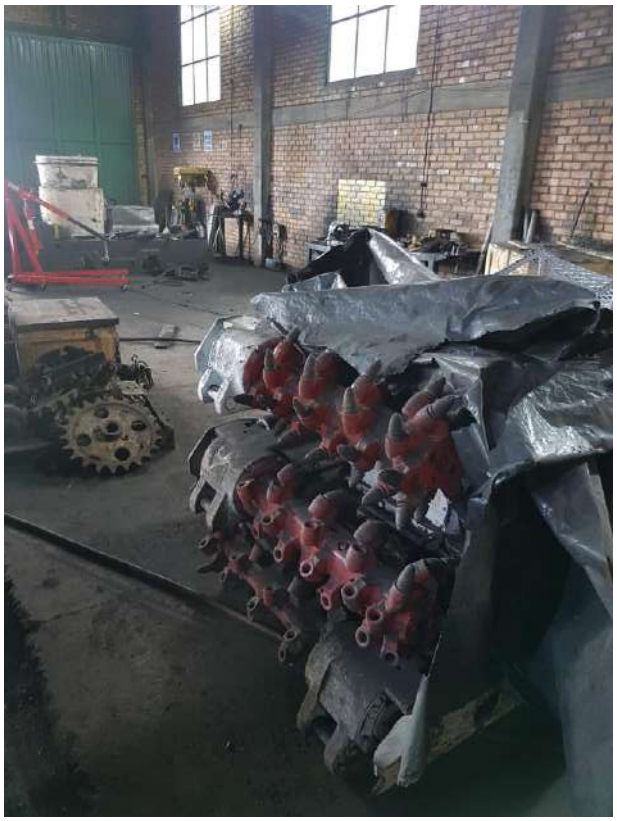
LOGROS OBTENIDOS

C.I. MILPA S.A. – UNIMINAS S.A.S.

