ENVIRONMENTAL MANAGEMENT IN QUERÉTARO'S AUTO PARTS INDUSTRY

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José Jaime Paulín Larracoechea

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FOREWORD

The relationship between the automotive industry and environmental management is particularly complex. During the first quarter of the twenty-first century, companies such as DaimlerChrysler, Mercedes-Benz, Kia and Hyundai, Audi, Fiat Chrysler, Bosch, and Volkswagen—perhaps the case with the greatest global impact—were involved in violations of laws and regulations governing the control of pollutant emissions. These cases reveal a broader pattern of illegal practices within the automotive industry, in which companies seek to circumvent environmental regulations, resulting in financial penalties and increased regulatory scrutiny.

In response to these practices, legislation has been enacted at both global and local levels to prevent violations related to pollutant control in the automotive sector. Such measures include the implementation of environmental audits, the imposition of financial penalties for non-compliance with official regulations, the promotion of clean technologies, and mandatory adherence to international environmental management standards, such as ISO 14001. Nevertheless, significant obstacles remain regarding the effective enforcement of these measures and the continuous updating of environmental regulations.

The book you hold in your hands (or are reading on your preferred electronic device), *Environmental Management in Querétaro's Auto Parts Industry*, by José Jaime Paulín Larracoechea, offers an in-depth analysis of the relationship between the automotive industry and the environment. It highlights the importance of environmental management within the auto

parts sector in Querétaro, Mexico, and examines how local companies respond to environmental challenges in the context of a global climate crisis and ongoing transformations in the automotive industry.

Theoretical Framework

The first part of the book presents the theoretical foundations of the research, outlining a solid framework that integrates perspectives from social and environmental theory to examine the relationship between the automotive industry and the environment. This approach makes it possible to understand the dynamics shaping the decisions and actions of the actors involved, taking into account the economic, social, political, and environmental pressures specific to the context of Querétaro, Mexico.

One of the central theoretical pillars is Enrique de la Garza's configurationist proposal, particularly his analysis of the interplay between structures, subjectivities, and actions. This perspective emphasizes that while economic and regulatory structures exert significant pressure on actors, they do not fully determine their behavior. Instead, it highlights actors' capacity for agency, allowing them to act in accordance with their values, emotions, and experiences, and to carve out spaces for decision-making.

José Jaime Paulín contrasts two paradigms: the Human Exceptionalism Paradigm and the New Ecological Paradigm. The former, anthropocentric in nature and optimistic about technological progress, prioritizes economic gain while downplaying the significance of environmental degradation. The latter, the New Ecological Paradigm, emphasizes the interdependence between human beings and the global ecosystem, promoting a more balanced relationship between the economy and nature. This contrast reveals that the automotive sector in Querétaro operates largely under the Human Exceptionalism Paradigm, generating tensions between economic objectives and the need to protect the environment.

Closely linked to Human Exceptionalism is economic rationality as the guiding principle of business decision-making, in which growth and profit take precedence over environmental considerations. In contrast, there is a call for the adoption of environmental rationality, aimed at integrating eth-

ical, social, and ecological values into collective decision-making and fostering sustainable development that respects diversity and life on the planet. Within this framework, different forms of environmental ethics are explored—those centered on human beings, animals, life, and ecological holism. The automotive industry in Querétaro operates predominantly under anthropocentric ethics, where environmental decisions are justified mainly by their impact on humans, relegating the well-being of other living beings and the natural environment.

Building on these approaches, the author incorporates the concept of ecological economics with the aim of developing methodologies and fostering dialogue between society and the environment, thereby promoting a transition toward an alternative and sustainable model. Within this framework, the circular economy is introduced as an innovative approach to transforming systems of production and consumption by encouraging reuse, recycling, and waste reduction. The analysis also includes a theoretical–practical component: the triple helix model, which proposes a virtuous interaction among companies, universities, and governments in the development of the automotive industry and in environmental management.

The book is positioned at the intersection of the sociology of work and environmental sociology, examining how transformations in the world of work are connected to environmental and climate pressures. From this perspective, it advances a broader understanding of work that incorporates socio-environmental dimensions and considers the emergence of new forms of employment—such as green jobs—which are essential for the transition to a more sustainable economy.

Overall, the theoretical proposal provides a strong foundation for a comprehensive analysis of the relationship between the automotive industry and the environment, addressing not only economic and regulatory structures but also the subjective interactions and agency of the actors involved.

Subject of Study: The Auto Parts Sector in Querétaro

The diversity of auto parts production in Querétaro is striking. The state stands out for its wide range of suppliers and is widely recognized as one of

the most dynamic automotive hubs in the country. Its production portfolio includes automotive lubricants, decorated plastic components, die-cast parts, catalytic converters, molded and extruded silicone components, aluminum brake parts, valves and master cylinders, alternators, ventilation systems, window regulators and sensors, as well as components for electric motors, among many others. At the national level, electrical components account for 19% of total production, followed by transmissions and clutches (10%), fabrics and seats (9%), engine parts (8%), and suspension and steering systems (7%).

This high degree of specialization and diversity positions Querétaro as a key player in the Mexican automotive industry. However, while business discourse often emphasizes the importance of complying with environmental regulations—regulations that are becoming increasingly stringent in response to climate change and sustainability concerns—such compliance is frequently perceived as a burden rather than an opportunity. This perception ultimately constrains the adoption of more innovative and productive environmental practices.

The automotive industry is one of the main engines of the global economy. In Querétaro, its development has been concentrated almost exclusively in the auto parts sector, which has experienced sustained growth and has become a cornerstone of the state's economy. With more than 300 companies and approximately 80,000 jobs, the sector accounts for a substantial share of the Manufacturing Gross Domestic Product (24.7%). It is the dominant industry within the manufacturing sector, underscoring its economic and strategic importance for the region. However, this economic expansion has not been matched by equivalent progress in environmental performance, creating significant challenges in terms of environmental management.

José Jaime Paulín's study shows that although local companies have implemented environmental management systems, their level of engagement remains limited. This is largely due to insufficient knowledge of existing regulations and the perception that such practices do not generate tangible economic benefits and are even viewed as a waste of time. This narrow perspective reflects the limited integration of sustainability as a strategic value within the sector—a critical shortcoming, as it undermines long-term

competitiveness and leadership. In addition, weak cooperation among companies and fragile links with universities and research centers reveal shortcomings in the triple helix model, further constraining the development of innovative and sustainable solutions.

Environmental leadership within companies is another key issue highlighted in the study. The commitment and guidance of business leaders are essential to the success of environmental initiatives. In the absence of strong leadership, companies tend to adopt reactive approaches, limiting themselves to meeting minimum regulatory requirements rather than pursuing proactive transformations toward more sustainable practices. Effective leadership should go beyond regulatory compliance and actively promote an organizational culture in which sustainability is recognized as a core value.

Another issue that warrants discussion is electromobility. Despite its growing importance in the global automotive industry, the participation of the auto parts sector remains marginal. This is a critical concern, as the transition to electric vehicles and clean technologies is a global trend that is fundamentally reshaping the automotive market. Electromobility is already part of both the current and future industry agenda and cannot be overlooked. In this context, the auto parts sector in Querétaro faces significant challenges, including limited infrastructure and the need to develop technological and human capabilities to adapt to this new reality. Failure to respond adequately could undermine the sector's competitiveness relative to other regions and countries that are advancing rapidly in this field.

At present, the auto parts sector in Querétaro remains a fundamental pillar of both the state and national economy, characterized by a high degree of specialization and a substantial contribution to economic development. However, an analysis of its strengths and limitations reveals that environmental management remains an unresolved challenge. The limited integration of sustainability as a strategic value, combined with delays in the transition to electromobility, are issues that require urgent attention to ensure the sector's long-term competitiveness and sustainability. Paulín's research offers a critical and detailed assessment of these challenges, providing a valuable framework for reflecting on the actions needed to move toward a more responsible and sustainable model for the auto parts industry in Querétaro.

The Auto Parts Sector and the Environment

Contributions to sustainability in the automotive industry can be grouped into four main areas, each aimed at reducing environmental impacts and promoting more responsible practices: environmental management, technological innovation, the circular economy, and supply chain management. Each of these areas plays a distinct role in advancing sustainability within the sector.

Environmental management. Automotive companies have increasingly adopted environmental management systems to reduce their ecological footprint. A prominent example is the implementation of ISO 14001 certification, which establishes internationally recognized standards for environmental compliance. These initiatives go beyond merely meeting regulatory requirements; they also seek to improve overall environmental performance by reducing the consumption of natural resources, optimizing production processes, and lowering the generation of waste and polluting emissions.

Technological innovation. Significant investments are being directed toward the development of cleaner and more sustainable technologies, including more efficient and fuel-saving engines, as well as the design and production of hybrid and electric vehicles that help reduce greenhouse gas (GHG) emissions. These innovations not only benefit the environment but also respond to the growing consumer demand for environmentally friendly transportation options.

Circular economy. In Querétaro, the Automotive Cluster has taken a leading role in promoting circular economy and decarbonization initiatives. These efforts aim to transform production processes by encouraging material reuse, waste prevention, and the adoption of cleaner production practices. This approach is particularly noteworthy, as it not only reduces environmental impacts but also enhances the efficiency and competitiveness of companies in the global market

Green supply chain. In an effort to comply with regulations and avoid economic sanctions or plant closures, automotive companies are increasingly extending sustainability practices throughout their supply chains. As mentioned in the book, these actions include requiring suppliers to hold

environmental certifications to ensure compliance with ecological standards, as well as promoting internal environmental stewardship programs. The development of a supply network committed to sustainability is thus encouraged, with the potential to generate significant benefits across the entire value chain.

Overall, these actions reflect—albeit to varying degrees—the auto parts sector's commitment to advancing green initiatives within the automotive industry, contributing to environmental protection and to the development of a more responsible and environmentally conscious economy.

Nevertheless, significant shortcomings persist, with adverse effects on both the environment and society. These challenges, which stem from both vehicle manufacturing and vehicle use, demand urgent attention if the sector is to move toward a truly responsible and sustainable model. The research under discussion identifies several critical issues that must be addressed: pollutant emissions, the consumption of natural resources, the generation of hazardous waste, the environmental impact of road infrastructure, energy consumption, and the effects associated with the extraction of materials used in electric vehicles. Each of these issues is examined below.

Polluting gas emissions. Vehicles powered by internal combustion engines remain a major source of greenhouse gas (GHG) emissions, including carbon dioxide (CO_2) and nitrogen oxides (NO_x). These emissions contribute directly to climate change by accelerating global warming and degrading air quality. The resulting air pollution poses serious risks to human health, particularly respiratory and cardiovascular diseases, and harms ecosystems by damaging flora and fauna.

Consumption of natural resources. Automobile manufacturing requires vast quantities of raw materials such as iron, aluminum, copper, plastics, and rubber. The intensive extraction of these resources not only depletes natural reserves but also generates significant environmental impacts, including ecosystem degradation, deforestation, and soil and water pollution. These processes can have serious consequences for local communities that depend on these resources for their livelihoods.

Generation of hazardous waste. Vehicle production generates hazardous waste, including used oils, solvents, and other polluting substances. When these materials are not properly managed, they can have severe en-

vironmental consequences, contaminating soil and water sources, harming biodiversity, and posing serious risks to the health of humans and animals that rely on these ecosystems.

Impact of road infrastructure. The construction of roads, parking facilities, and other infrastructure required for vehicle use has a substantial impact on ecosystems. Such developments alter natural balances, degrade landscapes, fragment habitats, and contribute to biodiversity loss. Moreover, the urban expansion associated with infrastructure development increases the risk of soil erosion and leads to higher levels of dust and particulate emissions.

Energy consumption. The automotive industry is highly energy-intensive, both in vehicle manufacturing and in their use. This high level of energy consumption increases demand for fossil fuels and non-renewable energy sources, thereby contributing to the emission of polluting gases. Although efforts have been made to develop more energy-efficient technologies, these initiatives have been limited and slow to materialize, and the transition toward renewable energy sources continues to lag behind.

Impact of material extraction for electric vehicles. While electric vehicles offer clear environmental advantages in terms of reduced emissions during use, their production also entails significant environmental and social costs. The extraction of key materials such as lithium and cobalt, which are essential for battery production, can be highly damaging to ecosystems and local communities. Mining activities are often associated with pollution, environmental degradation, and social conflicts.

Taken together, these challenges reveal the structural tensions that characterize the automotive industry's relationship with the environment. The sector's reliance on intensive resource extraction, high energy consumption, and complex supply chains highlights the limits of current production and consumption models. Without a substantive shift toward sustainability—one that goes beyond incremental improvements and regulatory compliance—the environmental and social costs of the industry will continue to accumulate. Addressing these issues requires coordinated action among firms, policymakers, and research institutions, as well as a redefinition of competitiveness that incorporates environmental responsibility and social equity as central components of long-term industrial development.

Aspects of Interest for Labor Studies

A review of José Jaime Paulín's research highlights several key aspects that make a valuable contribution to studies of labor and environmental management in the auto parts industry in Querétaro. As discussed throughout the analysis, the study offers a comprehensive perspective on the links between environmental management and labor dynamics within this sector. Its multidisciplinary approach, the articulation between local and global processes, the examination of environmental management systems, the role of key stakeholders, future scenarios, and ongoing transformations in the world of work together provide important analytical tools for reflection and debate on the future of the automotive industry.

The analysis encourages the various actors involved in the sector, as well as scholars interested in labor issues, to take an active role in shaping a development model that balances economic growth with environmental protection and social well-being. From this standpoint, several key issues deserve particular attention.

First, the multidisciplinary approach integrates perspectives from sociology, economics, history, organizational studies, and environmental studies. This framework allows the subject to be examined through a critical yet constructive lens, addressing environmental management in the auto parts industry not only from a technical standpoint but also in terms of its social, economic, and cultural implications, which shape the sector's practices and outcomes.

Second, the relationship between the local and the global is a central theme. The study underscores the importance of the automotive industry in Querétaro while showing how local dynamics are deeply intertwined with international trends. This perspective helps situate the region within a global context, illustrating how local decisions and practices both influence and are influenced by global markets, regulatory frameworks, and policy agendas.

Third, the research offers a detailed analysis of the implementation of environmental management systems, such as the ISO 14001 standard and the Environmental Audit Program of the Federal Attorney General for Environmental Protection (PROFEPA). By examining both the benefits and

the limitations of these instruments, the study provides a critical assessment of their effectiveness and highlights the challenges companies face in meeting environmental standards.

Fourth, the author emphasizes the role of the various actors involved in the socio-technical configuration of the sector, including senior management, environmental managers, trade unions, and public authorities. This focus offers a novel perspective for analyzing the relationships, tensions, and forms of collaboration among these actors—an essential dimension for understanding and designing effective environmental management strategies.

Another key aspect that deserves attention is the discussion of possible future scenarios. The book outlines three alternative trajectories for the sector's development toward 2035. The first, an ideal scenario, envisions a strong environmental commitment on the part of auto parts companies, characterized by the normalization of certification processes and participation in environmental programs, the strengthening of green supply chain initiatives, the promotion of innovation, and improvements in labor relations. The second scenario, one of decline, represents the opposite path: a lack of commitment to environmental management, the presence of corruption and insufficient resources among those driving policy, the abandonment of green supply initiatives, and the deterioration of labor relations. The third scenario, stagnation, is defined by the maintenance of the status quo, with conservative and bureaucratic compliance with environmental requirements, limited certification, a weak green supply chain, and minimal dialogue among productive actors.

These scenarios reflect varying degrees of commitment and action within the automotive sector, ranging from an ideal trajectory to situations of stagnation or regression. At the same time, they offer a forward-looking perspective that encourages reflection on the steps required to move toward sustainability. Beyond their value as projections of possible futures, these scenarios function as strategic planning tools, helping industry actors anticipate challenges, make informed decisions, and design strategies that align sustainable development with productivity and long-term profitability.

Another important contribution of the book lies in its analysis of potential transformations in the world of work. It examines how environmental and climate pressures are reshaping labor dynamics, including the emer-

gence of new forms of employment such as green jobs. These occupations underscore the growing importance of sustainability and environmental protection and represent an opportunity to transform the automotive industry in line with the demands of a society increasingly aware of environmental challenges. From this perspective, the discussion advances a broader understanding of work that incorporates socio-environmental dimensions and highlights its impacts on both natural ecosystems and local communities.

The Future of the Auto Parts Sector

Reading the book invites reflection on several key issues. Three of these reflections are outlined below.

Reflection 1: Environmental management as an ethical and economic challenge. The book shows that environmental management in the automotive sector in Querétaro is strongly shaped by economic logic, with decisions largely guided by the paradigm of economic rationality. As a result, corrective measures tend to be limited in scope and are often driven by market demands and customer pressure rather than by a genuine ethical commitment to environmental protection. This situation reveals a clear contradiction between public sustainability discourse and companies' actual practices: economic gain remains the primary driver of decision-making, while environmental and social well-being are relegated to a secondary role. From the perspective of the research, it is therefore essential for the sector to move toward an environmental rationality that recognizes the interdependence between nature and society and is grounded in respect for both.

Reflection 2: The importance of cooperation and innovation. Cooperation among companies, universities, research centers, and public authorities is crucial for improving environmental management and fostering innovation. However, such collaboration remains incipient in the automotive sector, as environmental cooperation is still limited and largely dependent on the individual motivation of the actors involved. Environmental innovation in Querétaro is clearly lagging, with relatively few companies

engaged in the design of sustainable products or in extending product life cycles. To maintain its position within the global automotive industry, the State must move beyond rhetoric and actively strengthen the triple helix of industry, academia, and government, while cultivating a culture of innovation that places sustainability at its core.

Reflection 3: The urgency of the transition to electromobility. The book argues that the shift toward electromobility is inevitable, yet the automotive sector in Mexico—and in Querétaro in particular—is advancing at a slow pace. The lack of adequate infrastructure, coherent public policies, and long-term planning poses a serious risk to the sector's competitiveness and to the employment of thousands of workers. Moreover, while electric vehicles offer clear environmental advantages, they also generate negative externalities, including intensive resource extraction and adverse impacts on vulnerable communities. For this reason, it is essential that automotive firms, public authorities, and environmental organizations work collaboratively to accelerate this transition, taking into account not only technological and economic factors but also social, labor, and environmental considerations to ensure a just and sustainable transformation.

Global trends clearly point to the need to move away from internal combustion engines and toward electromobility. The book offers valuable insights into both the importance and the opportunities associated with electric vehicles, provided that learning processes are accelerated and effective strategies are implemented to prevent the region from falling behind areas such as Europe and Asia, particularly China. While electromobility represents a promising pathway for mitigating the environmental impacts of the automotive industry, achieving this goal will require firm decisions and decisive strategies that embed sustainability throughout the entire vehicle life cycle—from the extraction of raw materials to the disposal and recycling of batteries.

This book invites readers to reflect on the need for a shift toward development models that prioritize sustainability and environmental responsibility in the automotive sector.

Marco Carrillo
November 2025

INTRODUCTION

Environmental and climate conditions are gradually reshaping everyday life. The ways in which we work, consume, live in our homes, eat, travel, separate waste, and educate our children are markedly different from those of just a few decades ago. Mobility patterns are also changing, particularly within and between cities, as transportation based on fossil fuels—especially private vehicles—contributes significantly to total greenhouse gas (GHG) emissions.[1]

As a result, the relationship between the automotive industry and the environment has become an increasing focus of attention for policymakers, business leaders, technologists, activists, and a growing number of consumers worldwide. This attention stems not only from the visible environmental and climate externalities associated with internal combustion vehicles, but also from the car's complex social significance. Automobiles function as sociocultural objects that enable mobility and individual freedom, as emotional objects that can take on meanings similar to those of a family member, and as economic objects that symbolize progress, employment, and development.

In this regard, the scale and importance of the automotive industry in Mexico are evident. According to the Instituto Nacional de Estadística y

[1] According to the Sixth National Communication and Second Biennial Update Report to the United Nations Framework Convention on Climate Change, motor transport accounted for 23.4% of the country's total greenhouse gas emissions, equivalent to 159.9 million tons of CO_2e (Secretaría de Medio Ambiente y Recursos Naturales [SEMARNAT] and Instituto Nacional de Ecología y Cambio Climático [INECC], 2018, p. 55).

Geografía (INEGI), between 1993 and 2023 the industry's gross domestic product grew at an average annual rate of 5.1%, exceeding overall GDP growth as well as that of key sectors such as the food industry, construction, freight transport, and educational services (INEGI, 2025, p. 9).

The relationship between the automotive industry and the environment has increasingly become a focal point for policymakers, business leaders, technologists, activists, and a growing number of consumers worldwide. This attention stems not only from the visible climate and environmental externalities associated with internal combustion vehicles, but also from the car's distinctive social significance. Automobiles function as sociocultural objects that enable mobility and individual freedom, serve as symbols of middle-class aspiration, carry strong emotional meanings—often likened to those of a family member—and play a central economic role as drivers of progress, employment, and development.

In this regard, the scale and importance of the automotive industry in Mexico are evident. According to the *Instituto Nacional de Estadística y Geografía* (INEGI), between 1993 and 2023 the industry's gross domestic product grew at an average annual rate of 5.1%, exceeding overall GDP growth as well as that of key sectors such as the food industry, construction, freight transport, and educational services (INEGI, 2025, p. 9).

At the regional level, the automotive industry has also become a cornerstone of Querétaro's economy. By 2018, it accounted for 8% of the total value of motor vehicle parts production (INEGI, 2018, p. 23), and by 2025 it represented 24.7% of the state's manufacturing GDP (Querétaro Automotive Cluster, 2025). Companies in the sector are organized within the Querétaro Automotive Cluster, established in 2013, which plays a key role in coordinating industry development in the region.

In the context of the profound socio-environmental challenges facing contemporary societies, it is essential to analyze and reflect on the state of environmental management in the automotive and auto parts sector—particularly in countries and regions such as Mexico and Querétaro, where thousands of families depend directly and indirectly on this industry for their livelihoods and economic well-being. Such an analysis not only helps to identify the organizational trends toward which human and material resources are being directed but also sheds light on the challenges the sector faces

in a future in which environmental concerns will continue to reshape habits and ways of life. More importantly, it allows us to understand how the sector is configured in relation to environmental management by broadening the analytical lens to include the relationships among companies, as well as their interactions with government agencies, educational institutions, and other social actors. This requires a multidisciplinary perspective rooted in labor studies — one that moves beyond a purely instrumental or technological approach and recognizes the crucial contribution of the social sciences to both critical reflection and the formulation of viable solutions.

From this standpoint, labor issues can no longer be examined solely through the lens of capital or by viewing workers only as agents of material production within factory settings, as was largely the case throughout much of the twentieth century. Contemporary labor studies must instead take into account new territories, institutions, social networks, and subjectivities (De la Garza et al., 2009a), while incorporating dimensions—such as the socio-environmental—that did not carry the same weight sixty years ago. Today, it is imperative to consider the increasingly diverse career trajectories that emerge within or are shaped by the environmental sector, as well as the new and creative collective identities that form around activism, sustainability initiatives, or green jobs, to name just a few examples.

In response to environmental and climate challenges, the global automotive sector has adopted five broad strategies. First, it has sought to extend the lifespan of internal combustion engines for as long as possible, as reflected, for example, in the boom in sport utility vehicle (SUV) sales. Second, it has invested in technological innovations aimed at reducing the environmental impact of internal combustion engines, such as the development of more efficient powertrains. Third, the industry has increased investment in and preparation for hybrid and electric vehicles. Fourth, automakers have pursued alliances and mergers while exploring alternative business models for electromobility, as illustrated by the merger agreement announced between Fiat Chrysler and Peugeot in December 2019 to address present and future challenges. Finally, companies have worked to improve the environmental management and performance of their plants and facilities—most notably through the adoption of environmental management systems such as ISO 14001 certification—which constitutes the central focus of this research.

These responses, which are neither mutually exclusive nor free of internal tensions, have unfolded unevenly across original equipment manufacturers (OEMs) and firms within the supply chain, reflecting their distinct historical trajectories. Moreover, despite the global character of the automotive industry, it is essential to conduct more detailed and context-specific analyses of how these processes play out in particular places and moments—for example, in Querétaro. This need points to a clear opportunity for multidisciplinary labor studies, which, despite notable exceptions (e.g., García, 2015; Covarrubias, 2017a, 2017b), remain insufficient to fully capture what is at stake both now and in the years ahead. This gap is especially evident given the recurring events that continue to place automakers and the sector at the center of public scrutiny, as illustrated by the following cases:

1. In December 2005, the U.S. Environmental Protection Agency (EPA) and the Department of Justice announced a settlement of USD 94 million with DaimlerChrysler Corporation over defective catalytic converters installed in approximately 1.5 million Jeep and Dodge vehicles manufactured between 1996 and 2001 (EPA, 2005).
2. One year later, in December 2006, the EPA reported that Mercedes-Benz agreed to pay USD 1.2 million for violations of the Clean Air Act, specifically for failing to report defects in catalytic converters and airbags in a timely manner in multiple vehicle models produced between 1998 and 2006 (EPA, 2006).
3. In Europe, the failure of voluntary agreements encouraging automakers to reduce CO_2 emissions to 120 g/km prompted regulatory intervention. As a result, in December 2007, the European Commission enacted legislation making these emission reductions mandatory (Iguchi, 2015, p. 44).
4. In November 2014, the EPA and the U.S. Department of Justice announced that Kia and Hyundai were fined USD 100 million for selling nearly 1.2 million vehicles that emitted approximately 4.75 million metric tons of greenhouse gases (GHGs) above the levels certified by the EPA (EPA, 2014).
5. In September 2015, the Volkswagen emissions scandal—commonly known as Dieselgate—came to light. The company had authorized the

installation of an illegal software program, the Electronic Control Module (ECM), in approximately eleven million diesel vehicles worldwide (including about 600,000 sold in the United States) to falsify emissions data. Under real driving conditions, nitrogen oxide emissions from these vehicles were found to be between 10 and 40 times higher than legally permitted levels.

6. At the beginning of President Donald Trump's first term in 2017, automakers themselves exerted pressure on the federal government to reduce regulatory constraints. Shortly after taking office, President Trump asked leading manufacturing executives for recommendations on how to roll back regulations perceived as obstacles to business activity (Eilperin, 2017). Notably, of the 168 recommendations submitted—many through organizations such as the National Association of Manufacturers—business leaders identified the U.S. Environmental Protection Agency (EPA) as the agency most detrimental to their operations (79 mentions), particularly through the enforcement of the Clean Air Act (48 mentions) (Eilperin, 2017).
7. In April 2017, a study conducted by the German Federal Environment Agency revealed that under real-world driving conditions—rather than laboratory testing—pollutant emissions from the latest generation of Euro 6 diesel engines significantly exceeded legal limits. Nitrogen oxide emissions averaged 507 milligrams per kilometer, compared to the maximum permitted level of 80 milligrams, exceeding the standard by more than six times (Boutelet, 2017).
8. In July 2017, *Der Spiegel* published an article reporting on possible collusion among Volkswagen, Audi, Porsche, BMW, and Daimler to coordinate technical aspects of diesel emissions systems (Dohmen and Hawranek, 2017). In response, the European Commission launched a formal investigation in September 2018 into BMW, Daimler, and Volkswagen.
9. In January 2018, media reports revealed that Volkswagen, BMW, and Daimler had funded experiments in which monkeys and human subjects were exposed to exhaust gases from diesel engines, raising serious ethical and environmental concerns (Müller, 2018).

10. In July 2018, Nissan admitted that some employees at its Japanese plants had falsified the results of anti-pollution tests, further highlighting systemic weaknesses in emissions compliance (Nissan Motor Corporation, 2018).
11. Also in July 2018, the European Commission disclosed evidence indicating that several car manufacturers had manipulated CO_2 emissions data, inflating reported levels to make it easier to meet mandatory reduction targets of 15% by 2025 and 30% by 2030 relative to 2021 levels (European Commission, 2018a).
12. In August 2018, Japan's Ministry of Transport announced that Mazda, Suzuki, and Yamaha had conducted inadequate testing of fuel efficiency and emissions in some of their vehicles (Shiraki, 2018).
13. Also in August 2018, the U.S. Environmental Protection Agency published the *Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026: Passenger Cars and Light Trucks.* This proposal sought to relax fuel economy and emissions standards compared to those established during the Obama administration, a move that triggered intense legal and political conflict—particularly between the federal government and the state of California, which has consistently advocated for more stringent environmental regulations in this area (EPA, 2018).[2]
14. Audi's statement in October 2018 accepting responsibility and agreeing to pay a fine of €800 million for violating the law on toxic emissions from six- and eight-cylinder diesel engines [3] (related to the 2015 *Dieselgate* scandal) (Audi MediaInfo, 2018).
15. In January 2019, Fiat Chrysler Automobiles announced that it had agreed to pay USD 800 million to settle lawsuits in the United States related to the use of illegal software designed to conceal emissions in approximately 100,000 vehicles—specifically 2014–2016 Ram 1500 and Jeep Grand Cherokee models equipped with three-liter EcoDies-

[2] The uncertainty that would have existed in the meantime, and above all the final legal outcome, would have had potentially significant economic repercussions for this sector and consumers around the world, in addition to obvious environmental and climate consequences.

[3] It is ironic that the statement ends with an institutional caption that reads: "Audi focuses on sustainable products and technologies for the future of mobility."

el V6 engines. The company maintained that it had not intentionally committed fraud or sought to deceive regulators (Fiat Chrysler Automobiles, 2019).

16. Also in January 2019, Bosch stated that, as part of the settlement referenced above, it would pay USD 27.5 million in addition to USD 98.7 million to resolve an investigation conducted by 50 U.S. states and territories concerning Volkswagen and Fiat Chrysler diesel vehicles sold in the United States. In its statement, Bosch neither accepted responsibility nor admitted to the allegations raised by the plaintiffs (Bosch, 2019).
17. In April 2019, the European Commission formally charged Volkswagen, Daimler, and BMW with violating EU antitrust rules. The indictment alleged that, between 2006 and 2014, the companies had colluded to delay the implementation of technologies designed to reduce vehicle emissions (European Commission, 2019).
18. In October 2019, reports indicated that General Motors, Toyota, Hyundai, Fiat Chrysler, Mazda, Nissan, Kia, and Subaru supported the Trump administration in a case before the U.S. Court of Appeals for the District of Columbia, which sought to prevent the state of California from setting its own vehicle emissions standards—a regulatory authority the state had exercised for more than five decades (Reuters, 2019).
19. More recently, reports in 2025 pointed to renewed pressure from President Donald Trump's second administration to halt incentives for the electric vehicle industry, signaling a potential shift away from policies supporting the transition to electromobility (AFP, 2025).

In light of the seriousness of the global environmental and climate crisis, as well as the central role played by the automotive industry, this book offers a qualitative, cross-cutting, and explanatory analysis of the configuration of the auto parts industry in Querétaro, Mexico, in relation to environmental management. Environmental management is understood here as the set of decisions and actions undertaken by companies to improve their environmental performance in an effective, continuous, comprehensive, and ethically grounded manner. In turn, environmental performance refers to the measurable outcomes of a firm's industrial activities, assessed against parameters and objectives aimed at continuous and responsible improvement.

The study pursues several interrelated objectives. First, it seeks to reveal the links between the socio-technical configuration of the auto parts industry in Querétaro and its environmental management practices, highlighting the levels of participation of the various actors involved amid global transformations in the automotive sector and the broader environmental crisis. Second, it aims to identify both the advances achieved and the challenges that persist in environmental management within the local auto parts industry. Third, it examines whether the automotive cluster functions as an effective mechanism for improving the environmental management of the firms that comprise it. Finally, the book analyzes the position of the auto parts industry in Querétaro in the face of the changes introduced by the emerging paradigm of electromobility, which moves beyond reliance on the internal combustion engine.

It is worth mentioning that this book is the result of doctoral research conducted between 2016 and 2021 within the Multidisciplinary Studies on Work program at the Autonomous University of Querétaro. The study draws on Enrique de la Garza's (2018) configurationist approach, which emphasizes the intensity and variability of the relationships that shape the socio-technical configuration under analysis. Some of these relationships are strong—such as the decisions made by original equipment manufacturers (OEMs) and customers within the supply chain to require specific forms of environmental management, as well as compliance with regulations and certifications—while others are comparatively weak, including cooperation within the automotive cluster and the participation of organized civil society. This framework also makes it possible to contrast expectations with empirical realities, identify contradictions, recognize the constantly evolving nature of the configuration, and acknowledge that, despite structural pressures, actors retain agency and act in accordance with their subjectivities.

The book focuses on the auto parts industry dedicated to the production of passenger vehicles, defined by the International Organization of Motor Vehicle Manufacturers (OICA, 2020) as motor vehicles with at least four wheels used for passenger transport, with no more than eight seats in addition to the driver's seat. The book is organized into four chapters: (I) the automotive industry and the environment; (II) the automotive industry in Mexico; (III) the auto parts industry in Querétaro; and (IV) final reflections.

Abstract

Examining environmental management in the automotive and auto parts industry from the perspective of multidisciplinary studies on work is essential—not only because of the socio-ecological challenges involved, but also because of the industry's economic and labor significance in strategic regions such as Querétaro, Mexico. This book therefore aims to uncover the links between the sociotechnical configuration and environmental management in Querétaro's auto parts sector, highlighting the levels of participation among the actors involved amid global transformations in the automotive industry and the broader environmental crisis.

The study draws on the configurational methodology proposed within the sociology of work, which makes it possible to analyze multiple levels at once, address the ambiguities and contradictions between environmental discourse and practice, and underscore the influence of structure–subjectivity–action relationships within the emerging configuration. The main findings suggest that local environmental management operates under pressure from diverse forces—most notably the market, whose intensity shapes and often constrains action, generating tensions between what companies publicly declare and what they actually do. While the sector as a whole has made significant efforts in this area, there remains considerable room for improvement, particularly regarding the role and influence of key stakeholders such as workers and unions.

Keywords: *environmental management, automotive industry, auto parts, configuration, Querétaro.*

CHAPTER I
THE AUTOMOTIVE INDUSTRY AND THE ENVIRONMENT

1. THE AUTOMOTIVE INDUSTRY AND THE ENVIRONMENT

José Jaime Paulín Larracoechea*

The environmental impacts of industrial and consumer society became increasingly visible from the 1950s onward, prompting growing public concern over the damage that prevailing ways of life were inflicting on nature. Two particularly significant episodes illustrate this shift in awareness in relation to the automotive industry. In December 1952, the event known as the Great Smog of London unfolded, resulting in an estimated 12,000 deaths and more than 100,000 illnesses. The disaster was caused by a combination of specific weather conditions and the widespread burning of fossil fuels for industrial activity and transportation. In the capital of the empire that had given rise to the Industrial Revolution, the human consequences of this ambitious development project became tragically evident, affecting everyone from ordinary citizens to Queen Elizabeth II herself.

At the same time, in Los Angeles, California, chemist Arie Haagen-Smit identified the source of the smog that had plagued the city since the 1940s: emissions produced by the internal combustion engines of the millions of automobiles circulating through its streets and highways (Elkind, 2011). From that point forward, Los Angeles—and the state of California more broadly—emerged as global leaders in the regulation of air pollution. The creation of the California Air Resources Board (CARB) in 1967 marked a

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turning point, as its policies and programs—such as the Zero Emission Vehicle (ZEV) program launched in 1990—have had far-reaching effects on the automotive industry not only in the United States but worldwide. These regulatory efforts have frequently generated tensions between automakers, industry lobbies, and policymakers in Washington, D.C., particularly among Republican lawmakers, who have traditionally aligned with business interests and, in some cases, with right-wing organizations that deny climate change, such as The Heritage Foundation and the Cato Institute.

Over time, people and scientists in different parts of the world began to observe noticeable changes in nature and in humanity's relationship with it: rising noise levels, the spread of paved roads and waste, and a decline in trees, arable land, and access to clean water. Two of the most visible consequences of these transformations were directly linked to automobiles: air pollution and climate change.

