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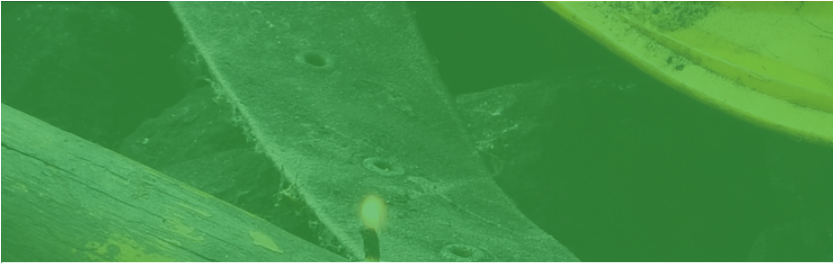
A photograph of a coal miner's yellow hard hat with a headlamp, a pickaxe, and a pair of orange gloves resting on a pile of dark coal. A semi-transparent dark grey box is overlaid on the bottom right of the image, containing the title and subtitle text.

# Perspectives from the coal industry in Mexico

A systems approach



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**For more information:** <https://www.wwf.org.mx/transicionjusta>

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Mexico City, October 2021

# Project Presentation

Coal-fired electricity generation is one of the most important sources of pollution in the world, significantly contributing to greenhouse gas (GHG) concentrations in the atmosphere. Although in Mexico this activity currently represents about 6% of total electricity generation, it generates about 20% (23.6 Mt-CO<sub>2</sub>e) of the sector's GHG emissions.

For this reason, we seek to promote a progressive phase-out of coal in electricity generation and accelerate the transition to renewable energy. In 2017, Mexico signed the Powering Past Coal Alliance, committing to gradually reduce its use for electricity generation.

A year later, at the United Nations Framework Convention on Climate Change (UNFCCC) COP24, Mexico signed the Silesia Declaration, recognizing the importance of solidarity and justice policies to facilitate the energy transition to low-emission technologies.

Subsequently, in September 2019, the country joined the Climate Action for Jobs Initiative, committing to promote fair energy transition policies. These commitments are additional to the climate commitments that Mexico established within the Paris Agreement, equivalent to a 22% reduction in total greenhouse gas emissions regarding a baseline.

**The use of coal to generate electricity has important impacts on the formation of acid rain - precipitation that presents high concentrations of sulfuric and nitric acid, increasing the toxicity of aquatic environments, which affects trees and insects - and on the deterioration of air quality, affecting human health, especially the respiratory and cardiovascular systems.**


In Mexico, there are three power plants that use coal to produce electricity, two of which are in Coahuila and are the main producers of key pollutants in the country. Specifically, the Carbón I or José López Portillo coal power plant located in the municipality of Nava (Coahuila) is the main producer of nitrogen oxides in the country (55,871 tons), the first in methane (153 tons), the second in carbon dioxide (just over 10 million tons), the first in nitrous oxide (229 tons) and the second largest producer of mercury (678 kilograms), in addition to being an important emitter of small particles PM<sub>10</sub> and PM<sub>2.5</sub> and sulfur dioxide.

Additionally, the Carbon II coal power plant, located in the same municipality, is the second source of nitrogen oxides in the country (49,915 tons), third in carbon dioxide (9 million tons), third in methane (136.75) and nitrous oxide (205 tons) and third in mercury (604.79 kilograms), in addition to contributing to the emission of small particles PM<sub>10</sub> and PM<sub>2.5</sub><sup>1</sup>.

Coal production and the generation of electricity based on this fuel are geographically concentrated in the so-called Coal-producing Region in the state of Coahuila. **The origins and cultural identity of this region are grounded in coal mining activities dating back 200 years. Mining has been and is the economic pillar for over 160 thousand inhabitants that live in the region.**

Considering these factors, it is essential that any strategy or policy focused on the progressive reduction of coal in the power sector considers the local communities that depend on this activity, putting the economic and social impacts, as well as the alternatives for the recovery and economic restructuring of said region, at the center of the discussion.

According to the International Labor Organization (ILO), a just transition seeks to generate coherent policy packages, defined in social dialogue and respecting fundamental rights to minimize the destruction of employment when moving from one economic model to another and maximize the creation of decent employment opportunities in sustainable companies, considering the effects on communities and people who lose their jobs.



This report is part of the “Creating enabling conditions for a just transition away from coal in Mexico” project implemented by WWF Mexico in association with the Universidad Autónoma de Coahuila (UAdeC) and the International Labor Organization (ILO). The specific objectives of this project focus on the development of strategic information for decision-makers at the national and local levels, the strengthening of capacities of key stakeholders on the just transition and green jobs, and the creation of networks between stakeholders to promote the social dialogue.

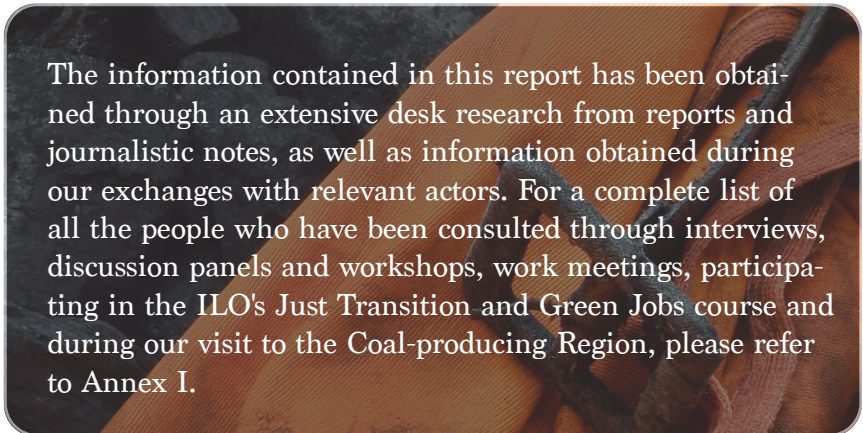
Throughout the life of the project, different activities and reports have been developed to address the objectives previously mentioned, namely:

1. Proposal of a feasible coal power plant retirement scenario and estimation of the economic impacts at the local and national level.
2. Identification of strategies for the diversification and economic restructuring of the Coal-producing Region.
3. Analysis of the configuration of the coal production value chain, including the main stakeholders and their perceptions on quality of employment in the Coal-producing Region.
4. Training on just transition and green jobs for 30 stakeholders from the state government, civil society organizations and the private sector.
5. Interviews and a futures workshop with key stakeholders at the national and local level to discuss feasible prospects for the Coal-producing Region and coal-fired electricity.
6. Production of an informative video about the coal industry and the coal region.

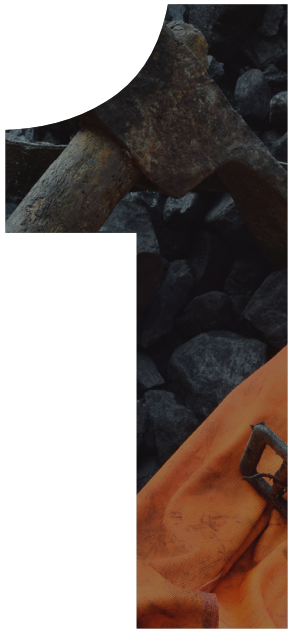
**In this process, we have analyzed different factors affecting the Coal-producing Region, as well as having identified the stakeholders that play an important role from the economic, political, and social point of view, and the different perspectives and preferences that exist regarding the future of the region.** This analysis describes the main findings of this process using a systems approach as a frame of reference.

The systems thinking approach stems from the premise that problems do not happen in a vacuum, but rather are dependent of the context and affected by interrelated and interdependent factors which, in turn, generate patterns and dynamics of behavior. Consequently, if we want to solve problems, it is necessary to understand these factors, as well as the relationships and patterns that cause them.