Annex VIII

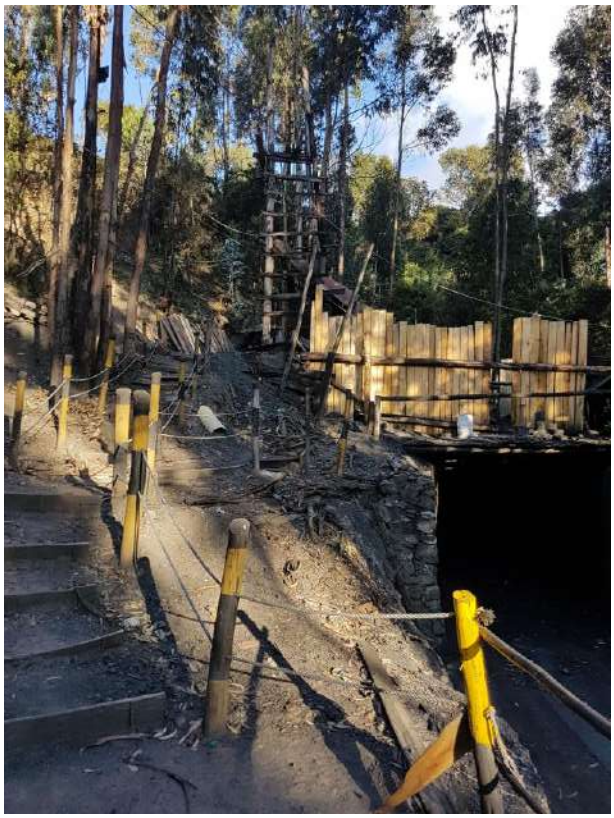
Pictures

A. Casablanca Mine (2nd biggest in the country)



B. Average Mine


LOS 10 MANDAMIENTOS
LA SEGURIDAD EMPIEZA POR NOSOTROS



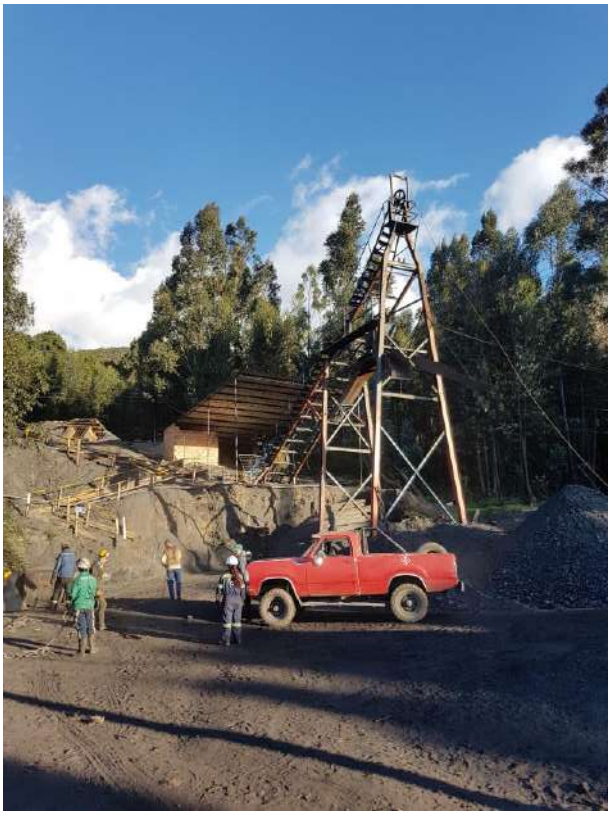

MINA EL ROBLE E.U
USE ELEMENTOS DE PROTECCION PERSONAL
GUANTES
BOTAS
CASCO
AVISA A LOS TRABAJADORES QUE ES:
1. PROHIBIDO VIAJAR EN EL COCHE CARGADO