Gradually, it became clear that the environmental impact of the automotive industry extended beyond the use of vehicles themselves to include production processes, supply chains, and conditions within factories. Industry, more broadly, came to be associated with environmental risk, prompting the adoption of various practices—such as international environmental standards and cross-company environmental audits—aimed at addressing both its public image and its material impacts. At the same time, evolving notions of competitiveness expanded the traditional factors that supported it—such as the division of labor and specialization, quality, managerial and organizational capacity, productivity, technology, and macro- and microeconomic conditions—to include new sources of advantage. These newer elements, such as the management of knowledge, control over information, and intangible assets like customer relationships, the workforce, and investors, increasingly came to incorporate environmental preservation as a central component:

> Another source of competitiveness that has gained prominence since the mid-1970s is linked to environmental preservation and product safety, driven by the deterioration, scarcity, depletion, and even disappearance of natural resources that are essential to present and future quality of life. In response to this situation—and to secure consumer acceptance—companies

> have increasingly adopted preventive measures in both their production processes and product design, seeking to reduce environmental harm and protect ecosystems (Peñaloza, 2005, p. 58).

The negative impact of automobiles—on the environment, the climate, and public health—together with technological advances and the emergence of new business models, have triggered a rapid and ongoing transformation with far-reaching implications for everyday life, society, the economy, and the environment. It is therefore no coincidence that analysts speak of a profound shift in the automotive sector, and even of a broader socio-technical paradigm change: the transition from an automotive industry based on petroleum-powered internal combustion engines to an electromobility industry in which renewable energy will play a central role. Some authors describe this transformation as a second revolution in the history of the automobile (Freyssenet, 2009), while others argue that three revolutions are unfolding simultaneously—those of the automated, shared, and electric vehicle (Sperling, 2018).

Nevertheless, the pace, scope, and outcomes of these changes—whether labor-related, social, environmental, commercial, geographic, or political—remain uncertain, uneven, and at times contradictory. As a result, highly optimistic views coexist with more cautious assessments. On the one hand, there are claims that "the smart car is just around the corner" (Cirett and Torres, 2017, p. 99); on the other, more measured perspectives emphasize that "the future of the automotive industry is characterized by great uncertainty" (Bensusán, 2017, p. 277), that "it may take decades for this idealized future to fully materialize, and even then […] it will not make sense in all regions or climates" (Bailo et al., 2018, p. 3), that "there is significant uncertainty about when large-scale adoption of electric vehicles will occur" (Tschiesner et al., 2020), or that "manufacturers around the world are struggling to persuade even affluent consumers to abandon the internal combustion engine" (Bloomberg, 2025).

1.1 Research on the Subject

Research on industrial development and sustainability in Mexico has traditionally focused on technical and economic–administrative perspectives. Only in recent years has the topic gained greater visibility within the social sciences and the humanities, to the point that some authors now speak of environmental humanities. This delayed incorporation may help explain the current need for new analytical concepts—understood as substantive frameworks rather than merely descriptive adjectives—to better capture and explain the transformations now underway.

Broadly speaking, the main bodies of work related to the relationship between the automotive industry and the environment can be grouped into the following categories:

a) **Technical documents:** These include Mexican Standards, Official Mexican Standards, reference standards, foreign standards and international guidelines; quality and environmental management systems issued by the International Organization for Standardization (ISO); as well as articles, books, and specialized studies in engineering, chemical sciences, and biology. This category also encompasses environmental impact assessments, environmental operating licenses or certificates, and related technical documentation.
b) **Legal documents:** This group comprises national, state, and municipal development plans; international, federal, state, and local environmental legislation; international treaties and agreements; and bilateral or multilateral trade agreements relevant to the automotive and auto parts sector.
c) **Administrative documents:** These include corporate social responsibility (CSR) plans, annual corporate reports, and business strategies aimed at organizational decarbonization and environmental performance improvement. To examine research that addresses the relationship between the automotive industry and the environment, it is useful to consider the experiences of GERPISA and the ITIAM

Network (Innovation and Work in the Mexican Automotive Industry) as illustrative examples.

1.1.1 GERPISA and the ITIAM Network

GERPISA (the International Network of the Automobile) was founded in France in 1992 by sociologist Michel Freyssenet and historian Patrick Fridenson as a multidisciplinary initiative dedicated to the study of the automotive industry. From this perspective, Freyssenet has been the author, co-author, or coordinator of numerous influential studies aimed at understanding the industry and its direct and indirect dynamics. Notable works include *Les modèles productifs* (Boyer & Freyssenet, 2003) and *Le monde qui a changé la machine. Essai d'interprétation d'un siècle d'histoire automobile. Quatorze textes préparatoires* (Boyer & Freyssenet, 2006), in which he challenges the notion of a linear automotive history divided into only three stages—artisanal, mass, and lean production—and instead analyzes the interplay between nationally adopted growth regimes and corporate profit strategies.

In *The Second Automobile Revolution* (Freyssenet, 2009), he reflects on the impending end of the internal combustion engine–gasoline tandem that characterized the first automobile revolution. This shift is driven, among other factors, by the negative externalities associated with automobiles, the emergence of large new markets (such as Brazil, Russia, India, and China—particularly the latter two, which have limited oil resources), and the sharp rise in oil prices, which exceeded ninety dollars per barrel in 2008. According to Freyssenet, this transition will profoundly transform mobility patterns and everyday life, reshaping the structure, geography, and economic organization of the automotive industry.

However, he emphasizes that this second revolution is marked by deep uncertainty regarding its pace, stages, future technological standards, key actors, industrial organization, geographical distribution, and energy geopolitics. Rather than clear trajectories, Freyssenet identifies contradictions and divergent business strategies in response to an uncertain future—for example, PSA's 1998 decision to focus on improving internal combustion engine performance while abandoning electric vehicle research, contrast-

ed with Toyota's early commitment to hybrid technology through a single model, the Prius. It should also be noted that other scholars within the GERPISA network have made equally significant contributions, including economist Robert Boyer, whose work is widely cited in this field.

The history of GERPISA, along with its annual conferences and research programs, reveals several key developments: (a) a growing interest in the social sciences in automotive sector research since the 1990s[1] ; (b) the incorporation of a multidisciplinary approach—bringing together sociology, management, history, economics, engineering, chemistry, political science, and related fields—to better understand the sector and its central role in society; and (c) the emergence of sustained reflection on the interconnections between nature, environmental management, sustainable development, and work as core topics of debate.

Within this framework, GERPISA's approach to sustainable development has focused on a wide range of issues, including theories of sustainable development; corporate trajectories and the sustainability of business strategies; emerging automotive industries and markets; the relationship between industrial crises and sustainability; new and traditional technologies; established and emerging manufacturers; national policies and evolving regulatory commitments; shifting business models; macroeconomic configurations; the rise of new actors and strategic alliances in a "green" context; changing mobility patterns; and the role of local and municipal policies.

One of the outcomes of this research program on sustainable development and the automotive industry was the publication of *The Greening of the Automotive Industry* (Calabrese, 2012), in which the authors examine business models, consumer behavior, and regulatory frameworks as key factors shaping the future of the automobile. A year earlier, the issue had already been addressed as part of the broader transformations in the automotive world in *Industrie automobile. La croisée des chemins* (Jullien and Lung, 2011). In that work, the authors argue that the environmental

[1] It is not our intention to ignore the significant contributions made by these sciences in the past (especially the sociology of work and the psychology of work), but reflection and research on the subject, with a momentum capable of dominating the agenda and the emergence of environmental concerns, can be traced back to the end of the 20th century.

and safety challenges the industry began to face in the 1970s were intensified by the 2008 crisis, pushing the sector to the brink of a profound transformation. According to GERPISA researcher Jean-Pierre Durand, there remains a significant lack of research and published work on the relationship between the automotive industry and sustainability, particularly within the sociology of work and nature:

> One problem with environmentalists is that they often isolate themselves from the broader social world and rarely engage with socioeconomic contradictions. At times, they seem to be imagining an idealized world far in the future rather than grappling with present realities. In fact, La nouvelle revue du travail has not published a special issue on this topic precisely because the relationship between environmentalists and sociologists is quite difficult, except in a few limited areas of dialogue that are not particularly productive. There is very little research on the relationship between human beings and nature; the only author who comes to mind in this regard is Serge Latouche (personal interview).

In Mexico, environmental management and sustainability are still relatively new areas of interest for researchers and practitioners in the automotive and auto parts sector, particularly within the social sciences and labor studies. Despite the urgency of the issue—since environmental degradation and its consequences already affect millions of people through impacts on health, water scarcity, soil erosion, forced displacement, and other factors, while also generating costs amounting to billions of dollars—research in this field remains limited. This situation has been noted by Alex Covarrubias, former president of the Mexican Association of Labor Studies (AMET) and coordinator of the Innovation and Work in the Mexican Automotive Industry Network (Red ITIAM), which was created in 2015 and currently brings together around 120 national and international members from various disciplines. One of the network's four specific objectives is to produce studies and proposals grounded in science, technology, and innovation (STI) that can inform and influence high-impact opportunities and challenges related to the competitive scaling and sustainable development of the automotive industry in Mexico. To this

end, Red ITIAM has supported several research projects, including one focused on the development of solar-powered charging stations for vehicles (*enersolineras*)."[2]

Covarrubias (2017c), in his analysis of whether institutional configurations act as a differentiating factor in the regional development of the Mexican automotive industry, finds that in the cases examined "areas related to cultural structuring and environmental sustainability practices are only beginning to take shape, and therefore should be assessed with caution" (Covarrubias, 2017, p. 37). Beyond official statements by government authorities, significant gaps in knowledge on these issues remain. Similarly, in their study of the Mexican automotive industry, Maldonado-Guzmán, Molina-Morejón, and Juárez-del Toro note that "little is known about the relationship between environmental regulations, eco-innovation, and sustainable performance, as few studies in the literature have focused on this analysis" (2024, p. 78). In recent years, Humberto García—also a member of the ITIAM network—has emerged as a pioneering researcher in this area, particularly with his doctoral dissertation *Mechanisms of Environmental Innovation in the Automotive Industry in Mexico* (2011).

The experience of the ITIAM Network highlights several key points: first, the growing interest of the social sciences in Mexico—at the highest levels of research—in the study of the automotive industry; second, the need for this research to continue from a multidisciplinary perspective, incorporating fields such as sociology, psychology, political science, philosophy, economics, and engineering; and third, the clear need for more social science research on issues related to nature, environmental management, and sustainability.

With regard to clusters and sustainability, the work of Porter and Van der Linde (1995) and Sharma (2000, 2014) is particularly noteworthy; however, as De Chiara points out, these contributions remain insufficient to fully capture the complexity of the issue (2017, p. 50):

[2] One of the project's expected outcomes is the installation of five solar-powered charging stations for electric vehicles, strategically located along highways in the state of Guanajuato, along with the development and presentation of a viable business model to support their operation.

Only in recent years has theory begun to systematically address the links between clusters and sustainability (Knorringa and Nadvi, 2016; Lund-Thomsen and Pillay, 2012), with particular emphasis on the role of small and medium-sized enterprises (Battaglia et al., 2010; Hoivik and Shankar, 2011; Testa et al., 2012), as well as on the challenges of adopting and complying with sustainability approaches in clusters located in developing countries (Knorringa and Nadvi, 2016; Lund-Thomsen et al., 2016).

All of this leads us to the following considerations:

1. The convergence of the social sciences and the humanities in general—and labor studies in particular—in the analysis of the automotive and auto parts industry, from a multidisciplinary perspective that seeks to capture the complexity and significance of the processes at work within the sector, will continue to attract growing scholarly interest in the coming years.
2. A substantial portion of research on environmental issues in the automotive industry has taken an outward-looking approach. In other words, attention has focused primarily on the product—the vehicle itself—and on issues such as the emissions it generates; technologies designed to reduce pollution (e.g., catalytic converters); policies aimed at discouraging car use (e.g., "No Driving Today" programs); electric vehicles, battery materials, and driving range; the social and environmental consequences of extracting materials for the car of the future (e.g., lithium); the phase-out of diesel and gasoline; cases of corruption within the industry (e.g., Dieselgate) or in government (e.g., vehicle inspection centers); consumer habits and preferences; and the relationship between automobiles and urban space. As a result, internal dynamics have received far less attention—namely, what happens inside plants and offices, within work processes, environmental management systems, and the links between management and environmental innovation, environmental leadership styles, and the personal and institutional motivations that shape environmental performance in the sector.
3. Environmental issues in Mexico and Latin America call—both now and in the years ahead—for a greater volume of quantitative, qualita-

tive, and mixed-methods research from the social sciences and humanities, particularly in areas related to environmental management and innovation.

1.2 Work and the Environment

Adopting a multidisciplinary approach, this research is situated at the intersection of two fields of knowledge: the sociology of work and environmental sociology.

1.2.1 Sociology of Work

The book is grounded in the Latin American tradition of new labor studies, which moves beyond the classical conception of work—centered on workers laboring in mechanized factories, as in the era of Henry Ford, Karl Benz, or Robert Bosch—to adopt a broader understanding of labor. This perspective makes it possible to consider sociotechnical configurations that involve other actors, such as middle managers and civil servants, as well as social movements like indigenism, environmentalism, and climate activism. Although these actors and movements may initially appear disconnected from the world of work, they ultimately shape it—or have the potential to do so, depending on the configuration that emerges (De la Garza, 2009b). In this context, there is growing discussion of green jobs and the development of a climate jobs agenda (Mijin-Cha and Skinner, 2017).

From an etymological standpoint, work is closely linked to the earth—that is, to nature.[3] Although much has been written about the nature of work, there remains a need to explore more deeply the relationship between work and nature, since the two cannot be understood in isolation. As Burawoy argues:

[3] One of the etymological origins of the word "work" comes from the Latin word laborare, which is related to working the land, tilling; in English, labor studies are translated as labor studies.

> To make history, men and women must survive, and to do so, they must transform nature into useful things. We call these transformative activities economic activities. A society begins to exist when men and women establish social relationships with each other by transforming nature (1989, p. 34).

Work never takes place in a vacuum; it is always embedded in a world of objects, nature, and the earth—that is, within a territory. Ultimately, to speak of work is to speak of what occurs within a bounded spatial and territorial context, whether the factory, corporate headquarters, home, industrial park, street, workshop, or cluster. Until a few decades ago, these boundaries were relatively clear. However, the global reach of human activity and technological development achieved during the twentieth century has profoundly altered this reality. The automotive industry, with its highly integrated global production chains, is a clear example of this transformation.

The industry has long been paradigmatic in discussions of work: it exemplifies the transformation of natural elements such as iron, aluminum, and copper; the figure of the worker; the workplace, particularly the factory; the product of labor—the automobile; workers' organizations, such as labor unions; the social consequences of work, including wages, benefits, and social mobility; and innovation, in both technology and business organization. At the same time, it also exemplifies the environmental damage generated by labor and its products, including pollution and the depletion of natural resources.

The automobile occupies such a central place in labor studies that concepts like Fordism and Toyotism are routinely used to analyze phenomena far beyond the automotive industry itself. Indeed, this sector has long been regarded as the emblematic industry of the capitalist world—a symbol of innovation, entrepreneurship, versatility, creativity, technological sophistication, the future, social mobility, and even community building. The countries, regions, and cities that host automotive industries are often portrayed as models of progress and, in some cases, as core elements of collective identity or national branding. It is difficult to imagine the history of the United States without the "Big Three" automakers—Ford, General Motors, and Chrysler—or Japan without Honda, Toyota, Nissan, or Bridgestone; Germany without Volkswagen, Mercedes-Benz, or Continental Automotive;

Sweden without Volvo; France without Peugeot or Michelin; or even the industrial development of cities such as Querétaro without companies like Tremec. Countries that lack domestic automakers, such as Mexico, also actively seek to attract these firms within their borders.

Since the 1990s, the private sector has increasingly embraced the discourse of sustainable development, understood as meeting present needs without compromising the ability of future generations to meet their own (Gutiérrez and González, 2010). However, as Utting (2000, p. xiii) cautions, this shift has been driven less by ethical concern for the planet or social well-being than by economic, political, and structural factors. Among these are the pursuit of "win–win" opportunities, the potential to gain competitive advantage, image management, pressure from consumers and interest groups, existing or anticipated regulation, and changes in the global organization of production and marketing. Utting therefore issued a warning:

> Perhaps the greatest concern regarding some forms of voluntary and partnership initiatives is that they may weaken the key factors that drive corporate responsibility, namely: government regulation, collective bargaining, and certain forms of civil society activism. (Utting, 2000, p. xiv)

Returning to the question of ethics, Gudynas argues that "biocentric ethics once again brings to light the contradiction between capitalism and the environment—a contradiction in which any remedial measures are merely palliative or serve only to conceal the seriousness of the ecological crisis by postponing it into the future" (2010, p. 66). Similarly, Altvater contends that "if production and consumption patterns and structures remain at their current levels, it will never be possible to achieve a balance between energy use and production" (2011, p. 66).

One attempt to address this situation is ecological economics—an approach that should not be confused with environmental economics. The former:

> It is a transdisciplinary field of study. Perhaps its only original "sin" was being born with the label of economics; yet it is far more than a purely economic way of understanding the world. Ecological economics is a transdisciplinary

> approach that seeks to build methodologies and foster dialogue between society and the environment. Closely linked to the notion of productive ecology, and grounded in the best available science and technology, it promotes the protection of—and respect for—all human beings, all species on the planet, and their ecosystems. From this perspective, it proposes an alternative and sustainable response to the current civilizational crisis. (Pengue and Feinstein, 2013, p. 20)

In practice, this approach to ecological economics is closely linked to proposals such as the circular economy, in contrast to the linear model based on extraction, production, consumption, and disposal. It has already been incorporated into the theoretical and methodological frameworks of studies on the automotive industry in Mexico. One example is the work of Tagle et al. (2017), who use this perspective to highlight the environmental contradictions of the dominant economic model in the Bajío region of Guanajuato—one of the country's most important automotive clusters. In their analysis of this region, the authors find that:

> There are profound differences between sustainability goals and the development model promoted by the prevailing economic framework, along with a high opportunity cost between sustainability and economic growth—one that clearly favors the latter. In Guanajuato, the political class and economic elites prioritize maintaining high levels of foreign direct investment (FDI) as a synonym for development, despite the environmental and social vulnerabilities revealed by the state's environmental and socioeconomic indicators. (Tagle et al., 2017, p. 215)

The challenge, they conclude, "is to confront a political class that is dogmatic in its market ideology and reluctant to consider alternatives through conscious, informed, and organized citizen participation" (Tagle et al., 2017, p. 216). To this, we would add that workers cannot be excluded from this process, as the International Labor Organization has already emphasized (2007, 2010).

1.2.2 Environmental Sociology

It is useful to examine the relationship between society and the environment through the lens of the New Ecological Paradigm proposed by Catton and Dunlap (1978). In contrast to the Paradigm of Human Exceptionalism—which is anthropocentric, technologically optimistic, and deeply anti-ecological (Dunlap, 2002, p. 334)—this perspective assumes that: (1) human beings, despite their distinctive characteristics such as culture and technology, are only one species among many, all of them interdependent within the global ecosystem; (2) human affairs are shaped not only by social and cultural factors, but also by complex chains of cause, effect, and feedback within the web of nature, meaning that intentional human actions often generate unintended consequences; (3) humans live within and depend upon a finite biophysical environment that imposes significant physical and biological constraints on social life; and (4) although human ingenuity and technological capacity may create the illusion that the limits of carrying capacity can be indefinitely expanded, in reality it is impossible to escape the laws of ecology (Dunlap and Catton, 1978, p. 45; Dunlap, 2002, p. 333).

For both authors (Catton and Dunlap, 1978, p. 42), dominant sociological theoretical traditions—such as functionalism, symbolic interactionism, ethnomethodology, conflict theory, and Marxism—have historically shared an anthropocentric orientation. Dunlap even argues that in the foundations of sociology, Durkheim's legacy implied that "the physical environment should be ignored," while Weber's suggested that "it could be ignored" (Dunlap, 2002, p. 334). However, since the 1970s, it has become increasingly clear that sociologists can no longer afford to overlook environmental factors in their analyses, a realization that has also been embraced by natural scientists and progressive governments since "environmental problems are people problems" (Tábara and Polo, 2006, p. 180).

Without departing significantly from Dunlap's understanding of the environment as the physical and biological surroundings of a given community, Dunlap and Catton (2002) identify three main environmental functions: (a) the provision of resources essential for life (such as air, water, food, shelter, and transportation); (b) the absorption of waste (that is, the dispos-

al of the byproducts generated by human activity); and (c) the provision of living space (places in which people live, work, move, and engage in leisure).

Although these functions are directly relevant to this research—since, for example, an auto parts company depends on natural inputs, must manage the waste it produces, and operates as a workplace—and although the development of the automotive industry, which is constantly oriented toward expansion, is constrained by the fact that the planet is finite and governed by biophysical limits and natural laws, it is nevertheless impossible to ignore the critiques and contributions that Latin American thought has offered in recent decades regarding concepts such as environment, development, sustainability, and progress. These perspectives, grounded in the so-called Epistemologies of the South, point toward alternative ways of understanding and organizing social life. Thinkers such as Aníbal Quijano, Boaventura de Sousa Santos, Boris Marañón, and Arturo Escobar outline paths that diverge from dominant Western paradigms.

Within Latin American environmental thought in particular, Enrique Leff stands out. He understands the environmental crisis as the result of a deeper crisis of knowledge and civilization—one rooted in the persistent emphasis on ideas of development and progress that obscure the plurality of human ways of being in the world. For Leff, the environment "is knowledge of the ways in which the world and nature are appropriated through power relations embedded in dominant forms of knowledge" (Leff, 2006, pp. 13–14). His proposal is to move beyond dominant capitalist economic rationality toward an environmental rationality that incorporates ethical principles, social interests, diversity, difference, and uncertainty, envisioning a sustainable future in which neither the economic order nor the apparatus of the state continues to dominate the civilizational project, as they have throughout modernity (Leff, 2006, pp. 42-49).

Thus, we can see that there is currently a mosaic of different orientations toward environmental issues shaped by industrial and financial capitalism, which tends to prioritize economic gain over other vital and existential concerns. At the two ends of this spectrum are what we refer to here as continuist and ruptureist orientations—although in practice these positions often overlap, blur into one another, and interact in ways that are highly contradictory.

Table 1.1

Continuist orientation	*Ruptureist orientation*
It favors the urban lifestyle	It questions the urban lifestyle that views nature as incidental, distant, or decorative.
The automobile occupies a central place in urban mobility	The automobile does not occupy a central place in urban mobility.
Commitment to industrial environmental management	It questions industrial environmental management, so that it is not a simulation.
It has a Eurocentric vision	It has a worldview that does not neglect the epistemologies of the South.
Modern rationality	Environmental rationality
Focus on development	Criticizes the notion of development
It is colonizing	It is decolonizing
Anthropocentric	Man and nature are consubstantial
Privileges the self	It privileges the "We"
Nature (natural capital) provides services and resources to humans	There is an interrelationship of respect with Nature
There is an absence of grand narratives	It thinks in terms of ecoutopias
Growth is what matters	De-growth is important
The current economic model is sustainable	The current economic model is unsustainable
We can identify three areas of sustainability: economy, society, and environment, where the first is the basis of the economic system.	Reality is a continuum; betting above all on an unsustainable economy ends up destroying life.
Beings are above all individuals.	Beings are, first and foremost, a community.
It is heteropatriarchal.	It has a gender perspective.
Nature can have economic value.	It is impossible to assign an economic value to nature.
Capitalist companies are socially responsible and allies in the search for solutions to environmental problems.	The current capitalist business model is a direct cause of environmental problems.
It is not concerned with job insecurity. Responsible consumption.	It is committed to green and decent jobs. It is necessary to put an end to consumer society.
Individual action.	Collective action.
The dominant paradigm is mechanical-industrial, centered on the global market.	Human and non-human life is respected, and it focuses on the planet as a whole.
There is a gap between nature and culture. Its temporality focuses on the present.	Nature and culture are not separate. Its temporality takes into account the past (e.g., traditions, ancestors), present, and future (future generations of living beings)
The environment can be managed.	It criticizes the idea that the environment can be administered or managed

There are different paradigms of environmental management.	The environment cannot be thought of solely in terms of environmental administration
It emphasizes dichotomy.	It privileges the relational
Technical and scientific knowledge is paramount.	It is necessary to incorporate non-scientific and non-technical knowledge.

Source: Own elaboration.

The use of the term rupture is deliberate. It signals a break with the individualistic and environmentally destructive way of life that has become increasingly entrenched in recent decades—something reflected, for example, in the dominance of private transportation. It also implies interrupting the flow of the global economic routine, which operates under the mantra of living to work and working to consume[4], a logic that is usually taken as natural and self-evident when it is not. The main characteristics of these two orientations are summarized in Table 1.1

All of the above is closely connected to the focus of this research. Within the continuist orientation, urban life, automobiles, and automotive companies play a central role. At the same time, the growing scale of damage to human health and entire ecosystems, the intensification of natural phenomena (such as droughts, hurricanes, and wildfires), and even the framing of climate change as a human security issue (Connelly, 2016)—together with pressure from certain segments of the public—have pushed the industry to respond. These responses, however, are generally expected to avoid economic losses, for example through the adoption of environmental management systems.

1.3 Environmental Management

The term management comes from the Latin *gestio*, *gestionis*, which in turn derives from *gestus* (action, attitude, gesture, bodily movement), the past participle of the verb *gerere* (to carry, bring, wage war, or carry out). It therefore also carries the meaning of administering, as reflected in words such as *manager*

[4] Let us not forget that one of the meanings of the verb to consume is, quite literally, to destroy.

and *management*. The term has an active, even forceful connotation, echoed in related words such as *belligerent* or *feat* (Anders et al., 2018).

According to the Dictionary of the Royal Spanish Academy (2018), *management* refers, first, to the action and effect of managing, and second, to the action and effect of administering. To *manage* means: (1) to carry out an initiative or project; (2) to oversee the administration, organization, and operation of a company, economic activity, or organization; and (3) to deal with or handle a problematic situation.

These etymologies and definitions show that, at the core of environmental management, there is an administrative logic aimed at resolving a problem. As mentioned earlier: (1) without the environmental problems generated by industrial society, environmental management would not have emerged—or at least not with the speed and intensity we see today; and (2) environmental management is a natural outcome of an economic worldview in which nature is something to be managed, rather than admired, contemplated, experienced, or thought about.

There is no single, universally accepted definition of the term. In the 1980s, the Organization of American States (1987), in a publication prepared jointly with the Government of Peru, stated that the goal of environmental management is to improve the quality of human life—an explicitly anthropocentric view—which requires "the mobilization of resources and the use of government to manage the use of natural and economic goods and services."

If environmental management is understood as "a set of decisions and actions aimed at sustainable development" (Granero and Ferrando, 2007, p. 12), or as "a set of procedures through which a public entity can intervene to modify, influence, or guide the uses of the environment, as well as the impacts of human activities on it" (Interconsulting Bureau, 2017, p. 253), then corporate environmental management, from Quiñónez's perspective, refers to:

All actions aimed at preserving the environment. In this sense, it must be seen as part of the company's social responsibility, seeking to respond to the following situations:

- How to generate less waste and manage it efficiently.
- How to identify alternatives for raw materials with less environmental impact and/or how to reduce the level of harm to society and ecosystems.

- How to respond to post-consumer responsibilities for products placed on the market.
- How to prevent ecosystem pollution.
- How to increase efficiency in natural resource management. (Quiñonez, 2015, p. 21)

The Environmental Protection Law for Sustainable Development of the State of Querétaro defines environmental management as "the actions carried out by public administration entities and individuals that are undertaken in, or have an impact on, the environment" (2009, p. 6).

For Fernández (2000, p. 42), modern environmental management "is understood as the set of actions aimed at guiding and encouraging changes in our social and economic activities, as producers and consumers, to place them on the path toward sustainable development. More concretely, environmental management involves directing and implementing a wide range of decisions, resources, and actions—governmental, private, and social—designed to protect, care for, and restore the environment."

Similarly, Valadez and Lana (2003, p. 59) argue that environmental management is structured "as a set of actions intended to guide and encourage changes in the social and economic activities of producers and consumers, through which it becomes possible to move toward sustainable development." For these authors, environmental management must adopt "a global perspective of the interactions and impacts of global and interregional processes" (Valadez and Lana, 2003, p. 59) and, together with environmental policy, should aim to "prevent environmental degradation by promoting changes in technological processes and encouraging the use of less polluting alternatives" (Valadez and Lana, 2003, p. 60). This perspective already points to the essential relationship between environmental management and innovation.

Finally, for SEMARNAT (2006, p. 14), environmental management constitutes "the essential link between environmental policy and its implementation, in accordance with the current legal framework and through the use of the administrative means and resources available."

In this book, by environmental management we mean the decisions and actions taken by a company to improve its environmental performance in an effective, continuous, comprehensive, and ethical manner. In turn, an envi-

ronmental management system is considered here to be the administrative system of continuous improvement that enables and facilitates companies to make decisions and take actions to improve their environmental performance in an effective, efficient, continuous, and ethical manner.[5]

Part of the difficulty in defining environmental management lies in the fact that it can be understood in two different ways, each with distinct origins and effects. On the one hand, it can be seen as emerging from public administration, where its role is to ensure that environmental policy is aligned with development plans and programs. In this sense, it is implemented through various management instruments—such as actions taken by the State or environmental authorities to comply with legal objectives—as well as through command-and-control mechanisms, which use the coercive power of the State to require regulated actors to prevent pollution, repair environmental damage, or mitigate the impacts of their economic and productive activities.

On the other hand, environmental management can also arise from private initiative, aimed at improving a company's environmental performance. In this case, firms voluntarily grant authorities the discretion to review their operations and identify potential findings or irregularities within their production systems, thereby consolidating an environmental management system that is closely linked to quality management through voluntary instruments.

1.4 Environmental Ethics

Ethics is a central element in the definition of environmental management adopted in this book. The way a society relates to its natural environment is reflected in a set of principles that shape environmental ethics and have

[5] The Mexican Environmental Audit Standard NMX-AA-162-SCFI-2012 (2012) defines an environmental management system as an instrument through which a company formalizes the procedures and actions it undertakes by incorporating environmental considerations into all its activities. Through this system, the company identifies environmental objectives, defines responsibilities in this area, and operates in a systematic and orderly way under the principle of continuous improvement, developing, implementing, achieving, reviewing, and maintaining an environmental policy.

concrete, practical consequences—such as actions, behaviors, and value judgments. This relationship is neither automatic nor uniform; rather, it can take multiple forms. In this regard, Elliot (2004) suggests the existence of different types of environmental ethics:

1. **A human-centered ethical approach**, which prioritizes the interests of men and women and considers only human beings to be morally relevant (for example, their happiness and suffering).
2. **An animal-centered ethical approach,** in which animals are also regarded as morally relevant. Within this view, some authors argue that distinctions must be made among different types of animals, since their capacities and interests vary—for instance, between a primate, an ant, and a human being.
3. **Life-centered ethics,** which hold that all living beings are morally relevant, though not necessarily to the same degree. Elliot clarifies that more complex beings carry greater moral significance, and that this position "requires that, when deciding how to act, we take into account the impact of our actions on every living being affected by them" (Elliot, 2004, p. 395).
4. **An ethics of the whole,** according to which both living and non-living entities (such as a hill, a crater, an iceberg, a mountain, or a volcano) are considered morally relevant.
5. **Ecological holism,** in which moral relevance is attributed to two highly complex entities: the biosphere as a whole and the major ecosystems that make it up.

This classification allows us to argue that environmental ethics do, in fact, exist today, but that they are largely human-centered. This implies a possible yet limited understanding of ethical principles, in which human beings are placed above the natural environment and the other living beings that inhabit it. An investor or the CEO of a plant and their management team, for example, will almost certainly describe themselves as environmentally ethical—and, in a sense, they are—but within this narrow, anthropocentric framework outlined by Elliot. From this perspective, it is considered understandable and even justified for a company that consumes water, clears vegetation, or

alters ecosystems to be established, because it is seen as morally relevant: it creates jobs, improves (human) quality of life, attracts further investment, reduces migration, increases local and national GDP, raises surrounding land values, and so on. That these outcomes are achieved at the expense of physical elements of the environment (such as streams or underground resources) or other living beings—especially those that are less endearing, visible, or socially valued than jaguars, bears, wolves, eagles, turtles, dolphins, ahuehuete trees, Indian laurels, or cedars—is not viewed as a problem. The underlying assumption is that development inevitably entails impacts on nature (which will supposedly be minimized) and that these impacts are simply the price of progress within a global, extractive system of production.

For Leff, rationality is a way of understanding and acting in the world (2012); in other words, it is a concept with an inherent ethical dimension. However, the dominant economic rationality of our time—aimed at unlimited growth—is grounded in the belief in the supremacy of human beings over other living beings on the planet and in the universe (Leff, 2012). It also proves ineffective at genuinely incorporating an ethic of care for nature, since such care is often practiced merely as a kind of expiation of guilt— "a Sunday retreat from everyday life, only to resume our unsustainable behaviors the following Monday" (Leff, 2012, p. 120). By contrast, environmental rationality "emerges as both a reason and an ethic for life" (Leff, 2012, p. 20) and implies:

> the legitimization of new values, rights, and criteria for collective and democratic decision-making, along with new public policies and institutional arrangements, and ultimately the establishment of a new contract with nature. (Leff, 2012, p. 29)

Although ethical, labor, and environmental considerations remain limited within organizations such as the International Labor Organization, notable progress has been made over the past two decades. As Guy Ryder, former Director-General of the organization, notes:

> Sustainable development is only possible through the active involvement of the world of work. Governments, employers, and workers are not passive ob-

> servers but agents of change, capable of developing new ways of working that protect the environment for present and future generations, eradicate poverty, and promote social justice, while fostering sustainable enterprises and creating decent work for all. (Poschen, 2017, pp. xviii-xiv)

It is not difficult to imagine that as long as the economy is the grand narrative that shapes the human world, the ethics of otherness, of life, and of the whole will remain locked away in a glass cage, minimized or silenced in the face of concerns about current unsustainable modes of production and consumption that reduce the manifestations, richness, and diversity of life on the planet.

1.5 Paradigms of Environmental Management

When environmental management is examined from the perspective of countries and companies embedded in the global economic system—such as those in the automotive industry—it becomes clear that it is not approached from a single standpoint, but from a range of different paradigms. In this context, Michel E. Colby (1991) proposed one of the most widely recognized taxonomies of the relationship between environmental management and development in the early 1990s, identifying five distinct paradigms:

1. **Frontier economics.** This paradigm takes an extractivist and instrumental view of nature (for example, industrial agriculture). It assumes that environmental damage can be easily repaired once a sufficient level of development has been achieved—one that makes it possible to pay for environmental management.

2. **Deep ecology.** This emerged as an eclectic reaction to the dominant paradigm. It seeks to synthesize both traditional and modern philosophical views of the human–nature relationship, placing strong emphasis on ethical, social, and spiritual dimensions. It questions technological advancement and the ideas of progress and economic growth. In its most radical form, it points toward an

"ecotopia" that is unlikely to materialize, since returning to pre-industrial ways of life and standards of living would be neither practical nor desirable for most people. This suggests that, in Colby's view, even this paradigm is still judged through a developmentalist lens and cannot fully function as a disruptive alternative—although it does share several compelling and thought-provoking features.

3. **Environmental protection.** This paradigm represents a defensive or corrective approach, proposing the legal recognition of the environment as an economic externality. It can be understood as a more moderate version of frontier economics.
4. **Resource management.** In this paradigm, ecology is effectively "economized": nature is understood as a set of resources to be accounted for in national economies and assigned prices. Development and sustainability are seen as compatible and mutually reinforcing, with market-based incentives playing a central role in promoting efficient resource use (for example, carbon credits or green bonds).

5. **Eco-development.** The term eco refers simultaneously to economy and ecology—two concepts that share the same Greek etymological root. Here, humanity is viewed as neither above nor below nature, but as part of it. This paradigm promotes the greening of the economy, for instance by increasing taxes on extractive and polluting activities while reducing them for environmentally friendly ones. It embraces ecocentrism, prioritizes prevention (which is also seen as economically beneficial), seeks sustainability alongside economic well-being, and aims to reduce the "surprises" that arise when unknown ecological thresholds are exceeded.

Although, in theory, these paradigms help us identify broad worldviews—ways of constructing meaning around nature, development, the economy, and humanity, with clear implications for subjectivities, actions, and structures (that is, for the socio-technical configurations that emerge in socio-environmental analysis)—in practice they are not neatly or aseptically separated. Rather, they tend to overlap and interact through porous

boundaries that make it difficult to determine precisely where one paradigm ends, and another begins. They often run in parallel, intersecting in ways that are far from free of contradiction—for example, an instrumental view of nature may coexist with an expressed concern for ethics and social issues—and they rely on concepts that are themselves ambiguous and contested, such as sustainability, development, and resources.