The systems approach has been useful to understand problems that occur in contexts with a high level of uncertainty and that are subject to constant change. **The purpose of the systems approach is not to simplify a complex reality, but to offer a more structured analysis to provide clarity about the most relevant stakeholders, issues, and patterns in the system surrounding a problem.** It also allows to identify opportunities to facilitate a desired change.



The information contained in this report has been obtained through an extensive desk research from reports and journalistic notes, as well as information obtained during our exchanges with relevant actors. For a complete list of all the people who have been consulted through interviews, discussion panels and workshops, work meetings, participating in the ILO's Just Transition and Green Jobs course and during our visit to the Coal-producing Region, please refer to Annex I.



## Defining system boundaries

### Coal location and extraction

The Coahuila Coal-producing Region comprises the municipalities of Juárez, Melchor Múzquiz, Progreso, Sabinas and San Juan de Sabinas, and concentrates 98% of coal production in Mexico, of which 45% is used for electricity generation, while 43% is related to the manufacture of coke used in steel production processes. An additional 10% is used in the petrochemical industry and the remaining 2% is consumed within the activity itself.<sup>2</sup> In 2019, the coal industry generated about 6,500 formal jobs with an estimated revenue of about 18 billion pesos.

Within the Coal-producing Region are the Río Escondido and Sabinas basins, which in turn are divided into eight coal-producing subbasins. The potential of mineral coal reserves in Mexico is estimated to amount to 1.387 million tons of coal.<sup>3</sup>

Recent studies indicate that coal reserves will grow deeper, as easily accessible seams have been depleted. However, at a greater depth, coal of better quality and higher calorific value are found. This type of coal is ideal as coking coal and is applicable in the manufacture of other chemical and metal products and by-products.

As a comparison, in 2021 world coal reserves amounted to 1,074 billion tons, mostly concentrated in a few countries: USA (24%), Russia (15%), Australia (14%) and China (13%).<sup>4</sup> Regarding global consumption, although in 2020 there was a 4% drop because of COVID-19, by the end of that year demand had already rebounded 3.5% above 2019 levels.

Currently, China and India consume two-thirds of the world's total coal production, while the European Union and the United States account for only 10%, after having reduced their consumption considerably in the last decade. Thus, world trends

in this sector are firmly driven by Asia, where countries such as Indonesia and Vietnam have also increased their production and consumption.

Coal is formed from the decomposition of plant organic matter and the action of anaerobic bacteria, deposited mainly in swampy areas and shallow lagoons. This matter accumulated millions of years ago and underwent physical and chemical transformations due to the tectonic movements of the earth's crust and the high pressures and temperatures to which it was subjected, resulting in mineral coal.

Global coal demand is mainly determined by three factors: price and availability of natural gas, temperature, especially in winter, and plans of European countries to phase out coal use.<sup>5</sup> Globally, two-thirds of the coal produced is used to generate electricity, while only 15% is used in steel production. By far, China is the dominant country in terms of using coal for electricity generation, with more than 1,000 coal-fired power plants located in its territory and with plans to add more. India follows with 281 plants, next are the United States with 252, Japan with 87 and Russia with 85 plants.<sup>6</sup>

Notably, nearly half of the capacity removed in 2019 was in the United States. President Trump increased the withdrawal of coal plants by 67% compared to President Obama. While the US and the European Union are moving away from coal, Japan is now the biggest driver with new plants adding 11.9 GW to its coal generating capacity and increasing its carbon dioxide emissions by 50%. Outside its borders, Japan is also financing 24.7 GW of new coal-fired capacity, which exceeds Australia's current capacity (24.4 GW).<sup>7</sup>

Back to Mexico, two types of mineral coal predominate in the Sabinas basin: sub-bituminous coal, which is suitable for transforming into coke (metallurgical coal), and sub-bituminous type C, with high volatility and suitable for generating power (thermal coal). Of the total mineral coal production, in 2020 it was recorded that 39% of total production corresponded to thermal coal, 47% to metallurgical or coking coal, and the remaining 14% comprised washed coal.<sup>8</sup> Although thermal and metallurgical coal are traded

in different markets, one thing they have in common is the fact that they have always been traded locally, among few local buyers.

**Coal applications, uses and market structure**

There are two forms of mining to extract coal. The first is underground mining, which is obtained using mechanical cutters and hydraulic self-advancing supports that temporarily hold the roof while mining the coal. Once the area exploration is finished, the ceiling collapses. Small/independent miners working in the so-called *pocitos\** (Spanish term referring to a small well) extract the coal by entering vertical mines, between 50 and 150 meters deep, in a steel tank pulled from a strap or barrel, which also serves to bring to the surface the coal they extract by spiking the soil.

Although this practice is not illegal, it frequently incurs irregularities and omissions, especially in terms of safety. There are other cases in which canceled lots operate illegally. This type of mining is highly risky, since the ceiling of these mines is supported only with wooden beams, and miners become exposed to methane gas poisoning and eye and ear damage as they cannot wear glasses because the coal dust blocks their vision or use earplugs, so they are able to hear if a wall is broken by the pressure of groundwater.

Surface mining, on the other hand, is used when the coal is close to the surface. This method recovers a higher proportion - up to 90% - of the coal deposits than underground mining. These large open pit mines can cover hundreds of kilometers and use large equipment such as dredgers, dump trucks, excavators, and power shovels.

On the supply side, coal in this region is produced by a little more than 50 producing companies, of which 73% are large companies, 16% are medium-sized companies, 8% comprise small companies and 3% are micro-companies, besides a similar number of individual producers. Regarding the type of professional and technical profiles that are required to carry out this activity, we found that these companies mostly employ civil engineers,

mechanics, geologists, miners, and metallurgists, as well as graduates in administration, law, and labor law. As for the people who are operators of heavy equipment, welders, diesel and gasoline mechanics, operators of fuel stations, and pump operators usually have a high school education, while some laborers have some technical education.

Figure 1 illustrates that once extracted, coal goes to the preparation stage - also known as washing or beneficiation - in which it is prepared to guarantee its quality according to its final use. This phase may involve simple grinding or a more complex treatment process to reduce impurities. The coal is separated from other impurities by making it float in a tank with a finely ground magnetite suspension, a liquid with a higher specific gravity, which makes the coal float while the rock and heavier impurities sink and are removed.

The national production of coal satisfies only 70% of the total demand of the Mexican market. The remaining 30% is covered with imported coal, indicating a deficit in the commercial balance of coal in Mexico.

**Thermal coal supply in 2018**

Total: 14'008,790.39 t  
National: 6'772,528.21 t: 48.3%  
Imported: 7'236,262.18 t: 51.7%  
Colombia: 74.4%  
USA.: 25.6%

Source: Mexican Geological Survey, 2019.