PELIGRO
ALTO VOLTAJE
PRECAUCION
VENTILADOR
PELIGRO
ALTO VOLTAJE

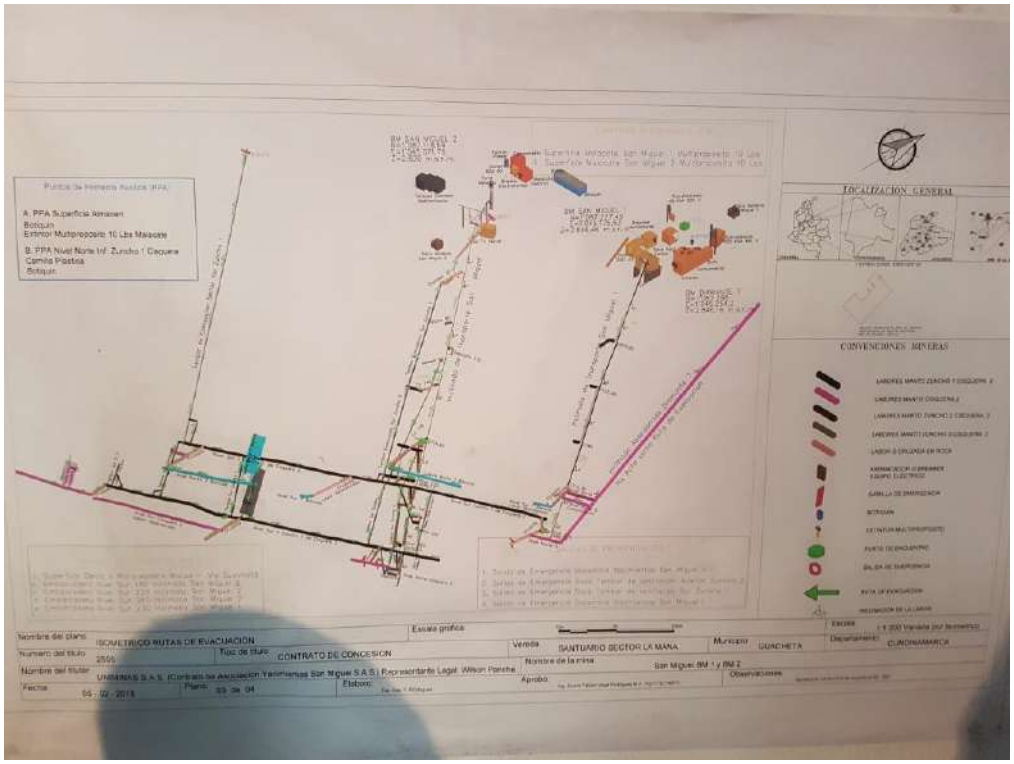

PERSONAL
GUANTES
BOTAS
CASCO
AVISA
1. PROHIBIDO
2. PROHIBIDO
3. FAVOR

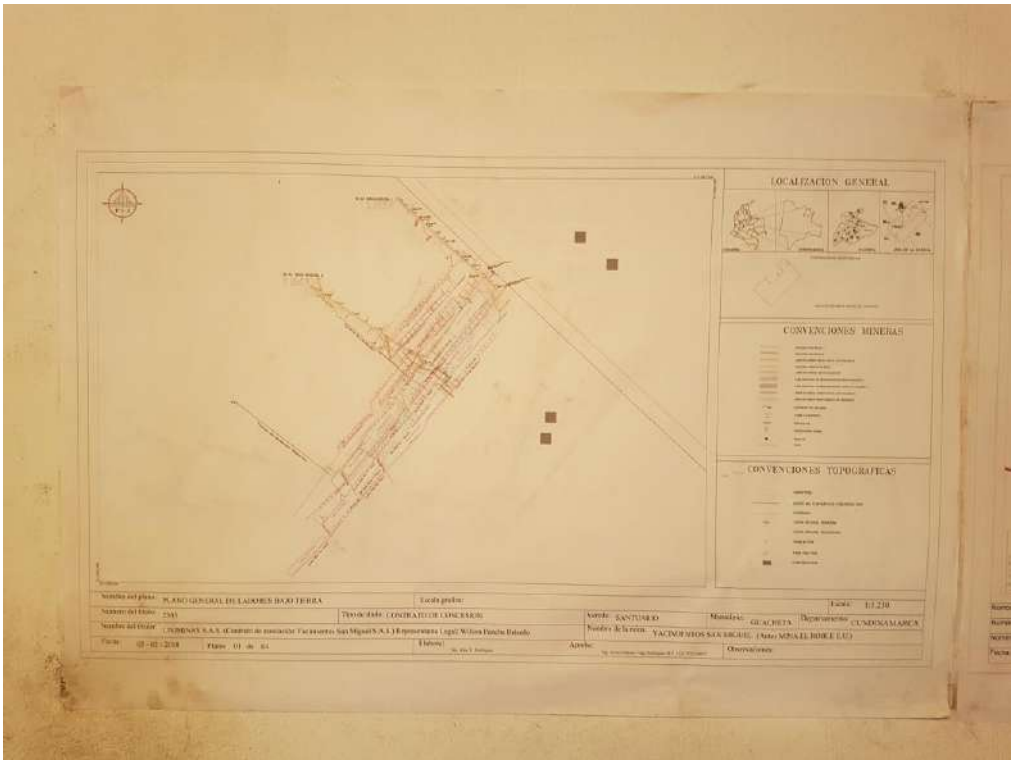

FRAGUA

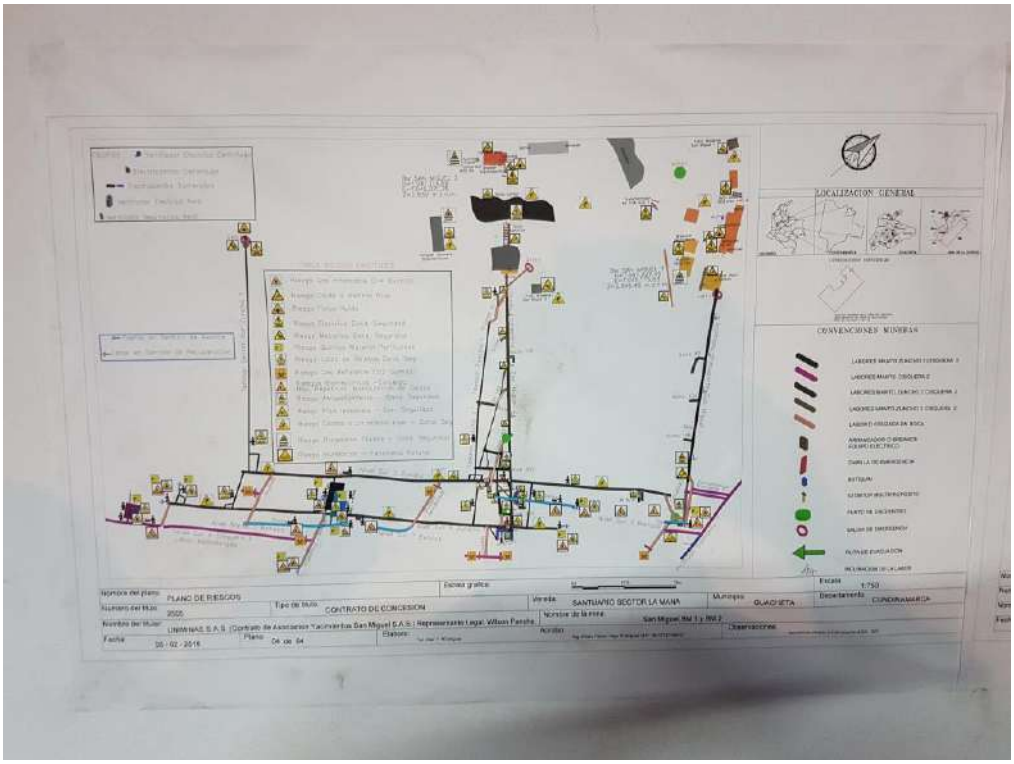
C. Average mine 2




KAESER


LOCALIZACION GENERAL
CONVENCIONES MINERAS
ISOMETRICO RUTAS DE EVACUACION
CONTRATO DE CONCESION
SANTUARIO SECTOR LA MINA
GUACHETA
CUNDINAMARCA


LOCALIZACION GENERAL
CONVENCIONES MINERAS
CONVENCIONES TOPOGRAFICAS
PLANO GENERAL DE LABORES BAJO TIERRA
CONTRATO DE CONCESION
SANTUARIO
GUACHETA
CUNDINAMARCA



D. Cementos Argos abandoned mine

Annex IX

Workshop Agenda

UNECE Group of Experts on Coal Mine Methane
Global Methane Initiative

Workshop
on
Best Practices
in
Coal Mine Methane Capture and Utilization

Bogota, Colombia
Radisson AR Bogota Airport
Avenida Carrera 60 No 22 - 99, Teusaquillo, 110010 Bogotá, Colombia

24-25 July 2018

Day 1: Tuesday 24 July 2018	
9:30 – 9:40	**Opening Remarks**
9.30 – 9.40	**Opening Remarks: What are best practices and how are they employed to facilitate sustainable energy development?** *Mr. Raymond C. Pilcher, Chair, UNECE Group of Experts on Coal Mine Methane*
9:40 – 9:50	*Speaker from Colombia*
9:50 – 9:55	*Mr. Michal Drabik, Economic Affairs Officer, United Nations Economic Commission for Europe*
9:55 – 10:00	*Ms. Felicia Ruiz, United States Environmental Protection Agency*
10:00 – 10:20	**Coffee Break**
10:20 – 11:45	**Session One:** CMM/AMM/VAM Project Development
	The Status of CMM Project Development in Colombia
10:20 – 10:40	Experience of a Local Project Developer *Speaker from Drummond*
10:40 – 11:00	Overview of CMM Project Development Studies in Colombia *Mr. Ruben Dario Chanci, UPME*
11:00 – 11:20	Pre-feasibility Study of Methane Drainage at the San Juaquin Mine, Antioquia, Colombia *Mr. Jonathan Kelafant, Senior Vice President, Advanced Resources International (ARI)*
11:20 – 12:00	**Q&A – Discussion with the Audience**
12:00 – 14:00	**Lunch**