Thus, in the world of automotive organizations, it is not uncommon to find a company whose discourse gestures toward an ecotopian vision with spiritual undertones (deep ecology), whose formal strategies are framed in the language of sustainability (eco-development), and whose day-to-day practices, remain firmly rooted in extractivism (frontier economics).

1.6 Environmental Innovation

Although the term *innovation* usually evokes ideas such as cutting-edge technology, modernity, progress, or the future, it would be inaccurate to suggest that innovation in industry emerged only with the turn of the millennium. As De la Garza (2013) notes, "in sociology it is an old topic—so much so that it cannot be said to have been 'discovered' by evolutionary theory; technological change is already present in the works of the classical authors of the sociology of work, such as Touraine, Friedman, Naville, Braverman, and Goldthorpe."

Within labor studies, Joseph Alois Schumpeter (1883–1950) is widely regarded as the father of innovation, due to the reflections and contributions the Austrian-American economist made throughout his intellectual career. Schumpeter "introduced, in his theory of economic development, two concepts that have had a profound influence on later thinking in this field: innovation as a driver of development, and the innovative entrepreneur as the key agent facilitating innovation processes" (Montoya, 2004, p. 209). Even so, despite the abundance of academic literature and policy discourse that emphasizes innovation, there remains considerable ambiguity about what is actually meant by the term when it is used in scholarly or governmental contexts.

The *Oslo Manual* itself presents innovation as a heterogeneous and multifaceted phenomenon (Organisation for Economic Co-operation and Development [OECD], 2018), which makes the use of clear and precise definitions especially important. Accordingly, it defines innovation as "a new or improved product or process, or a combination of both, that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or put into use by the unit (process)" (OECD, 2018, p. 20).

In the business context, innovation is understood as "a new or improved product or process, or a combination of both, that differs significantly from the firm's previous products or processes and that has been introduced on the market or brought into use by the firm" (OECD, 2018, p. 20). Innovation activities, in turn, include "all development, financial, and commercial activities undertaken by the firm that are intended to result in, or that result in, innovation for the firm" (OECD, 2018, p. 20). From this perspective, innovation goes beyond mere invention and can be analyzed through four measurable dimensions: knowledge, novelty, implementation, and value creation (OECD, 2018, p. 46).

In recent years, particular emphasis has been placed on the relationship between innovation and knowledge. As the OECD notes, "human capital is the essence of innovation. […] Higher education institutions and practical training centers are fundamental nodes in the innovation system; they both produce and attract the human capital necessary for innovation" (OECD, 2010, p. 87).

A national innovation system can be defined, for example, as an interactive model for the creation and use of knowledge in which the different agents involved in production and technological development participate (Rincón, 2004, p. 95), or as a network of public- and private-sector institutions whose activities and interactions are aimed at adopting and disseminating new technologies (Freeman, cited in Carrillo et al., 2016, p. 16).

In Mexico, a key actor in innovation policy until 2024 was the National Council for Humanities, Sciences, and Technologies (CONAHCYT), which in 2025 was transformed into the Secretariat of Science, Humanities, Technology, and Innovation (SECIHTI). At the state level, this role is

played by the Council of Science and Technology of the State of Querétaro (CONCYTEQ).

One of the areas in which innovation has taken on particular prominence is the environment. The clear and well-documented deterioration of environmental conditions—reported by international organizations and local governments alike, and experienced directly by the population, especially the most vulnerable groups—has made companies' environmental performance, and the innovation required to improve it, an increasingly urgent issue within the automotive industry, particularly in light of ongoing debates about the car of the future.

For the OECD, innovation is essential to addressing challenges such as climate change, health, food security, and access to drinking water, since a lack of innovation makes any proposed solution far more costly. According to the *Oslo Manual*, society and the natural environment are among the main external factors that stimulate business innovation, as companies seeking to reduce their environmental impact often turn to so-called "green" innovations (OECD, 2018). The manual also notes that environmental factors—such as floods, natural disasters, pandemics, epidemics, climate change, and water, land, and air pollution—can directly affect firms, and suggests that it is worth examining whether, in some cases, "businesses respond to environmental factors through innovation, or whether environmental factors create a barrier to innovation" (OECD, 2018, p. 159).

In Mexico, and within his research on the national automotive sector, García defines environmental innovation actions as "the adaptation of environmental technology to process and product design conditions, carried out by a company's engineers and interwoven with their social interactions" (García, 2015, p. 25). For this author, the central question in studies on environmental innovation is whether the automotive industry "is developing a new paradigm of energy conversion for its products, or whether it is the evolution of its practices and strategies for rationalizing its technological regime that is driving the incorporation of environmental innovations in product design and manufacturing" (García, 2015, p. 16). He further argues that, when considering what types of environmental innovations will be transferred from multinational corporations to their

plants in Mexico, "empirical evidence suggests that no significant changes are expected in the exercise of their environmental actions" (García, 2015, p. 160), largely because "the manufacturing architecture of the automobile will not change radically in the short term" (García, 2015, p. 160). From this perspective, given Mexico's position in the global automotive market and its strong ties to the United States, "the implementation of environmental innovation activities [in the automotive sector] has become part of strategies aimed at streamlining manufacturing processes." (García, 2011, pp. 56-57).

What is particularly relevant for this study is that the author also argues that, although the environmental innovations expected from voluntary programs such as *Clean Industry* "tend to reach a critical threshold that is relatively easy to achieve" (García, 2015, p. 160), the available evidence suggests that "once environmental manufacturing capabilities and competencies are consolidated, it becomes possible to move toward the transfer of product design functions under a sustainability-oriented approach" (García, 2015, p. 160). This view is consistent with other studies showing that voluntary environmental measures adopted by firms can stimulate innovation in both products and processes (Alfranca, 2009, p. 35).

Environmental innovation in the automotive industry, however, does not automatically or necessarily imply an immediate shift toward electromobility. As García notes, "what can be conjectured is that this change will not be radical but will begin with a productive reorganization of the sector" (2015, p. 159). This reorganization may take multiple forms, including the selection of alternative materials; the incorporation of electric motors; the development of new drivetrain technologies and energy-cell engines; the design of traffic systems and vehicle infrastructure; and the integration of recycling and remanufacturing practices for auto parts at the end of their useful life (García, 2015).

In this research, environmental innovation is understood as a novel change implemented in a company's products and processes—significantly different from previous practices—aimed at continuously and demonstrably improving its environmental performance.

1.7 The Automobile in Culture

With the Industrial Revolution, factories became the quintessential workplace. Gradually, work and workers came to be identified almost exclusively with the factory, leaving behind earlier forms of labor tied directly to the land or to artisan guilds. Modernity introduced two new central figures—the worker and the capitalist—within a new setting: the city. Yet another element soon entered this stage and powerfully linked work, factory, worker, capital, and city, eventually becoming both a symbol and a seemingly "natural" feature of the new era: the automobile.

This invention quickly positioned itself at the heart of an emerging society—closer to the city than the countryside, to the factory than the workshop, to appearance than to essence, and to mass production rather than singular craftsmanship.

The automobile came to embody freedom, technological excellence, and a marker of achievement, recognition, and social status. It also served as a clear—material, visible, and tangible—symbol of personal, family, and social advancement. In this sense, it represented yet another triumph of human ingenuity over space (moving from one place to another with unprecedented ease and building roads where none had existed), over time (introducing new speeds and sensations associated with travel), and over nature itself. Urban transport would no longer depend on animals—horses—with all their perceived inconveniences and discomforts, such as manure, feeding, aging, and disease.

As the car became one of the central protagonists of urban life, the city increasingly asserted itself as a space distanced from nature. Encountering animals now required deliberate effort—traveling to the countryside or, within the city, to parks or zoos.[6] Early on, the automobile was defined more by what it rejected and left behind than by what it promised to become. This is evident in the telling title of the first automobile magazine published in the United States in 1895: *The Horseless Age*. Animals were no longer necessary to move from point A to point B. In gaining indepen-

[6] London opened its zoo in 1828, Manhattan (NY) in 1860, Buenos Aires in 1875, the Bronx (NY) in 1899, Mexico City in 1924, and Paris in 1934.

dence, society entered a new era inaugurated through negation—an era without horses and, more broadly, with less nature—sustained by the illusion of dominating or overcoming it at speeds never before experienced.

As Basalla (2011) reminds us, the automobile was not invented in response to a shortage of horses at the end of the nineteenth century, nor because there was an urgent need for motorized transport. That need emerged later and was socially constructed and widely adopted with remarkable effectiveness. The automobile succeeded because it brought together a set of symbolic and experiential qualities—many of those outlined above—that ultimately situate it as much in the psychological realm as in the technical one.

As Gatersleben (2012) states, the literature on transport psychology shows that the car functions as a *primary territory*: it can be personalized to communicate or express identity and provides a sense of control and security. It offers flexibility, safety, speed, and comfort, while also carrying multiple layers of value. These include instrumental value (for example, traveling a given distance), affective value (such as experiencing driving as exciting or pleasurable), and socio-symbolic value (allowing drivers to express who they are, or how they wish to be seen). This last dimension is especially loaded with social meanings and prejudices—meanings that the marketing and advertising departments of car manufacturers have long known how to exploit.

Together, these dimensions can hinder the adoption of more environmentally friendly transportation behaviors. This is a topic of great relevance that remains relatively underexplored in Mexico and Latin America, and one that has contributed to the development of subfields such as traffic psychology and transportation psychology. In the coming years, research in this area is likely to expand, seeking not only to address road safety, but also to better understand and influence the preferences, perceptions, knowledge, behaviors, motivations, identities, attitudes, values, and emotions involved in owning and driving a vehicle. This includes, as well, the reasons for not owning or driving one—for example, choosing a scooter, bicycle, or public transportation instead of a car; relying always or occasionally on platforms such as Uber, DiDi, or inDrive; or the growing lack

of enthusiasm among younger generations for learning to drive. As Rui Lopes Viana Filho put it:

> There are people who want nothing more than to own an imported car. For me, a Volkswagen Beetle is enough, because cars are machines used to get people around. That's why I want to have the power to buy an imported car, so I can enjoy the pleasure of not buying one. (Cited in Guimarães, 2002, p. 53)

There is a vast field of research here that, although not the central focus of this paper, cannot be overlooked. The entire automotive and auto parts industry ultimately rests on a set of crucial decisions: those made by consumers who buy a car for their own use. Purchasing a vehicle, driving it, taking care of it, maintaining it, parking it, and inspecting it are all forms of action, and understanding these behaviors is essential to the industry's future. Equally important is how consumers react to measures adopted in other domains, such as increases in gasoline prices, which have repeatedly prompted people to take to the streets in protest.

The gap between what people say, think, and actually do with respect to environmental protection and mobility is a key element in understanding how to move beyond the current environmental crisis. This helps explain the growing body of research in environmental psychology (Paulín, 2019), which examines factors such as ignorance, trust, place attachment, perceived control, the rebound effect, social comparison, goal conflict, beliefs, risk perception, and uncertainty. In the face of uncertainty, humanity seeks to organize and predict the world it inhabits, primarily through language (for example, words that create an illusion of stability), science (such as mathematical models of climate change), norms (knowing what to expect in a given situation, which generates confidence), and faith (for instance, belief in a god). For this reason, as the American Psychological Association reminds us, any intervention must take into account that:

> Climate models deal in probabilities, and information therefore needs to be communicated in a way that avoids both excessive optimism and exces-

> sive pessimism. In either case, people are unlikely to change their behavior. (Paulín, 2019, p. 85)

Returning to the social dimension, how did the "obligation" to use a car become embedded in culture? It is worth remembering that, at the outset, the automobile was a luxury reserved for the wealthy. A decisive figure in this transformation was Henry Ford (1863–1947), who profoundly shaped the automotive industry. Ford's dream of an America on wheels would have been impossible without the Tin Lizzie—the popular name for the Model T—and without his vision of selling cars to ordinary people, especially farmers. Between 1908 and 1927, some 15 million units were produced. The Ford Motor Company's production system reduced the price of the Model T from $850 to $290 (Amblard, 2007).

Ford, however, was also a deeply controversial figure: "decidedly pro-fascist, antisemitic, anti-Marxist, nationalist, populist, racist, Darwinian, and organicist" (Amblard, 2007, p. 163). His outlook combined paternalistic, corporatist, and authoritarian tendencies, along with a strong concern for the virtue and morality of his workers. Nevertheless, his vision and socio-industrial project made it possible for one in six Americans to own a car by 1929 (Amblard, 2007).

The political, economic, and military hegemony achieved by the United States in the twentieth century projected the shadow of the American way of life across the world—a way of life that cannot be understood without the automobile as the quintessential consumer object. The car promised individuals and families a path of constant change: a machine of seemingly perpetual motion, attainable through work and fueled by imagination. In this sense, humanity let go of the sickle and took hold of the steering wheel.

It is hard to overstate the priority given to the automobile. It has become a cultural fetish—omnipresent and deeply internalized as an urgent necessity in the everyday lives of urban residents (Basalla, 2011). From this perspective, it seems normal to build hundreds of thousands of kilometers of asphalt, to turn traffic lanes into parking spaces (but not into bike lanes or public parks), or to accept that moving from one place to another entails the loss of thousands of human-hours in traffic.

The history of the automobile runs parallel to that of industrial capitalist society and to environmental—and environmentalist—history itself. It is no exaggeration to say that these trajectories are inseparable: any shift in one inevitably affects the other two. The fate of the car is inextricably linked to the fate of society, and vice versa—at least within the industrialized and financialized world of the past 120 years. The automobile has thus become a cultural fetish: an object that conceals the conditions of its production and a machine whose cultural narrative obscures the impacts, consequences, and effects of its use. It remains so today, sustained by decades of a dense and enduring car-centered culture.

The gasoline-powered automobile—developed by Karl Benz in 1885 and by Gottlieb Daimler and William Maybach in 1889 and propelled to mass popularity in 1908 with Henry Ford's Model T—permanently transformed not only how we move, but also how we live and relate to one another in everyday urban life. To capture the depth of this transformation, one might paraphrase Volkswagen and say that "we all have a car, at least in our heads."

A car provides not only physical mobility but also social mobility. Buying or owning a car—or not having one at all—along with the brand chosen or the price paid, communicates messages about social position and aspiration. Through the automobile, it becomes possible to make visible a transition from one social class to another or to convey a personal or family narrative. This is evident in the well-known cliché of the American way of life: a heterosexual couple with children and a dog, living in their own home (bought on credit), with their own car (also bought on credit), which takes them every summer to the beach or the mountains. Culturally, the car embodies ideals of life, liberty, and the pursuit of happiness—values repeatedly reinforced through automotive advertising in print media, television, cinema, and, more recently, the internet.

CHAPTER II
THE AUTOMOTIVE INDUSTRY AND THE ENVIRONMENT

2. THE AUTOMOTIVE INDUSTRY IN MEXICO

2.1 A Global Industry

The automotive industry carries enormous economic, political, labor, and social weight; indeed, it is a major engine of the global economy. According to the International Organization of Motor Vehicle Manufacturers (OICA, 2017), producing 60 million vehicles requires around nine million workers in vehicle assembly and parts manufacturing, representing about 5% of total manufacturing employment. Moreover, each direct job in vehicle manufacturing supports approximately five indirect jobs in related manufacturing and service activities, resulting in an estimated 50 million jobs worldwide (OICA, 2017).

The automotive industry also plays a central role in economic globalization—something that is far from new. Concepts such as Fordism and Toyotism, which are fundamental to the study of labor and capitalism, underscore the automobile's importance in shaping what is understood as technological, organizational, and economic modernity. Until the outbreak of the SARS-CoV-2 pandemic in the first half of 2020, the industry continued to expand following the collapse triggered by the 2008 financial crisis. While there were approximately 980 million vehicles in circulation worldwide in 2009, that number rose to 1.015 billion in 2010, and projections suggest that in the coming decades it could exceed two billion vehicles globally (Covarrubias, 2015, p. 8). Such growth will require thousands of additional kilometers of streets and highways, with significant impacts on natural areas (Laurance and Burgues, 2017).

The United States, Germany, France, Italy, Japan, South Korea, and—more recently—India and especially China stand out as countries that host

powerful automotive groups. However, it is important to remember that the transnational automotive industry is highly dynamic. Globalized capital is driven by profitability rather than national loyalties, and as a result, the sector has undergone decades of sales, bankruptcies, mergers, and joint ventures that continually reshape its structure. Illustrative examples include Nissan's acquisition of a 34% stake in Mitsubishi in 2016, and the 2021 merger between PSA (*Peugeot Société Anonyme*) and Fiat Chrysler, approved by PSA shareholders.

According to the OICA (2025), global vehicle production reached 92,504,338 units in 2024. The leading producing countries were China, the United States, Japan, India, Mexico, South Korea, and Germany. In the United States—a country with which Mexico maintains deep economic and trade integration—the automotive industry accounts for around 3% of GDP, directly employs 1.7 million people, and indirectly supports an additional eight million jobs (Broberg, 2024). Together, Canada, the United States, and Mexico, as members of the USMCA, produced 16,107,477 vehicles in 2024.

At the global level, the auto parts industry was already valued at more than USD 1 trillion in 2014, with no single component accounting for more than 15% of the market; tire manufacturing represents the largest segment of the industry (Sustainability Accounting Standards Board [SASB], 2014). This figure is expected to grow substantially, potentially reaching USD 2.4 trillion by 2030 (Research & Market, 2025).

As of 2025, the ten largest auto parts companies worldwide are: (1) Robert Bosch (Germany), (2) ZF Friedrichshafen (Germany), (3) Magna International Inc. (Canada), (4) CATL (China), (5) Denso (Japan), (6) Hyundai Mobis (South Korea), (7) Aisin Seiki (Japan), (8) Continental AG (Germany), (9) Forvia (Faurecia + Hella, France), and (10) Lear (United States) (Martínez, 2025).

Among the environmental issues that the auto parts industry has addressed over the past two decades (SASB, 2014) are: (a) reducing energy consumption associated with the use of manufactured products; (b) improving resource efficiency through waste management practices; (c) ensuring high standards of quality and safety in automotive components; (d) managing environmental and social externalities through product life-cycle management; (e) promoting competitive behavior through fair pricing; and

(f) developing strategies for responsible supply-chain management and the sourcing of key inputs, aimed at reducing externalities while minimizing risks to the company's value.

It is also worth noting that only about 12% of the energy required to produce a vehicle is consumed directly by manufacturers, while the remaining 88% is used throughout the supply chain (SASB, 2014).

2.2 General Overview in Mexico

The automotive industry occupies a central place in Mexico's economy. In 2023, it accounted for 4.6% of national GDP and 21.7% of manufacturing GDP (INEGI, 2025, p. 12). In 2024, the country closed the year with a production of 4,202,642 vehicles (OICA, 2025). The sector generates nearly one million jobs and plays a strategic role in employment, exports, industrial development nationwide and:

> When purchasing supplies for its activities, it has a positive impact on almost 60% of other economic activities. For example, inputs such as automotive parts, plastic products, internal combustion engines, transmissions, electronic components, and iron and steel products are purchased [...] During the period from 1993 to 2023, exports from the automotive industry experienced an average annual growth of 10.1%, and imports grew by 12%. (INEGI, 2025, p. 9)

In 2023, automobile and truck manufacturing accounted for the largest share of the automotive sector's GDP, at 57.1%, while auto parts manufacturing represented 41% (INEGI, 2025). Because the United States absorbs around 80% of Mexico's automotive and auto parts output, the country remains strongly tied to vehicles with internal combustion engines. This dependence is also evident in the domestic market, where there are still no significant incentives to encourage the purchase of hybrid or electric vehicles. As a result, Mexico is still far from seeing electric cars circulate on a massive scale on its streets and highways.

According to the consulting firm Deloitte (2020), at the beginning of this decade auto parts already accounted for 8% of total Mexican exports.

Reflecting its strategic importance, auto parts manufacturing was classified in 2020 as an essential economic activity, with the aim of resuming operations and reactivating supply chains—primarily to the United States—during the COVID-19 pandemic.

Today, there are more than 2,000 auto parts companies operating in Mexico. The sector employs over 880,000 people and ranks as the world's fourth-largest producer of auto parts, with 87% of domestic production destined for export and Mexico serving as the main supplier to the United States (Industria Nacional de Autopartes, 2025). In 2024, production reached USD 121.693 billion, while foreign direct investment totalled USD 2.467 billion, led by Germany (39.7%), Japan (22.5%), and South Korea (12.1%) (García, 2025). Among the most exported auto parts to the United States the following stand out:

> […] cable assemblies for spark plugs, body components, seats, internal combustion engines, and catalytic converters, which together account for 55% of total shipments. On the import side, Mexico primarily purchases internal combustion engines, storage battery components, and gearboxes from the United States. In terms of domestic production, electrical components represent the largest share, at 19.49% of the total, followed by transmissions and clutches (10.02%), fabrics and seats (8.99%), engine parts (7.89%), and suspension and steering systems (6.68%). (García, 2025)

The data indicates that "85% of automotive parts manufacturing was concentrated in nine states: Coahuila de Zaragoza, Guanajuato, Nuevo León, Puebla, Mexico, Querétaro, Aguascalientes, San Luis Potosí, and Chihuahua." (INEGI, 2025, p. 18).

2.3 Automotive Clusters in Mexico

At the end of the twentieth century, Porter (1999) articulated cluster theory, emphasizing the importance of geographical proximity among firms for maintaining competitiveness in a globalized economy. Contrary to the expectation that location would lose relevance in a context of free trade, the

spatial concentration of companies has remained a key factor. As Unger and Chico (2004, p. 917) note, "the original maquiladora logic, which dictated the geographical separation of parts or phases of production in order to gain wage advantages and isolate production processes, has gradually been replaced by the advantages of collective learning, which justify new waves of deeper industrial integration." In this context, efficient and well-coordinated value chain logistics are essential for competitiveness. Porter begins from a paradox: "in a global economy, lasting competitive advantages increasingly depend on local factors" (1999, p. 130). From this perspective, clusters are defined as geographic concentrations of interconnected companies and institutions operating within a specific field.

In Mexico, the first automotive cluster formally established as a legal association emerged in the state of Nuevo León in July 2007, bringing together seven companies, two universities, and two government agencies (Montoya, 2014, p. 15). Since then, additional clusters have been created in Aguascalientes, Jalisco, Querétaro, Sonora, Chihuahua, La Laguna, Coahuila, San Luis Potosí, the Metropolitan Area (Mexico City, State of Mexico, and Hidalgo), and the Central Zone (Puebla–Tlaxcala). These clusters have progressively strengthened their collaboration through regular meetings and joint initiatives, including the creation of the National Network of Automotive Industry Clusters, founded in 2019 and based in Monterrey, whose mission is to reinforce the automotive ecosystem by strategically promoting regional cooperation.

Each cluster organizes working committees according to the specific needs of the region and of the member companies that comprise it. Until 2020, however, it was uncommon for clusters to include a committee explicitly devoted to environmental issues. A noteworthy exception—particularly relevant for this study—is the Nuevo León Automotive Cluster (CLAUT). Its sustainability committee, which is further divided into three subcommittees (energy, industrial safety, and social responsibility), seeks to reduce the negative environmental impacts of manufacturing operations, mainly through initiatives focused on zero discharges, the circular economy, and carbon neutrality.

Despite the growing relevance of sustainability, the literature on this topic within clusters remains limited, as most studies have focused on the "sin-

gle company level" (De Chiara, 2017, p. 50). In this sense, a novel, relevant, and methodologically viable approach for analyzing environmental management in the automotive and auto parts industry in a specific territory such as Querétaro is to consider the automotive cluster as a structuring analytical category. In this research, the cluster is not the object of study per se—the focus is instead on the Querétaro auto parts industry as a whole—but it is taken from the outset as a key articulating node. From this position, the cluster mediates between the macro level (OEMs, global associations, multinational organizations, and international regulations), the meso level (firms, national associations, research and innovation centers, and federal authorities and regulations), and the micro level (companies, associations, universities, and state and municipal authorities and regulations). Its capacity for dialogue, cooperation, and coordination allows the researcher to access valuable information from multiple actors and to better understand the intensity and directionality of the relationships that emerge within this configuration.

2.4 What is Happening within Companies in the Sector?

Not only is it important to know what the industry is doing to make its products (cars and auto parts) less harmful to the environment, but also what companies are doing internally from a social and environmental standpoint; for example, reporting on how they are managing or addressing environmental issues.

2.4.1 Industrial Environmental Legislation in Mexico

The industrial environmental regulatory framework in Mexico—essentially a command-and-control instrument—is grounded in Article 4 of the Constitution, which establishes that "every person has the right to a healthy environment for their development and well-being" and assigns the State the duty to guarantee this right, while also stipulating that environmental damage and degradation give rise to liability for those who cause it, in accordance with the law. This framework is further supported by Article 17, which allows for the promotion of collective actions; Article 25, which assigns the State responsibility for guiding national development so that it is compre-

hensive and sustainable; Article 73, section XXIX, subsection G, which grants environmental jurisdiction to all three levels of government—federal, state, and municipal; Article 115, which confers powers on municipalities; Article 124, which does the same for the states; and Article 133, which establishes that the Constitution, the laws enacted by Congress, and international treaties consistent with it constitute the supreme law of the land.

At the statutory level, the cornerstone of environmental legislation is the General Law of Ecological Balance and Environmental Protection (LGEEPA), enacted in January 1988. This law addresses, among other issues, environmental risks, water, soil, non-renewable resources, the atmosphere, waste, and climate change. Article 5 defines the powers of the Federation, and section XII specifically refers to the regulation of atmospheric pollution, as well as the prevention and control of emissions from fixed and mobile sources under federal jurisdiction, among which the automotive industry is explicitly included (Article 111 Bis). Article 7 establishes the powers of the states, while Article 8 does the same for municipalities. More broadly, the LGEEPA recognizes a range of environmental policy instruments, including environmental planning and ecological land-use planning, economic instruments, environmental regulation of human settlements, environmental impact assessment, Official Mexican Environmental Standards, self-regulation and environmental audits, as well as ecological research and environmental education.

Various texts derive from the LGEEPA. Article 19 of the General Law for the Prevention and Comprehensive Management of Waste specifies waste requiring special handling, including (in section VIII) technological waste from the automotive industry. For its part, Article 17 Bis, subsection E, of the General Law on Ecological Balance and Environmental Protection in Matters of Prevention and Control of Atmospheric Pollution specifies the activities of the automotive industry subject to federal jurisdiction. [1]

[1] I. Manufacture of new tires and inner tubes; II. Manufacture of gasoline and diesel engines for industrial use, when carried out through thermal or casting processes; III. Manufacture of machinery for transport and lifting, when it includes thermal or casting processes; IV. Manufacture of automobiles and trucks, including tractor-trailers and similar vehicles; V. Manufacture of gasoline or diesel automotive engines; VI. Manufacture of parts for automotive transmission systems, when thermal or casting processes are involved; VII. Manufacture of parts for suspension and steering systems, when thermal or casting processes are involved; VIII.

To comply with legal requirements, companies in Querétaro (depending on the type of activity and whether they operate at the federal or state level) must consider, among other documents:

a) Environmental Impact Statement (EIS): a document that, based on studies, discloses the significant and potential environmental impact that a project or activity would generate, as well as how to avoid or mitigate it if it is negative (LGEEPA, 2018).
b) Single Environmental License (SEL):

It is an authorization established in 1997 under the regulations governing the operation of fixed sources under federal jurisdiction with respect to atmospheric matters. Its purpose is to prevent and control the release of hazardous substances into the environment; in addition to regulating air emissions, it also covers wastewater discharges and the generation of hazardous waste. The authorization is granted through a one-time procedure, except in cases where the license holder's information must be updated (such as a change in the company name), when authorized production levels increase, when production processes are modified, when new emission-generating equipment is incorporated, when facilities are expanded, or when new types of hazardous waste are generated (Semarnat, 2018).

c) State Environmental License: A procedure that must be carried out by "those who carry out production or industrialization activities that generate emissions into the atmosphere, as they are considered fixed sources under state jurisdiction." (Secretariat of Sustainable Development [SEDESU], 2025)
d) Annual Operating Certificate (COA)/Annual Report on the Registry of Emissions and Transfer of Contaminants. At the state level:

It is the instrument through which companies report their environmental performance for the previous year, specifically regarding emissions and

Manufacture of parts for automotive brake systems, exclusively through thermal or casting processes; IX. Manufacture of other auto parts, when thermal or casting processes are involved; and X. Manufacture of motorcycles, including ATVs and similar vehicles.

> transfers of pollutants to air, water, and soil, as well as materials and non-hazardous waste. This report also serves as the primary mechanism for integrating information into the State Pollutant Release and Transfer Register (PRTR) database. In addition, it helps consolidate the management and reporting requirements established in environmental regulations. Submission is mandatory on an annual basis for all companies holding a State Environmental License, as well as for individuals or legal entities that operate under a Non-Hazardous Solid Waste Management Plan or a Special Management Plan (SEDESU, 2025).

This measure not only facilitates compliance with environmental legislation but also supports the adoption of actions aimed at improving industrial environmental performance, strengthening internal coordination across areas and departments, generating cost savings, and providing the kind of verifiable response—such as certification—that stakeholders increasingly expect from companies in light of the environmental damage they cause or may cause. Specifically, this measure refers to the implementation of environmental management systems by auto parts companies located in the state. As a voluntary self-regulation instrument, an environmental management system enables these companies to align the obligations, objectives, policies, and goals they choose—or are required—to pursue, whether on their own initiative or in response to external pressures.

2.4.2 Environmental Management Systems

Environmental management is not an isolated act of goodwill, but rather a set of decisions and actions that must be systematized in order to be implemented, monitored, and continuously improved in a timely manner. If a management system is understood as the "set of elements of an organization that are interrelated or interact to establish policies, objectives, and processes for achieving these objectives" (International Organization for Standardization [ISO], 2015, p. 1), then an environmental management system is "the part of the management system used to manage environmental aspects, comply with legal and other requirements, and address risks and opportunities" (ISO, 2015, p. 2).

For companies, the main benefits of implementing an environmental management system include cost reductions—derived from lower consumption of natural resources, waste minimization, and the recovery of by-products—as well as a range of intangible benefits. These include improved relationships with authorities, competitive advantages, increased employee motivation, new business opportunities, stronger relationships with consumers and greater consumer confidence, advantages in public procurement processes, and simplified compliance with environmental regulations (Interconsulting Bureau, 2017).

In the automotive and auto parts industry, particularly among tier-one suppliers, having certified environmental management systems in place is essential. Such systems can be implemented informally, for example through internal programs, or formally, through the adoption of recognized standards. In the latter case, examples include: (a) the international EMAS (Eco-Management and Audit Scheme) promoted by the European Union; (b) the international ISO 14001 standard developed by the International Organization for Standardization; and (c) in Mexico, the PROFEPA Environmental Audit Program, based on standards NMX-AA-162-SCFI-2012 and NMX-AA-163-SCFI-2012.

2.4.3 EMAS Standard

The EMAS Standard is a voluntary European instrument for the environmental management of public and private organizations, developed by the European Commission in 1993. Although ISO 14001 has been an integral part of EMAS since 2001—allowing organizations to obtain EMAS registration while avoiding duplication of procedures—EMAS is distinguished by several additional requirements. These include the publication of an annual environmental statement, a strong emphasis on employee involvement and continuous improvement in environmental performance, and validation by a national public authority within Europe (and Turkey) (European Commission, 2018b). EMAS also recognizes other environmental management systems, such as Ecoprofit, Ecolighthouse, the Eco-dynamic Label, and Green Key.

2.4.4 ISO 14001 Standard

It is based on the 1992 BS 7750 standard, developed by the British Standards Institution, which became the first national standard for environmental management. First published in 1996 and currently in its third edition (released on September 15, 2015), this standard is applicable to both public and private organizations. It defines a management system as "a set of elements within an organization that are interrelated or interact to establish policies, objectives, and processes for achieving these objectives" (International Organization for Standardization [ISO], 2015, p. 1). An environmental management system, in turn, is the part of the management system "used to manage environmental aspects, comply with legal and other requirements, and address risks and opportunities" (ISO, 2015, p. 2).

Under this framework, organizations are required to establish an environmental policy and planning process, implement the system, monitor and verify its performance, and continuously improve it in order to minimize their environmental impact. Once the environmental management system has been implemented, organizations may seek certification or obtain an environmental label ("green label") for their products.

2.4.5 National Environmental Audit Program (PNAA)

In Mexico, the National Environmental Audit Program (PNAA) was created in 1992 and is administered by the Federal Attorney General's Office for Environmental Protection (PROFEPA, 2020). The program is voluntary and free of charge. Although it was originally designed for industrial activities—particularly those considered high risk—it has gradually expanded to include other sectors, such as commerce, services, and tourism facilities

Currently, the PNAA offers three types of certification, each valid for two years and renewable: *Clean Industry* (for manufacturing and processing companies), *Environmental Quality* (for companies in commercial and service activities), and *Tourism Environmental Quality* (for companies engaged in tourism-related activities and services). The first certificates under this program were awarded in 1997 during the administration of President Ernesto Zedillo.

The program is grounded in the General Law of Ecological Balance and Environmental Protection and its Regulations on Self-Regulation and Environmental Audits, as well as in the Mexican Standards NMX-AA-162-SCFI-2012 and NMX-AA-163-SCFI-2012. Through these instruments, the PNAA evaluates a wide range of environmental aspects, including water, air, waste, risks, environmental emergencies, soil and subsoil, natural resources, wildlife, forest resources, noise, and waste management (urban solid waste, special management waste, and hazardous waste[2]).

The PNAA seeks to improve the environmental performance of economic sectors through environmental auditing, with the goal of going beyond mere legal compliance. To this end, it comprises a set of activities designed to promote the implementation of environmental audits that enhance organizations' production efficiency, environmental performance, and competitiveness (PROFEPA, 2020). The program defines environmental auditing as:

> A method for evaluating a company's processes in terms of pollution and environmental risk, compliance with applicable regulations, international standards, and good operating and engineering practices. […] It is a voluntary approach that differs from inspection and enforcement activities, as it promotes the identification of opportunities for improvement and the implementation of projects that reduce pollution and enhance competitiveness. […] As a technical tool, it identifies environmentally critical areas within a facility and its processes, making it possible to design and apply appropriate technical and management solutions. (PROFEPA, 2020)

The basic steps of an environmental audit include gathering environmental information, evaluating it, and drawing conclusions, including the identification of areas for improvement (PROFEPA, 2020). Certification can be

[2] Municipal solid waste refers to waste generated through domestic activities. Special waste is produced in industrial or productive processes and does not meet the criteria to be classified as either municipal solid waste or hazardous waste, or it is generated by large producers of municipal solid waste. Finally, hazardous waste includes any waste that exhibits one or more CRETIB characteristics—corrosivity (C), reactivity (R), explosiveness (E), toxicity (T), flammability (I), or biological-infectious properties (B)—as well as containers, packaging, and soils that have been contaminated, in accordance with the provisions of the General Law for the Prevention and Comprehensive Management of Waste.

obtained through three pathways: (1) by conducting an environmental audit prior to submitting the application; (2) by conducting an environmental audit after the application, without an action plan; or (3) by conducting an environmental audit after the application, with an action plan. Certification renewal, in turn, can take place in two ways: (1) by submitting an Environmental Diagnostic Report prepared by an accredited environmental auditor demonstrating that the company has maintained or improved its environmental performance; or (2) by submitting an Environmental Performance Report prepared by the company itself, provided it has achieved the highest level of environmental performance (PROFEPA, 2020).

Environmental auditors are accredited by the Mexican Accreditation Entity (EMA) and authorized by PROFEPA. Their evaluations focus on two main aspects: compliance with environmental regulations and the implementation of good environmental practices.