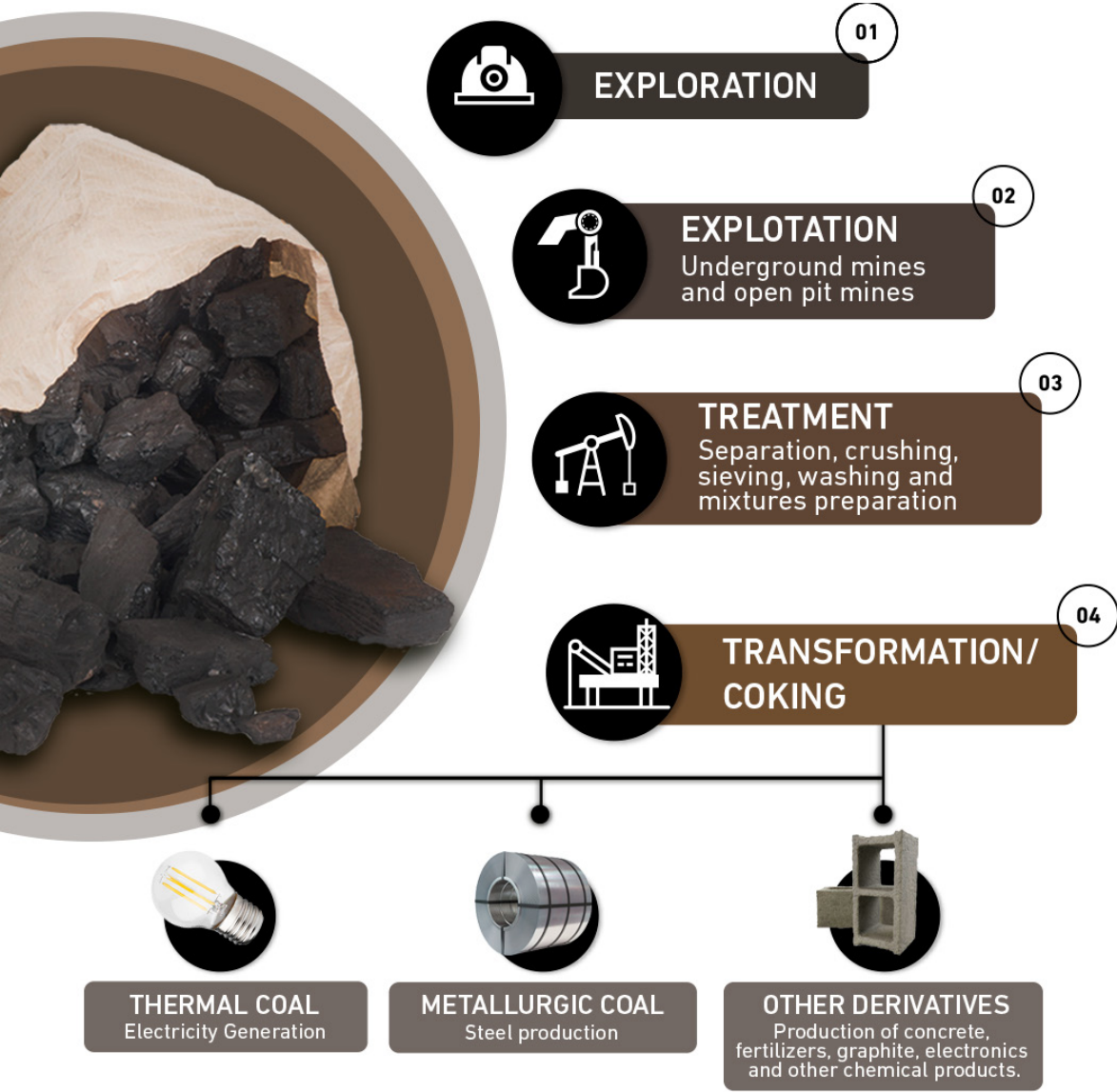


Figure 1. Coahuila's coal industry value chain

After preparation is complete, the coal is transported by belts or trucks over short distances. For longer distances, it is transported by trains and ships, or, alternatively, it can be mixed with water to form suspended solid carbon which is transported through pipelines.

On the demand side, the total of Coahuila's production is consumed almost entirely by a regional market concentrated in five large consumers, which include AMSHA, CFE, Cemex and Cementos Apasco. The cement industry uses coal in at least three different processes: first, as fuel to create cement clinker; second, the ash produced by burning coal in power plants is used as a component for cement kilns; and third, this same ash is used as a mineral additive in concrete mixes.<sup>9</sup>

In Mexico, there are three coal-fired power plants; two are in Nava in the Coal-producing Region of Coahuila and one in Petacalco, Guerrero. All three plants are owned by the Federal Electricity Commission (CFE). In 1970, this state company established an experimental plant in Coahuila to test whether the long-flame coal obtained from the Fuentes-Río Escondido basin was useful for generating electricity. It worked and so began the extraction of hard coal, a mineral coal less suitable for use in power plants.

The solution CFE found was to mix this hard coal with other coal from the United States and the border area to make boilers work. Today, this mixture is known in the sector as “design coal” and it is used in the Carbón I (also known as Río Escondido or José López Portillo) plant, inaugurated in 1983, and Carbón II, which dates from 1993.

In relation to the steel industry, it was in 1941 when the government of Mexico and a group of businessmen founded the company Altos Hornos de México in Monclova, due to its proximity to coal, iron ore and other basic raw material reservoirs.<sup>10</sup> In 1944, the first blast furnace was lit and in 1955 the Coking Plant 1 was inaugurated, converting coal into coke to feed the blast furnaces and melt iron. Since the 70s, Altos Hornos has faced debt problems, together with lacking competitiveness and a high environmental impact. In 1991 it was acquired by Grupo Acerero del Norte (GAN), which, up to this day, has continued to vertically integrate its businesses, allowing it to control the process from coal extraction, through its subsidiary Micare, up to production of national steels for the manufacture of heavy machinery, rail cars, wind towers and high specification pipes.<sup>11</sup>

Among the most recent applications of coal in specialized products, we see the use of coal by-products in the manufacture of chemical products such as creosote oil, naphthalene, phenol and benzene used in plastics, PVC and textile industries and as adhesives in timber and footwear industries and as resins for decorative and industrial laminates. Ammonia gas recovered from coke furnaces is used to make fertilizers, while activated carbon is used in water filters and air purifiers, as well as in kidney dialysis machines. Carbon fiber is an extremely strong, yet lightweight material used in construction. Other products that contain carbon include nylon, rayon, dyes, solvents, aspirin, soaps, water repellants, resins, cosmetics, and toothpastes.<sup>12</sup>





## Main stakeholders in the coal industry and their dynamics

Systems analysis allows to analyze the dynamics between the different stakeholders that make up a system and how these dynamics have positive and negative effects on the change we intend to achieve. The most relevant stakeholders include those that are responsible for change, those that can influence or pressure to favor or block change, those that can use or not use the results of change and, finally, those who would benefit from the change that occurred.

By nature, coal production in Mexico has a complex structure that spans from the Coal-producing Region population up to the Federal Government. In this section we present all the stakeholders included in the system and analyze in greater detail the stakeholders that are most relevant from our perspective.

As shown in Figure 2, stakeholders of all types and sizes affect and are affected by coal industry. First, we have the federal government, which establishes the applicable regulatory frameworks and the major development guidelines for the sector. The Ministry of Energy (Sener) and the National Center for Energy Control (Cenace), as well as the CFE, are the most relevant stakeholders. Year after year, CFE negotiates coal purchase contracts based on its energy planning. This process is largely managed together with the Mining Development Promoter (Prodemi), a decentralized body that since its creation in 2003 has promoted the development of the coal industry, organizing producers to fulfill CFE contracts and providing technical and financial advice to modernize the coal industry.<sup>13</sup>

During the most recent signing of supply contracts with CFE in 2019, preference was given to small coal producers, granting 73% of the contracts to 39 micro and small producers, 16% to medium producers and the remaining 10% to large companies.<sup>14</sup> Although this has clear advantages for some producers, there are other stakeholders who are concerned about the capacity of micro and small companies to increase their production in record time and comply with labor and safety regulations to fulfill such contracts.

At state level, the Ministries of Economy, Environment and Labor stand out when managing developments and investments in the local energy sector, safeguarding natural resources and enforcing their correct use, as well as ensuring the creation of decent jobs in the territory.