14:00 – 15:30	**Session Two:** Calculation of Methane Gas Reserves in Coal Beds
	Drilling Techniques, Sampling, Required Analysis, and Models for Estimating Reserves
14:00 – 14:20	Is there methane gas potential in Colombia? *Mr. Jorge Eliecer Mariño Martinez*
14:20 – 14:40	Estimating Reserves and Resources – Colombian experience (TBC) *Mr. Roger Tyler*
14:40 – 15:00	Standard Techniques for Sampling and Data Analysis to Estimate CMM/CBM Reserves *Mr. Jonathan Kelafant, Senior Vice President, Advanced Resources International (ARI)*
15:00 – 15:30	**Q&A – Discussion with the Audience**
15:30 – 17:30	**Session Three:** Drainage and Co-Development of Coal and Gas Resources
	Pre-Mine Drainage
15:30 – 15:50	CBM potential in carboniferous zones of Cundinamarca, Boyacá and Santander *Mr. Marco Antonio Rincón Mesa, Servicio Geológico Colombiano*
15:50 – 16:10	Pre-Mine Drainage in Poland*ICE-CMM Poland - Mr. Jacek Skiba, Chief Specialist, Experimental Mine "Barbara", GIG - Central Mining Institute*
16:10 – 16:30	Co-Development of Coal and Gas Resources – Coal Mining in an Established Gas Field *Mr. Raymond C. Pilcher, Chair, UNECE Group of Experts on Coal Mine Methane*
16:30 – 17:30	**Drilling Solutions for Methane Drainage – panel discussion with Q&A from the audience** *Mr. Roger Tyler, Mr. Jonathan Kelafant, Mr. Raymond C. Pilcher, Mr. Jacek Skiba, Mr. Marco Antonio Rincón Mesa*

Day 2: Wednesday 25 July 2018	
9:30 – 10:40	**Session Four:** Mine Safety
9:30 – 9:50	**Good Practices in Risk Assessment** *Ms. Felicia Ruiz, United States Environmental Protection Agency*
9:50 – 10:10	**New Directions in R&D aiming to decrease methane hazard and to increase CMM capture - based on GIG experience** *Mr. Jacek Skiba, Chief Specialist, Experimental Mine "Barbara", GIG - Central Mining Institute*
10:10– 10:40	**Q&A – Discussion with the Audience**
10:40 – 11:00	**Coffee Break**

11:00 – 15:00	**Session Five:** Ventilation
11:00 – 11:20	**Overview of Ventilation Characteristics, Practices, and Challenges in Colombia** *Ms. Gloria Catalina Gheorghe, ANM* **Good Practices in Effective Ventilation of Underground Coal Mines**
11:20 – 11:40	U.S. Practices and Regulations *Ms. Susan B. Patton, Senior Associate, Agapito Associates, Inc.*
11:40 – 12:00	Polish Practices and Regulations *Mr. Henryk Koptoń, Head of the Gas Hazard Department, GIG - Central Mining Institute*
12:00 – 14:00	**Lunch**
14:00 – 14:20	**VAM processing - international experiences from proven technology** *Mr. Richard Mattus, Consultant, RM Business Consulting*
14:20 – 15:20	**Regulations for Coal Mine Ventilation and Their Impact on Methane Abatement -** panel discussion with Q&A from the audience Moderator: *Mr. Raymond C. Pilcher, Chair, UNECE Group of Experts on CMM* *Ms. Susan B. Patton, Senior Associate, Agapito Associates, Inc.* *Mr. Henryk Koptoń, Head of the Gas Hazard Department, GIG - Central Mining Institute* *Mr. Richard Mattus, Consultant, RM Business Consulting* *Mr. Willian Guevara, Manager, Uniminas*
15:20 – 16 :45	**Session Six:** Abandoned Mine Methane
15:20 – 15:40	**Abandoned Mine Methane – Significance and Utilization** AMM utilization - Experiences of methods for utilizing of low-quality methane as energy source, applicable for abandoned mining methane *Mr. Richard Mattus, Consultant, RM Business Consulting*
15:40 – 16:00	**Best Practices in Transition from Operating Mine to Abandoned Mine Methane** Case study: Closed Mine, Mongua, Boyaca *Argos*
16:00 – 16:45	**General Discussion among the Experts and Q&A with the Audience**
16:45 – 17:00	**Closing Remarks** *Mr. Raymond C. Pilcher, Chair, UNECE Group of Experts on Coal Mine Methane*