Certified companies are classified into two levels of environmental performance. At Level I, the company complies with applicable environmental regulations, identifies and prioritizes its significant environmental aspects, and defines programs, policies, or actions aimed at pollution prevention and environmental risk management (PROFEPA, 2016, p. 7). At Level II, the company has an Environmental Management System that supports continuous improvement through defined objectives, goals, and indicators; implements concrete actions that generate measurable environmental benefits; documents and monitors these actions, identifying responsible actors as well as their results and impacts; demonstrates the ongoing application of a preventive and comprehensive environmental strategy in production and service processes to reduce environmental risks and negative impacts; and proposes at least two specific indicators to the Attorney General's Office, which, once approved, are reported annually (PROFEPA, 2016, p. 7).This classification into Levels I and II was introduced with the publication of the NMX-162 standard, which entered into force on December 2, 2013. This shift was significant because it moved the focus from simply assessing regulatory compliance to promoting the implementation of an environmental management system.

What do companies gain from PNAA certification? First and foremost, it helps them avoid penalties. The Federal Environmental Responsibility Law, published in the Official Gazette of the Federation in 2013, establishes

in Article 20 that the minimum and maximum financial penalties for legal entities may be reduced to one-third when at least three of the five conditions listed in that article are met—one of which is holding a certificate derived from the environmental audit provided for in the LGEEPA. Similarly, Article 26 states that joint and several liability does not apply when it can be proven that the responsible party, among other conditions, holds such a certificate.

In this sense, the objective is to encourage companies to voluntarily participate in the PNAA as a way to prevent and reduce fines. Certification thus becomes a voluntary preventive tool that supports business continuity and reduces legal and financial risks.

2.5 Challenges of Mexican Environmental Legislation

Mexico has made notable progress in environmental law, building on two key twentieth-century precedents: agrarian law and the right to health. In 1983, the right to health was incorporated into Article 4 of the Constitution as part of what were then known as individual guarantees. In 1999, the right to an environment suitable for development and well-being was also recognized in that same article.

Despite this constitutional recognition, between 1999 and 2011 citizens had very limited access to the effective enforcement of this right. This situation changed in 2011 following one of nine rulings issued by the Inter-American Court of Human Rights in the case concerning the forced disappearance of Rosendo Radilla.[3] That decision prompted a profound transformation in the Mexican constitutional framework, shifting the interpretation of individual guarantees toward a broader human rights paradigm. In 2012, Article 4 was amended once again to explicitly enshrine the right to a healthy environment.

[3] Rosendo Radilla Pacheco was illegally detained at a military checkpoint on August 25, 1974, in Zihuatanejo, Guerrero. In the absence of a response from the Mexican government, the case was brought before the Inter-American Commission on Human Rights in 2001. In November 2009, the Court issued a ruling condemning the Mexican government for serious human rights violations, which triggered historic changes in our country's legal system.

Over the past decade, this human rights–based approach has reshaped the Mexican legal system. It has opened new avenues for citizens to seek justice and demand the enforcement of Article 4, including the possibility of filing collective actions and requesting access to environmental information generated by companies—such as environmental impact statements, preventive reports, and annual operating certificates—which is now considered public information.

In addition, Mexico has played a relevant role at the international level thanks to the relative modernity of some of its environmental laws. For instance, the General Law for the Prevention and Comprehensive Management of Waste, published in 2003, was ahead of its time and has even served as a model for other Latin American countries. Likewise, Mexico's Climate Change Law, enacted in 2012, was the second of its kind worldwide, preceded only by the United Kingdom.

Moreover, during the administration of President Enrique Peña Nieto, the Mexican government "remained, as it had during the previous six-year term, among the first developing countries willing to assume greater mitigation commitments, while emphasizing that these should not be mandatory" (Torres, 2019, p. 1213). This stance, together with Mexico's climate diplomacy, helped the country project a positive international image and strengthen ties with several European nations, as well as with the administrations of Barack Obama in the United States and Justin Trudeau in Canada (Torres, 2019).

However, these advances should not obscure the significant challenges that Mexican environmental legislation continues to face:

1. The rule of law in the country remains weak.
2. The budget allocated to environmental protection is insufficient, leading to multiple consequences, including job losses.
3. Regulations are frequently modified without being given enough time to mature and without consistently ensuring legal precision or clarity in their wording.
4. In recent years, Mexico has lost international leadership in this area; for example, Latin American countries such as Ecuador and Bolivia are

already advancing discussions on the rights of nature.[4] President Andrés Manuel López Obrador (2018–2024) showed little sustained interest in environmental issues, while President Claudia Sheinbaum Pardo (2024–2030) has been positioned between environmentalist and extractivist narratives; notably, she did not attend the Climate Summit held at United Nations headquarters in New York in September 2025.

5. Regarding the right to information, although it is formally protected, there is still a significant gap between access to information and the ability to truly understand it—that is, to interpret and make sense of the information provided to citizens.
6. Environmental regulations require continuous review and updating.
7. Progress in environmental legislation and regulatory compliance is uneven across states.
8. In cases of non-compliance with environmental regulations, sanctions are not always effectively enforced.

[4] The Constitution of Ecuador, promulgated in 2008, states in its preamble: "We, the sovereign people of Ecuador […] celebrating nature, Pacha Mama, of which we are a part and which is vital to our existence […] decide to build a new form of civic coexistence, in diversity and harmony with nature, to achieve good living (sumak kawsay)." Chapter II of Title II addresses the rights of good living, Title VII deals with the regime of good living, and Chapter VII is expressly devoted to the "Rights of Nature." Article 71 further establishes that: "Nature, or Pacha Mama, where life reproduces and flourishes, has the right to have its existence fully respected and to the maintenance and regeneration of its vital cycles, structure, functions, and evolutionary processes." Similarly, the Constitution of Bolivia, promulgated in 2009, declares in its preamble: "We populate this sacred Mother Earth with different faces, and from then on, we have understood the plurality of all things and our diversity as beings and cultures. […] Fulfilling the mandate of our peoples, with the strength of our Pachamama and thanks to God, we refound Bolivia." Article 8 states that the State adopts and promotes as ethical–moral principles of a plural society: ama qhilla, ama llulla, ama suwa (do not be lazy, do not lie, do not steal), suma qamaña (living well), ñandereko (harmonious life), teko kavi (good life), ivi maraei (land without evil), and qhapaj ñan (the noble or righteous path). Similarly, the Political Constitution of Mexico City, enacted in 2017, affirms in its preamble: "Let us remain faithful to the echo of the ancient word; let us care for our common home and restore, through the hard work and solidarity of its daughters and sons, the transparency of this region that emanates from water." Article 3 establishes as one of its guiding principles "the social function of the City, in order to guarantee the well-being of its inhabitants, in harmony with nature." Article 13, which addresses the right to a healthy environment, further provides that "for the fulfillment of this provision, a secondary law shall be issued with the purpose of recognizing and regulating the broadest protection of the rights of nature, understood as all its ecosystems and species as a collective entity subject to rights."

CHAPTER III
THE AUTOMOTIVE PARTS INDUSTRY IN QUERÉTARO

3. THE AUTOMOTIVE PARTS INDUSTRY IN QUERÉTARO

3.1 Context

The state of Querétaro—made up of eighteen municipalities and covering an area of 11,690.58 km²—is located in central Mexico and borders the states of Mexico, San Luis Potosí, Michoacán, Hidalgo, and Guanajuato. It lies approximately 240 km from Mexico City, and its capital is the municipality of Querétaro. The state has a population of 2,368,467 inhabitants, with an average age of 29. The primary sector accounts for 2.2% of state GDP, the secondary sector 41.8%, and the tertiary sector 49.6%, with manufacturing alone representing 34.4% of the state's GDP (Government of the State of Querétaro, 2024).

As we examine the auto parts industry in Querétaro—our main area of interest—we encounter a state with a long-standing connection to the automotive sector. This link dates back to 1964, when the company Tremec[1] (Transmisiones y Equipos Mecánicos) was established in the state capital by Bernardo Quintana and others, during the administration of Governor Manuel González Cosío Díaz (1961–1967). His government was marked by a strong push toward modernization and industrialization, reflected in ini-

[1] The purpose of establishing this company in the city of Querétaro—where it generated 1,120 jobs in its first year of operation—was to "create an automotive industry that would save a large amount of foreign exchange previously spent on importing transmissions. Another important factor was the decentralization processes so necessary for Mexico, as well as the development of non-industrialized areas […] The company was founded with an international vision that has had a significant impact on local and national development" (Rivera, 2008, p. 10). Today, Tremec is an associate member of the Querétaro Automotive Cluster.

tiatives such as the creation of the State Economic Council and efforts to modernize the Autonomous University of Querétaro, an institution founded in February 1951. The next governor, Juventino Castro Sánchez (1967–1973), was "notable for creating the Committee for Industrial Development in the State of Querétaro, headed by Bernardo Quintana" (Daville, 2012, p. 699). As a result, the 1960s marked the beginning of the establishment of companies in the metal-mechanical sector, which today is the most important industrial sector in the state (Daville, 2012, p. 700).

The entry into force of the North American Free Trade Agreement (NAFTA) further boosted Querétaro's development. To give a sense of the scale of this growth, in 2024 the state's auto parts industry reached a production value of $8.957 billion:

> […] with an annual growth of 2.75%, more than double the national rate (1.2%). In this sense, Querétaro's performance surpasses that of the national industry as a whole, as well as the growth of the country's Gross Domestic Product (GDP). The state ranked as the fifth largest producer of auto parts in Mexico, accounting for nearly 7.4% of national production, and as the second largest producer in the Bajío region, behind only Guanajuato. (Estrella, 2025)

This same industry employs more than 80,000 people in the state, accounts for 24.7% of Querétaro's manufacturing GDP, and operates within an attractive innovation ecosystem that includes 12 research and development centers, 112 Tier 1 companies, and more than 200 Tier 2 suppliers (Querétaro Automotive Cluster, 2025). Foreign direct investment in Tier 1 companies comes mainly from Germany (26%), Japan (19%), the United States (13%), and Canada (11%) (Querétaro Automotive Cluster, 2025).

Together, these figures point to a dynamic and highly competitive local auto parts sector, made up of more than 300 companies from over a dozen countries across three continents. These firms must navigate and respond to international, national, and local environmental policies, regulations, authorities, legislation, programs, as well as a wide range of internal and external pressures.

3.2 Visited Companies

For the purposes of this study, we visited eight companies with an average workforce of 507 employees. All of them have a publicly stated environmental policy; seven have implemented an environmental management system; six are certified under ISO 14001, and one participates in PROFEPA's Environmental Audit Program (at Level I). None of the facilities were both ISO 14001 certified and enrolled in the Environmental Audit Program.

At each site, we were received by the environmental manager. Four of them were men and four were women, and seven work for companies with transnational capital. Their academic backgrounds varied: three hold degrees in physics or mathematics, two in chemistry, two in economics or business administration, and one in the humanities. On average, they had 4.3 years of experience in their position. In three of the plants, assistants or collaborators of the environmental managers—invited to address specific topics in greater depth—also took part in the interviews, bringing the total number of interview participants to twelve.

Table 3.1. *Visited companies and their environmental managers*

Visited company	*Source of capital*	*Number of employees*	*Environmental manager position*	*Years in the position*	*Education*	*CAQ member company*	*Public and declared environmental policy*	*ISO 14001*	*Clean Industry Program*	*Clean Industry Level*
Company 1 (C1)	German	54	Quiality Systems and Clean Industry Coordinator	5	General Psycology	No	Yes	No	Yes	I
Company 2 (C2)	American	500	Safesty, Health, Hygiene, and Enviromental Coordinator	2 years, 7 months	Business Administration and Strategy	Yes	Yes	Yes	No	N/A

Company 3 (C3)	English	334	Health, Safesty, and Enviroment Engineer	3 years, 5 months	Enviromental Chemistry	No	Yes	Yes	No	N/A
Company 4 (C4)	Belgian	120	Quality Manager	3	Industrial Engineering	Yes	Yes	Yes	No	N/A
Company 5 (C5)	Mexican	246	Safesty, Health, and Enviroment Assistant	4	Chemical Engineering	Yes	Yes	No	No	N/A
Company 6 (C6)	German	800	Safesty, Health, and Enviroment Manager	One Year, seven months	Industrial Engineering	Yes	Yes	Yes	No	N/A
Company 7 (C7)	Japanese	800	Senior Enviromental Specialist	One Year, one month	Marketing	No	Yes	Yes	No	N/A
Company 8 (C8)	American	1200	Enviromental Coordinator	14 years	Industrial Engineering	Yes	Yes	Yes	No	N/A

Source: Own elaboration.

Table 3.*2. Main activities of the facilities visited*

Companies	***Main activities of the facilities visited***
Company1	Automotive lubricants
Company2	Decorative plastic parts and die-cast components for vehicles
Company 3	Catalytic converters
Company 4	Plastic products and semi-finished components
Company5	Molded and extruded parts made from silicone and other polymers
Company 6	Aluminum components for brakes, valves, and master cylinders
Company 7	Alternators, gears, valves, and electronic components
Company 8	Window regulators, ventilation systems, and components for electric motors

Source: Own elaboration.

The main environmental issue[1] reported by companies, accounting for 33.3% of mentions, was electricity consumption, followed by waste at 25%.

Table 3.*3. Main environmental considerations of the plants visited (I)*

Company	*Main environmental considerations*
Company 1	Hazardous waste
Company2	Oil spills
Company 3	Nitrogen oxide (NOx) emissions
Company 4	Water consumption
Company5	Electricity consumption
Company 6	Municipal solid waste
Company 7	Electricity consumption
Company 8	Water consumption

Source: Own elaboration.

Table 3.*4. Main environmental considerations of the plants visited (II)*

Environmental consideration	*Number of mentions*	*%*
Electricity consumption	4	33.3
Waste	3	25
Water consumption	2	16.7
Emissions	2	16.7
Spills	1	8.3
Total	12	100

Source: Own elaboration.

Table 3.5 provides a summary of the people who were interviewed, both within and outside the companies as part of this research.

[1] Environmental issue: "Element of an organization's activities, products, or services that interacts or can interact with the environment" (ISO, 2015, p. 2).

Table 3.*5. People interviewed as part of this research*

Key for interviewed person	*Position*
CA1	Manager of the Querétaro Automotive Cluster
CA2	Advisor to the Querétaro Automotive Cluster
CA3	Member of the Nuevo León Automotive Cluster
RA1	Quality Systems and Clean Industry Coordinator at Company 1
RA2	Safety, Health, Hygiene, and Environment Coordinator at Company 2
RA3	Health, Safety, and Environment Engineer at Company 3
RA4	Quality Manager at Company 4
RA5	Quality Engineer at Company 4
RA6	Safety, Hygiene, and Environment Assistant at Company 5
RA7	Safety, Hygiene, and Environment Manager at Company 6
RA8	Senior Environmental Specialist at Company 7
RA9	Collaborator in the Environmental Management System at Company 7
RA10	Maintenance Supervisor at Company 7
RA11	Environmental Coordinator at Company 8
RA12	Environmental Assistant at Company 8
B1	Director of the High Technology Unit at UNAM-Juriquilla
B2	Research Professor at UAQ
B3	Director at the Polytechnic University of Querétaro
B4	Director of the Automotive Technology Engineering program at the Polytechnic University of Querétaro
B5	Spokesperson for Company of Automotive Parts and Technology
AG1	Official at the Federal Government's Ministry of Economy
AG2	Inspection and Surveillance Coordinator at the State Attorney General's Office for Environmental Protection and Urban Development
AG3	Environmental Audit Supervisor at the State Attorney General's Office for Environmental Protection and Urban Development
AG4	Inspector at the State Attorney General's Office for Environmental Protection and Urban Development
AG5	Inspector at the State Attorney General's Office for Environmental Protection and Urban Development
AG6	Former Deputy Delegate for Environmental Auditing at the PROFEPA Delegation in Querétaro
AG7	Deputy Delegate for Environmental Inspection at the PROFEPA Delegation in Querétaro
V1	Environmental consultant
V2	Engineer working at an Environmental Verification Unit located in Querétaro
V3	Engineer working at an Environmental Verification Unit located in Querétaro

V4	Engineer working at an Environmental Verification Unit located in Querétaro
V5	Executive at CTM- Federación Corregidora-Huimilpan
CP1	Executive at the ITIAM Network
CP2	Executive at the Pierre Naville Research Center (France)
CP3	Member of the UN Intergovernmental Panel on Climate Change (IPCC)
CP4	Advisor on Science, Technology, and Innovation to the President of Mexico
CP5	Director of the Organization for Economic Cooperation and Development (OECD)
CP6	Automotive industry executive
CP7	Official at the Secretariat of Sustainable Development of the Government of the State of Querétaro

Source: Own elaboration.

3.3 Environmental Management in Local Industry

This research shows that environmental practices in the Querétaro auto parts industry are strongly shaped by economic pressures. In recent years, large companies have paid greater attention to environmental issues mainly due to pressure from their customers and the risk of losing business if requirements are not met. This has pushed firms in the sector to respond in two main ways: first, by implementing environmental management systems in their plants (where these were not already in place), and second, by obtaining ISO 14001 certification. This certification, in particular, has become a key requirement demanded by both corporations and clients—especially for first-tier suppliers (Tier 1 or T1)—as a way to demonstrate commitment to environmental responsibility and continuous improvement.

While the Querétaro Secretariat of Sustainable Development maintains that the automotive industry—like industry in general—"is clearly focused on being more productive, but [also] aware of the importance of the environment in its processes" (CP7), the management of the Querétaro Automotive Cluster emphasizes that companies pursue environmental certification largely "because of market pressure; at the end of the day, this is a business, and a great deal is demanded of those who operate in it" (CA1). In this sense, firms seek to "maintain their certification, obviously in order not to lose business, because everything is a business in this world" (CA1).

One cluster advisor openly acknowledges the presence of "vested interests in the industry: I have to sell more vehicles at any cost" (e.g., Dieselgate) (CA2). Similarly, the quality manager of one of the plants visited noted that a key question raised by senior management when implementing an environmental management system was, "How much is it going to cost us to raise awareness?" (R4). Taken together, these perspectives reveal a form of corporate Darwinism in which economic logic clearly takes precedence:

> "[The] mandatory nature of certifications and environmental management systems in the supply chain is a matter of survival and natural market selection, from OEMs to tiers, and their various suppliers will have to become green companies in order to survive; those that do not adapt to this context will not be able to compete. These changes are likely to lead to a smaller but stronger and more complete market." (EC).

Companies face strong pressure from their corporate headquarters to keep environmental management systems fully operational. As one interviewee explained: "Because if we don't, we don't sell. In other words, it's indirect pressure from customers. [For example,] one of them says: for me to buy from you, Company 3, you have to provide your ISO 14001 certificate—otherwise, there's no deal" (RA3). In turn, headquarters pressures Company 3 to audit its own suppliers: the department head has personally visited Mina, Nuevo León, and Apaxco, State of Mexico, where the company's waste is managed. Companies must also be especially careful to ensure that all their environmental permits and authorizations remain valid.

An environmental auditor accredited by the Mexican Accreditation Entity (EMA) summarizes this dynamic clearly: "When we are able to make company shareholders understand that failing to comply with environmental requirements harms the business, then they will take action or issue instructions to ensure that environmental management systems function properly" (V4). A public official from the Federal Ministry of Economy is even more direct: "At the end of the day, they are companies, and what they are trying to do is maximize their profits." (AG1).

Before joining Company 3, the environmental manager had worked at another firm within the Querétaro Automotive Cluster, one that manufac-

tures braking, steering, and suspension systems. That transnational company was undergoing a major period of growth and transition after being acquired by another firm whose parent company was based in a different country. Although it was ISO 14001 certified and the audits were demanding, "they managed to hide things" (RA3), which runs counter to the very logic of an environmental management system aimed at continuous improvement. At the plant where he had previously worked:

> hazardous or not. Some laboratories classified it as non-hazardous, while others said the opposite. Around sixty tons were produced every day: part of it went to a landfill because it was considered non-hazardous, while some ended up in vacant lots or even shooting ranges. Later, it was proven to be hazardous, and the company was sued. The prevailing approach was not to prevent waste generation but simply to get rid of it— "*Get it out of here*" or "*See what you can do with it*." This was particularly troubling for me, since I was working in the waste area and kept thinking: *How much waste is this, where is it all going, and how much contaminated water is being generated?* The response, however, was usually: *"It doesn't matter. Don't look for co-processing; I'm not interested. I'll give you the money to fix it."* There was money, but it was used to deal with immediate problems rather than to support improvement or transition. The logic was more like: *We already have a problem—just patch it up.* I'm not saying my superiors didn't care, but they seemed stuck in a mindset of *doing the best they could with what they had*. When I raised issues by saying, *"We need this because it's required by law; otherwise, we're going to pollute,"* the response was often: *"Leave it—we have something else to deal with in production."*

These statements stand in contrast to what automotive companies publicly claim: a total, permanent, and unquestionable commitment to addressing the environmental and climate crisis, as reflected in their environmental or integrated corporate policies. This contradiction has occasionally been exposed through scandals such as Volkswagen's *Dieselgate* in 2015, as well as through media reports like those mentioned at the beginning of this document. Such cases reveal that the timeframes guiding corporate decision-making often do not align with the timelines identified by science in environmental matters.

3.4 Timing

Company 5 planned to obtain ISO 14001 certification. As one interviewee explained, "The quality engineer is very aware that this is one of the requirements that is increasingly being demanded not only by the automotive industry, but now also by the aerospace sector. […] If there isn't at least a little pressure, we simply don't have much time" (RA6). This is because other priorities tend to take precedence, such as "attracting more customers, keeping productivity close to 100% every day, and making sure we don't run out of personnel" (RA6).

In the context of the global environmental crisis, temporality has become a critical issue, reaching a level of maximum urgency within the scientific community. The year 2030 is widely regarded as a key threshold within the shrinking window of opportunity humanity has to prevent further temperature increases and accelerated degradation of nature. However, as this statement illustrates, the sense of time referred to by the interviewees is strictly economic and administrative—linked to factors such as tenure in a position, bureaucratic deadlines, process durations, routines, working hours, action plans for environmental goals, or certification timelines like those of ISO 14001—rather than the emergency timeframe demanded by the rapid deterioration of global environmental indicators. The pace of action is still not being driven by a sense of environmental or climate emergency. However, what occurred in 2020 during the health emergency caused by the coronavirus that led to COVID-19 offers a clear example of the labor, economic, and social consequences that could arise if an environmental crisis were to suddenly and persistently disrupt our usual ways of producing and consuming. Unlike the pandemic, the environmental and climate crisis threatening us cannot be resolved with a vaccine that would allow a return to a "new normal" within a matter of months.

Unfortunately, the urgent calls from the scientific community to act quickly and decisively have not yet been matched by corporate actions or timelines. The findings of this research show that senior management plays—and will continue to play—a central role in determining the speed at which companies adopt the changes that are required.

3.5 Leadership

Leadership plays a crucial role in determining whether a company's environmental management efforts are successful. This became especially clear with the 2015 revision of the ISO 14001 standard, which requires senior management to demonstrate greater involvement in environmental matters. This shift invites reflection on how plant directors and managers actually understand and implement these responsibilities in their day-to-day practices, beyond the occasional visit from an external auditor.

For a plant's environmental commitment to translate into sustained improvements in environmental performance, decision-making must be carried out by individuals whose choices are implemented through concrete, supervised actions. In this sense, those in leadership positions are central—most notably the CEO and the management team. When an environmental auditor notes that companies' lack of interest in obtaining certification under PROFEPA's Environmental Audit Program is mainly due to a "company mindset" and a lack of awareness (V2), this should not be understood literally. Companies themselves do not possess minds or awareness; rather, the statement points to the local decision-makers—leaders whose limited environmental motivation permeates the organization, overriding any pro-environmental discourse expressed in corporate statements or formal documents. Company leaders, through their agency, subjectivity, and institutional roles, are central actors in environmental management. The interest that senior management demonstrates through their everyday practices—both in their offices and on the shop floor—has a direct influence on what happens within the plant.

In Company 2, for instance, a former CEO would not even meet with the environmental coordinator, whereas the current CEO regularly asks:

> What do we need to do? How are we doing? He pays close attention to waste monitoring, and when waste levels rise sharply, management responds immediately: Hey, what's going on? Why are we using more paint, solvents, and so on? As the director has made clear, it's not just about production; we also need to start focusing people's attention on safety and environmental issues (RA2).

A year earlier, the company "wasn't concerned about what we had to do for the environment [...] All they said was: What do you need to get by? I would tell them, and they would reply: Is there any way you can do this with something else? Because it was expensive" (RA2). Now, with the new director, when there is a spill, for example, "the protocol is followed, we have everything in place, we have learned our lesson, we do the 8Ds[2] , so that it doesn't happen again" (RA2). An additional point is that the interest is no longer reflected only in the director but also in the production manager, who now asks about "details of pollution or environmental issues" (RA2).

At Company 4, the general manager—who had left the plant just three weeks before the interview—placed strong emphasis on the 5S[3] methodology and carried out daily rounds, one in the morning and another in the afternoon. During these walk-throughs, he would call out staff if he noticed clutter or dirt, which gradually led to changes on the shop floor. Employees became more involved and more careful—for example, cleaning their areas and workstations regardless of whether he was present—largely because no one wanted to be publicly corrected by the director himself. He also supported monthly meetings to share lessons learned, including environmental ones, with other plants in the company. Although the new director now splits his time between offices in Mexico and Europe, the former director's "culture of cleanliness and order" (RA4) has endured.

The environmental coordinators interviewed agree on the importance of senior management showing both interest in and understanding of environmental issues in their daily work and meetings. As one of them put it, this commitment "permeates the management team" (RA7). Another explained: "We lead by example. […] If the directors, or we as area representatives, ignore it, people ignore it too. That's why it's important for a manager to be truly aware of these issues, so that it spreads throughout the team"

[2] The 8D methodology, or Eight Disciplines Problem-Solving, consists of the following steps: (1) forming a work team; (2) identifying the problem; (3) implementing a temporary solution or containment action; (4) analyzing the root causes; (5) defining permanent corrective actions; (6) implementing and monitoring those corrective actions; (7) preventing recurrence; and (8) formally closing the process and acknowledging the contributions of those involved.

[3] Japanese management technique based on five actions: sorting (*seiri*), organizing (*seiton*), cleaning (*seiso*), standardizing (*seiketsu*), and sustaining (*shitsuke*).

(RA4). In fact, they had already experienced a situation in which a former director paid little attention to environmental management practices, and his lack of interest clearly affected what happened with the team.
Another interviewee noted that when the quality manager shares this vision, it makes a significant difference, because "if we don't start at the top, how can we expect the rest to follow?" (RA6). Similarly, one coordinator summarized it bluntly: "If the human factor at the top is not involved, no matter how hard you try, ISO 14000 will never really sink in" (RA11).

Based on these accounts, it is possible to identify three main leadership styles present in the automotive sector in Querétaro:

1. *Environmentally responsible leadership:* This leadership style is characterized by leaders who actively champion, understand, and closely monitor the environmental actions carried out through the company's environmental management system. These leaders aim to position the organization as a sector benchmark, while consistently recognizing the company's environmental responsibility. They maintain open channels of communication with the environmental manager and their team, whom they trust to drive continuous improvement at the plant. Environmental issues are treated on an equal footing with economic and social concerns, in line with a sustainability perspective, and leaders actively encourage this approach to permeate the entire organization. They are committed to leading by example, ensuring that environmental actions are ethical and addressing shortcomings when they arise. In addition, this leadership style values training, innovation, and collaboration on environmental issues. Overall, it reflects an open, supportive, and responsible form of leadership, often accompanied by social initiatives focused on environmental protection.

2. *Environmentally indifferent leadership:* This leadership style is characterized by leaders who delegate environmental decision-making—whether good or bad—to the environmental manager and their team, or to other members of the organization. Their interest in environmental matters is largely limited to what is strictly necessary to avoid problems in meetings, certifications, or audits. Under this type of

leadership, a plant may or may not have an environmental management system, and it may show strong or weak environmental performance, innovation, communication, cooperation, or training. However, these aspects depend primarily on the motivation and personal commitment of other actors within the organization and, in some cases, on the perceived financial costs involved. Environmental issues are therefore subordinated to business considerations and constrained by the willingness of others to ensure that they do not interfere with operations or profitability. Overall, this reflects a laissez-faire style of leadership driven mainly by commercial interests. As a result, it is possible for a company to display good environmental performance, effective training, communication, or regulatory compliance despite—rather than because of—its senior management.

3. *Environmentally inconsistent leadership:* In this case, the leader approaches environmental management primarily from an economic standpoint, treating it as a marginal concern. Because the social dimension is likewise neglected, there is no real commitment to sustainability. This type of leadership may tolerate or even enable unethical environmental practices within the plant. There is little motivation to lead by example, either personally or organizationally, and no genuine interest in eco-innovation, cooperation, or training and awareness-raising across the company. The leader's involvement is limited to knowing only what is strictly necessary to respond to questions in meetings, certifications, or audits. Overall, this reflects an authoritarian and unreflective leadership style, reliant on bureaucratic solutions and characterized by a short-term perspective.

However, it is important not to assume that influence flows only from the top down. Environmental coordinators also exercise agency in shaping the environmental decisions made by CEOs. As one interviewee explained, part of their role is to "give the manager or director a little push to change their mindset. If it's not one way, it has to be another" (RA6). In this sense, coordinators may also influence senior management's decision not to pursue additional certifications (such as PROFEPA's Clean Industry Pro-

gram), given the extra workload involved, or help ensure that, under constant cost–benefit pressure, management does not give in solely to economic incentives.

To illustrate this dynamic, in 2013 the environmental manager of Company 8 noticed, while reviewing the list of legal requirements, that the supplier responsible for removing special waste had only one week left before its operating license expired on March 31. He therefore informed the supplier that:

> Hey, your license is about to expire. Do you have the new one yet? Hurry up because on April 1st you won't be able to do anything. And [since he didn't renew it on time] they didn't do anything for a week. My director was furious, and I said, "Well, I'm sorry, sir, but we can't do anything"; that was my take on it, and he got mad at me, but I didn't want to get fined. And these are things that, in your role as coordinator, you have to be aware of and make sure people understand. (RA11)

Challenging a CEO or senior manager is rarely easy, especially when they are exerting pressure. In this case, the environmental manager's personal background played an important role. He was the most experienced interviewee, with fourteen years in the role and retirement only a year away, and he also enjoyed a strong relationship with his director, whom he addressed informally, as illustrated in the quote above. Having been born, raised, and worked in the north of the country, he developed an open, communicative, frank, and charismatic personality.

Table 3.*6. Examples of environmental leadership styles*

Leadership style	*Examples*
Environmentally responsible leadership	• [My boss tells me:] "You know what? Get in touch with plants in other parts of the world and tell them we have this chemical. We'll give it to them for free—they just have to cover the transportation costs." (RA3 Manager) • "The CEO was very involved in the 5S program, and little by little he got the entire staff on board. Every morning and afternoon, he would walk around the plant and say, 'Look, that's lying around,' or 'It's dirty here—there's resin over there.'" (RA4) • "If I tell my boss, 'We need resources to solve this problem, otherwise it could have bigger consequences,' he replies, 'Okay, go ahead.'" (RA7) • "What can I say about my director? I have nothing but respect for him. He pays attention to the environmental management system day after day. Honestly, he's like a thorn in our side—but in a good way. He's deeply committed to environmental guidelines and the company's requirements, and that's why the plant is in the condition it's in. If he weren't interested, I'm sure we wouldn't be as successful as we are." (RA11) • "It's essential that the person in charge knows how to lead and has the ability to convince others. When a director truly sees the importance of it and says, 'Of course this matters—we're going to invest in projects,' everything starts to flow. Things happen, communication improves, and you can really see the company reach a whole new level, with initiatives that have real impact." (CA3)
Environmentally indifferent leadership	• "We weren't really involved with management. All I would ask was, 'What do you need to get this done?' I'd explain it to them, and they'd respond, 'Is there any other way you could do this? Because it's an expense.' That was always the issue." (RA2) • [Senior management sent him the message:] "You handle it." "I didn't even know what the environmental objectives were, or whether we were meeting our energy-consumption targets." "Managers would act like they were holding a meeting about environmental issues, and then that was it." (RA4) • "Up until 2018, the staff wasn't aware of the importance of legal requirements, and there was also very little communication." (RA9)
Environmentally inconsistent leadership	• "At a previous company where I worked, they would say, 'Who's asking for this? [ISO 14001 certification] It's not mandatory. What do I get in return? How does this benefit the company?' In the end, they felt it didn't generate any tangible value. 'I'm here to make money,' they said." (RA1) • "At a previous company where I worked, a huge amount of waste was generated, and it often wasn't clear whether it was hazardous or not. The labs said no, others said yes. About sixty tons were produced every day. Some of it went to landfills because it was considered non-hazardous, and some ended up in vacant lots and shooting ranges. Later, it was proven to be hazardous, and the company was sued. Senior management's instructions were things like, 'Get it out of here,' 'See what you can do with it,' 'Don't look for co-processing,' 'I'm not interested,' 'I'll give you the money to deal with it,' 'Fill the hole, fill the hole!' I said, 'No way—how much waste is this, and where is it going? How much contaminated water is being generated?' The company was growing so fast that it couldn't be controlled. There was money, but only to put out fires—to deal with urgent problems—not to improve things in the long term." (RA3) • "When the CEO shuts down initiatives, it becomes a dead end." (CA3)

Source: Own elaboration.

In the emerging socio-technical configuration, structures clearly exert pressure, but they do not fully determine outcomes, as actors also retain agency.

3.6 Agency

Corporate directives and environmental policies may pursue similar goals—namely, environmental protection—but these broad, often poetic and even utopian statements (for example, "Protecting the air, land, and water with our hearts and technologies to ensure a better future for all") are interpreted and implemented in very different ways. Senior management tends to view them through the lens of productivity and cost–benefit considerations; environmental managers and their teams focus on the technical requirements needed to meet targets, prevent accidents, and comply with regulations in order to avoid fines; and workers, unsurprisingly, are primarily concerned with getting through their workday. As a result, the pressures acting on the organization are experienced and internalized differently across roles and levels.

Consider the case of Company 8. In 2017, the environmental team at this plant took the initiative to introduce a control mechanism that allowed the environmental coordination team to review purchases—such as chemical products—before they were finalized. This made it possible to verify whether proposed purchases complied with environmental and safety requirements (for example, having a safety data sheet in Spanish or not appearing on the list of prohibited substances). If a product failed to meet these criteria, the purchase was canceled, even when it was explicitly requested by a customer. The procedure proved so effective that it was later adopted by the company's other three plants in Mexico, and the environmental coordinator now hopes it can eventually be implemented worldwide.

It is striking that workers' behavior is identified as the main difficulty—or at least one of the most significant challenges—in maintaining the environmental management system across all eight companies visited. In four of them, interviewees greeted me and addressed me as "engineer," which is common in this context given that environmental work involves a high degree of technical detail and frequent interaction with engineers. When I clarified that my background is in psychology, their surprise was often followed by comments suggesting that having a psychologist involved would be both interesting and useful, particularly to help foster pro-environmen-

tal behaviors and motivations within the plant. Once again, this highlights the importance of ethos in the configuration, understood here in terms of behavior.

> What we must always be working on is people's awareness, because it is somewhat complicated: you can program a machine to behave in a certain way, with specific, defined, and expected movements, but you can train a person and they will forget; in the end, it is an education. […] What I work on every day is behavior. (RA7)

> [Clean Industry certification] is an activity that requires a lot of support from people to ensure that we are monitoring and ensuring compliance with our KPIs or indicators. [...] The staff are noble, they look after things, and when they are made aware or conscious of something, there is a very good response. (RA1)

At Company 7, the greatest challenge in implementing the environmental management system was engaging employees and raising their awareness. At Company 5, interviewees noted, "We keep trying to change people's culture, which—honestly—is really difficult," explaining that at home "there's no education on the subject," and that during an audit "that can be fatal" (RA6). At Company 4, they described workers in the following way: "They do listen to you—or rather, they hear you, but they don't really listen. They receive the information, but they don't absorb it, they don't put it into practice, and they don't take it any further. Meanwhile, we're working hard, trying to align ourselves with all of this, and maybe we'll manage to make some progress" (RA4).

This idea of "being tough and strict" refers, for example, to putting up posters that remind employees of the company's environmental policy, painting trash cans to "make them look nice so they're attractive and people buy into this culture" (RA4), and, of course, organizing training courses to raise awareness and educate staff. These efforts, however, face a clear limitation: budget constraints. Costs must be reduced because "that's what the industry demands" (RA4), while at the same time managers still have to "sell the idea to people" (RA4). As a result, when planning training, the

recurring question becomes, "How much is it going to cost us to raise awareness?" (RA4), especially since this is not a very large plant. Although interviewees claim that cost concerns are less frequent given the importance of environmental issues in Europe (where Company 4 is headquartered), the main challenge they face is participation: courses are scheduled for fourteen people, with advance notice and transportation provided, yet only three or four actually attend.