In 2020, in collaboration with the Energy Cluster and the Universidad Autónoma de Coahuila, the state government presented the program *Rescue and Economic Diversification of the Coal-producing Region*, in which it proposed to work on three lines of action: strengthening tourism, taking advantage of the new rules on national content included in the T-MEC to attract investment from companies in the automotive sector and investing in the integral use of coal, especially in the carbo-chemical industry. Unfortunately, formal activities related to this program have not yet started.

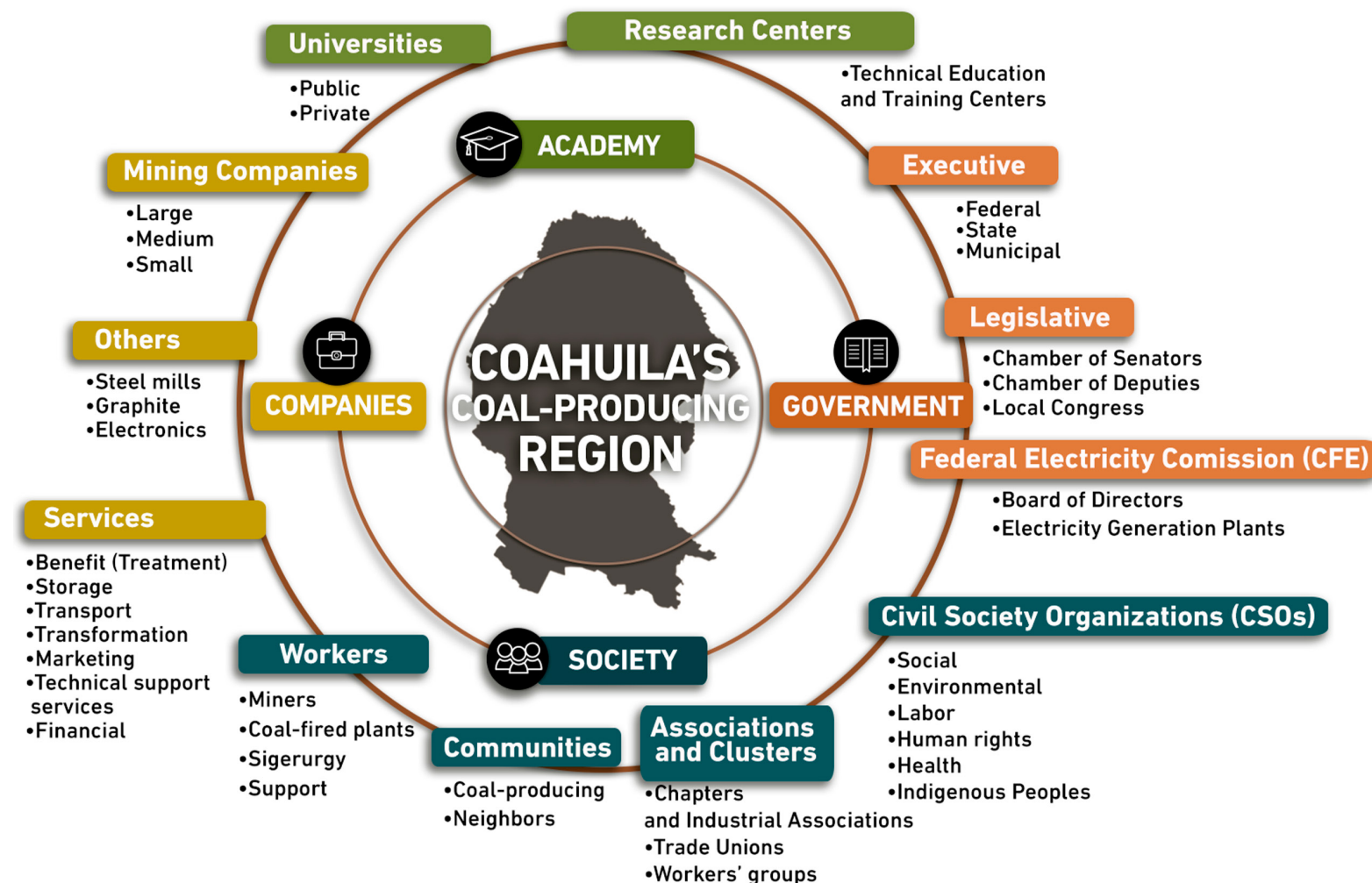


Figure 2. Stakeholders related to the coal industry in Coahuila

The Coahuila Energy Cluster was established in 2014 to coordinate efforts to attract investment, obtain permits and do commercial promotion for the different types of energy generated in the region. It is constituted as a civil association and has about 100 associates from all sectors whom it helps to articulate collaborative projects.

In relation to the private sector, there are about 50 formal coal producing companies, 21 of which are micro, small, and medium-sized enterprises (MSMEs), and the rest are larger companies. Regarding the so-called pocitos, in 2012 the ILO estimated that there were 290.<sup>15</sup> It is also estimated that between that date and today about 100 people have died working squatting more than 100 m deep, without any safety measured. It is also estimated that between that date and today about 100 people have died working squatting more than 100 m deep, without any safety measures.<sup>16</sup> Other companies that provide products and services to the coal industry are also considered, such as transporters and firms providing technical, legal, accounting and financing advice.

With regards to the unions, the oldest organization is the National Union of Mining, Metallurgical, Steel and Similar Workers (SNT-MMySRM), created in 1934 in Pachuca (Hidalgo) and currently chaired by Napoleón Gómez Urrutia. During his exile in Canada and because of the legal proceedings against him for the controversial disappearance of 55 million dollars, the union's membership decreased significantly, until it fragmented and led to the creation of two new unions.

One of them is the Don Napoleón Gómez Sada National Mining Metallurgical Union (Frente), founded in 2010 and led by Carlos Pavón, who served for many years as a political operator and spokesperson for Gómez Urrutia. There is almost no public information on the membership and activities of the unions, but it is estimated that Frente has around 8,000 members.<sup>17</sup> Finally, the National Mining Alliance (AMN), founded in 2009 in Coahuila, brings together around 14,000 members belonging to the union sections of Altos Hornos de México (AHMSA). The National Mining Alliance promotes “a new mentality” based on the common good, away from the proletarian line of the 1970s and 1980s –characterized by a logic of struggle through strikes and popular mobilization–, incorporating the union as an active part in the introduction of systems and techniques such as total quality and just in time.

Additionally, some sections of the SNTMM and SRM have declared to be independent and there has been a rise in the creation of “company” unions that negotiate directly with the respective management of the companies' salary reviews, productivity bonuses, collective contracts, and labor regulations<sup>18</sup>. Hence, labor representation in recent years has largely focused on serving particular in-

terests. During the development of our research and project activities, we repeatedly tried, without success, to contact representatives of the trade union organizations mentioned here.

Regarding civil society organizations (CSOs), the majority of those we identified in this study oppose the use of coal for electricity generation due to its environmental, health and working conditions impacts in small-scale mining. A quick search of the Federal Register of CSOs revealed that there are only between 10 and 15 organizations in the Coal-producing Region dedicated to environmental and social development issues.<sup>19</sup>

One of the associations that has gained recognition in recent years is Familia Pasta de Conchos, made up of the relatives of the 63 miners buried in 2006 in the Pasta de Conchos mine, operated by Grupo México. This organization mainly seeks the rescue of the miners' bodies, in addition to denouncing users who continue to buy coal from mines that do not comply with the legality and safety measures in the law.<sup>20</sup> Another relevant organization is the Ecological Council for Citizen Participation (CEPACI) of the Coal-producing Region, which brings together a small number of citizens committed to sensitizing and training governments, businesses and educators about protecting the environment, specifically the Sabinas River, and the afforestation of the region.

Finally, regarding the academic sector, the Instituto Tecnológico de Estudios Superiores de la Region Carbonífera (ITESRC), the Universidad Americana Noreste (UANE), and Universidad Autónoma de Coahuila stand out, including the Center for Socioeconomic Research and the Center for Research in Applied Geosciences. These institutions provide training to technicians and professionals who work in the coal sector and are a key element to ensure its permanence and modernization.

Based on the system presented in Figure 2, we have identified some stakeholders as central due to their ability to influence the future of the coal sector. In the following table, we analyze each of these groups in greater detail, based on their goals, visions and expectations for the future and their level of power and influence within the system. The information presented was obtained from interviews, informal conversations, workshops, and publications. See Annex 1 of this report for a detailed list of people consulted during this project.

Stakeholder	Goals	Vision for the future of coal	Level of power and influence
<b>Ministry of Energy and CFE</b>	<ul style="list-style-type: none"> <li>Ensure a dispatch model that prioritizes the entry of electricity generated by CFE plants into the Mexican Energy System, over that generated by private companies.</li> <li>Maintain coal in electricity generation in a similar proportion to the current one until the year 2035.<sup>21</sup></li> </ul>	<ul style="list-style-type: none"> <li>According to 2020 National Electricity System Development Program (Prodesen), coal-fired electricity generation is ensured until 2035. Even if there is still no clarity on the type of contracts that will be granted, the companies that will supply it, or the price that will be paid for it.</li> </ul>	<ul style="list-style-type: none"> <li>Very high.</li> <li>They define CFE's policies and planning. They are also responsible for complying with international commitments on climate change and can contribute to strengthening and diversifying the Coal-producing Region.</li> </ul>
<b>State government</b>	<ul style="list-style-type: none"> <li>Promote the development of the state of Coahuila, enhancing productivity in each region.</li> <li>Promote alternatives to diversify income in the Coal-producing Region to overcome recurrent economic crises and unemployment largely caused by dependence on CFE.</li> </ul>	<ul style="list-style-type: none"> <li>Strengthen and diversify the economy of the Coal-producing Region.</li> <li>Promote a diverse and healthy environment for the inhabitants of the state, centered in the conservation of bodies of water, clean air, endemic species, and natural beauty in general.</li> <li>Position the energy sector in Coahuila, taking advantage of all available sources in the region: coal, oil, shale gas, solar and wind energy.</li> </ul>	<ul style="list-style-type: none"> <li>Very high.</li> <li>It has the capacity to promote regulations and investments that strengthen the Coal-producing Region. Ability to organize and mobilize relevant local stakeholders around a common vision.</li> </ul>
<b>Coal mining industry</b>	<ul style="list-style-type: none"> <li>Continue to exploit existing coal reservoirs for the next 15 years.</li> <li>Promote a more positive narrative of coal, sensitizing consumers to its various applications and the role it plays in their lives.</li> <li>Obtain a fair price for their product, in line with coal's international price.</li> <li>Access more markets and a greater number of customers.</li> <li>Develop greater capacity to produce coke and other by-products with greater added value.</li> </ul>	<ul style="list-style-type: none"> <li>Promote investments and technologies that reduce the environmental impacts of coal production.</li> <li>Offer good job prospects to young people, since 1/3 of the region's population are students.</li> <li>Stop being a "booty" region from which politicians and other external stakeholders' benefit.</li> <li>Be consulted before signing international declarations that seek the elimination of coal and in any decision that affects them.</li> </ul>	<ul style="list-style-type: none"> <li>Moderate.</li> <li>Although they are an important economic stakeholder, they are also affected by the largest mining companies, smuggling, the ups and downs in political decisions and the bad reputation created by miners who operate illegally.</li> </ul>
<b>Workers</b>	<ul style="list-style-type: none"> <li>Access decent and safe employment opportunities in the region.</li> <li>Benefit from the good salaries offered by the coal industry (between \$ 3,000 and \$ 5,000 pesos compared to \$ 900 in the <i>maquila</i> per week).</li> <li>Professionalize to access a better position.</li> </ul>	<ul style="list-style-type: none"> <li>Greater demand for coal to secure their work and livelihoods.</li> <li>For their children to have more work options besides mining, given the risks that this activity implies.</li> </ul>	<ul style="list-style-type: none"> <li>Moderate.</li> <li>It is a relatively fragmented group, without a common vision or effective collaboration mechanisms.</li> </ul>

Stakeholder	Goals	Vision for the future of coal	Level of power and influence
CSO's	<ul style="list-style-type: none"> <li>Protect and restore the Sabinas River, recognized as a Ramsar site.</li> <li>Implementation of participatory processes to promote ecologically sustainable, socially just and economically viable societies.</li> <li>Social justice for mining workers, rescue of the bodies of workers who have died and assignment of responsibilities for accidents that have occurred.<sup>22</sup></li> </ul>	<ul style="list-style-type: none"> <li>Improve public sanitation systems to avoid pollution of the Sabinas River.</li> <li>Integrate and promote a touristic corridor that includes sightings of bison and butterflies, Cuatrociénegas and the Sabinas River.</li> <li>Expand the education and training curriculum in universities and technical schools to include careers related to the arts and humanities.</li> </ul>	<ul style="list-style-type: none"> <li>Low.</li> <li>These organizations do not have a large membership/ donor base from which to derive their legitimacy, and they have very limited resources. However, they are key stakeholders to increase citizen participation in the transformation of the Coal-producing Region.</li> </ul>
Energy Cluster	<ul style="list-style-type: none"> <li>Contribute to the development and implementation of energy projects in Coahuila and a model for other states in the country.</li> <li>Position Coahuila as a leading state in energy generation using all the resources of the region, including renewable energy, gas, shale gas, coal and oil.</li> <li>Streamline procedures related to the planning and development of energy projects to attract investment to the state of Coahuila.</li> </ul>	<ul style="list-style-type: none"> <li>Innovate in the coal industry, taking advantage of wet gas to produce petrochemicals.</li> <li>Work together with CFE to plan the construction of new coal plants with more modern and efficient technology.</li> <li>Develop a local supply system, linking small local companies with larger companies in the region.</li> </ul>	<ul style="list-style-type: none"> <li>High.</li> <li>Due to its structure, the cluster is in a good position to coordinate activities with a diverse group of stakeholders. This allows access to investors, state and federal government officials, as well as civil associations and academia. The cluster has good experience obtaining funds from scientific and/or philanthropic sources, which provides it with a certain degree of autonomy in relation to other institutions.</li> </ul>
Academy	<ul style="list-style-type: none"> <li>Carry out applied research for the development of the local coal industry.</li> <li>Train competent technicians and professionals who contribute to the development of the region.</li> <li>Provide coordination and implementation services for energy projects.</li> <li>Train public officials on basic issues related to coal mining.</li> </ul>	<ul style="list-style-type: none"> <li>Help coal producers move away from the convenience of focusing on a single customer.</li> <li>Promote investment to develop coke plants in the state and add value to the local industry.</li> <li>Support the modernization of existing coal plants.</li> </ul>	<ul style="list-style-type: none"> <li>High.</li> <li>Although the UAdeC and the ITES-RC cannot define the direction of the coal industry, they are key players in the modernization of the sector, the promotion of innovation and training professionals to be equipped with the latest technological developments. In addition, due to their nature as public universities/institutes, they have a specific political weight that allows them to influence the public agenda.</li> </ul>

**Table 1.** Analysis of the main players in the coal sector



## Building a vision for the future in the Coal-producing Region

In this section we will use the three horizons framework<sup>23</sup> to define the main characteristics of a *desired future* for the coal region, according to the analysis presented in the previous section. We will also define the *current situation* and identify the most important challenges that exist to achieve that desired future (see Figure 3). Finally, we will analyze some *change signals* that are opening opportunities to approach that situation.