At the same site, interviewees added, "I think we've already gotten past the hardest part—constantly reminding them what they have to do, how to identify materials, and so on. They're starting to do it on their own now" (RA5). However, staff turnover—an ongoing issue at the plant and in the local sector—often makes continuous environmental training necessary and "makes follow-up difficult" (RA5), because "you have to start from scratch" (RA4).

With the 2015 revision of ISO 14001, the focus shifted from purely operational practices (for example, separating waste and being able to explain why, or knowing where oils should be disposed of) to a more preventive approach (such as knowing how to avoid oil spills in the first place). While this shift is easy to describe on paper, "the real issue was getting staff to understand what actions they needed to take to avoid creating the problem in the first place" (RA4). It took months of training, monitoring whether the practices were actually being applied, and—when they were not—explaining them all over again.

In Company 3, they explain that three years prior to the interview:

> A study known as a Gap Analysis was conducted, and it revealed what was missing: culture. When an accident, pollution, or some other incident occurs the last thing that fails is the person's beha vior—what they decided to do or not to do. It's entirely cultural. I can put safe guards in place so nothing happens to you, but if you decide to cause an acci dent or pollute, you will. It's a decision (RA3).

Along similar lines, the environmental manager at Company 8 (RA11) noted that getting all workers to behave in an environmentally responsible way is not easy, particularly because many employees equate 'the environment' simply with putting trash in the right place. In his experience, the real

challenge lies in moving from having a system on paper to actually implementing it on the ground.

> "We started to make that change, moving away from a culture focused only on keeping everything in its place and toward practices such as containment in case of leaks, reporting incidents, making improvements, and protecting the company's image. That's where the real cost has been for us: the human factor" (RA11).

At this plant, change is pursued through several mechanisms. New employees receive an induction course, and every year staff attend talks, training sessions, or educational activities. Information is also shared through internal communication screens, and brochures are produced. However, staff turnover affects these programs, as new employees are constantly arriving, and training becomes the most "tedious" task (RA11). Indeed, the environmental manager consistently points to the human factor as the critical weakness of the environmental management system, particularly in a national context where quality management systems—mandatory in the automotive industry—are given greater importance than environmental systems, which remain voluntary. As he put it, "That's the issue: maybe we should change that from voluntary to mandatory" (RA11).

Company 6 has implemented a safety-oriented program with strong environmental implications known as Behavior-Based Safety (BBS). Under this program, a group of workers is selected to go onto the shop floor and conduct real-time observations related to health, safety, and environmental practices. For example, if an observer sees a worker correctly wearing safety glasses, earplugs, and safety shoes—fully complying with the work procedure—but then disposing of a contaminated glove in a regular trash bin, they intervene immediately. First, they acknowledge and reinforce the worker's correct behavior (positive reinforcement), and then they explain that throwing the glove into the bin contaminates a larger volume of waste and has environmental consequences (feedback).

The interviewees recognize that addressing environmental issues with plant workers is not simply a technical, routine, or procedural matter. Rather, it has the potential to transform workers' own subjectivity. Environmen-

tal responsibility is not only—at best—a question of knowing *what* (the conceptual dimension) or knowing *how* (the practical or cognitive dimension), but also of knowing *how to be* (the attitudinal dimension). As such, it engages not only reason but also emotion.

It is noteworthy how individual actors can take what the organizational structure provides—such as pressures, regulations, corporate values, or training content—and apply it to other areas of their lives. In doing so, environmental concerns extend beyond the workplace into personal and family spheres, reshaping habits as well as perceptions and emotions related to the environment, nature, and the world more broadly. What begins as an issue mobilized within the workplace thus spills over into other domains, such as the home, social relationships, and environmental citizenship.

> As one interviewee put it, "What they apply here, they can also apply outside. The issue is, for example, that you can't be wasting water. So, it's about raising awareness here so that they also go home, to their families, and say, 'Don't waste water'" (RA2). Another mentioned, "We are aware of the environmental impact we have in Mexico, in Querétaro, and here at the company; we are increasingly raising awareness" (RA1). A third emphasized the cultural shift achieved: "Thank God, we've changed the mindset of many people here at the plant. And if you go to their homes, you'll see a 5S program in place… awesome!" (RA11).

One interviewee (RA4) noted that her concern for environmental issues at work has influenced how she educates her son. Another reflected, "Every day there's something new; every day I have to correct someone in order to feel that I'm contributing—changing the world, changing people" (RA7). A third explained that her job "has made me much more aware, even at home. It's led to changes in my personal habits. It's made me more conscious, because before I used to say, without much interest or enthusiasm, 'Oh, yes… the environment'" (RA1). Another added that he himself is an example of this change: "I apply ISO and 5S here at the plant, so why wouldn't I apply it at home? That would be ridiculous!" (RA11).

An engineer who serves on the Sustainability Committee of the Nuevo León Automotive Cluster described a similar approach:

> "I try to begin committee meetings with a reflection, an image, or a video about the environment. I look for ways to help people connect with it on a personal level—for example, asking them what they think about someone throwing trash on the street. When you raise awareness, you start seeking the best wherever you are. […] I feel I'm doing something, even if it's very small, and I hope that personally I can do much more—not just for the automotive industry, but for Mexico and for the world, for all of us who live here." (CA3)

The interviews show that working on environmental issues allows participants to find greater meaning in both their personal lives—by feeling that they are doing something for the planet and for humanity—and their professional lives—by being part of an organization that cares about the environment. This was captured repeatedly in a single word that emerged across the interviews: pride

> "We make an environmentally friendly product, and we're very proud of it because it helps the environment" (RA3).

> "During your studies, you learn about the idea of a Clean Industry, and you start to imagine how meaningful it would be to achieve certification. I remember thinking, 'This is where I belong—I want to be able to say that I certified E5.' My goal is to pursue that, not only for the company, but also because it has a strong professional impact on you personally" (AR6).

> "I'm very proud of Mexico, its plants, and its workers" (AR7).

> "I'm proud of what's being done in Mexico" (AG6).

One member of the Sustainability Committee in Nuevo León described how this sense of pride emerges in practice:

> "Here in Nuevo León, my colleagues feel proud during Sustainability Committee meetings when they have the chance to present their projects. We tell them, 'You have 20 minutes on the agenda to present what you've done on a

> specific topic,' but they often go over time—happy and proud of what they're doing in their companies and eager to share it. What I've seen in the automotive industry in this state is that people genuinely appreciate the companies they work for. You can see it in the company shirts they wear and the way they defend them: 'My company did this…' They're proud to be where they are. I can't say whether they earn a lot or not, but from what I observe, they are very loyal. You end up wanting to be part of the company's values." (CA3)

Environmental concerns flow across different spheres of life without clear boundaries. This is hardly surprising, since nature encompasses our bodies, our surroundings, and the people and other beings with whom we share our everyday environments. We ourselves are part of nature at all times, even if this is often forgotten.

The sense of pride described by interviewees is expressed in several ways: (a) putting into practice what many of them studied in college out of genuine vocation; (b) enjoying their roles and daily work; (c) "wearing" the company shirt and embodying its values; (d) contributing to the company's success; (e) extending the pro-environmental practices and discourse developed at work into their private lives, families, friendships, and broader citizenship; and (f) helping to improve the environment, the planet, and the future of their children and of coming generations.

This commitment, however, is not always understood by colleagues or by individuals with lower levels of environmental awareness, whether inside or outside the plant or offices, as they often fail to perceive the psychosocial complexity underlying this sense of responsibility:

> People who are unfamiliar with the profession often tend to downplay it. As one interviewee explained, "They think all you do is take care of trees. They can't even imagine the impact that environmental non-compliance can have on a plant. These are legal issues—critical issues for the organization, the environment, and environmental performance as a whole. But many people still judge it as, 'You just plant trees'" (RA7).

During our meetings, when interviewees moved beyond the technical and administrative matters that usually dominate their work and were given space to reflect on the personal and social dimensions of what they do, a recurring concern emerged—one that affects both them and their families and illustrates how their environmental commitment extends beyond the plant and formal obligations. This concern was education: both the education they received during their own academic training and, especially, the education of their children and future generations. (At the beginning of the meeting, I also clarified that I am a university professor as well as a psychologist.) Their work leads them to reflect on how the care the planet requires—care to which they contribute professionally—must be reinforced and accelerated through education at home, in public spaces, and in schools, all of which are contexts in which they themselves also participate and take action:

> "I've seen a change in the way workers approach environmental issues since I joined this company eight years ago. Before, to be honest, it was more difficult. But now I have an eight-year-old son, and they teach him about these issues at school" (RA4).
>
> "We need to change people's mindsets, because at home we're taught to waste water. Dad goes out to wash the car and turns on the hose. You grow up with that mindset, and now you look back and say, 'Don't be ridiculous!'" (RA6).

Another interviewee emphasized the role of formal education: "My point was about how to reinforce issues as important as these through classroom education and raise students' awareness of how important the environment is, and how much their everyday actions matter—because they will either suffer or benefit from the consequences. […] And above all, something else I think is critical is that major universities haven't really taken on the task of addressing environmental issues. Which universities here in Querétaro even offer environmental engineering? […] I don't understand why we haven't done more to push universities further, so that students graduate with a mindset focused on changing the world" (RA7).

> "When you see an issue as important, you invest a great deal of effort in it. Personally, I'm very passionate about this topic. Ever since my degree in chemical engineering, I've focused on these issues, and in the Nuevo León cluster our goal is to ensure that proposals don't stop at being discussed in a meeting—where you have a talk and then that's it. We want to go further, generate meaningful actions, and raise issues that truly have an impact on our members. […] Another key point is that, if we look back to previous years, environmental issues were never a central part of my academic training. There's a real need to educate people about why this matters and why it should be of interest to them. I think that's something many people are still missing." (CA3)

Structural factors undoubtedly exert pressure, but actors retain agency and make sense of their experiences through their own histories, education, beliefs, prejudices, motivations, desires, knowledge, encounters, expectations, and personal and family relationships. No matter how many courses, seminars, or training sessions individuals attend—whether within the company or elsewhere—they bring with them a subjective "baggage" that shapes how they interpret the relationship between work and environmental management (or, more broadly, between work and the environment) and how they express environmental behavior, sometimes extending it into other areas of their lives. Workers and employees, therefore, can never be understood as passive "containers" to be filled with environmental information by management, ISO 14001 manuals, auditors, or regulatory authorities.

As this analysis shows, the psychological dimension of environmental management—with all its complexity—cannot be overlooked when implementing decisions within organizations committed to environmental responsibility. The ISO 14001 standard is not a rule or a ruler (in the etymological sense of *standard*), no matter how much corporations, auditors, or certification bodies might wish it to be. Human agency and psychology—with their capacity for creativity as well as resistance—can ultimately overwhelm any attempt at rigid imposition or structural control. As Carrillo reminds us:

> "The actions of actors are not governed by external mechanisms that condemn them to passive behavior. […] We study social structures designed to shape conditions and situations, yet these structures do not always succeed, due to the intervention of emotional factors, the multiple aims of actors, and their attitudes and subjective dispositions, which ultimately draw analysis into the symbolic realm" (2018, p. XI).

Those responsible for following instructions, procedure manuals, technical files, and other documents—such as those used to implement an environmental management system—must not overlook this dimension, which emerges clearly in the configuration. At the same time, caution is required: companies should avoid the temptation to delegate or individualize environmental responsibility by placing it primarily on workers. It is the company that controls the means of production, generates pollution, and makes environmental decisions on a far greater scale than workers, employees, or other stakeholders.

3.7 Ethics

The ethical dimension therefore becomes central. Environmental certification is of limited value if it does not genuinely drive continuous change and improvement within the organization—or worse, if it is obtained and maintained merely as a form of simulation. As one plant environmental coordinator explained, "It's one thing to have certification, and another to have the awareness and sense of responsibility of those in charge of environmental issues" (RA4). She added that it is possible for those responsible for environmental management to prepare in a way that allows them to "create the audit scenario," effectively steering the process so that auditors do not encounter the facility's or processes' weaknesses:

> "The auditor starts asking questions, and you start answering. If you've studied and prepared for the audit, you respond in a way that prevents them from asking about what you know is wrong. It's not that you lie or hide anything—it's simply that they never reach the point where the weakness is." (RA4)

This brings us directly into the realm of ethics. Not only because a company may focus more on form—obtaining a document that certifies compliance—than on substance—doing everything possible to improve its environmental performance and protect the environment—but also because auditors must uphold principles, in addition to having sufficient technical expertise to support their reports and decisions. These principles should prevent them from placing economic or commercial interests above environmental ones, even when doing so may mean losing a client. An environmental auditor with a long career in the field, who began working when the Clean Industry Program was launched, explains:

> I have friends who work for ISO 14001 certification bodies, and they tell me, "Our hands are tied; the certification bodies won't allow it." As auditors, they can point things out, but the certification body responds, "You can't do that—you have to do it this way." Why? Because it might affect their clients. A company being certified in Querétaro may have four or five plants there and another four or five in Guanajuato, all covered by international certification agreements. Then an auditor may determine that one plant does not meet the requirements and is therefore going to lose its certification. The client—the industry—complains because they don't like the outcome. And sometimes the certifying body ends up telling the plant, "All right, we'll give you another chance; we'll review it at the next audit." In that way, boundaries begin to blur, so to speak.

Environmental managers themselves acknowledge that some plants merely appear to have an environmental management system yet have still been certified by companies and auditors with little real environmental commitment, operating under the logic of: "I'll certify you, even if you have a dump on your site" (RA8).

The companies visited are aware that this practice—obtaining certification without truly deserving it—is possible, and they respond to it in different ways. One European-owned company (Company 3) explains that, to avoid this, its corporate headquarters requires the certifying body to be registered with the United Nations and to have a solid track record. This, they argue, ensures the credibility of the certification and prevents situations

in which the auditor lacks knowledge of the process or fails to examine issues thoroughly due to overly familiar relationships ("we're friends") (RA3).

Another European-based company (Company 4) highlights the autonomy granted by its parent company to choose its own certifier. It acknowledges that the selected firm has been highly transparent and has helped them avoid tunnel vision, leaving them with "a very good impression" (RA4). This positive assessment is reinforced by the fact that the certifier "puts itself in your shoes as a company that needs to generate revenue and retain customers" (RA4).

In a U.S.-owned company (Company 6), the corporate office audits the certifying body itself "to make sure they are really doing things right and that we are truly in compliance" (RA7). By contrast, the Mexican-owned company (Company 5) argues that the ideal arrangement would be certification by an external public authority (e.g., PROFEPA), which it considers "more credible" (RA6), since "the authority is less prone to that kind of simulation." (RA6).

One way to prevent companies from falling into the comfortable temptation of simulation—for example, obtaining certification out of conviction or pressure while failing to actually improve their environmental performance—would be for them to also participate in PROFEPA's Environmental Audit Program (known as Clean Industry). However, this approach raises a fundamental question as well: being an auditor accredited by the Mexican Accreditation Entity (EMA) does not make one infallible. This brings the discussion squarely back to ethical behavior rather than technical expertise alone.

For instance, an auditor with experience in the mining, oil, or service sectors may have little knowledge of what happens inside the automotive industry yet may still agree to audit a company in that sector if their ethical principles do not lead them to decline the assignment—or to seek specialized support. The EMA validates the technical competence of accredited auditors primarily through an interview process, as one interviewee explains:

> If the technical expert conducting the interview wants to take it easy, they approve you; if they want to be very strict, they fail you. Then the attorney

> general's office comes in and gives you a relatively simple test to check that you at least know what you're talking about. But once you start putting it into practice—for example, in the automotive sector—you realize you're entering a completely different world (V4).

For those who agreed with the statement above, the ethical conduct of environmental auditors revealed a fundamental weakness. Around the year 2000, Environmental Audit regulations were introduced requiring auditors to obtain accreditation from the EMA within a thirty-month period, under the premise that those who failed to do so would no longer be allowed to practice. However, by the end of that period, only a small number of auditors had completed the accreditation process. As a result, PROFEPA decided not to concentrate the entire auditing workload on that limited group.

> "I don't want to favor anyone," I remember the deputy attorney general saying at the time. From my perspective, that was where the audit process took a serious hit. Why? Because an individual or a company could submit an application to the EMA, and simply having it stamped as received was enough to allow them to carry out audits. This happened after the original thirty-month deadline set by the authority and lasted for about a year. As a result, while the Environmental Audit Program continued to expand, the quality of the audits declined significantly (V4).

This situation had clear consequences. Anyone who carried out a poor or inadequate audit—before being properly accredited by the EMA and thus operating solely under the protection of a formal seal of approval—would later find it "difficult to tell the company that they had done a bad job" (V4) when returning.

Today, this type of ethical behavior is often undermined by "commercial considerations. There are companies that can't compete because others conduct audits simply to make a living, with one or two people doing all the work" (V4). This has driven costs down and pushed some firms to seek other ways to boost their income, such as developing alternative lines of business.

Unethical decisions in the environmental field affect not only the environment itself or the organization involved, but also the professional, personal, and subjective lives of those who make—or are affected by—them. One environmental manager, who worked for a large transnational company that failed to meet its ecological responsibilities, devalued environmental concerns, and made no effort toward co-processing, waste reduction, or pollution prevention, ultimately chose to resign. As she explained: "I left that place because of my professional ethics. I saw what was happening and said, 'I'm doing the best I can with what I have, but I don't agree with this. I just don't want to be here anymore'" (RA3). No matter how much pressure the organizational structure exerted, the engineer's subjectivity could not be contained. On the contrary, her resignation became an act through which that subjectivity was expressed—and resisted.

This final case also illustrates how ethics—understood as the internalization of norms, rules, and values acquired from childhood—constitutes a fundamental axis of subjectivity. On this basis (for example, valuing care for nature or honesty), certain actions can be re-examined and undone, such as resigning from a company. This, in turn, opens the way for new courses of action, like working with satisfaction and pride in a different, locally based organization where one's personal ethics align with the company's code of ethics. In this sense, ethics becomes a prism through which actions are refracted, shaping how individuals act and make meaning within the micro-, meso-, and macro-level relationships that define their social and professional worlds.

3.8 Environmental Authorities

The position of the Querétaro state government regarding environmental management in the local automotive industry can be summarized in two main points: (1) to encourage, as far as possible, the "goodwill" (CP7) of organizations to adopt or implement actions in favor of the environment and climate change; and (2) to enforce the obligations established under state law. In this way, "one way or another" (CP7), companies are required to comply with public policies and actions aimed at environmental protection.

In practice, companies in Querétaro interact primarily with the Ministry of the Environment and Natural Resources (Querétaro office) and the Federal Attorney General's Office for Environmental Protection (Querétaro office). Although they also have some interaction with municipal or state agencies—such as the Ministry of Sustainable Development or the State Attorney General's Office for Environmental Protection and Urban Development—these actors did not appear to play a significant role in shaping the overall configuration.

3.8.1 State Attorney General's Office for Environmental Protection and Urban Development

Since 2012, the state of Querétaro has had the State Attorney General's Office for Environmental Protection and Urban Development (PEPMADU), whose regulations were published on October 8 of that year.[4] The first attorney general, José Alfredo Zepeda Garrido, took office on October 31. Before PEPMADU was created, the Ministry of Sustainable Development was responsible for authorizing and sanctioning environmental matters under state jurisdiction, effectively acting as both judge and jury. At the time, it had only one inspector who, in addition to carrying out inspections, was responsible for initiating proceedings, following up on cases, issuing notifications, and imposing fines, with support from an already overburdened legal department.

In response to this situation—which was also criticized by local environmental groups—the creation of PEPMADU was promoted. However, when the agency began operating in 2012, it consisted only of the attorney general and one additional staff member. It was not until the following year, in 2013, that PEPMADU gradually began to add personnel, although staffing levels remain insufficient to this day. At the time of the visit, the office had fourteen employees in total, all overworked and divided among admin-

[4] The Guerrero State Environmental Protection Agency was established in 1991, followed by the Guanajuato State Environmental Protection Agency in 1996 and the Environmental and Land Use Agency of the Federal District in 2001. Since then, several other states have created their own environmental protection agencies.

istrative, legal, and inspection functions. More specifically, the legal office consisted of three people—the coordinator and two assistants—while the inspection office had five staff members, including its coordinator, who estimated that a minimum of ten inspectors would be necessary to operate effectively (AG2). Indeed, due to limited staffing, it had not been possible to establish the Studies and Research Unit in PEPMADU's regulations. Beyond budget constraints that limit staffing, two additional issues affect the consolidation of the Attorney General's Office. First, there is the need to strengthen training and technical capacity. Second, there are frequent changes in leadership, as each attorney general has tended to prioritize different environmental concepts and agendas based on their professional background. For example, José Alfredo Zepeda Garrido (2012–2017) had previously served as president of the Autonomous University of Querétaro (UAQ); Alejandro Delgado Oscoy (2017–2018) was a local deputy; and José Luis Peña Ríos, attorney general since 2018, had been a federal delegate for PROFEPA. As a result, with each leadership change, "it is almost always a matter of starting from scratch" (AG2).

In June 2019, PEPMADU presented the Environmental Audit Program in Querétaro at an event chaired by the Secretary of Sustainable Development, during which 30 companies submitted letters of intent to collaborate. The press release stated that:

> Through this program, companies will be able to obtain environmental certification. In addition, environmental auditing will be promoted as a policy tool to help reduce the negative impacts associated with improper waste disposal. The Secretary highlighted the willingness of companies to collaborate in reducing their carbon footprint and noted that good practices help complement public policies and citizen initiatives, making environmental responsibility a shared concern (State Attorney General's Office for Environmental Protection and Urban Development, 2019).

None of the environmental managers interviewed mentioned any comments, ideas, or future projects that were being developed at the time as possible medium- or long-term actions under the program, either at their own plants or at other facilities within their companies. In August 2025,

however, the same attorney general's office was preparing—together with the National Chamber of the Transformation Industry (CANACINTRA)—to implement the program in the municipality of San Juan del Río. The program's development and maturation, as well as its potential impacts and benefits for both companies and the environment, remain to be assessed at a later stage.

For some auditors, this type of state-level certification represents "double work; it is excessive and a waste of resources, because its scope should be limited to state and municipal requirements, but it usually tries to cover everything. It drains organizations, and they see no real value in it—it's money down the drain" (V2). Considering that seven of the eight auto parts companies visited already view PROFEPA's consolidated Environmental Audit Program as redundant and unnecessary if they are ISO 14001 certified, there is a clear risk that they may perceive a state-level program in much the same way. This is an issue that Querétaro authorities should take into account as they seek to expand, develop, and consolidate their Environmental Audit Program.

The PEPMADU inspection department prioritizes citizen complaints. Each year, the department prepares an operational plan; at one point, for example, it set a target of carrying out 30 inspections per month. Most of these inspections respond to citizen complaints, leaving only "small gaps for the industrial sector" (AG2). In the department's inspection work, local auto parts companies—many of which are dedicated to plastic injection molding—do not tend to generate significant environmental problems and are generally among the most compliant with environmental regulations. These companies:

> "They don't pollute as much as chemical companies do. In fact, when they come to Querétaro, it's mainly to work. They generate waste that they often sell, so what they produce is more like the urban waste any company generates. Occasionally, they have some emissions, but most of the companies here are involved in plastic injection molding. The environmental issue isn't really with this type of company; besides, they generate a lot of jobs—a lot" (AG4).

3.8.2 SEMARNAT (Querétaro Office)

Like PEPMADU, the state delegation of the Ministry of the Environment and Natural Resources (SEMARNAT) also faces staff shortages. At the time of the interviews, the delegation had a total of fifty employees, sixteen of whom were trust staff. Of these, ten were assigned to the Subdivision for Environmental Protection and Natural Resources Management, which is responsible for all technical matters related to industry, environmental impact, and the use, conservation, and restoration of natural, forest, and wildlife resources.

In 2016, a nationwide budget cut led to the elimination of three positions at the federal delegation, one of which belonged to the management subdivision mentioned above. This reduction in staff has at times caused delays in the procedures and authorizations that companies must obtain from SEMARNAT.

The situation worsened in subsequent years. Under the 2018–2024 federal administration, and in the name of "republican austerity," the environmental budget continued to be reduced (Martínez, 2023; Guillén, 2024). For the state subdelegate:

> The reality is that we have very limited staff and equipment. Only one person is responsible for regulating the industrial sector, and last year the number of positions in this area was reduced. We hope that decision-makers will begin to give greater attention to environmental issues and recognize that they need to be a priority. (AG5)

In response, the subdivision has focused on training companies so they can better comply with their environmental obligations. For example, it participated in a sustainability course for the industrial sector organized with the National Chamber of the Transformation Industry (CANACINTRA), and specialists from the central offices were brought in to guide regulated entities through the preparation and submission of procedures such as the Single Environmental License (LAU) and environmental management plans.

According to the subdelegate, these efforts have produced positive results. Environmental compliance levels in Querétaro are high: more than 90% of the companies required to submit an Annual Operating Certificate (COA) do so each year, and, in her view, participation in PROFEPA's Environmental Audit Program is also significant. Drawing on her ten years of experience at the agency, the subdelegate mentions that Querétaro has experienced synergy and parallel growth across the industrial, state, and federal levels, as well as in environmental regulation. One example is the adoption of a state-level instrument similar to the federal LAU to regulate pollution prevention and control, particularly air emissions. At times, however, the pace of industrial growth has outstripped existing legislation. This is the case, she explains, with the aeronautical industry, which did not exist in the country when the LGEEPA was drafted and was therefore not included among the subsectors covered by federal environmental regulations. As a result, it is now regulated at the state level.

From the subdelegate's perspective, there are two additional examples of how Querétaro has been at the forefront of environmental progress at the national level. First, it was the first state to enact a Law on Waste Prevention and Comprehensive Management, published in the official gazette on February 20, 2004. This law aligns with the General Law for Waste Prevention and Comprehensive Management (LGPGIR). Second, Querétaro adopted a preventive—rather than corrective—approach through its Air Quality Improvement Program (ProAire). Thanks to the insistence of both the state government and the federal delegation, the program was approved in 2012 by PROFEPA's General Directorate of Air Quality Management, even at a time when the city of Querétaro—unlike the Mexico City Metropolitan Area or municipalities such as Salamanca, Guanajuato—did not yet face serious air quality problems. These problems have since emerged, due in part to the growth in the number of vehicles.

From SEMARNAT–Querétaro's perspective, the local auto parts industry—despite its significant presence in the state—does not pose major environmental problems. Given the nature of their activities, the hazardous or special-handling waste they generate "is among the most typical" (AG5), and the oils and solvents they use are also common. As a result, there is a

broad range of environmental service providers capable of offering comprehensive management of these materials.

Some challenges are acknowledged in relation to smelting processes, for which authorities are "reviewing what strategies may be available at the central level" (AG5). However, as noted by one official, "the industrial sector has largely moved away from thermal processes that rely on fossil fuels; in other words, it no longer operates large thermal treatment furnaces, and many processes are now carried out using electricity. This has significantly reduced emissions, at least at the plant level" (AG5). It is worth recalling that Article 17 Bis of the LGEEPA explicitly establishes that companies engaged in thermal or smelting processes fall under federal jurisdiction. Another issue identified involves companies that are newly established in the state, which often lack adequate information about the procedures and regulatory requirements applicable to their operations.

3.8.3 Federal Attorney General's Office for Environmental Protection (Querétaro Office)

At the time of the interviews, the Querétaro office of the Federal Attorney General's Office for Environmental Protection (PROFEPA) had a staff of twenty-eight people. For the purposes of this study, two units within the office are of particular interest: the federal inspection sub-office and the environmental audit sub-office.

3.8.4 Subdivision for Industrial Inspection

In addition to the deputy delegate, this office is staffed by two inspectors and one assistant. Although there were five inspectors in previous years, staffing levels have since declined and are now insufficient for the workload of an industrialized state like Querétaro. Given these limitations, the office prioritizes the complaints it receives—around two per month in the case of industrial facilities. Companies that participate in the Environmental Audit

Program are generally not targeted for inspection, as the office seeks to work with them as collaboratively as possible.

His assessment of the state's auto parts sector is positive: "Given the number of companies involved, we do inspect them, since most are large generators and some fall under federal jurisdiction with respect to emissions. Overall, they comply well" (AG7).

Drawing on his professional experience at PROFEPA, he also notes a strong effort to coordinate actions between PROFEPA and SEMARNAT. Moreover, the fact that his former supervisor and state delegate is now head of PEPMADU has further eased communication and cooperation between the two offices. Once again, this highlights how personal relationships play a key role in facilitating coordination and moving work forward.

Are the tools available to authorities sufficient to exert meaningful pressure on industry? It is worth recalling that the Mexican press has reported that only a very small percentage of the fines imposed by PROFEPA on companies—especially the largest ones—are actually paid, largely due to legal strategies designed to delay payment for as long as possible (Carabaña, 2019). From the deputy's experience, "fines don't hurt them as much as shutdowns. With shutdowns, they really react: one closure is enough, and the very next day there are people here negotiating how to lift it, what conditions must be met, and what urgent corrective measures are required" (AG7). From the companies' perspective, one engineer puts it this way: "The reality is that they treat you according to how they see you" (RA3). Another engineer highlights a clear difference in how companies approach safety versus environmental issues. When it comes to safety, he explains, "They'll never deny you a fire extinguisher because of the cost. If the plant catches fire, they'll go after the person who approved—or blocked—the purchase order" (RA2). In other words, the fear of serious sanctions shapes behavior very differently from what happens in the environmental realm, where the prevailing attitude, in his view, is: "If you get fined, well, you just pay it or fix it, and nothing really happens" (RA2).

3.8.5 Environmental Auditing Subdivision

Regarding the PROFEPA–Querétaro Environmental Audit subdivision, a few clarifications are necessary. This office is particularly relevant to the focus of this study, as it is responsible for the Environmental Audit Program (Clean Industry), which, as mentioned earlier, promotes the adoption of environmental management systems by companies that choose to participate on a voluntary basis.

For seventeen years, an engineer (AG6) headed this subdivision. To speak about the evolution of the Environmental Audit Program in Querétaro over those years is, in many ways, to speak about her. During the visits and interviews conducted for this study, her name and work were repeatedly mentioned. Together with her team, she played a central role in shaping environmental management within industry more broadly, not only in the auto parts sector. Those interviewed emphasized her professionalism, commitment, and attention to detail in handling procedures, supporting others, and resolving questions.

However, at the end of the first half of 2019, amid restructuring and austerity measures within the federal public administration—which significantly affected the environmental budget—the engineer left PROFEPA, along with all state environmental audit subdelegates across the country. As a result, the subdivision was left without a head and staffed only by a secretary and two technicians with training in biology (whereas previously there had been three technicians, in addition to contract-based support staff).

One environmental manager learned during the interview that she was no longer working at PROFEPA and reacted with surprise: "Where are they going to put her? Did they just fire her? You hear so many things. I'm shocked to hear that she's no longer at PROFEPA" (RA6). Drawing on her years of experience at PROFEPA, the former deputy delegate notes that the environmental performance of the auto parts industry in the state is generally good and that companies in the sector have a reputation for being strict. At the same time, she emphasizes the need to identify areas for improvement beyond the initial "we're doing well" attitude that companies often display. She does not identify any specific environmental problem in the sector and

acknowledges that environmental regulations in Querétaro are more robust than those in many other states.

She views it positively that the state attorney general's office has begun to implement environmental audit processes, although she believes that strengthening these efforts will take time—particularly considering that the Clean Industry Program began in the 1990s. According to her, pressure for companies to address environmental issues comes "from all sides," primarily through state, federal, and corporate regulations, but it can also originate within the company itself, from individuals who are genuinely committed to the issue, such as environmental coordinators. She adds that some employees, by contrast, prefer not to get involved, as they see environmental responsibilities as "more work."

There are also incentives that can encourage compliance. For example, she explains that one industrial park offers a direct incentive in the form of reduced water payments to companies that obtain environmental certification.

Finally, to conclude this section on environmental authorities, it is worth noting that neither PEPMADU nor SEMARNAT–Querétaro identifies corruption as a problem. On the contrary, both institutions report increased oversight and monitoring:

> In our experience, bribery is not part of our culture. I don't see why companies would be anxious about our arrival, leading them to offer us bribes and us to accept them. We have different procedures in place to eliminate any type of dishonest practice. (AG2)
>
> In my experience, no one has ever offered me money to do anything else. (AG4)
>
> There is a lot of awareness, at least in the state of Querétaro and among the people who work with me. We cannot charge for our services; we must be very professional and ethical and guide citizens. PROFEPA is being closely monitored to ensure that no such acts occur. (AG5)
>
> Not in my area. I have never seen anything like that, nor would I allow it. (AG6)

None of the companies or interviewees mentioned—even anecdotally—any acts of corruption in the sense of authorities in Querétaro requesting or accepting bribes. This is, of course, a very positive finding. However, it does not mean that everything is flawless, as there were references to actors who attempt to obtain benefits outside the law and ethical standards, or who appear to abuse their power:

1) Suppliers. The environmental manager of Company 8, who has lived and worked in northern Mexico, noted that corruption "is much more prevalent along the border" (RA11), particularly in matters related to plant security. He also recalled an incident in Querétaro in which a supplier from Mexico City, hired to conduct a wastewater study—whose results are often outside regulatory parameters—asked him directly, "How do you want it: in or out?" In response, the engineer canceled the request and contacted a different supplier.
2) Environmental authorities in other states. Two environmental auditors reported having heard about—or personally experienced—possible cases of corruption in other states, particularly when a PROFEPA delegate or an environmental audit subdelegate pressures or directly encourages companies to select a specific verification unit. As one auditor explained: "Here in Querétaro, no—but in other states they tell industrialists, 'Go with this one; it has to be that one.' Sometimes they don't even ask us for quotes anymore, or they tell us outright, 'I was told not to go with you.' That's how much influence the delegate can have" (V2).
3) National and international companies and lobby groups. These include corporations and industry associations from various sectors—automotive among them—that use their connections and influence to pressure governments, authorities, or legislators to shape regulations in ways that suit their interests, allowing them to comply with the law with minimal difficulty. As one interviewee put it: "Corporate lawyers aren't stupid. What they've done is make sure they're present when environmental laws are drafted. The problem is that our governments are so small… they don't have the capacity. Corruption creeps in everywhere when laws are made. In the end, the issue is the

laxity of the rules—direct financial corruption is no longer even necessary" (B2).

The underlying objective, then, is for regulation to apply pressure without becoming overly restrictive. As one idea circulating in the sector suggests, "If you happen to get fined, well, you know what—just have it reduced or fix the issue, and nothing will happen" (RA2). This stands in stark contrast to a scenario in which the threat might be, "If this happens in the environmental area, we'll go after your legal representative" (RA2). Unlike the previous two cases, this example reflects the attempt of economic and corporate power to influence—and potentially override—political and democratic authority. Both the PROFEPA subdelegate and the PEPMADU inspection staff agree that environmental regulations are outdated, although some argue that there are still solid regulatory frameworks in place. While previous administrations have made efforts to update certain regulations, progress has often been stalled by corporate resistance:

"Updates are often driven by the interests of the sectors themselves. Regulation becomes increasingly strict, and then those updates end up being stalled" (AG5).

"We need to update our laws; some of them are very old and have been overtaken by technological advances. In some cases, they're simply too lax. You can see a cloud of pollutants, but as long as it falls within the established limits, we have no way to enforce anything" (AG7).

"The corporation asked us to measure volatile organic compounds (VOCs). We carried out the study using an EPA method, based on a California standard—one of the most advanced states in the U.S. in terms of environmental regulation. That became our point of reference, because there is no Mexican standard to rely on" (RA3).

4) National and international certification bodies and their local auditors. These are organizations that certify companies' environmental management systems and practices, but they may place greater em-

> phasis on commercial interests than on rigorous technical assessment, given the business relationships involved. Certification bodies will often do everything possible to avoid withdrawing a certificate from a company that already holds one and pays for an ISO 14001 audit. Why? Because revoking a certificate means losing a client. Something similar may also occur within the Environmental Audit Program, particularly because audits are budgeted, quoted, and awarded as contracts, and the ultimate goal is for the company—if satisfied with the process—to return to the same certification body in the future. This dynamic is what sustains many verification units (V4).