### The desired future for the Coal-producing Region

- The next generation of entrepreneurs in the coal region develop value-added products applying best practices in the fields of environmental protection, occupational safety, and circular economy.
- The use of coal to generate electricity is progressively abandoned as the Carbon I, Carbon II and Petacalco coal plants end their lifecycle. A plan is put in place to harness the skills and competencies of workers from coal-fired power plants and the coal-processing industry, so they are able to find jobs in alternative sectors.
- The region attracts young, talented professionals and can integrate the new families that come to live in the region seeking prosperity and safety.
- The Sabinas River is restored and protected. Its management and exploitation models are a success story among Ramsar sites. Two new water treatment facilities are put into operation. The river is no longer the dump of the region.

- The coal region emerges as an attractive tourist destination. People from all over the country and other parts of the world come to visit the tourist corridor that extends from the plains of the bison in Maderas del Carmen in the north of the region, following the migratory route of the monarch butterfly to the magical town of Múzquiz and its Kikapú population, followed by a hike through the mountains and water activities along the Sabinas river, and closing with a guided visit to the coal mines, swimming in the Cuatrociénegas pools, and seeing the house of Venustiano Carranza. An industry of tourist services develops along this route, including accommodation, food, transportation, tourist guides and shops.
- The dynamism of the region generates decent jobs in a diversified and modernized coal industry, as well as in complementary green sectors such as tourism, sustainable construction, solar energy, high-end agriculture, waste management, and comprehensive of water management.
- The new coal and tourism industries are founded on a logic of responsibility, honesty, trust, and social equity. There are new opportunities for more people to prosper and succeed. Entrepreneurship is facilitated and rewarded, seeking to create a new generation of businessmen and businesswomen who do not come from the “usual” families and who take advantage of the opportunities offered by technology and connectivity.
- Through existing higher education institutions, new professional careers are offered in the areas of humanities and administrative sciences such as sociology, anthropology, psychology, communication and marketing, business administration, finance, tourism, and hospitality to train the professionals who will lead the transformation of the Coal-producing Region.
- The origins and cultural identity of the Coal-producing Region are honored and preserved, while the coal industry is driven towards modernization based on innovation, sustainability, and competitiveness. An international outlook is adopted and relationships with other markets are built through research, trade and the exchange of best practices.

Figure 3. Transition towards the desired future for the Coal-producing Region



*Local focus  
of the coal  
Industry*

*No  
long-term  
vision*

*Renewable  
energies*

*New  
professional  
careers*



*Frequent  
accidents*

*Economic  
transformation  
of the  
Coal-producing  
Region*

*Best  
practices in  
enviromental  
protection*

*Attractive  
tourist  
destination*

*Economic  
crisis*

*Producer's  
Uncertain situation,  
with no growth  
or investment  
opportunities*

*Responsible  
production  
for other  
coal-related  
industries*

*Sabinas River  
is restored  
and protected*

*The origins  
and cultural  
identity of  
the region  
are honored*

*Jobs in green  
sectors/  
Circular  
economy*



### Current dynamics in the system and challenges faced by the Coal-producing Region

- There are conflicting views about the future of coal: while some groups seek to reduce coal use to generate electricity, others seek to reactivate this market. There are currently no spaces for dialogue and exchange between both groups where a common path of action could be outlined.
- The expansion of fossil fuels over renewable energies in the electricity sector in Mexico puts climate goals at risk. Mexico is far from meeting the targets set in the Paris Climate Accord and the national Energy Transition Law.
- There is no long-term policy for the development of the Coal-producing Region that contemplates the modernization of the coal industry, as well as the development of other employment and wealth generation alternatives.
- The Coal-producing Region has been in an economic crisis since 2015, when the demand for thermal coal dropped drastically. Many people have lost their jobs. Only Micare, a subsidiary of Altos Hornos de México located in Nava, has had to let go around 3,000 people since 2020 given the cancellation of supply contracts with CFE.<sup>24</sup>
- EIn 2021, the demand for coal increased slightly because of the announcement of new tenders put forward by CFE. The resulting supply contracts, however, have a duration of less than three years, leaving producers in a precarious situation, without the possibility of investing to grow their businesses.
- The coal value chain is structured around a local market, which implies that any change in coal supply and/or demand has immediate impacts on the entire production chain and the economies of families in the region.

- Because since its inception the coal sector has fully relied on local companies to purchase its output for producing electricity and steel, companies in the Coal-producing Region did not enter international markets in the 1990s. The vision and scope of the coal sector continues to be very localized. Entering new markets new involves significant barriers given the global conditions.
- In 2021, a new accident was registered in a small mine in Múzquiz, leaving seven miners buried under tons of coal and mud. Civil society organizations affirm that such accidents frequently occur among small producers who do not comply with occupational safety provisions and promote irregular mining.<sup>25</sup> This situation increases tensions between local stakeholders, reducing the possibilities for communication and collaboration.
- There are few spaces for dialogue between government officials, businesses and citizens. Effective mechanisms for dialogue and participation are required to address economic, social, and environmental problems in the region.



### Some change signals

- Most developed and developing countries are transitioning to decarbonized, decentralized and digitized electrical systems.<sup>26</sup> In a context of climate emergency, this implies working towards an accelerated reduction of electricity produced from fossil fuels, starting with the most polluting ones (i.e., coal and fuel oil) and advancing towards a sustained expansion of renewable sources, predominantly solar and wind, which are the most competitive worldwide.
- Electricity generated from renewable sources continues to get cheaper, as more regions and countries successfully manage to fully integrate it into their electrical systems.<sup>27</sup> Projects awarded from public bids in Mexico added 2,500 MW of capacity to the system at record costs from 2014 through 2019.<sup>28</sup>
- In 2020, the state government of Coahuila presented the *Rescue and Economic Diversification of the Coal-producing Region Program* in collaboration with the Universidad Autónoma de Coahuila and the Energy Cluster, with the aim of promoting an economic reactivation plan through diversifying investments and developing new economic activities to generate quality jobs. Up to date, plans for implementing the program, sources of financing and the expected impacts in the short and medium terms, remain unknown.
- There are talks to create a Coal Cluster, a multisectoral non-profit organization dedicated to developing additional applications and market outlets for the coal produced in Coahuila.

- The economic crisis caused by the low demand for coal to produce electricity made clear that it is essential to achieve a more diversified local economy, to avoid depending almost exclusively on contracts with CFE. Many employers, workers and government representatives are convinced that this is necessary.
- In other countries, tests are being carried out to produce steel free of fossil fuels. Green hydrogen-based alternatives and renewable energy are emerging as good alternatives to coal in steelmaking, while the use of waste-derived fuels and thermal efficiency minimize the environmental impacts of cement and concrete production.<sup>29</sup>





## Initiatives to promote change

Based on the elements described in the previous section, we have identified five initiatives to enable a brighter future for Coahuila's Coal-producing Region.

These are described below:

<b>1</b>	Designing an industrial policy to promote coal in other industrial applications under a logic of modernization, sustainability, diversification of the client portfolio, and participation in global markets.
<b>Actions</b>	<ul style="list-style-type: none"><li>• Overcome the uncertainty surrounding the coal industry, placing local producers in a better position to enter other markets.</li><li>• Provide technical assistance for companies to adopt new and more efficient coal extraction and transformation technologies, improve their marketing and management systems, and address their environmental impacts.</li><li>• Promote the adoption of standards/certifications that guarantee the responsible production and purchase of coal.</li><li>• Support the creation of cooperatives that bring together and organize small coal producers so that they have access to better financing options, can enter new markets, and diversify their business to start venturing into other industries, such as solar energy.</li></ul>
<b>Stakeholders involved</b>	Ministry of Economy of the state government of Coahuila, municipal governments, Energy Cluster, businesses, academia and research centers.