Once again, this highlights the importance of ethical conduct among those involved in environmental management systems. It also underscores the need for ongoing vigilance across the sector and among stakeholders, to ensure that different forms of corruption do not, at any point, become a threat or a systemic problem.

3.9 Environmental Audit Program

Obtaining Clean Industry certification implies a firm commitment by a plant to improve its environmental performance through what is described as a "holistic approach" (AG6). This approach not only encompasses the wide range of areas assessed—air, noise, water, soil, hazardous and non-hazardous waste, special handling, risk, emergencies, management, natural resources, and wildlife—but also places people at the center of the process. As one interviewee explains, "the most important lens is the person. You can't separate care for staff from the operational side of the process or from its environmental impact, both inside and outside the plant" (AG6). Under this perspective, there is also an intention to strengthen individual skills and to encourage companies to align their suppliers with certification efforts, despite the challenges this poses—particularly for micro, small, and medium-sized enterprises (MSMEs) (AG6).

The first company to receive this recognition in the 1990s was Air Products Resinas (synthetic resin production) on April 3, 1998. It was followed

by Valeo (automotive transmission parts) as the eighth certified company on March 3, 2000; Alambrados y Circuitos Eléctricos (electrical and electronic equipment for automotive use) as the thirteenth on September 22, 2000; and Arvin (other auto parts) as the thirtieth on July 16, 2001.

Among the eight plants visited for this study, only one (Company 1) currently holds a Clean Industry certificate (Level I). Another (Company 5) began the certification process in 2016 but did not complete it due to rapid growth and the production changes that growth required.

Despite efforts by both the industry cluster and environmental authorities to provide information to companies in the sector—for example, through courses on environmental legal compliance—we found that seven of the eight plants visited were largely unaware of what the Environmental Audit Program (Clean Industry) is and what participation in it involves. Both environmental authorities and EMA-accredited auditors emphasize that the program offers advantages beyond those of ISO 14001. However, because it is not a market requirement, there are few incentives for auto parts manufacturers to participate. In practice, there is little pressure and no clear economic benefit to encourage its adoption.

One auditor describes how he attends meetings with senior management at companies in an effort to persuade them of the program's advantages:

> "In the talks I give, I usually say: I'm not here to talk to you about joining the Environmental Audit Program to discuss birds—no offense to birds. I'm here to convince you that joining the program can help you reduce risks, inventories, hazardous substances, downtime, and so on. And you can even translate that into benefits for social security, in terms of risk factors. That's when they say, 'Hey, now that's something worth paying attention to'" (V4).

Auditors and environmental managers frequently criticize the idea that the environment is limited to "birds and trees." This perception, which they encounter not only in society at large but often among their own colleagues, reveals how deeply rooted the cultural notion is that nature exists outside the human sphere—outside the city, the home, or the workplace—and is therefore seen as something separate from everyday work and industrial activity.

Company 1—whose plant in Querétaro, unlike its facilities elsewhere in the world, was not yet ISO 14001 certified—chose on its own initiative to join the program in 2013, without explicit pressure from either corporate headquarters or customers. The decision was made to ensure compliance with applicable regulations and to establish a benchmark for defining sustainability-related KPIs. At the corporate level, the company reports annual indicators in this area, and, as one interviewee explained, "in order to align the work, the decision was made to certify ourselves under the Clean Industry program" (RA1). Senior management decided to join the program "first to ensure regulatory compliance, and second because of our conviction that we are a company committed to caring for the environment" (RA1). Since participating in the program, the company has implemented a range of measures, including tighter controls across its operations. It now monitors water pollution not only to comply with oversight from the State Water Commission (CEA), but also to ensure that discharge parameters remain within permitted limits.

The company has upgraded its lighting systems by installing LED fixtures and motion sensors in office areas, replaced older air-conditioning units that used R-22 gas—harmful to the ozone layer—with systems that use more environmentally friendly refrigerants permitted under Mexican standards, and installed dry urinals and a 5,000-liter water storage tank to supply water for use by an external party.

The company is currently certified at Level I and has expressed interest in progressing to Level II, but:

> "We haven't really had the support to identify what we're missing. It's something we asked about at the time—we wanted to move up to the next level—but the reality is that my day-to-day responsibilities haven't allowed me to follow up on it as closely as I would have liked" (RA1).

On the other hand, several noteworthy themes emerge from the responses of interviewees whose companies do not participate in the Environmental Audit Program. ISO 14001 is clearly preferred, first because it is required by customers and second because it is the most widely recognized and useful standard at the international level.

From the perspective of environmental managers, participation in the Environmental Audit Program is neither mandatory nor necessary. Instead, it is seen as an additional expense—something that enhances visibility or provides extra recognition but also entails more work. While this effort can be worthwhile for identifying areas for improvement and, importantly, for earning a distinction that increases recognition and strengthens brand positioning, it is not viewed as essential.

Table 3.*7. Comments from companies that are not part of the Environmental Audit Program*

Company	***Comments on the Environmental Audit Program***
Company 2	"The idea would be to see what the program actually requires from us and whether it covers aspects that ISO doesn't. Another point is having an additional certification that we could even promote to our customers: We have ISO, IATF, and we're also certified as Clean Industry. That could be a selling point." (RA2)
Company3	"To be honest, we're not interested because it's extra work that doesn't really give us anything in return. If I go through Clean Industry, what's the benefit? Basically none, because ISO 14001 is more demanding. So the answer was: no, I don't want to take that on right now. With ISO 14001, I keep both corporate and the customer satisfied. Clean Industry just feels like sticking your neck out." (RA3)
Company 4	"When something isn't a customer requirement, it tends to get pushed aside because it's not mandatory at that point. If we were to look into it and really understand the benefits of Clean Industry, we might find something attractive. But if it were a customer requirement, someone on our team would have already analyzed it and implemented it." (RA4)
Company 5	"So far, none of our customers have asked for it. The quality engineer is very aware of the requirements that come up on a daily basis. In practical terms, Clean Industry is just a little extra star." (RA6)
Company 6	"We don't have the Clean Industry certification. Honestly, our Management System takes us much further. We don't have any plans to pursue it. From what I understand, it's somewhat redundant with ISO 14001. It requires a significant investment of both time and resources, since you need a certain budget to get certified. And, in the end, I can say that our Management System fully complies with ISO 14001 and actually goes beyond what Clean Industry requires. I respect the companies that go through the process, but essentially, it's very similar to ISO 14001." (RA7)
Company 7	"We're not part of the program yet. We haven't really considered joining; it could be useful, perhaps, for the legal compliance benefits. It was proposed to management at one point, but since everything was already covered by ISO 14001, it wasn't seen as a priority. I think ISO is slightly more demanding than the Clean Industry Program. That said, having an additional form of recognition is always positive." (RA8)
Company 8	"We've looked into it, but since we're already ISO 14001 certified, we don't see it as necessary because we already comply with everything PROFEPA requires. And, as you know, their audit is a headache… [the interviewee pauses without finishing the word 'expense']. In the end, even though they say the program is free, it really isn't. It costs around 350,000 pesos, which is very similar to the cost of ISO 14001. For that reason, the group decided not to join the Clean Industry Program, since we already have an environmental certification that backs us up and, in a way, protects us." (RA11)

Source: Own elaboration.

Understanding the perspective of environmental auditors is particularly important, as they are the actors who visit industrial plants, interact directly with environmental managers, and issue the reports that document the results of environmental audits. Their position—situated between the environmental authority and the companies—combined with the need for in-depth, first-hand knowledge of both current environmental legislation and the internal operations of the facilities they audit, makes their experiences especially relevant for the purposes of this study.

Environmental verification units are accredited by the Mexican Accreditation Entity (EMA). This arrangement means that PROFEPA no longer acts as both judge and jury in the process of granting environmental certifications such as the Clean Industry certificate; in the early years of the program, the agency itself was responsible for both auditing and issuing certifications. Under the current system, verification units are subject to annual surveillance assessments conducted by a third party—another EMA-designated verification unit—which reviews their audit reports. When irregularities are detected, such as false information, the use of outdated regulations, or conflicts of interest, an investigation is initiated that may lead to the suspension or cancellation of the unit's accreditation. Through this mechanism, the EMA seeks to ensure the reliability and technical integrity of environmental verification units nationwide.

What has been the experience of the environmental auditors interviewed with the auto parts sector in Querétaro? In their view:

> it is perhaps the industry most engaged with environmental issues. Auto parts companies rigorously enforce the requirements imposed by automakers, which seek to ensure compliance with environmental standards throughout the entire supply chain. For these firms, quality management systems and environmental management systems are equally important. In Querétaro, auto parts manufacturers generally hold ISO 14001 certification, and many also pursue PROFEPA certification—according to the auditors—because it is required by their corporate headquarters. As one auditor put it, "They are, honestly, very responsible companies" (V2).

Unlike other, more "complex" states in the country—particularly in their interactions with environmental authorities—Querétaro is seen as a "well-behaved state that provides facilities and is very supportive" (V4). By contrast, in the neighboring state of Guanajuato, companies often complain that environmental procedures and processing times are far more cumbersome. As one auditor explained, "The rules are the same, but the way they are evaluated, enforced, and monitored is very different. Guanajuato has a large number of technical regulations; of all the states we have worked in—Querétaro, Guanajuato, the State of Mexico, Baja California, and Veracruz—it is the one with the most regulations" (V2). Another interviewee added that "the environmental authority there is very imposing in the way it operates" (V4). They do not identify any environmental problems that clearly stand out in this sector. However, they note that some companies pose greater risks because of the chemicals they handle and the waste they generate—risks that are not always communicated in advance. One engineer (V3), for example, mentioned a company that uses sulfur hexafluoride (SF_6)[5] in its casting processes for steering wheel manufacturing. This example highlights that, although the auto parts industry is generally not considered highly polluting, there is considerable diversity in the products and processes involved.

Auditors also point out that, over the past five years, several companies have made significant efforts to reduce energy consumption, such as purchasing electricity from wind farms or investing in cogeneration. As one auditor explained, these measures are often adopted "not for environmental reasons but for economic ones, although they still result in reductions in CO_2 emissions" (V2).

From the auditors' perspective, the Environmental Audit Program is more demanding than ISO 14001, as it seeks the genuine implementation of an environmental management system and requires concrete evidence of compliance, rather than mere commitments or intentions to improve.

> Right now, we are about to start an audit of a huge auto parts company (it's a complex). They have just been recertified in ISO 14001, but the plant is in a

[5] Greenhouse gas with the highest global warming potential recorded by the IPCC and a lifetime in the atmosphere of 3,200 years (Flores et al., 2012).

> sorry state. We did a pre-audit last year and there are areas with environmental liabilities. They need to update all their paperwork and generate a lot of documentation... But they've already been recertified under ISO 14001! (V2).

While they acknowledge that ISO 14001 is a positive step and that obtaining it gives companies a significant head start, they also emphasize that environmental auditing goes further. At Level I, it certifies compliance with all applicable legal requirements, and at Level II, it validates self-regulation commitments across all areas. In addition, it brings non-regulated aspects under control and confirms that an environmental management system is not only in place but actively operating.

> The vast majority of companies want the certificate mainly so they can show it to the authorities and to society. So far, I haven't seen any real competitive advantage to reaching Level II. Perhaps—just as an example—if companies could pay one percentage point less in income tax, they might say, "Okay, now it makes sense to go for Level II." (V4)

According to this auditor, companies in different sectors that move on to Level II generally do so more "because of encouragement from the attorney general's office than out of genuine conviction" (V4). One of the aspects that often proves most challenging when companies begin the Clean Industry certification process—which can take between eight and ten months—is identifying the environmental aspects of each material and their associated impacts and then determining which of these are most significant so that compliance goals and improvement objectives can be defined.

Although large and/or transnational companies are generally under greater pressure to have a functioning and certified environmental management system—and also have more tools to achieve it (such as financial and human resources, contacts, access to technology, and dedicated environmental staff)—this does not mean that they automatically perform better. In some cases, Tier 2 or Tier 3 suppliers maintain solid environmental performance, while in Tier 1 companies it is still possible to find environmental aspects that, given the resources at their disposal, one would not expect to see.

Once again—this time from the perspective of environmental auditors—the need to update key regulations becomes evident. Auditors point, for example, to the two lists of high-risk activities[6] issued in the 1990s and to NOM-053-SEMARNAT-1993, as well as to the lack of specific regulations on volatile organic compounds (VOCs). In such cases, even when a company is technically within permitted limits—or when no limits exist at all—the auditor can still identify opportunities to improve environmental performance and recommend concrete actions. Doing so requires calculating emissions, comparing the plant's performance, and proposing internal control mechanisms. Unfortunately, this is not always carried out in practice, which means that a company may obtain the Clean Industry certificate without having all the necessary elements to achieve the level of improvement it should.

> It often happens that when an auditor asks to see a previous report prepared by a colleague, they realize there is actually nothing of substance in it. In fact, it is not uncommon for auditors to request an earlier report and simply change the date and the company name. But that completely misses the point—the workplace has to be evaluated properly. (V4)

From the companies' side, there are also cases where they "receive the report and just file it away. They only care about whether they complied or not, and that's it. Or they pull out three pages from the action plan and stop there" (V4). From one engineer's perspective, the challenge is to make it clear that environmental performance is a business condition, and that an environmental audit "has to pay for itself":

> When we manage to explain to company shareholders that failing to meet environmental requirements actually hurts the business, that's when they start to act or give clear instructions to make management systems work. Right now, it's often seen as: *Oh, it's just another requirement. But when you tell them, if you have a management system, your business becomes more profitable in terms of safety and environmental performance because it pushes you*

[6] Defined as those that handle hazardous substances in a volume equal to or greater than the reportable quantity and those that handle flammable and explosive substances.

> *to innovate, reduce materials, lower risks, and so on, then they say: Ah, okay—then let's do it.* Because in the end, that helps prevent disruptions to operations. Ultimately, everything an industry does is driven by profit. (V4)

This statement brings a new—though somewhat diffuse—actor into the discussion: the shareholder, understood as a stakeholder primarily concerned with profit. Economic profit becomes a key parameter guiding decision-making. While economic considerations are indeed part of the concept of sustainability, environmental and social dimensions are equally fundamental. In practice, however, as the interviewees repeatedly note, these latter dimensions tend to be subordinated to economic ones, under the logic of economic rationality (Leff, 2006) that governs markets and society.

It can therefore be said that companies do not deny or ignore the need to take actions to improve their environmental management, and that such actions may even be innovative, technically sound, and socially ambitious. Nevertheless, they remain constrained and shaped by what those actions represent in economic terms.

> The vast majority of companies join the Environmental Audit Program—some of them genuinely convinced—saying something like: *"Look, this will benefit me, and it will also keep these guys at PROFEPA satisfied"*. The idea behind their participation is that, over time, they will see for themselves that the program brings productive benefits, that it makes economic sense, and that, at the same time, it helps improve environmental and safety conditions. (V4)

It is worth returning to the last expression: *in parallel*. Indeed, rather than the three circles of sustainability (economy, environment, and society) intersecting and interacting, as they ideally should within a business logic, what tends to emerge is an attempt to keep these dimensions running in parallel, along different tracks and at different speeds (for example, economic–administrative time versus the time of the environmental and climate emergency). Although complex reality does not operate in this way, the illusion of a humanity separated from nature—one that can be managed and from which profits can be extracted (economic, reputational, or competitive)—leads some companies to "join for convenience" (AG7), often after

receiving a fine as a result of an inspection process. Even so, "much depends on the company, the corporate office, and the executives. What they tell us is that certifications give them a good image" (AG7).

Drawing on more than fifteen years of experience as former deputy delegate of Environmental Auditing at PROFEPA, she explains that, particularly when dealing with directors or managers, it is essential to present the issue in numerical terms in order to obtain authorization to join the Clean Industry program: showing potential savings, the costs of continuing current practices, and the economic benefits that could result from improvements, since "they are very interested in the cost–benefit ratio" (AG6). After 17 years of interviewing company managers and CEOs, the question becomes direct: what actually made their eyes light up when the Environmental Audit Program was explained to them? "The savings—the economic benefits. We told them that if a violation of environmental regulations led to penalties or even a shutdown, it could jeopardize a commercial agreement with a customer" (AG6). The environmental coordinator of the Nuevo León automotive cluster observes the same dynamic in that state: "Yes, in many cases, it's really a sales issue—what are they going to save? We have to generate value. The leader or person responsible for sustainability has to find a way to sell the project, to communicate why internal sustainability matters" (CA3).

Automotive companies operating within this economic system tend to follow a logic of *$ustainability* rather than sustainability in the full sense of the term. From this perspective, it is not surprising that environmental coordinators often fall short—or fail altogether—of linking the three pillars of sustainability (environmental, social, and economic) simultaneously, as doing so would inevitably open a direct discussion about Corporate Social Responsibility, a topic that was notably absent from their responses. This limitation became evident during an interview with one respondent, who remarked: "Although automakers claim to support 'social responsibility,' each of them is rolling out electric vehicles alongside combustion engines" (AG1).

As he made this statement, the official raised both hands from the desk to chest level and pronounced the words "social responsibility" while flexing his index and middle fingers twice, forming air quotes—using nonverbal language to signal a different, more skeptical register in his speech. In this

sense, socially responsible organizational behavior remains a pending issue within the sector.

It is worth emphasizing that, beyond these structural pressures—where economic considerations prevail and remain embedded in a paradigm of human exceptionalism, far from any truly disruptive shift—ethically grounded, honest, motivated, and supportive individual and collective environmental actions continue to emerge. This is precisely what this document seeks to capture, illustrate, and bring to light. Even as the current economic system and its prevailing economic rationality persist in their damaging logic, there are still decisions and actions taken by individuals that make a real difference, some of them profoundly so.

Undoubtedly, there are people—shareholders, directors, managers, environmental coordinators, middle managers, employees, operators, and workers—whose leadership styles, education, habits, concerns, pro-environmental behaviors, perceptions, desire for transcendence, personal histories, emotions, and even aesthetic sensibilities drive them to do everything within their reach to ensure that their work within companies and within the automotive sector has a positive environmental impact, with tangible consequences for mitigation and adaptation. As the former deputy delegate for Environmental Auditing explains, for a company to decide to participate in the program, "I think we have to try to talk to the right person. You have to reach out to people who have vision. Someone else might say, 'No—on top of my twenty other tasks, I also have to do this? No thanks'" (AG6), a reaction that was echoed during the course of the investigation (RA3). Even in the face of structural pressures, the right people within companies—because of their subjectivity, training, relationships, position in the hierarchy, motivation, or personal vision—can have the ability and the opportunity to make a substantial difference in environmental management.

The challenge, of course, is that the "right person" is different in each organization, and their room for maneuver also varies, depending in turn on other actors and structures. Each plant, moreover, is a configuration in motion.

3.10 ISO 14001 Certification

Many of the ideas discussed in the previous section also apply to this one, which focuses on the ISO 14001 standard. The main reason companies decide to pursue certification under the international ISO 14001 standard is the need to have it in order to sell—and, therefore, to secure economic benefits in a highly competitive market. In this sense, certification becomes a market requirement that also serves to demonstrate and legitimize an environmental commitment. In this study, six of the eight companies visited already held ISO 14001 certification, and one additional company (Company 5) had already received a customer requirement to begin the certification process.

The key finding is that ISO 14001 certification does not necessarily guarantee an improvement in a company's environmental performance. Based on the experience of environmental auditors and their ongoing visits to auto parts facilities in Querétaro, as long as companies can provide evidence that their environmental management system is in place and functioning—such as conducting internal audits, training staff, setting goals that may not have existed previously, developing implementation programs, and reviewing unmet objectives—it is relatively easy for them to obtain certification:

> I've seen companies here in Querétaro that are ISO 14001 certified and still don't even know where their wastewater goes. They lack basic waste-management controls and other fundamental practices. What tends to happen is that automotive companies—and companies in all sectors—that are not used to maintaining a standard treat the audit as a one-off event: they know an audit is coming, so they prepare for it a week in advance. Once the auditor leaves, everything goes back to the way it was. I've been in automotive plants where, the moment you walk in, you can see that the tanks aren't even labeled. And you think, how is that possible? And you have ISO 14001? It doesn't make sense that, during an environmental audit, I'm seeing that some issues haven't even been considered. At that point, I'm not evaluating the system anymore—I'm evaluating what they actually manage. (V2)

For auditors, the fact that a company holds ISO 14001 certification indicates what the organization says it will do to move toward full compliance over time. It also shows who is responsible for implementing and reviewing procedures, how often this will happen, and how these actions are documented through records and formal processes. However, as one auditor points out, "they are not actually required to achieve 100% compliance right away; they are expected to work toward it over time. Of course, they must know everything that applies to them and have the necessary documentation in order, but when will they reach full compliance? As an improvement system, that is always left for the future" (V2)—a future, one might add, shaped by economic and administrative uncertainty.

Another auditor notes that there are auto parts companies he has visited that meet automakers' requirements by holding ISO 14001 certification, nevertheless:

> What did we find when we audited a company that already had an environmental management system, compared with one that didn't? At first glance, you would expect the former to be much stronger in terms of regulatory compliance, but that wasn't the case. During the audits, we identified findings that even the company's own system had not taken into account. In other words, ISO—the environmental management system used by automakers—is no guarantee that a company is actually complying with environmental regulations here in Mexico (V3).

What he has observed is that, at times, even ISO auditors themselves do not have a solid grasp of current federal and local environmental regulations, which "are enormous—a vast and complex universe—which is why accreditation as an environmental auditor is the most demanding process within the EMA" (V3). In other cases, auditors may simply lack sufficient technical expertise. As a result, their focus tends to be limited to verifying that the system functions on paper: conducting management reviews, internal audits, staff training, implementing established programs, and reassessing previous objectives. In other words, they confirm that the management sys-

tem works, even if this does not necessarily translate into improved environmental performance.

As one auditor explains: "As long as the system works, the company is certified under ISO 14001. They can even walk into a warehouse and see that the spill containment pit is dirty, make a note saying 'clean it up,' and that's it. But that is a long way from the level of legal compliance required by PROFEPA for Clean Industry certification" (V2). A PROFEPA sub-delegate reinforces this point, noting that ISO certification does not necessarily guarantee compliance with legal requirements because "it is independent" of regulatory enforcement (AG7). An audit engineer echoes this view, pointing out that during an ISO 14001 review, companies must declare which legal requirements apply to them; if auditors can confirm that these declarations are accurate, the process moves forward. However, there are cases in which auditors are unaware of certain requirements, or companies fail to declare obligations that they are, in fact, required to meet:

> What will the company do if it is found to be in breach of a legal obligation? Say: "Oh, well, I'll include it and I swear that within a year or two I'll meet the requirement". At that point, ISO 14001 certification proceeds, with plans, objectives, and targets. Not so with Clean Industry: in this program, you don't have to make promises, you have to comply with the legal requirement. (V4)

For this very reason, when a company begins the ISO 14001 certification process and is already participating in the Clean Industry program, it can simply present its PROFEPA certificate, and the legal compliance component is largely taken as validated, since the Environmental Audit Program allows for "more detailed verification—down to the fine print—to ensure that regulations are actually being met" (AG6). By contrast, companies can obtain ISO 14001 certification without necessarily having the controls they should, operating under the logic of: "We got the certificate, and that's it—now let's focus on production" (AG6).

A company may manufacture a high-quality product (ISO 9001), but that does not mean it manages environmental issues in the best possible way—even if it also holds ISO 14001 certification. Closing this gap therefore becomes essential, and this is precisely where environmental auditing could

play a key role. Ideally, auto parts manufacturers in the state should both hold and comply with ISO 14001 and Clean Industry standards, a position shared by the environmental coordinator of the Nuevo León automotive cluster:

> I think it's both important and necessary to have both certifications because they complement each other. There is a clear difference: Clean Industry focuses on full legal compliance and goes further than ISO 14001 by actually requiring continuous improvement. I've been involved in Clean Industry processes, and they really go through everything in detail, verifying that you truly comply and that the controls are actually in place. Ideally, all plants should have both certifications. We know that even though the Clean Industry process with PROFEPA is free, there are still costs that companies have to absorb, but in my view, it's worth it. (CA3)

Although several studies point to a positive influence of the ISO 14001 standard on corporate environmental performance (Erauskin et al., 2019), there is also evidence that certification can serve as a way for companies to engage in symbolic environmental behavior. According to Ferrón (2017, p. 35), this term refers to "the adoption of advanced corporate management practices with the aim of legitimizing corporate actions, without producing significant improvements in environmental performance." In her analysis of an international sample of 1,961 industrial business units with more than 50 employees across manufacturing sectors in Germany, Canada, the United States, France, Hungary, Japan, and Norway, the author finds that her results:

> […] contribute to the existing literature on the symbolic adoption of ISO 14001 (Aravind and Christmann, 2011; Castka and Prajogo, 2013; Iatridis and Kesidou, 2016; Yin and Schneider, 2009), showing that the more symbolic a company's environmental behavior, the greater the likelihood that it will adopt ISO 14001. (Ferrón, 2017, p. 37)

From the industry perspective, the experiences of environmental managers with ISO 14001 certification and recertification suggest that the 2015 version

of the standard has several positive features, particularly greater involvement from senior management, increased attention to organizational context (such as neighboring companies, universities, and other stakeholders), and a stronger emphasis on product life cycles. At the same time, environmental managers face significant pressure to obtain and maintain certification, as many businesses depend on it. There is also broad agreement that ISO 14001 certification does not necessarily guarantee strong environmental performance.

Table 3.*8. Comments from the companies on the ISO 14001 standard.*

Company	***Comment***
Company 3	"A customer tells me: *If I'm going to buy from you, you have to show me your ISO 14001 certificate; otherwise, there's no deal.* Every year we worry about recertification because we don't want to lose the business. And yes, it's also important to us because, by nature, we care about the environment" (RA3).
Company 4	"I think it's very appropriate because, in the end, it tells you: *comply with legal requirements*, and then it tells you: *comply with your own procedures*. And within those procedures, you have to think about prevention and how your activities affect the environment. You decide how much time you give yourself and how far you push—depending on what your organization can handle. It fits well with environmental needs and with our reality and location" (RA4).
Company 5	"One of our advisors told me that it's much easier to get ISO 14001 than Clean Industry" (RA6).
Company 6	"As a Tier 1 company, we do have customers who say: *If you don't have this certification, I won't give you any work*. Having ISO 14001 doesn't guarantee that you won't pollute—I agree with that. ISO 14001 doesn't require environmental projects; it focuses on operational controls" (RA7).
Company 7	"With ISO 14001, there isn't much interaction with the authorities; with Clean Industry, on the other hand, you work closely with them" (RA8). "At first, our staff didn't really understand the importance of legal requirements. Through the ISO 14001 process, they finally became aware of where we were falling short in terms of compliance—what we need to do, how often, and in which month we have to submit things" (RA9).
Company 8	"So far, I don't know of any company with ISO 14001 that's in complete disarray. As the person responsible for environmental issues, I can't allow us to lose this certification because, even though it isn't mandatory, there are customers who require us to have Clean Industry certification to make sure that the products we sell them don't contain hazardous or prohibited substances, like lead" (RA11). "If you're measuring NOx and COx emissions, that's basically enough, because in reality there's no standard that sets a maximum permissible limit for them. With particulate emissions, where there is a standard, you have to verify: this is the limit, and this is your result. As long as you don't exceed it, you're fine. If you do, then there's a problem. Internally, we can set stricter targets and say: this year the legal limit is 500—just to use a number—but we don't want to go over 200. That's an internal goal you manage within the plant. From an auditing perspective, as long as you comply with the law, everything is considered acceptable" (RA12).

Source: Own elaboration.

Environmental management is connected to environmental innovation in different ways, some stronger than others. The following section explores how this relationship plays out within the configuration examined in this study.

3.11 Environmental Innovation

According to the three stages of environmental evolution proposed by García (2011), the plants visited are currently positioned in stages I (regulatory compliance) and II (manufacturing control with export platforms). For instance, Company 7 is in stage I, as it has only recently implemented its environmental management system and obtained ISO 14001 certification—a milestone that García identifies as critical for a plant's transition into stage II. Given that its environmental management system is still in its early stages, environmental innovation is seen as a distant objective, particularly due to budget constraints:

> As an environmental manager, what matters to me—even more than environmental innovation—is first having all our environmental aspects under control: complying with legal requirements and getting the basics right. Once we have a system that is well implemented and properly controlled, innovations will probably emerge, especially those that help reduce costs. At the moment, the only innovation we have in place is the installation of solar panels, and in my view, further innovation is unlikely in the short term. The priority now is to establish the system, ensure it is stable and well managed, and only then move on to the next step. Simply having an environmental management system does not mean we need to start making improvements right away; the first step is control. (RA8)

To illustrate stage II, we can look at Company 2, where they are working on "how to make sure hazardous waste is no longer so wet, and what we can do with it—or with everything we remove from the plant—to reuse it or give it some other use" (RA2). At this plant, corporate authorization is only required when the investment for innovation activities exceeds one hundred

thousand Mexican pesos.

At Company 3, efforts are focused on achieving the co-processing of all waste, a goal that has not yet been fully realized, partly because the supplier has proposed different options for handling the waste and also because:

> Sometimes the limitation is the technology available in the country. We are a developing country that is still catching up. What is possible in Europe is not always feasible in Mexico. Even so, we make a strong effort to see what can be done, and I am constantly looking for options to co-process materials. (RA3)

No evidence was found that any of the plants have reached stage III. At Company 4, innovation is described as happening "more at the corporate level, involving larger changes" (RA4). One interviewee mentions that, in this respect, in Mexico:

> There is still a long road ahead. Innovation is taking place, but mostly at the university and prototype level. We need to keep pushing forward so that Mexican talent can move beyond its well-known strength in manufacturing toward the creation of applied, real-world innovation—and so that this innovation can ultimately reach the market. (B5)

The *Oslo Manual* (2018, p. 47) states that for a new idea, model, method, or prototype to be considered an innovation, it must actually be implemented.

At the plant level, while Company 1, for example, is carrying out several research projects in Germany in response to the growing adoption of electric vehicles, a union leader in Querétaro observes that there is a significant innovation effort in the state, particularly among companies that bring their own innovation centers. However, he notes that "they are the ones who keep the patents—that's the problem" (V5).

An advisor to the Querétaro Automotive Cluster raises a similar concern: "If we talk about Mexico, how many auto parts companies have their own engineering? You can count them on the fingers of one hand: Tremec, Metalsa, Rassini, maybe one or two more, and that's it. We don't really develop innovation or engineering" (CA2). There are only a few companies

with national capital developing electric vehicles (e.g., LEO-RDA, Zacua), and when they do, they face challenges precisely because of the lack of a strong innovation culture in the country (CP6).

For a federal official and advisor on Science, Technology, and Innovation to the President of the Republic: Mexico is an automotive powerhouse, but the industry urgently needs to adapt to a new reality and a new industrial revolution, as change in this field is happening very rapidly. He argues that the country must invest more in research and development and rely less on manufacturing (CP4).

Another federal official connected to the automotive industry, in this case from the Ministry of Economy, notes that Mexico has placed particular emphasis on attracting research and development centers. When an automaker or automotive supplier sets up operations, the message is clear: *don't just come to assemble vehicles—bring new processes, transfer technology, and help train engineers, especially at the upper-middle level* (AG1).

Mexico—and Querétaro in particular—occupies a very important position within the automotive industry, one of the most globalized and dynamic sectors in the world. However, this position also faces clear obstacles and limits in other areas. One of them is the possibility that environmental innovation might reach the third stage proposed by García (2015), which would involve incorporating product design and life-cycle considerations. What we find instead is that environmental innovation does not receive the importance, resources, or autonomy it should have within company strategies in the Querétaro auto parts sector. Rather, plants are largely focused on following instructions, or on receiving information, technologies, and products from their parent companies. Their room for maneuver in terms of innovation is not non-existent—indeed, it could be much greater than in other sectors—but it is constrained by the lack of investment in research, development, and innovation at the local level, investment that would be necessary to match the region's strong production capacity and to foster Mexican engineering, which remains limited.

It is therefore not surprising that this limited capacity for innovation is also reflected in universities and in public and private research centers. With a few notable exceptions—such as the UNAM High Technology Unit, the Center for Engineering and Industrial Development (Cidesi), and the Carso

Research and Development Center (Cidec), all located in Querétaro—research and development for the automotive industry lacks the resources, capabilities, and networks needed to advance more rapidly. It is telling that, without exception, all eight companies visited pointed to the need for stronger links with universities and agreed that establishing or deepening these collaborations would be highly beneficial.

The Polytechnic University of Querétaro (UPQ), for example, began offering a degree in Automotive Technology Engineering in September 2016. Within six months of graduation, 80% of its graduates are already employed (B3). Since October 2015, the university has also offered a degree in Automotive Mechanical Engineering. While UPQ does address environmental issues—such as treating them as a cross-cutting theme in its programs, participating in research projects led by faculty, competing in initiatives like Cleantech Challenge Mexico, carrying out student-led materials recycling projects, offering courses related to sustainability and the environment, and installing solar panels at school bus stops—these issues are acknowledged as "not a priority" (B3).

Faculty members who previously worked in the auto parts industry note that environmental concerns have gained momentum, particularly since 2007–2009. However, they also point out that even when companies are willing to implement environmental management systems, they often lack the financial resources to do so. This typically changes only when certification is required by a customer.

An executive from UNAM's High Technology Unit at the Juriquilla campus in Querétaro points out that everything humans design—directly or indirectly—has an environmental impact, and that "the only thing you can do as an engineer is to strive for a better world: greener, more socially responsible products, services, and processes" (B1). He adds that being green can also be good business:

> We cannot ignore the fact that the means of production, development, and the technologies we use are in private hands; in the end, this is capitalism. The means of production and the manufacturing of what we design are in the hands of companies—or the government—which, of course, must generate jobs and make a profit, and that is not a bad thing. (B1)

One obstacle to innovation that he highlights—and that should not be overlooked—is the difficulty of supporting initiatives that are simply not convenient: "There are many very good ideas from academics and researchers that end up sitting on a shelf, in a thesis, or in an archive because they are not politically convenient. They are not timely, and they do not align with particular interests." (B1).

We therefore see a highly important automotive industry whose capacity for innovation remains constrained, particularly in areas such as research, product design, and life cycle thinking. This limitation is also reflected in the interviews: among all the topics discussed at the plants visited, this was one to which environmental managers devoted the least attention. Eco-innovation[7] appears to face an "eco-limitation," in terms of both budget and the real possibilities for environmental change grounded in science, research, and technology at the scale and speed required. In other words, despite its undeniable strengths at the regional, national, and international levels—and the efforts of some companies and research centers—scientific, technological, and innovative development in Querétaro's automotive industry seems to have reached an eco-innovation ceiling. This structural limit on the sector's potential becomes evident in several ways: a low number of registered patents, scarce economic resources, a tendency to frame innovation without prior knowledge generation, a narrow focus on incremental changes in production processes, and weak links with public universities in the state, among others.

The challenge for Mexico to rank among the top five countries in automotive innovation—just as it already does in vehicle production—is enormous. Meeting it will require the coordinated involvement of key players in the auto parts sector: universities and research centers, government, and industry. In other words, it will depend on the effective collaboration of the actors that make up the triple helix on which the Querétaro automotive cluster is based.

[7] The term is used as a synonym for environmental innovation.

3.12 The Querétaro Automotive Cluster

The Querétaro Automotive Cluster was established in June 2013 with twelve companies, two universities, a research center, and the state government. It was created under an industry–academia–government collaboration model that brings together technical schools and universities, the state government, OEMs, Tier 1 and Tier 2 companies, and research and development centers. As the fourth cluster formed in the state[8], its aim is to build "trust-based links that will guide the automotive sector toward a promising future" and to promote "greater competitiveness in the regional automotive sector through projects and actions involving leading companies in the state, universities, community stakeholders, and the state government" (Querétaro Automotive Cluster, 2025).

The cluster is governed by an eleven-member board of directors made up of a president, vice president, secretary, treasurer, and seven additional members. Engineer Daniel Hernández has served as director of the Querétaro Automotive Cluster since 2015 and has been involved since its early stages, when he was part of the government team that promoted the initiative.

At the time (2011–2012), the state government was asking what the next step should be after the strong push given to the auto parts industry in areas such as networking, bringing companies together, attracting projects, and developing training and certification programs. The answer was clustering, based on the principle of company-to-company cooperation and the identification and joint solution of shared problems. As Hernández explains, "We looked at what was being done in Europe and in other states in Mexico, and from there we tried to develop a model that could be applied to local companies. It is a model based on cooperation and, above all, on generating results" (CA1).

One of the main challenges in establishing the cluster association—"because clusters already exist; they are not invented" (CA1)—was dealing

[8] Eight clusters have been formed within the state: the first (information and communication technologies) was formed in March 2006, followed by aeronautics (November 2012), biotechnology (November 2012), and automotive (June 2013). By 2025, there will be a total of eight, with two more planned.

with legal and governance issues, particularly in a sector dominated by large foreign companies, "where final decisions are often made elsewhere, not in Querétaro" (CA1). Once this hurdle was cleared, the cluster was formally established in June 2013. Its consolidation and the positive results achieved so far are largely attributed to "a very solid governance structure, which is the key to making this work" (CA1). As he explains, this structure underpins participation, shared responsibility, and commitment—both to the people involved and to the goals that are set. In this sense, the number of members matters less than "the results we are able to generate" (CA1). At the same time, he stresses that "each cluster is different, each one emerges from a different reality, and each region has its own context" (CA1), even though they share common objectives. This perspective helped position the Querétaro cluster as one of the drivers behind the creation of the Mexican Automotive Cluster Network.

The scope of the cluster's work has expanded over time. The number of committees grew from six in 2020 to nine in 2025: supplier development, operational excellence, human capital, industrial safety, property security, TR2, innovation, training, and environmental sustainability. The environmental sustainability committee, created in 2021, became the platform from which work began on implementing a Circular Economy System in the state of Querétaro. This effort followed an invitation from the Undersecretary of the Environment of SEDESU for the automotive sector to pilot the initiative, with the intention of later extending it to other sectors. For the president of the cluster, this initiative:

> This is giving us a competitive advantage over other states and countries, because in the future we simply won't be able to manufacture auto parts if we fail to comply with international agreements and regulations. Today, project approval is no longer driven by financial criteria alone; it requires both a financial and an environmental driver, working together to ensure the project's overall viability. (Becerril, 2022)

By 2025, the system had engaged nearly 300 companies in 370 decarbonization and circular economy projects across 25 economic sectors, with the ongoing aim of building "organizational capacities in the state to design

initiatives for cleaner production, process optimization, cost savings, and waste prevention" (Querétaro Circular Economy System, 2025). That same year, the system launched the *Circular Economy and Decarbonization Award*, featuring six categories: circular innovation and design, circularity in processes, decarbonization, circular value chains, ecosystem restoration, and circular social impact. One of its key objectives is to involve 1,000 actors in promoting business competitiveness through a range of projects by 2027.

Environmental issues are seen as "key and involving major technological challenges, particularly in the development of more efficient vehicles or those powered by alternative energy sources" (CA1). All clusters are aligned in their efforts to address this challenge in one way or another, by "facilitating access to knowledge, financing, know-how, training and workforce development, and the adoption of new technologies, among other actions" (CA1).

At the macro level, the focus is on reducing pollution from vehicles—a major challenge for automakers, especially in their innovation and R&D areas—while at the micro level, attention is placed on the technological challenges faced by suppliers. "That is where we have tried to lay the groundwork," notes CA1. In practice, this has included initiatives such as ISO 14001 training courses and coordination with environmental authorities to bring companies closer to the Clean Industry Program and raise awareness of its benefits, particularly in terms of competitiveness and cost savings.

Who has been driving environmental change in the industry? As one interviewee explains, "It is usually the automaker that pushes technological, material, and knowledge changes down through the different levels of the value chain; the automaker sets the standard. In the end, there may be regulations, but if manufacturers do not work to comply with them, nothing will be achieved" (CA1).

This is largely because OEMs are under intense pressure, both from traditional competitors and from new entrants such as Tesla, Google, and Apple, in an increasingly demanding market. They are also responding to shifts in consumption patterns that, in some cases, have led companies to engage in illegal practices or cheating, as discussed in the introduction to this document. The precedent set by the Volkswagen scandal in 2015, according to CA1, "will force companies to align their efforts properly, because

that is how the market is behaving. The market will push them to become increasingly efficient, competitive, and environmentally friendly."

Are there illegal practices related to environmental issues in local industry? According to the director of the Querétaro cluster, there may be isolated cases, but overall, he believes that "there is significant oversight by the authorities" and "increasing compliance" with environmental regulations. In his view, companies are attracted to the state not because environmental laws are weakly enforced or because labor is cheap—"in Querétaro, wages are higher than in the rest of the region"—but rather because of "logistics, connectivity, quality of life, and the workforce that has been developed in Mexico, particularly in Querétaro, since the 1960s, along with the large number of universities we have."

Following Porter's theoretical framework (1999), clusters foster both competition and cooperation. This raises an important question: is there environmental cooperation within the local cluster, and if so, how is it being promoted and facilitated?

3.13 Environmental Cooperation

All of the interviewees from the companies agree that there is significant room to strengthen this kind of cooperation. One coordinator sums it up clearly:

> "There should definitely be more cooperation, and if you think about the future, there should be—but it doesn't really happen. We're not very innovative either. It always helps to hear other ideas and bring them into your own organization" (RA4).

Beginning in the second half of 2018, the cluster started to schedule monthly cross-audits on safety among its member companies, which—until the pandemic—were carried out on a regular basis:

> "There were times when we identified environmental issues. […] And that was basically the only kind of support we could say we received from other

> companies through the cluster. As you mentioned, there really wasn't any additional support beyond that. It was more like: 'Hey, does anyone know a supplier for this?'—and that was it" (RA2).

From the professional experience of the sustainability committee in Nuevo León, a similar view emerges:

> "Sometimes sustainability doesn't carry as much weight as quality, customer service, or industrial safety, but it should never be sidelined […] It's very important that those responsible for environmental issues in the plants are able to go back to their companies and say, 'Hey, this is a good project—let's get involved'" (CA3).

Since 2019, the cluster has awarded a sustainability prize. As one interviewee explains, "Everyone who entered wanted to win. Even though they all have different processes, it's fair to say that it's a healthy competition, and they feel proud to showcase their projects at the meetings" (CA3).

Support within the Querétaro cluster often depends on the goodwill, willingness, and personal relationships of environmental managers with their peers. As one interviewee explains, "It really depends on personal disposition—on whether you're willing to give a colleague a hand. Fortunately, I've seen a good response from everyone involved" (RA6). Another puts it more simply: "I think it depends a lot on each individual" (RA7). An environmental auditor adds that even within the same corporate group, support is sometimes lacking because "there's a lot of jealousy" (V2). Once again, this highlights that no matter how many initiatives are launched or could be promoted—such as training, audits, forums, or networking groups—it is ultimately individuals who interpret them, give them meaning, and respond based on their own contexts, experiences, emotions, and personal dispositions.

We also found that collaboration varies widely—from within individual plants, to coordination with other plants in the same corporation, to interaction with companies in the same sector (not necessarily within the cluster), and even with neighboring facilities. In some cases, environmental managers are not informed by their own product development departments

about the materials being used—materials that may be hazardous or polluting—and only discover this to their surprise "once the part is already being produced, and it's like, 'Wait, since when have we been doing this?'" (RA1). Others report limited interaction with plants in the same sector in Querétaro. Even within the same corporate group, some acknowledge that there is room for stronger cooperation and greater support, particularly in working with customers:

> They are very open to us calling them and saying, "Hey, we're dealing with this issue—how do you handle it?" Sometimes the response is, "This is how we do it," and other times it's, "I'm not sure, let me look into it and get back to you." Overall, there seems to be a stronger culture of mutual support between clients and suppliers than among colleagues on the periphery or even within the same cluster (RA4).

In other cases, internal communication works very well. For example: in one instance, 30 tons of a product were manufactured that the customer ultimately did not want. The EHS team then contacted other plants to see if the material could be used elsewhere, preventing it from going to waste (the receiving plant covered the transportation costs). Similar arrangements have been made with other chemicals, for example by reallocating them to plants in Ireland or returning them to suppliers (RA3).

The environmental manager at Company 3 acknowledges that there is limited cooperation among auto parts companies in Querétaro, particularly when it comes to environmental risks associated with chemicals "that people or companies are not taking into account" (RA3) and about which they are often unwilling to share information. One example dates back to 2014, when a neighboring company dedicated to the collection and storage of hazardous industrial waste caught fire, affecting Company 3's plant and leaving five people injured. Drums from the neighboring facility were even thrown into Company 3's parking lot, yet the company had no information about the chemicals involved and therefore did not know whether they could be extinguished with water or required another response, such as sand.

In the industrial park where Company 2 is located, there was also "a nearby company that handled chromium; you would go over there and they would load it in complete disorder, and you didn't even know what it was because it wasn't identified" (RA2). Meanwhile, at Company 8, there is concern within the plant about providing support to both other facilities belonging to the same corporate group and to environmentally relevant suppliers, since if these actors are unaware of what they are handling or are managing things incorrectly—such as lacking an internal environmental program or not knowing how to mitigate certain environmental impacts—this can pose risks not only to themselves but also to neighboring companies:

> I go and train them—and do you know why? Because they are our partners. If we don't take care of them, sooner or later their actions will affect us. Environmental regulations are very clear about this: you are jointly responsible for the impacts. So I have to make sure they don't end up affecting us. I've gone to help friends in other companies by giving courses. When I attend regulatory training, I meet people from other firms, we exchange contacts, and I've gone out to support them on behalf of this company, at no cost. I tell them, "Sure, no problem." I send them information by email, explain how to start their system, and basically provide free consulting to other companies. (RA11)

This kind of support—very much in line with the spirit of the standard and the idea of a green supply chain—takes the form of a personal initiative on the part of the environmental manager. It originates with him and ultimately depends on his willingness to act. He himself frames it this way, noting that someone else in his position (with less time, motivation, or enthusiasm) might say they would like to help more or even visit other plants, but could just as easily find a reason not to—such as workload or travel constraints:

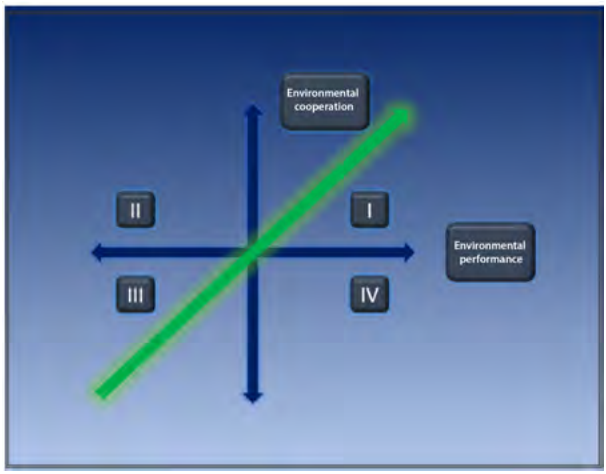
> "Yes, it depends on me. It's a very personal decision. I go with friends from other plants, and they introduce me to their people. They know I'm from here, and I'm wearing my company shirt with the logo. Of course, I let my

manager know: 'Hey, I've been invited to visit such-and-such company.' And he knows that I'm going there to do a review, as a form of support." (RA11)

With respect to industrial parks, Company 6, for example, is the one that engages in the greatest level of cooperation outside its own organization. This takes place through a working group that produces a biannual report and carries out follow-up activities. Within the company itself—which holds an annual meeting with all its plants in Mexico, the United States, and Canada—cross-audits are also conducted to review the management system, with the aim of "seeing opportunities with fresh eyes" (RA7). By contrast, the industrial park in which Company 7 is located does not yet have environmental working groups, only safety-related ones (RA8).

These findings point to significant opportunities for both the cluster and companies in the sector to improve their environmental performance by strengthening environmental cooperation. All plants collaborate with some organizations, while cooperation with others is limited or non-existent, indicating a clear area for further development. The results also make it possible to construct a map of environmental performance and environmental cooperation, which could help companies identify their current position and chart pathways for improvement.

Figure 3.*1. Environmental performance— environmental cooperation*



Source: Own elaboration.

Scenario I: Good environmental performance with strong environmental cooperation.

In this scenario, companies in the automotive and auto parts industry have implemented environmental management systems or programs that clearly reflect their commitment to environmental issues and translate into measurable outcomes. They certify these systems and commit to continuous improvement, demonstrating a clear understanding of their environmental responsibilities. At the same time, they actively seek to cooperate with other companies and actors across the global value chain to promote a green supply chain.

This cooperation—supported by senior management—takes the form of active and ongoing engagement with clusters, industrial parks, sister plants, and other units within the same corporation, as well as with neighboring companies, suppliers, customers, universities, unions, and citizen groups. Such interactions, in turn, foster improved environmental performance among the participating organizations, generating a virtuous green cycle.

This represents the most desirable scenario: a collective approach that also allows us to envision a company capable of distancing itself from the core assumptions of the Human Exceptionalism Paradigm.

Scenario II: Poor environmental performance with some degree of environmental cooperation.

In this scenario, companies in the automotive and auto parts industry either lack an environmental management system or have one that is largely ineffective, resulting in weak environmental indicators. This occurs despite their participation in initiatives intended to promote or facilitate environmental cooperation through clusters, industrial parks, sister plants, or other units within the same corporate group. However, when it comes to environmental issues, these companies have no—or only very weak—links with neighboring firms, suppliers, customers, or other external actors.

This situation may stem from several factors, such as limited support from senior management, financial constraints, the absence of a dedicated environmental manager, insufficient technical capacity on the part of environmental staff, or even organizational simulation. Although the company

participates in cooperative structures, meaningful internal change does not follow.

Nevertheless, this is a scenario with significant potential for improvement. With sustained effort, the company could draw on the professional and technical expertise available within these associations and organizations. In other words, it knows what needs to be done, but remains passive and continues to postpone the internal actions required to improve its environmental performance.

Scenario III: Poor environmental performance with little or no environmental cooperation.

In this scenario, companies in the automotive and auto parts industry either lack an environmental management system or environmental program, or have one that is largely ineffective, resulting in poor environmental indicators. In addition, they do not participate in—and may not even show interest in—initiatives that promote environmental cooperation through clusters, industrial parks, sister plants, or other units within the same corporate group.

This represents the worst possible situation for both the company and the environment, as the chances for improvement are minimal. Indifference, lack of awareness, or ignorance of existing and potential environmental responsibilities and opportunities severely limit any possibility of change.

Scenario IV: Good environmental performance with little or no environmental cooperation.

In this case, companies in the automotive and auto parts industry have an environmental management system or environmental program that enables continuous improvement in environmental performance and measurable indicators. However, these improvements are achieved in a largely isolated and autonomous manner, with limited exchange of experiences and little willingness to share achievements, failures, doubts, or lessons learned with other organizations.

This scenario presents a clear opportunity for progress. With greater openness, motivation, or institutional mechanisms to facilitate collaboration, such companies could become key actors and strategic allies. By shar-

ing their knowledge and experience, they could help strengthen environmental management not only within their own operations, but also across industrial parks, clusters, and the broader value chain.

It is worth reiterating that having companies positioned at Stage I makes it easier for them to cooperate with other firms and with different segments of the global value chain. One of the key outcomes of this process is the gradual development of a much-needed green supply chain.

3.14 Green Supply Chain and MSMEs

The pressure placed on the companies visited is pushing them to implement—or at least consider implementing—an environmental management system, since this has become a business requirement for selling their products. Ideally, however, corporate environmental concern and behavior should not be limited to individual plants and their immediate surroundings but should extend throughout the value chain to which the company belongs. Otherwise, the credibility of its environmental commitment is called into question. What position does a company that claims to be environmentally responsible occupy when it knows—or chooses to conveniently ignore—that its suppliers or customers act carelessly or are openly negligent in this regard?

As cases in other sectors have shown, when companies fail to take into account the practices of actors along their value chain, their own image and commitments tend to generate mistrust (for example, child labor in the textile industry, human rights violations in mining, or unnecessary animal suffering in livestock production). The objective, therefore, should be the development of green or sustainable supply chains within the automotive industry—an issue that is, in fact, already beginning to gain attention in the domestic context.

In a study of logistics and supply chain management professionals from companies in Mexico's automotive and auto parts sector, Montaudon and Gil (2016) identified fourteen factors with the greatest impact on the industry, with environmental pollution ranking first. Although policies have been developed to encourage greater engagement with environmental sustain-

ability, for a long time these efforts were limited "exclusively to production, leaving logistics aside" (Montaudon and Gil, 2016, p. 8).

> "It is not enough to simply have a car that does not pollute—or that pollutes less; the manufacturing process itself must also be environmentally sound, and there are, of course, regulations and international standards that have been established for this" (CA1). This logic generates a cascade effect: "The assembly companies are the ones that set the example and then pass it down as a requirement, as part of the business model, to Tier 1 companies". (CA1)

Within this cascade, the Querétaro cluster plays a key role in supporting local Tier 2 companies—such as those engaged in plastic injection, machining, stamping, forging, or rubber manufacturing—which traditionally have not been "as concerned with this issue" (CA1). Their priorities have tended to focus more on technology acquisition or capital flows than on the implementation of environmental management systems.

Some leading buyer companies are now "trying to push their suppliers to align in a timely manner, which is highly commendable on the part of large firms from other investment origins that are established in Querétaro and are seeking ways to ensure that their suppliers are not left behind" (CA1). In this process, Tier 1 companies "show the way to smaller firms" (CA1), particularly with regard to what is required for legal environmental compliance.

We can observe that the green supply chain in Querétaro's auto parts industry is made up of both strong links—such as OEMs that have incorporated environmental considerations into their business plans and strategies, and companies at other tiers that actively collaborate with their suppliers—and weak links, including OEMs that look for ways to circumvent environmental regulations, firms that place little value on cooperation, and government programs that remain unconsolidated or fail to attract companies.

Clearly, this green chain is not static; like all elements of the configuration, it is constantly evolving. An automaker with a solid track record in environmental management and innovation may, at some point, stop being a positive example. A government support program designed to help small

and medium-sized enterprises (SMEs) obtain ISO 14001 certification may disappear with a change in administration. A company that once ignored the environmental behavior of its customers may begin to monitor it after a shift in management or ownership. Others may enter the chain on the basis of an environmentally responsible image that, in practice, amounts to greenwashing[9]. Likewise, a cluster that initially set out to align smaller firms around environmental issues may deprioritize those efforts in the face of an economic crisis, and so on.

In the companies visited, it became clear that when they discuss the level of attention or requirements placed on suppliers, a distinction is made between environmental service providers—those with whom environmental managers interact directly—and other plant suppliers, with whom they do not necessarily have direct contact. As part of their responsibilities, and in order to oversee the plant's environmental management, those in charge of environmental issues tend to maintain a much closer relationship with environmental suppliers. The extent to which this relationship is developed depends largely—once again—on pressure from corporate headquarters, as well as on other incentives, the priority given to environmental issues by senior management, and the personal subjectivity of those responsible (for example, their values, ethics, and emotional commitment).

Company 3 offers a clear example. Its corporate headquarters requires the environmental team at the Querétaro plant to audit its suppliers, including conducting on-site visits to the facilities where waste is sent (in Nuevo León or the State of Mexico) to verify that it is properly controlled and that no incidents occur. Smaller suppliers are also audited, and particular care is taken to ensure that all their permits with SEMARNAT are valid. This level of vigilance stems from a previous incident: three years ago, one of the company's hazardous waste treatment suppliers in northern Mexico was shut down by PROFEPA for several months. During that period, Company 3 happened not to send any waste to the supplier, but it was unaware of the closure. Corporate headquarters, however, did learn of the situation— "they have very good international investigators" (RA3)—and contacted the in-

[9] Misleading practices by companies to feign respect and concern for the environment.

terviewee's supervisor to warn them that they were working with a supplier that had been shut down.

Another example is Company 6, whose internal management system requires it to audit its suppliers, particularly in environmental matters. As a result, the environmental manager audits the companies that handle hazardous waste, metal shavings, special-handling waste, and scrap, in order to ensure that they are reliable and not misrepresenting their practices. As the interviewee explains, "to increase their profits, they could just take it to the hill next door and dump it there, but that would contaminate the subsoil" (RA7). Company 6 also notes, through its environmental manager, that because the products it receives do not involve hazardous processes, "I don't recall ever seeing us condition the purchase of certain materials on supplier certification" (RA7). In contrast, Company 7 makes recommendations to its suppliers to improve or certify their environmental practices. Company 4 does not extend the requirement to have an environmental management system to its suppliers, and Company 2 has no environmental requirements for its suppliers at all.

For its part, Company 1 acknowledges that, in terms of environmental issues, "actions are being taken, but it is not a priority" (RA1) along the value chain. It also notes that suppliers who deliver products directly to corporate headquarters are held to higher standards than domestic suppliers—such as packaging or pallet providers—where the challenge is even greater. As the interviewee explains, "something could be done, but only as part of a project they agree to, because it has to be a win–win situation. That same pressure will eventually force you—if you really want to be competitive—to be fully aligned with environmental requirements" (RA1).

Company 5, which has customers that require quality certifications for the raw materials it uses, shares this view: "It's the same logic—if they require it from me, I require it from you. There's no way around it; you have to comply in order to sell to me, and for me to be able to sell to them" (RA6).

An interesting case was found at Company 8. Its environmental manager not only believes that a green supply chain is possible but has actively worked to build one. As a result of his personal initiative and that of his team, since 2017 any material or product must first be reviewed by the environmental and safety department before the purchasing team is allowed

to authorize its acquisition: "If we don't approve it, no matter how necessary it is, it cannot come in. We started this control here in Querétaro and then implemented it in all the plants in Mexico" (RA11).

In addition, the corporation requires that all environmentally relevant suppliers—that is, those whose products may generate environmental impacts—be audited and classified as high, medium, or low risk. During a visit to one cleaning service supplier, for example, the environmental manager found chemicals spilled on the floor, among other irregularities; as a result, the supplier "failed, and until they implemented corrective actions, they were not allowed back into our plant" (RA11).

Some suppliers cannot afford ISO 14001 certification, so they are instead asked to demonstrate another form of certification or, at minimum, an internal environmental management or care program. In the case of the pallet supplier—classified as a high environmental-risk supplier—the company requires proof, through a certificate of origin, that the wood used is legal. It is also worth noting that when suppliers do not know how to implement an internal environmental program, they are offered guidance and training.

This case highlights that, while environmental considerations are becoming increasingly relevant in automotive supply chains, micro, small, and medium-sized enterprises (MSMEs) are not in the same position as large companies to invest substantial resources in this area. They are also often unaware of the advantages of improving their environmental performance or of becoming part of green supply chains.

We heard this perspective from an environmental manager who, before her current position, worked at a medium-sized auto parts company that manufactured plastic components. At that company—already certified under ISO 9001—the possibility of pursuing ISO 14001 certification was raised:

> "And do you know what the response was? 'Who is asking us to do that? It's not mandatory. What do we get in return? What's the benefit for the company?' Someone answered, 'Prestige, reputation, environmental protection,' and the reply was, 'Well, yes, but at the end of the day that doesn't generate any tangible value for me. I'm here to make money. An environmental certification doesn't add value for me. Process certification does, because it guaran-

> tees to the customer that what we deliver meets quality standards—but the environment? What does that give me?'". (RA1)

Company program, none applied for or obtained funding specifically to pursue ISO 14001 certification.

More recently, in 2025, the State Subprogram for Supplier Development (PEDEPRO) was introduced to promote, strengthen, and support supply chain development, including assistance for certifications aimed at accessing new markets and making the adjustments required to obtain accreditation.

On a national level:

> In Mexico, the market for environmental management currently offers few solutions to SMEs, which generally cannot find products or services that meet their operational needs at affordable prices. This is largely due to the widespread perception that environmental issues are not associated with the competitiveness of companies (Federal Attorney General's Office for Environmental Protection, 2019, p. 4).

As a former executive of a major national auto parts manufacturer noted, "here, small and micro-enterprises are more concerned with meeting payroll or avoiding inspections" (CA2) than with environmental issues, compounded by their limited access to credit. The authorities themselves acknowledge that compliance with environmental regulations is particularly challenging for SMEs: "This is a reality in virtually all industrial sectors, not only in the automotive industry" (AG5).

In an effort to address this situation, the Environmental Leadership for Competitiveness (LAC) initiative was created at the federal level within SEMARNAT in 2009. In 2011, it was renamed the Environmental Leadership for Competitiveness Program (PLAC) and placed under the operation of PROFEPA as part of its voluntary programs, with the aim of:

> Promoting better environmental management in small and medium-sized companies, which requires efforts to be directed towards changing attitudes and the concept of development based exclusively on economic growth, to-

> wards one that more clearly recognizes the role of efficiency in the use of raw materials and supplies in competitiveness. (PROFEPA, 2019a, p. 5)

In 2016, the program served 995 Mexican companies through nine operating agencies. One of these—the Center for Research and Technological Development in Electrochemistry, located in the municipality of Pedro Escobedo, Querétaro—supported fourteen companies. However, in fiscal years 2017 and 2018, no financial resources were allocated to the program, leaving the subsidy at zero pesos. As a result, the program continued operating only thanks to leading companies that convened their supply chains and invited participating firms. In 2019, with the arrival of a new federal administration, the program was suspended (AG6).

According to Lee and Klassen (2008), three main factors motivate SMEs to strengthen their environmental management capabilities: (1) concern for the environment; (2) access to external resources; and (3) support and oversight from large buyers. Evidence also suggests that SMEs with more advanced environmental management practices tend to be led by managers with a higher-than-average level of personal development (Boiral et al., 2010). This personal development is linked to belief systems that shape managers' worldviews, deeper motivations, and capacity to engage with complexity (Boiral et al., 2010).

3.15 The Electric Car

The arrival of the "car of the future," characterized in part by electromobility—a response to the environmental impact of the sector and, above all, of its products—is rapidly reshaping the global automotive industry. These transformations are unfolding in real time, with limited clarity or certainty about how they will ultimately take shape or when they will fully materialize. Given that this industry employs millions of people worldwide, it is essential to examine what is happening, and what may happen, within the sector in places such as Querétaro, for example from the perspective of plant-level environmental managers. A representative of a German automotive parts and technology company notes that:

> We believe that many jobs will be affected but not necessarily lost. By "affected," we mean that workers' skills and competencies will need to evolve. A growing share of the workforce will require knowledge in areas such as electronics, software, and the Internet of Things. Mexico is still in the early stages of developing these mobility-related capabilities, and we need to accelerate our learning curve to catch up with Europe and Asia. If Mexico, as an industry, does not improve its level of expertise, knowledge, and engagement in this field, we risk falling behind and losing the position and strength we have built in the automotive sector in recent years (B5).

In Mexico, unlike in Europe or Asia, and despite recent progress, entry into the electromobility industry has been slow, largely because "they have a very revolutionary model there" (AG1). A study by Arana and Morgan reports the following:

> Mexico has made some progress, but it remains insufficient. For instance, in 2023, electric vehicles accounted for only 1.03% of total new vehicle sales; electricity generation from clean sources declined compared to previous years; and most targets lack proper follow-up with verifiable indicators (Arana and Morgan, 2025, p. 967).

Several factors help explain this slow pace. These include delays in opening and incentivizing the electricity market; insufficient infrastructure; weak linkages between government, academia, society, and companies; the failure to integrate sustainable mobility into public policy; a pro-oil discourse at the federal level; and continued reliance on gasoline vehicle sales driven by U.S. market demand, reinforced during the presidency of Donald Trump, a well-known climate change denier, which further shaped the trajectory of the North American mobility industry.

As one director of the Organization for Economic Co-operation and Development (OECD) put it, "We are all entangled in oil. The problem is that the political economy of carbon taxes is toxic: it is extremely difficult to create incentives for economic actors to move away from high-carbon technologies" (CP5). The social protests triggered by fuel price increases in different parts of the world—such as Indonesia (2014), France (2018), Iran

(2019), Ecuador (2019), and Colombia (2023)—sometimes resulting in injuries and even deaths, underscore the profound socioeconomic challenges involved in transforming how people and goods move, as well as the importance of addressing these issues through multidisciplinary research.

Let us consider another example of this deep entanglement with oil. A federal official summed up his experience in dialogues with the national auto parts industry in a single sentence: "They will try to extend the life of the internal combustion engine for as long as possible. I once heard a company representative say: '*We believe the internal combustion engine will continue, and we will try to delay its demise as much as we can*'" (AG1). For more than five years, Volkswagen experts themselves have questioned "whether it is worth investing scarce resources in producing silent electric versions if they do not appeal to fans of noisy, high-octane brands" (Reuters, 2020). Once again, sustainable development appears subordinated to profit and governed by economic and administrative timeframes, making it convenient to postpone for as long as possible the end of the combustion engine–gasoline tandem that sparked the first automotive revolution.

For the Querétaro Automotive Cluster:

> There are changes, and that is normal in any technological transition. The question is what will happen to the established supply base. Many suppliers will remain relevant—a car will still need wheels, tires, seats, and, at least in the first stage, steering wheels (and in a later stage, perhaps not even those). In some very specific cases, however, business models will clearly change, components such as gears or alternators may no longer be necessary. Ultimately, this is a technological shift in which companies either evolve or adapt by exploring other areas of the business (CA1).

Even the companies affected by this transformation "will still have a very wide margin in spare parts and replacements" (CA1), given the millions of internal combustion vehicles that will not disappear overnight. In 2017, the cluster acknowledged that the sector was closely watching changes in the automotive market of Mexico's northern neighbor, particularly consumers' growing preference for utility vehicles over compact cars: "That's good for

us" (Durán, 2017). This is undoubtedly good news for combustion vehicles and their industry—but not for the environment or the climate.

Regarding the implications of electric vehicle production, the Querétaro Ministry of Sustainable Development remains optimistic, viewing "the electric car as an opportunity for the industry as a whole" (CP7). For environmental auditors, however, the main future challenge lies in the need for stricter state regulation that requires auto parts companies to establish adequate mechanisms for the final disposal of the technologies, waste, and new materials used in manufacturing electric vehicle components. As one auditor notes, "Companies must know how waste and new materials will be disposed of" (V3), and another adds that "regulation must be stronger" (V2), since current reduction and recycling management plans are often "very declarative." In their view, "solutions focused on the life cycle of the product should be established" (V2).

Once again, this highlights the need for environmental management and innovation to move forward together, further strengthening the Circular Economy System.

Within the Querétaro Automotive Cluster, perceptions of electric vehicles range from cautious moderation to optimism. One executive states that "the vast majority of companies are already aware of this change. Each one, depending on the products we manufacture, is already looking at where we can participate, where we can compete, and what changes we need to make to our products" (Estrella, 2019). By contrast, a plant engineer offers a more skeptical view: "I don't see many companies anticipating this. When it happens, what are you going to do with all of them? There are auto parts that are less critical, and at any moment they're going to say, 'Hey, I'm not buying that cap anymore'" (RA3).

A market that increasingly demands electric vehicles will also have significant consequences for the world of work. Conventional vehicles have around 1,400 parts in their engines and transmissions, whereas electric vehicles have roughly 200 components. This sharp reduction implies less labor demand: some estimates suggest a workload decline of between 50% and 70% in traditional engine plants that currently produce more complex gasoline and diesel vehicles (Friedrich Ebert Stiftung, 2015).

Several studies in Germany have already warned of the potential loss of thousands of jobs in the medium and long term. As early as 2009, estimates suggested that up to 60,000 workers in the state of Baden-Württemberg could be affected by the transformation facing the auto parts industry (Friedrich Ebert Stiftung, 2015). A subsequent study published in 2019 for the same state outlined multiple scenarios: in the most optimistic case, employment would increase by 1.9% (approximately 8,900 jobs) by 2030, while in the most pessimistic scenario, job losses could reach 6.6% (around 30,800 jobs). Although these figures refer to the automotive industry as a whole, the impact is expected to be significantly greater in subsectors and companies dependent on the internal combustion engine, where employment losses could range from 10% to 50% (e-Mobil, 2019).

Similarly, the Fraunhofer Institute for Industrial Engineering estimates that by 2030 the production of electric vehicles will require between 11% and 53% fewer jobs than conventional vehicle manufacturing (Acosta, 2019). In March 2019, Volkswagen CEO Herbert Diess stated that building an electric car requires 20% to 30% less effort than producing a traditional vehicle, concluding that "this means we will need to make job cuts" (Cordero, 2019), and suggesting that layoffs and early retirements alone may not be sufficient to achieve the necessary reductions. SEAT president Luca de Meo echoed this concern, noting: "Either I plan to sell 20% to 30% more cars, or we will have to find other solutions for this 30% of workers" (Granda, 2018).

Some key challenges that must be addressed at the local level include forward-looking scenario planning by the auto parts industry, the development of strategies to help the local supply chain absorb the impacts of the expected mass adoption of electric vehicles, and the abandonment of excessive confidence—such as the assumption that the industry can navigate the transition without affecting workers, particularly those outside Tier 1 and Tier 2 companies. The passivity of the local sector and other stakeholders, combined with weak incentives for innovation, could leave the industry exposed and dependent on decisions made by external actors, with potentially serious consequences for thousands of families.

It is also important to recognize that the automotive industry will inevitably move toward the "car of the future," seeking creative ways to maintain

a robust market by presenting these vehicles not only as efficient means of transportation but also as solutions to climate change. However, ACES vehicles (autonomous, connected, electric, and shared) also generate socio-environmental externalities that merit closer academic scrutiny. These include the human rights violations documented by Amnesty International (2016) in the extraction of cobalt—whose largest global reserves are located in the Democratic Republic of Congo—as well as the environmental and social impacts of lithium extraction, often referred to as "white petroleum." Lithium, found in large quantities in Bolivia, Chile, and Argentina and essential for electric vehicle batteries, is extracted through evaporation processes that consume vast amounts of water, affecting indigenous communities, as well as local flora and fauna, particularly in regions such as Chile's Atacama Desert (Boddenberg, 2018).

> Latin America and the Caribbean play a critical role in the global energy transition because of their vast reserves of key minerals such as lithium, copper, and cobalt, which are essential for clean technologies including batteries, solar panels, wind turbines, and energy storage systems. […] It is time to move toward a new paradigm grounded in social justice and respect for human rights—one in which territories and communities are not treated as the cost of change, but rather as central actors in a just and sustainable transformation. The right to a healthy environment, recognized by the Inter-American system as an autonomous and justiciable right, is a fundamental pillar of a truly just energy transition (Special Rapporteur on Economic, Social, Cultural, and Environmental Rights, 2025).

In Mexico, to mention just one case, activists, citizens, and researchers will need to closely monitor how the enormous lithium deposit discovered in 2010 in Bacadéhuachi, Sonora, is developed, as well as the broader consequences of mining activities in the country that form part of the supply chain for the car of the future.

3.16 Stakeholders

Since environmental issues began to emerge as a societal concern—particularly in the 1970s—and especially after the Earth Summit in Rio de Janeiro in 1992, stakeholders—understood as individuals, groups, entities, companies, and organizations with an interest in automotive firms (e.g., employees, suppliers, customers, shareholders, competitors, governments, unions, civil society organizations, and local communities)—have become increasingly vocal in demanding commitments and changes in companies' environmental performance. These demands, however, have not been expressed in the same way or with the same intensity across stakeholders, companies, countries, or tiers of the value chain.

An anecdote recounted by Utting (2000) illustrates the need for corporate decision-makers to genuinely feel this pressure and influence on environmental and social issues. The sociologist describes how, in 1999, during a workshop at the United Nations Conference on Trade and Development (UNCTAD) on corporate social responsibility (CSR), a former executive of a major oil company remarked that if the win–win argument were truly so compelling—that is, if companies could simultaneously increase profits and improve their social and environmental performance—"then we would not be sitting around this table" (Utting, 2000, p. 21). In other words, as Utting explains, under that win–win premise:

> […] companies would have embarked on this path long ago. Instead, the former oil executive reminded participants that it was primarily pressure from NGOs (non-governmental organizations) and consumers that pushed companies such as BP and Shell to change their behavior (Utting, 2000, pp. 21–22).