<b>2</b>	Developing a regional economic development program, designed and managed by a multisectoral local committee and operated through a transexenal trust. The trust invests and helps attract complementary investments.
<b>Actions</b>	<ul style="list-style-type: none"><li>• Create and promote the tourist corridor from Maderas del Carmen Natural Protected Area to Cuatrociénegas, triggering investment in infrastructure and the necessary tourist services along the corridor.</li><li>• Invest with universities and professional training institutions to broaden the education and training offering and introduce professional studies in the areas of humanities, administration, and tourism.</li><li>• Expand existing study programs on Earth sciences to include studies and research related to the conservation of ecosystems and biodiversity, as well as the sustainable use of natural resources.</li><li>• Provide seed capital for the creation of entrepreneurial ventures and new businesses in the infrastructure and tourism services sectors, as well as local supply companies for the mining and manufacturing sectors.</li><li>• Place women at the center of the program and generate new opportunities for economic and professional development that help shape a new identity for the region.</li></ul>
<b>Stakeholders involved</b>	Ministries of Tourism, Economy and Labor of the government of the state of Coahuila, municipal governments, universities and professional training centers, civil society organizations, businesses and youth/student groups.

<b>3</b>	Shaping an environmental agenda at the local level and activating networks of stakeholders to facilitate implementation.
<b>Actions</b>	<ul style="list-style-type: none"><li>• Identify organized social groups that pursue environmental objectives.</li><li>• Create spaces for dialogue and exchange where environmental organizations can meet. Ensure participation of young people and entrepreneurs, as well as representatives of CSOs and academia.</li><li>• Strengthen the creation of a coordinated agenda to ensure synergies between organizations.</li><li>• Identify pathways to influence public policies.</li><li>• Raise awareness and mobilize citizens around critical environmental issues in the region.</li></ul>
<b>Stakeholders involved</b>	Civil society organizations, youth groups, the state government's Ministry of the Environment, businesses, universities and professional training centers.

4	Defining a just transition strategy around phasing out of coal in the electricity sector, considering local effects and impacts.
Actions	<ul style="list-style-type: none"> <li>Raise awareness among the local population about the impacts of the pollution produced by Nava's coal-fired power plants on human and ecosystem health.</li> <li>Creation of a multisectoral committee in charge of defining and guiding the transition process, as well as guaranteeing transparency and accountability.</li> <li>Creation of a national coal transition fund for granting: <ul style="list-style-type: none"> <li>Remediation of accumulated environmental costs/liabilities derived from an inclusive process involving all affected groups.</li> <li>Direct compensation to workers and their families to support the transition to another employment/productive activity.</li> <li>Voluntary early retirement.</li> </ul> </li> <li>Channel opportunities for skills reconversion and professional updating among workers who want to access jobs in other industries or are interested in creating new business ventures of their own.</li> </ul>
Stakeholders involved	Federal and state government, unions, CFE, civil society organizations, universities, and professional training centers.

5	Supporting Coahuila's Ministry of Labor to increase supervision, monitoring, and law enforcement capacity.
Actions	<ul style="list-style-type: none"> <li>Ensure proper implementation of the existing safety regulations to reduce the number of accidents and deaths among coal workers.</li> <li>Design a recognition and promotion campaign for mines that effectively implement the protocols, seeking to provoke an attitude change towards safety issues among employers, miners, and their families.</li> <li>Promote tripartite dialogue between employers, workers, and unions around labor rights, safety conditions at work, and the future of the coal sector.</li> <li>Contribute to the reorientation of technical-professional training towards new employment opportunities in other sectors and other productive activities.</li> </ul>
Stakeholders involved	Ministry of Labor of the State of Coahuila, International Labor Organization, universities, training centers, and businesses.

# Factors driving and inhibiting change



The systems approach points out that there are factors that enable or complicate change at different levels. Structural factors refer to the physical and social spheres, including the political and economic environment and its institutions. Attitudinal factors include beliefs, values, norms, and intergroup relationships, which affect the way we think and behave. And finally, transactional factors have to do with the processes and interactions used by people when dealing with social, political, and economic problems and can include lobbying, blackmail, influence, mediation, or rhetoric.<sup>30</sup>

In Table 2 we present the most important factors of change that we found throughout the activities of this project.

Types of factors	Inhibitors	Drivers
Attitudinal	Perceived tension between environmental sustainability objectives and economic growth among coal industry representatives.	Interest of local stakeholders to remain living in the Coal-producing Region.
	Belief that natural resources exist to be exploited until they are extinguished and a subsequent rejection of the idea of energy transition.	Coal miners' expectation of their children no longer being engaged in extraction due to the risks involved.
	Lack of long-term vision.	Strong sense of work ethic and search of individual improvement.
	Large dependance of contracts with CFE and AMSHA, waiting for them to be renewed instead of exploring new market outlets.	Poor implementation of safety regulations at work and penalties for irregular practices, which encourages young people to search for other job opportunities.
	Limited interest from unions to engage in dialogue with other actors.	A common sense of belonging and pride associated to the extraction of minerals.

**Table 2.** Factors that affect the future of coal in Mexico's electricity sector

Types of factors	Inhibitors	Drivers
Structural	The regional nature of the market structure of the coal industry.	Cheaper, cleaner, and more efficient alternatives for electricity generation.
	Existence of three coal-fired plants, one of which still has ahead a few years of operation and two whose life can be extended.	Natural attractions in the state of Coahuila (i.e., Cuatrociénegas, Sabinas River, natural protected areas, endemic species).
	Lack of public demand for the elimination of coal use in the electricity system.	Growing interest in mining tourism.
	No political gain in promoting the elimination of coal use in power generation.	Proximity to the U.S. border, Monterrey and Saltillo. Good land connectivity.
	Widespread perception of corruption in the state of Coahuila with major scandals involving former governors, senators, and union representatives.	Low perception of insecurity among the citizens of the state of Coahuila. <sup>31</sup>
	Fragmented land tenure system, linked to the allocation of mining permits, which limits large investments.	
	Rivalry among unions.	
	Fragmented worker's groups in the coal industry.	
	Limited vocational training options, except for certain engineering degrees.	
	Low population density. There are not enough workers to meet the demand of new companies.	

Types of factors	Inhibitors	Drivers
Transactional	Evident connections between politics and business, which reinforces the existence of an elite that controls economic activity and helps propagate clientelist dynamics.	Entrepreneurs' commitment to their region. Investments in public infrastructure.
	Contract negotiations and allocations established based on pacts rather than open processes with transparent rules.	Contract negotiations and allocations established based on pacts rather than open processes with transparent rules.
	Tension between civil society organizations, government authorities, and the private sector.	

# Final reflections

Deciding about the future of coal-fired power plants will have important economic, environmental, and social implications in the Coal-producing Region. The Río Escondido plant is close to completing its cycle, while Carbón II still has 13 years to go. Planning an early retirement of these plants will avoid emitting a significant amount of greenhouse gases, as well as making inefficient investments to guarantee the continued operation of the plants. However, a just energy transition also demands considering the jobs and wealth that are lost by shutting down entire industries.

While the proportion of electricity produced in coal-fired power-plants in Mexico is small in comparison to countries like China, India, the United States, Japan, and several European Union countries, it is worth to bring this discussion to the public agenda and outline an economic development plan for the Coal-producing Region. Using coal to generate electricity will continue to shrink as Mexico grows more and more dependent of imported, cheaper natural gas and other growing technologies that already compete in price and efficiency with coal, such as solar and wind.

In the case of coal produced in Coahuila, it is important to remember that only about half of it is used in electricity generation. In the steel and cement sectors, coal substitution is still difficult and expensive. Although the first samples of fossil fuel-free steel are already reaching the market, the complete elimination of the coal industry in Mexico and the world is hardly feasible.

In this sense, talking about a just transition away from coal in the electricity sector in Mexico requires reflection on several levels. The first has to do with the progressive retirement of coal-fired power plants in Mexico and the loss of jobs and wealth that this implies for the people living where coal is extracted and burned. From an environmental point of view, while a batt-



le would be won, the war against the emissions associated to the extraction and transformation of coal would remain vital. From a social viewpoint, the precarious working conditions, associated to health problems, and the large dependence of the coal sector to provide employment are topics that require attention too. It will be necessary to also consider the extraction of coal for the steel and cement industries. The conditions of production and trade, price, the associated environmental and health impacts, market access and distribution of its benefits are relevant issues that cannot be neglected.

The transition narrative is not binary. Rather, it is a process that encompasses the future of various industries linked to a producing region and its inhabitants. The identity of the Coal-producing Region remains closely linked to its productive vocation and it is difficult to think that it can mutate and redefine itself when it has been shaped by and around coal for more than 200 years.



Accompanying a coal phase-out strategy in the electricity sector with a transformation strategy for the region would allow exploring, among other things, the development of new applications and industrial uses of coal, applying existing technologies to reduce emissions and taking advantage of the coal industry as a transition platform towards renewable technologies. This would also provide extractive companies with more room for maneuver, allowing them to continue their business based on a broader customer market, while adopting stricter environmental and social criteria to comply with global standards.

While phasing out the use of coal in electricity generation is not the only measure required to limit the rise of global temperature and the devastating consequences of climate change, it would place Mexico on a path towards ambitious climate action and would serve as example for other countries in the region. A transition process away from coal, however, must be driven taking a justice approach and putting the impacts and alternatives for economic diversification in the Coal-producing Region at the center of the discussion. It requires a comprehensive strategy that considers the system as a whole and creates pathways of transformation for all local stakeholders, minimizing difficulties for workers and their communities through active political and financial support, while considering the implications for the national power sector. •

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Annex I: People consulted throughout the project

Name	Organization	Position
Abdelali Soto Vázquez	Ministry of Labor, state of Coahuila	Planning Director
Adriana M. Ochoa Lagunas	Britsih Embassy in Mexico	UK PACT Support Officer
Alberto E. Dueñas Sánchez	Grupo Parlamentario del Partido Acción Nacional	Policy Advisor
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Ana Belén Sánchez	International Labor Organization (ILO)	Regional Specialist in Green Em- ployment for Latin America and the Caribbean
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Araceli Moreno Loera	Frente Amplio Nacional por la Defensa del Ambiente	Coordinator
Armando Díaz Cárdenas	Minera del Norte (MINOSA), Grupo Acerero del Norte	General Manager
Arturo Bueno	Asociación Ingenieros Minas, Metalurgistas y Geólogos de México	President
Arturo Bueno Tokunaga	Universidad Autónoma de Coahuila	Research Professor
Arturo Siller Rodríguez	Presidencia Munipal San Juan Sabinas	
Blanca R. Medina López	Federación de Trabajadores de Coahuila (CTM)	Union Planning and Strategy
Bogar Montemayor Garza	Unión de Productores de Carbón de México	President
Carlos E. San Juan Terrones	Asociación Mexicana de Energía Solar, A.C.	Project Manager
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Eglantina Canales Gutiérrez	Ministry of the Environment, state of Coahuila	Secretary of the Environment
Elvia Ramírez Cabrera	Conacyt	Energy and Climate Change Director
Ernesto Navarro Hinojoza	Universidad Autónoma Agraria Antonio Narro	Research Professor
Feliciano Heredia	Mar y Sierra Salvaje, A.C.	Project Manager
Fernando Mendoza	FERVIM S.A. de C.V.	General Manager
Francisco Treviño Aguirre	Ministry of the Economy, state of Coahuila	Coordinator of Strategic Projects for the Energy Sector
Genaro de la Rosa Rodríguez	Universidad Autónoma de Coahuila; Asociación Ingenie- ros Minas, Metalurgistas y Geólogos de México	Lecturer; Coordinator Región Noreste
Gloria Yáñez Rodríguez	Ministry of the Environment and Natural Resources, Mexico	Deputy Director of Economic and Fi- nancial Evaluation
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Gregorio Garza	CANACO	President
Guillermo Cena Pacheco	Presidencia Munipal San Juan Sabinas	
Guillermo García Alcocer	Instituto tecnológico Autónomo de México (ITAM)	Excomissioner CRE. Lecturer
Héctor J. Treviño González	Asociación Mexicana de Energía Eólica, A.C.	Executive Director
Iliana Valdés	Clúster Energético Coahuila	Communications Director
Israel Castrejón	Mar y Sierra Salvaje, A.C.	Project Manager
Iván Pérez Pérez	Canacintra/Grupo Fox	General Manager
Jesús M. Hernández Carmona	Asociación Mexicana de Energía Solar, A.C. )	Regulatory Manager

Name	Organization	Position
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Jorge Gutiérrez Villareal	Presidencia Municipal de Sabinas Coahuila	Head of Economic Development
Josdeny A. Alarcón González	Secretaría de Relaciones Exteriores (SRE)	Head of Climate Change Department
José Á. Alvarado Delgado	Presidencia Munipal San Juan Sabinas	
José A. Pacheco Hernández	Cámara de Diputados	Policy Advisor
José C. Muñoz Lara	Federación de Trabajadores de Coahuila (CTM)	Sec. General of Nueva Rosita Del.
José L. Guadiana Tijerina	Materiales Industrializados SA de CV (MINSa)	General Manager
Juan J. Guajardo Lara	Universidad Autónoma de Coahuila	Head of the Environmental Agenda
Juan M. Beltrán	Minera del Norte (MINOSA), Grupo Acerero del Norte	Operation and Control Manager
Juan Veloz	Minería y Energía	Project Manager
Judith A. Maldonado Cruz	Centro de Investigaciones Socioeconómicas (CISE)	PhD student in Regional Economics
Judith A. Flores Aguilar	Consejo Ecológico de Participación Ciudadana Región Carbonífera de Coahuila México	Coal-producing Region representative
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Marco Cantú Vega	Ministry of Labor, state of Coahuila	Deputy Secretary of Labor
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Rafael Fonseca Chávez	Centro de Colaboración Cívica (CCC)	Sustainable Development Program Officer
Rafael Medina Portugal	Ministry of the Economy, state of Coahuila	Director of Regional Economic Develo- pment
Ramon Falcón	Corporativo 88	Managing Director
René del Castillo Aceves	Federación de Trabajadores (CTM)	President of the Institute of Innovation
Reyna E. Rodríguez Pérez	Universidad Autónoma de Coahuila	Research Professor
Rogelio Montemayor Seguy	Clúster Energético Coahuila	President
Rubén G. Muñoz Ortega	Ministry of the Environment and Natural Resources, Mexico	Deputy Director of Administrative Procedures
Sergio Colín Castillo	Centro de Investigaciones Socioeconómicas (CISE)	Research Professor
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Violeta Contreras Ramírez	Ministry of Labor, state of Coahuila	Planning Department
Ylsel A. Gutiérrez Alonso	Centro de Investigaciones Socioeconómicas (CISE)	PhD student in Regional Economics



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