Although social pressure is one of the factors that companies may consider when improving their environmental performance, such pressure was largely absent in the local context studied. In Querétaro, there was no evidence of civil society organizations (CSOs), citizen groups, activists, or neighboring communities whose concerns or initiatives significantly influenced the activities of the automotive sector as external stakeholders. It is

possible that, in the future, the perceptions held today by young people in Querétaro may translate into collective action capable of exerting meaningful pressure on the local manufacturing sector, particularly given the environmental education they are receiving. Throughout this research, the only instance of pressure from local activists or environmental groups was mentioned in relation to their insistence on—and subsequent support for—the creation of the State Attorney General's Office for the Environment (AG2).

The global automotive industry is closely watching the transformations it may face as a result of new competitors (e.g., Uber, Didi, Google) and the emergence of a new consumer profile (Deloitte, 2020) with different habits and preferences—such as the use of digital applications and big data, less enthusiasm for taking on debt to purchase a car, greater acceptance of car sharing, and increased attention to engine type or non-traditional manufacturers—along with growing environmental awareness. For former IPCC chair Rajendra K. Pachauri, the power of consumers "is what will define the type of public or personal transportation we will have in the future. If customers demand electric vehicles, that is what there will be" (CP3).

In Querétaro, however, studies are still needed to identify the characteristics and motivations of this emerging consumer or customer profile and to assess its potential role as a driver of environmental management in the coming years. This should be done while keeping in mind the well-documented gap between what people say and what they actually do when it comes to pro-environmental behavior.

Within the configuration analyzed, there is also little pressure from unions as internal stakeholders. Their agendas generally do not include environmental issues, except when these are linked to occupational safety within plants. Only in Company 2 did an interviewee mention some level of union involvement: "One thing we do is the joint committee tour, which includes the union, and we added environmental issues—such as spills and the presence of safety kits—to the checklist. We look at that, and sometimes they point out spills. But it's not like they are fully pushing the environmental issue" (RA2).

Since the Rio Summit (1992), increasing attention has been given to the role trade unions should play in building a more sustainable world. As the International Labor Organization notes:

> Trade unions, as representatives of workers, are essential actors in advancing sustainable development, given their close relationship with industrial change, the high priority they place on protecting both the working environment and the natural environment, and their promotion of economically and socially responsible development (International Labor Organization, 2007, p. 13).

In 2006, at the Conference of the Parties held in Nairobi, trade unions put forward six priorities on climate change. These included promoting worker participation as a key element in shaping the sustainability of climate policies and recognizing the workplace as a primary arena for climate action (ILO, 2007).

Similarly, the International Labor Organization emphasized in 2007 that workers around the world—and their organizations—have a crucial role to play. To influence how companies affect both workers' communities and the environment, the ILO stressed that "freedom of association and the right to collective bargaining are fundamental elements" (International Labor Organization, 2007).

In the context of the United Kingdom, Hampton (2015) argues that the intertwined processes of labor exploitation and ecological degradation create conditions under which workers can take up climate change as an issue of direct concern. As agents positioned at a central point in capitalist relations of production, workers possess significant transformative potential. For this reason, Hampton considers workers and trade unions to be strategic climate actors capable of influencing mitigation and adaptation efforts through what he terms "climate solidarity," understood as specific forms of representation and mobilization around climate issues.

Unfortunately, trade unionism in Mexico—and in Querétaro in particular—is still far from even attempting to assume a leading role in environmental matters. The country's history of corporatist unionism (De la Garza, 2001), combined with features of today's world of work such as job insecurity and the sharp decline in unionization rates, means that unions remain far from being seen as powerful allies of the environmental movement. As De la Garza argues, the Mexican union model "is narrow in the face of a more heterogeneous and diverse landscape. Above all, it is narrow in terms of representing actors in the plurality of their spheres of action: productive,

political-electoral, reproductive, ecological, gender, ethnic, etc." (De la Garza, 2001, p. 1).

According to a local union leader—who represents 28,000 workers across 180 union registrations, between 60% and 70% of which correspond to the local automotive industry—environmental issues are not yet a union priority. At most, unions tend to align themselves with the agendas set by companies. In Querétaro, he explains, "union members set other priorities for us, so you have to weigh them and decide where to focus your efforts, especially since we don't have an army of human resources either" (V5).

The interviewee does acknowledge that environmental legislation in Querétaro has become increasingly stringent and that auto parts manufacturers have implemented very rigorous waste control measures, mainly in response to customer requirements. However, he adds, "I don't see pressure from the government, I don't see pressure from companies, and I don't see pressure from us, the unions; I see more pressure from citizen organizations" (V5). In this context, he refers to Querétaro-based activist América Vizcaíno, a biologist by training and co-founder of the civil association Ambientalistas de Querétaro. Nevertheless, as discussed earlier, neither this organization nor any other citizen group emerged in the research as a significant source of pressure on the sector.

The union leader goes on to explain that union members—particularly those working in small or Tier 2 companies, some of which lack sufficient budgets to adequately address occupational safety and environmental issues—frequently report the mishandling of waste, chemicals, solvents, and other hazardous substances that put their health at risk. "If it's not handled properly, there could be a fire or something that affects the worker while they're pouring it or inhaling it; that's when the worker raises their hand" (V5). These complaints are usually communicated to the union through Facebook, with no fewer than ten to fifteen reports of this kind received each week.

This awareness of the environment–safety nexus among workers is not community-oriented. Rather, it is centered on harm to one's own body or that of coworkers within the plant and rarely extends beyond the factory gates to consider impacts on nearby communities, the region, or wider ecosystems. While the health and safety of workers within the company must

never be minimized, there is a clear need to foster greater environmental awareness among union members—one that stretches across space and time to include others, even those who are distant or not yet born. From the perspective of the world of work, this is a cause worth defending, including through the assertion of rights such as the right to a healthy environment as a foundation for development and well-being.

For De la Garza, "neoliberalism has portrayed unions as shameful sidekicks or impotent challengers" (De la Garza, 2001, p. 22). It is therefore unsurprising that the economic factor—so prominent in the configuration identified here—is accompanied by a profound weakness of trade unions in the area under analysis. The longer action is delayed to bring about a substantive shift toward environmental rationality, the greater the risk of undermining both the quantity and the dignity of jobs and workers.

It is thus imperative that actors such as activist groups, citizens, and trade unions assume a proactive role in initiatives, actions, and projects that enable them to become meaningful nodes of pressure, in support of both environmental protection and the world of work.

CHAPTER IV
FINAL REFLECTIONS

4. FINAL REFLECTIONS

The aim of this study was to reveal the links between the socio-technical configuration and environmental management in the auto parts industry in Querétaro, Mexico, in order to identify the levels of participation of the actors involved, within a context of global transformations in the automotive industry and an ongoing environmental crisis. To achieve this objective, we drew on the methodological proposal of Enrique de la Garza (2018), which relates structures, subjectivities, and actions and allows for a comprehensive articulation of the ways in which actors think and construct meaning within the socio-technical configuration.

Based on the narratives of labor actors, two levels of discourse interpretation can be identified. The first is the cognitive level, through which actors express their degree of knowledge of the issues addressed and attempt to articulate their arguments in a logical and sequential manner. The second is the subjective level, in which actors convey their emotions, ethical judgments, personal relationships, and psychosocial experiences.

Together, these levels reveal weak and strong relationships, as well as discontinuities, tensions, ambiguities, compatibilities, incompatibilities, and contradictions. These elements make it possible to analyze the relationships between the structures, subjectivities, and actions of labor actors and open the door to theoretical reconstruction grounded in the empirical work carried out by the researcher (Carrillo, 2007).

The configuration that emerges from the theoretical and documentary review, together with the fieldwork conducted, shows that the auto parts sector in Querétaro—one of the main engines of the local economy and a key component of Mexico's automotive industry—operates in the field of environmental management under pressure from multiple forces. Among these, the market stands out as an extremely intense influence. As a result, the industry tends to operate within the paradigm of economic rationality (Leff), human exceptionalism (Catton and Dunlap), and human-centered ethics (Elliot).

In this context, companies' environmental decisions and actions are driven primarily by considerations of profit, cost–benefit calculations, and productivity. These decisions are grounded in an almost unquestioned assumption of the moral primacy of human beings over other living beings (such as "little trees" or "little birds") and non-living elements (such as farmland, aquifers, and the skies of Querétaro). With one exception (RA6), these non-human elements are largely absent from the interviewees' discourse.

This perspective has contributed to the partial normalization of the environmental impacts of industrial activity, which are commonly perceived as inevitable—though potentially manageable—and as a natural consequence of the state's intense industrial and economic development.

Why is market force so crucial in shaping this narrative? Because it is the original and historically decisive force behind the automotive industry, beginning with Henry Ford and the advent of mass production, which positioned the sector as one of the flagship industries of the capitalist system of production. From that point on, the trajectories of the automotive industry and capitalism have been deeply intertwined, sharing common origins and a closely linked destiny.

In Querétaro, moreover, the social and political narrative surrounding the metalworking sector—and the automotive industry in particular—remains strongly associated with ideas of development and progress (e.g., "Automotive industry, the origin of modern Querétaro") (Códice Informativo, 2020). This framing has had concrete consequences, such as the emergence of "a new logic of the territory" (Salinas et al., 2019, p. 29), along with significant increases in foreign direct investment, employment figures, and

other indicators highlighted in economic censuses, which are nevertheless often treated as automatically:

> [they] are not synonymous with environmental and/or social well-being. Understanding what environmental consequences are produced, what kinds of jobs are created, and who ultimately benefits from them are just some of the questions that must be asked when these indicators are used as benchmarks to assess economic development and to justify industrial growth. (Salinas et al., 2019, p. 33).

The market forces surrounding the transnational automotive industry—which turned the automobile into one of the quintessential fetishes of consumer society—have faced new and growing pressures since the second half of the twentieth century. Environmental and climate concerns, made visible both through scientific research and everyday experience (for example, smog), have become increasingly salient. These concerns have given rise to social and political pressures—expressed through collectives, civil society organizations, political platforms, and associations of environmentally committed scientists—which have become part of the sector's global landscape, particularly since the 1990s (though there are important precedents in earlier decades).

In turn, these social and political pressures have driven changes in international environmental regulations, as well as in national and subnational frameworks, including in Querétaro. At the same time, an increasing number of companies—whether in response to external demands or on their own initiative—have sought to incorporate green practices and strategies, such as innovation, corporate image-building, eco-design, advertising, internal environmental management, smart buildings, supply chain management, and reverse logistics. These efforts aim to improve environmental performance while maintaining competitiveness, often by publicly stating and/or demonstrating a commitment to environmental responsibility.

One way in which actors have sought to address the inherent tension between economic, environmental, social, political, and regulatory pres-

sures[1] is through the concept of sustainability, which rests on the premise that environmental concerns are as important as social and economic ones. In practice, this has taken the form of concrete measures such as the adoption and certification of environmental management systems by automotive companies, particularly under the international ISO 14001 standard (introduced in 1996) and, in Mexico, through PROFEPA's Environmental Audit Program (Clean Industry), whose first certifications were granted in 1998.

In the specific case of Querétaro, the creation of PROFEPA in 1992 and its Environmental Audit Program, together with the expansion of the auto parts sector following the signing of NAFTA in 1994 (and its Environmental Cooperation Agreement, adopted under pressure from U.S. partners), were key developments that reshaped the sector and gradually brought environmental issues onto its agenda. It should be emphasized that this has been a slow process—despite the urgency highlighted by the scientific community—as environmental management remains a relatively new concern even in the second decade of the 21st century. Its advancement depends on multiple factors, including corporate decisions, strategies, and budgets; customer requirements; regulatory compliance; company size and available resources; the environmental leadership style of senior management; and the subjectivities and psychosocial characteristics of environmental managers, employees, and workers (e.g., emotions, motivation, habits, behaviors, and attitudes).,

Economic pressure—operating under the market's inherent logic of economic and administrative temporality—is the most intense force in the local context, as capital accumulation and growth become both a condition and a central objective of business activity. From this perspective, environmental issues must not become an obstacle to profitability and, where possible, should instead facilitate or even stimulate it. It should be noted that this can be pursued either ethically or unethically—as reflected in the interviewees' experiences—and that when ethical considerations are taken

[1] There are always connections between these spheres that complicate their relationships, as actors with interests in one area attempt to influence others—for example, automotive industry lobbies and right-wing or far-right politicians seeking to roll back environmental legislation that affects car manufacturers, or media outlets that amplify the messages of climate change deniers.

into account, they are generally grounded in the principle of the moral relevance of humans. Closely linked to this is regulatory pressure, since companies must comply with environmental regulations—or, in some cases, simulate compliance—in order to operate and sell. In this regard, the continuous updating and strengthening of environmental regulations represents a clear area of opportunity.

Third, there is a more diffuse form of political and governmental pressure which, to become truly effective, would require measures such as not only maintaining but increasing public environmental budgets; strengthening environmental authorities and their inspection and enforcement capacities; adopting a governmental vision capable of accelerating the energy transition, investing in public transportation, and rethinking the importance of the environment beyond purely economic terms; promoting assertive policies in science, innovation, and technology; regularly updating environmental regulations; and fostering political parties that—unlike the Green Ecologist Party of Mexico (PVEM)—advance a genuinely environmental agenda.

Finally, social pressure is so weak that it does not even register within the configuration. This may be due to a combination of factors, including the weakness of trade unions and their lack of environmental demands; the fragility of civil society organizations; prevailing individualism; the absence of strong environmental citizenship; the wide range of pressing social and economic problems that tend to take precedence over environmental and climate concerns; the cultural idealization of the car as a consumer object; and the perception that the automotive industry is not among the most polluting sectors and, moreover, generates employment.

Within this configuration, environmental pressure cuts across all the forces described above but does not drive them. Economic rationality makes this difficult, often obscuring the setbacks that emerge, such as the continued commitment of government and a significant share of the local and national automotive sector to internal combustion vehicles rather than electric ones; the difficulties faced by micro, small, and medium-sized enterprises in integrating into greener value chains; and the existence of companies certified under ISO 14001 that merely simulate processes of continuous environmental improvement.

The evidence gathered suggests that environmental management has become yet another response to changing market conditions—one that seeks to sustain competitiveness and to ease tensions in the capitalism–environment relationship through the paradigm of sustainability. This paradigm allows companies to absorb and manage the new pressures they have faced since the final decades of the twentieth century. However, this response is unlikely to be effective in the long term if industry continues to operate— as ecological economics and environmental rationality have long argued—under the illusion of infinite resources within a world, and a state such as Querétaro, that are fundamentally finite. This points to the persistence, and likely intensification, of the underlying structural tension unless more profound transformations take place, including changes in the world of work, such as stronger unions, the protection of human and labor rights, greater worker participation, the promotion of green jobs, and the guarantee of decent work.

The forces outlined here are embodied in specific actors who, shaped by their histories, knowledge, expectations, attitudes, values, and emotions, are connected to other actors within the configuration and carry differing degrees of influence. In this case, the most prominent actors are senior management, plant managers, and environmental officers, along with customers and ISO 14001 and Clean Industry auditors. A second group, with more limited influence, includes Profepa inspectors, environmental officers from other plants and companies, and the employees and workers within the plants themselves. Finally, actors with the least weight in the configuration include members of the steering committee of the local automotive cluster and its director; staff from PEPMADU; university faculty and researchers from state research centers; lower-tier suppliers in the value chain; activists, citizens, and union leaders; and consumers.

It is worth recalling, once again, that this configuration is dynamic. Decisions made by organizations and actors at the macro, meso, and micro levels, together with global, regional, and local economic, social, environmental, and health conditions, continuously reshape structures, subjectivities, and actions, which in turn feed back into those same conditions. It is therefore to be expected that, in the coming years, the pressures, relationships, and forms of resistance identified here will evolve or give rise to new

ones. At present, the sector's efforts in environmental management—particularly those undertaken by companies with the interest, capacity, and resources to do so—are in many cases significant, but overall, they remain insufficient. There is still considerable room for improvement, including stronger cooperation among plants, companies, and industrial parks; greater knowledge of and active participation in the Clean Industry Program; closer collaboration with universities and research centers; increased awareness among senior management aimed at transforming or strengthening environmental leadership styles; the promotion of innovation; greater use by SMEs of state government support programs; the elimination of unethical or merely symbolic practices; and the strengthening of the environmental management activities of the Querétaro Automotive Cluster, for example through participation in the Circular Economy System.

The industry's greatest challenge will be to pursue all of the above while simultaneously rethinking its relationship with the environment beyond (unequal) profit, the (misguided) assumption of infinite resources, consumerism, and short-termism. This requires a deeper problematization—still scarce, as Salinas et al. (2019) note—of well-being, its implications, and its social effects. In other words, such reflection must be grounded in a different rationality (for example, environmental rationality), one that moves beyond the paradigm of sustainability, which tends to relegate the environmental dimension to a distant second place.

This perspective entails, following Leff, recognizing that another world is possible and that achieving it requires acknowledging that "the production of the world must be based on other principles" (2012, p. 83), such as the planet's ecological productivity. When linked to technological productivity, this approach foregrounds cultural values that "articulate human thought with the potential of nature" (Leff, 2012, p. 84). Leff further argues that whereas the goal has historically been to live well (in traditional societies) or to live better (in modern societies), what is now being called into question is life itself.

> The hope associated with sustainability, then, is not merely the hope of improvement or even of the transcendence of life, but the capacity to build a world in which human life is possible at all. From this standpoint, the call for

> a sustainable future demands not only a better world, but the recognition and construction of other possible worlds. (Leff, 2010, p. 228)

The results also make it possible to address the macro, meso, and micro levels of analysis, which are closely intertwined, and to capture what is taking place in a specific geographical context—Querétaro—within a global industry such as the automotive sector. Although global in scope, the industry is always locally embedded, exerting a major impact on the state economy through the circulation of capital and goods and, of course, through the employment it generates. Based on the findings, three analytical levels can be identified: (1) weak and strong relationships, (2) contradictions, and (3) expectations versus reality.

4.1 Weak and Strong Relationships

The research revealed the varying intensity of the (non-exclusive) relationships that make up the socio-technical configuration under study and identified several particularly strong ones. These include: (a) the pressure exerted by OEMs and customers along the supply chain, requiring first-tier suppliers to obtain ISO 14001 international certification as a condition for doing business (external motivation). This requirement has become a mechanism through which OEMs and suppliers publicly signal their commitment to the continuous improvement of environmental performance; (b) internal corporate and plant-level decisions to implement environmental management as part of standard operational practices, both to avoid risks (such as fines, reputational damage, or the loss of customers) and to achieve cost savings by optimizing production processes and reducing operational expenses (e.g., water and electricity consumption in offices); (c) compliance with federal and local environmental regulations applicable to facilities operating in Querétaro; (d) the environmental leadership styles of senior management, together with the technical, ethical—or, in some cases, non-ethical—actions of environmental managers and their teams; and (e) the regulations and requirements imposed by other national and subnational governments, particularly those of the United States, given the intensity of

cross-border trade and the country's role as Mexico's partner under NAFTA (since January 1994) and the United States–Mexico–Canada Agreement (since July 2020), both of which establish specific obligations for corporations and the sector.

By contrast, the weakest relationships were found in the following areas: (a) pressure groups—such as trade unions, civil society organizations, citizens, and consumers—which are virtually absent from this configuration; (b) the industrial cluster, which remains an underutilized actor that, despite its potential in terms of networks, contacts, and access to information, does not sufficiently promote environmental cooperation or facilitate environmental management initiatives, as these issues do not appear to be a priority on its current agenda; (c) lower-tier suppliers, who often lack both the motivation and the resources (economic, human, and organizational) needed to invest in environmental management; (d) the core of the production process itself, reflecting an inward-looking corporate vision in which the primary focus is placed on regulatory compliance and customer requirements (an outward-looking perspective), while less attention is paid to the environmental dimensions of the work process, such as water and energy use or waste management; and (e) local environmental authorities, which face significant constraints in terms of financial, human, and time resources, limiting their capacity to effectively audit and inspect a large sector like auto parts manufacturing, characterized by multiple, recurring environmental challenges.

Regardless of the intensity of the pressures exerted by structures and relationships, actors retain agency and act according to their own subjectivity. Environmental decisions may be administrative or technical in nature or even defined far from Querétaro—sometimes on another continent—but they are ultimately interpreted and implemented at the micro level, giving rise to a specific configuration. This can be seen, for example, in whether environmental managers choose to promote a particular certification to senior management—one that might improve the plant's environmental performance but also increase their workload; whether they support colleagues in other plants within the same corporation or in different companies; or whether the practices taught in training sessions are actually applied on the shop floor.

Drawing on their personal histories (both past experiences and future expectations), as well as their cognitive, volitional, emotional, aesthetic, and axiological resources, individuals interpret reality, assign meaning to it through their subjectivity, and take action. Through these actions, they may express dissatisfaction with a company's environmental practices (e.g., by resigning), support for them (e.g., by remaining with the company, expressing pride in their work, proposing improvements to environmental management, communicating effectively with their teams, or updating their professional skills), saturation or burnout (e.g., by avoiding additional responsibilities), or indifference (e.g., by skipping training sessions or showing little interest in learning about or addressing environmental issues).

Ultimately, the combination of individual agency, external pressures (from the company, government authorities, or certification bodies), and factors such as disinterest, lack of knowledge, or apathy toward environmental concerns can lead actors to make unethical decisions, making ethics a central pillar of environmental management practices.

People may even carry environmental awareness beyond the workplace—where they are "required" to consider it as part of their professional responsibilities—into their communities and families. Through reflection and changes in everyday habits, such as what they teach their children or practice at home, they begin to take ownership of the issue in a new way. In doing so, they give it a different meaning—one that ultimately transforms their most personal environment.

4.2 Contradictions

By placing environmental management at the center of the configuration, a clear gap emerges between what companies publicly declare—such as in their environmental policies or long-term sustainability visions—and what some of them actually do. This gap is evident in practices such as limited cooperation, obtaining ISO 14001 certification only when required by a customer, not considering participation in PROFEPA's Environmental Audit Program, simulating ecological commitment, or prioritizing economic costs over environmental benefits. This discrepancy reveals something so-

cially significant: the economic mediation that permeates this relationship and shapes decision-making.

Although the concept of sustainability is based on the interconnection between economic, social, and environmental dimensions, in practice it is the economic dimension that is privileged. This gives rise to a logic of *$ustainability*, in which benefits for the environment and the community are pursued only insofar as they do not interfere with company budgets and profits—or, conversely, insofar as they can enhance them through gains such as profitability or public recognition. This logic helps explain why plant managers in Querétaro can often be persuaded to participate in voluntary programs such as Clean Industry primarily when these initiatives align with economic incentives.

Economic power becomes visible in the configuration through highly intense relationships with clear practical effects, such as the pressure exerted by automakers on Tier 1—and increasingly Tier 2—suppliers, which is then transmitted to their local plants. Environmental managers are therefore required to respond simultaneously to client and corporate pressures at the macro level, while also complying with national regulations at the meso level and state and municipal environmental legislation at the micro level. In addition, they are expected to implement an environmental management system certified under ISO 14001, which has become an international requirement and the primary mechanism through which companies seek to demonstrate continuous improvement and sound environmental performance to their stakeholders.

There is also a clear contradiction between the environmental concern that federal and state governments publicly express (for example, in their development plans) and their actual practices. These include continued reliance on gasoline, fuel oil, and petroleum (as reflected in President López Obrador's energy policy); the hiring of too few inspectors (in PROFEPA and PEPMADU); job cuts (such as at SEMARNAT–Querétaro); the dismissal of experienced and well-regarded personnel (for example, the deputy delegate of Environmental Auditing at PROFEPA–Querétaro); reductions in the environmental budget at the federal level or insufficient funding for newly created agencies to consolidate (such as PEPMADU); the weakening of innovation programs (e.g., Conahcyt) without replacing them with new or

improved alternatives; and the cancellation of support programs for SMEs (such as the Environmental Leadership for Competitiveness Program). In this context, political power owes citizens a stronger commitment to ensuring that decision-makers act in a more pro-environmental manner within the configuration. A positive aspect, however, is that there is no evidence of corruption—in the sense of bribery or extortion—by local officials.

The configuration reveals a hybridization of environmental management paradigms. An extractive vision of nature (e.g., the urgent demand for minerals) and an instrumental one (e.g., nature as a means to achieve specific ends, or as something to be responsibly "managed" as good stewards of the planet) coexist with ethical positions (such as transparency and legality) and even philosophical stances (for example, "protecting the air, land, and water with our hearts and technologies to sustain a better future for all," as expressed by a Japanese company). These perspectives articulate a commitment—at least at the discursive level—to linking development with sustainability and to prevention, understood not only as an environmental imperative but also as something that can be profitable. This hybridization once again exposes the inherent contradictions of the capitalism ↔ nature relationship and shows that, under current market conditions, sustainability—subordinated to economic rationality—functions as a convenient discourse and practice, enabling companies to move between different environmental management paradigms in order to remain competitive.

4.3 Expectations *versus* Reality

The fact that a company has an environmental management system, holds ISO 14001 certification, or expresses interest in participating in the Environmental Audit Program does not automatically mean that it is making its best effort to improve its environmental performance. In many cases, there may be an intention—or even a pretense—to obtain the greatest possible benefits (e.g., certification, prestige, customer satisfaction, or the absence of problems with authorities) while investing the least amount of effort and resources.

One factor consistently identified across all companies as an obstacle to implementing and monitoring an environmental management system is the human element: how to get workers to actually do what is required of them. This once again brings subjectivity to the forefront, particularly the ways in which workers interpret these—often new—environmental tasks. The same applies to those in leadership positions. Assuming a role of authority does not automatically or naturally translate into the exercise of effective leadership, let alone leadership that actively supports environmental objectives.

With regard to PROFEPA's Environmental Audit Program, despite having been in place for almost three decades since its creation in 1992 and the efforts made by authorities to publicize its benefits, the sector remains largely unfamiliar with it. Many companies assume that ISO 14001 certification is equivalent to—or even better than—the Clean Industry certification, particularly because it allows them to avoid direct interaction with environmental authorities. As a result, the program is perceived as unattractive, and a valuable opportunity to strengthen environmental management is being missed.

Far from what the environmental and climate crisis would demand, significant areas of opportunity persist further down the automotive production chain. The current "green" value chain is very short, and most companies neither exert sufficient pressure on nor provide adequate support to their suppliers to accelerate its consolidation; those that do so remain a minority. Micro, small, and medium-sized enterprises—even when required to demonstrate some level of environmental commitment (e.g., through internal programs)—are still far from receiving the technical and financial support necessary to improve their environmental performance. Government actions aimed at addressing this gap (e.g., the Program for the Professionalization of Companies, Pro-Company) are clearly insufficient.

In the face of the environmental and climate crises, two different timeframes coexist. One is defined by science, which frames the situation as an emergency and stresses the urgent need to adopt mitigation and adaptation measures in response to climate change. The other is the economic-administrative timeframe within which industry operates, structured around costs, benefits, and profitability.

The local auto parts industry continues to operate largely within the Human Exceptionalism Paradigm. Although there are notable efforts—particularly among large, transnational, or well-established companies that can afford to adopt an environmental motivation or respond to external pressure to improve their environmental performance—the sector as a whole has not yet managed to transition toward the New Ecological Paradigm.

Progress toward electromobility in the local sector remains slow. Stronger collective efforts, clearer timelines, and concrete public policies are needed to anticipate this transition and its potential impacts on the local labor environment. In a context of international instability and profound uncertainty, the apparent strategy of many global actors has been to delay, as long as possible, the phase-out of the internal combustion engine and the structural changes required by the shift to electric vehicles.

Despite the strong international position of the automotive industry in Mexico and in Querétaro, this prominence is not matched by a comparable level of innovation in general, or environmental innovation in particular. The companies analyzed are currently concentrated in stages (I) of regulatory compliance and (II) of manufacturing control linked to export platforms. Even large firms and those with foreign capital do not appear to be moving easily toward the conditions required to reach stage (III) of environmental control, which is based on research and development in processes and products. For the rest of the companies in the sector, the situation in this area is even more precarious.

There is a significant opportunity for companies to strengthen environmental cooperation to move toward a more favorable scenario—one characterized by high environmental performance combined with high levels of collaboration (among plants, firms, cluster partners, industrial parks, and public and private entities, among others). Unlike innovation, environmental cooperation could be implemented more readily, since many of the actions that support it require fewer resources. By overcoming organizational insularity and limited communication around environmental management, companies could interact more and share experiences that help others improve. To date, the cluster has not played the role it could—and should—in promoting this cooperation. In both this area and in environmental management and innovation more broadly, the configuration

calls for greater effort and engagement from the actors of the triple helix: companies, government, and educational and research institutions.

The study has several limitations. First, it would have been desirable to visit a larger number of facilities engaged in different industrial activities; however, many auto parts companies did not respond to requests for access and interviews. Second, the fieldwork was conducted during the two years prior to the outbreak of the SARS-CoV-2 pandemic in 2020, which severely disrupted production chains in the state, regional, and global automotive industry. Future research should therefore examine the impacts of this disruption on different corporate areas, priorities, and budgets, including those related to safety and environmental management.

Finally, it is important to remember that the configuration identified here will continue to evolve. Nevertheless, based on the findings of this research—which can be taken as a baseline—and assuming a post-pandemic economic recovery in Mexico of up to five years (Morales, 2020), it is possible to outline three scenarios for 2035: (1) a best-case scenario, (2) a worst-case scenario, and (3) a business-as-usual scenario, which are described below.

4.4 Best Case Scenario

Environmental management is understood not only as a business requirement, but also as an urgent and essential internal commitment to society and the planet. As a result, environmental ethics are approached in a broad sense, no longer centered exclusively on humans. Similarly, verification units, environmental auditors, and certification bodies are themselves subject to professional oversight and adhere to codes of ethics that prioritize integrity in their work over profit.

Companies have environmental managers with professional profiles suited to the position; they are ISO 14001 certified and are familiar with—and actively participate in—PROFEPA's Environmental Audit Program and, where applicable, PEPMADU's State Environmental Audit Program. MSMEs in the sector have declared and publicly available environmental policies and programs and seek to participate in SEDESU support programs

to access the resources needed to obtain ISO 14001 certification, as part of a collective effort to expand the green supply chain.

Environmental authorities have sufficient budgets and an adequate number of inspectors and administrative staff to carry out their work effectively and without corruption, while also promoting updated and demanding environmental regulations. Under these conditions, an increasing number of plants operate in Moment III of innovation or can transition toward it.

For its part, the Querétaro Automotive Cluster stands as a national benchmark, strengthening the work of its sustainability committee and leading the Circular Economy System. In this role, the cluster facilitates linkages, communication, and cooperation among companies, authorities, industrial parks, universities, and research centers. This coordination enables local plants to continuously share and promote practices that improve environmental management, both within the state and beyond, allowing these experiences to be transferred to other regions and countries. In doing so, Querétaro sets an international example at a time when the car of the future and the paradigm of electromobility are becoming a reality.

As environmental management systems are implemented and strengthened within companies, working conditions and the quality of employment for workers also improve. Finally, local, regional, national, and international trade unions, together with civil society organizations, play an active role in monitoring and exerting pressure to ensure that companies operate with environmental management systems and pursue continuous improvement in their environmental performance.

4.5 Worst Case Scenario

Environmental management is largely viewed as a (often inconvenient) requirement for maintaining profitability, rather than being internalized as an urgent and essential ethical commitment. This outlook is reflected in several ways: the lack of resources and enabling conditions for environmental innovation in Mexican plants; limited attention to the ethical codes that govern verification units, environmental auditors, and certification bodies;

insufficient consideration of the professional profile required for environmental managers; weak institutional cooperation among plants and companies to share successful experiences or jointly address common problems; and the absence of mechanisms to promote or replicate effective environmental management practices across sites, resulting in a loss of international competitiveness.

The sector also faces difficulties, complacency, or significant delays in adopting the paradigm of electromobility, with clear repercussions for employment. At the same time, environmental authorities operate with reduced budgets and staff, which limits their capacity to adequately carry out inspections and to follow up on programs such as PROFEPA's Environmental Audit Program and the State Environmental Audit Program. In addition, cases of corruption persist. Environmental regulations at both the national and local levels lag behind international standards, and neither companies nor their suppliers show a genuine interest in developing a green supply chain that requires environmental certifications or structured environmental action programs.

Similarly, there are no programs in place to help SMEs access the resources needed to obtain ISO 14001 certification or to improve their environmental practices. Despite the discourse surrounding sustainability, the environment is not a real priority within the Querétaro Automotive Cluster, which limits its role in facilitating or promoting links, communication, and cooperation among companies, universities, and research centers. The Querétaro Circular Economy System has had no meaningful or lasting impact on the auto parts sector.

This neglect of environmental management goes hand in hand with a neglect of improvements in workers' conditions. Moreover, there is little oversight, pressure, or interest from trade unions or civil society organizations to ensure that local companies implement environmental management systems and continuously improve their environmental performance.

4.6 Business as Usual Scenario

Environmental management has become a business requirement for Tier 1 and Tier 2 companies and is addressed mainly through economic cost–ben-

efit considerations and a human-centered environmental ethic. Environmental managers do not always have a profile well suited to the position. In Mexico, only a small number of companies engage in environmentally innovative engineering or succeed in promoting ideas and processes that improve environmental practices in other states or countries.

Not all verification units, environmental auditors, and certification bodies are themselves subject to rigorous professional oversight or adhere to codes of ethics that place honesty above profit. PROFEPA and the State Environmental Prosecutor's Office carry out important but limited work, constrained by insufficient resources and an inadequate number of inspectors and administrative staff. In addition, many environmental managers are unaware of PROFEPA's Environmental Audit Program, which discourages company participation.

While national and local environmental regulations include some advanced provisions, others require updating, and the State Environmental Audit Program still needs to be consolidated. Finally, there is a clear lack of interest, planning, public policies, and concrete action by governments to actively promote electromobility. Instead, the focus remains on sustaining the millions of internal combustion vehicles currently on the road in North America and worldwide.

The sector's integration into the future of the automotive industry remains insufficient. Further efforts are needed to strengthen and expand the green supply chain. Many SMEs lack the knowledge and/or interest required to participate in SEDESU programs that support the acquisition of environmental certifications. Although the Querétaro Automotive Cluster has a sustainability committee and participates in the Circular Economy System in collaboration with SEDESU, there is still a clear need to reinforce links, cooperation, and communication among companies, universities, industrial parks, and research centers through the cluster.

Communication and cooperation between plants belonging to the same corporate group are also limited, which hinders the sharing of successful experiences and the collective resolution of environmental management challenges. Actions in this area often depend on the individual motivation of the environmental manager, manager, or director in charge. Moreover, environmental management is not systematically linked to decent work

within companies. Finally, there is virtually no pressure from trade unions or civil society organizations for local companies to implement environmental management systems or to continuously improve their environmental performance.

As a final reflection, it can be argued that the poverty of the neoliberal capitalist system—which De la Garza (2018) characterizes as cultural, but which can also be extended here to the environmental sphere—has generated profound tensions that threaten the very existence of life on this planet.

> On this contradictory and contested terrain—marked by struggles over experience, equality, and democracy, [and, we would add, over our relationship with nature] new social movements and subjects are emerging. For now, these do not articulate a clearly defined project for an alternative society; however, as forces accumulate, they may require more abstract levels of reflection in order to generate viable options for society and for life itself (De la Garza, 2018, p. 212).

Continuing to research and understand the contradictions, opportunities, obstacles, and specific relationships within the structures–subjectivities–actions that sociotechnically shape the local auto parts sector in relation to environmental issues—such as in the state of Querétaro—will make it possible to identify emerging trends. These, in turn, can be reflected upon and, above all, influenced, with the aim of preserving and caring for our shared home-world, so that work–environment relationships may point toward a good, free, beautiful, just, and supportive life for all.

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Examining environmental management in the automotive and auto parts industry from a multidisciplinary perspective on work is essential—both because of the socio-ecological challenges involved and because of the industry's economic and employment significance in strategic regions such as Querétaro, Mexico.

This book therefore aims to shed light on the relationship between the sociotechnical configuration and environmental management in Querétaro's auto parts sector. It explores the degree of participation of the various actors involved, within the broader context of global transformations in the automotive industry and the ongoing environmental crisis.

The study applies a configurationist methodology rooted in the sociology of work. This approach makes it possible to analyze multiple levels simultaneously, examine the ambiguities and contradictions between environmental discourse and actual practice, and highlight the structural–subjective–action dynamics that shape the emerging configuration.

The findings show that local environmental management is shaped by pressures from multiple forces, particularly market dynamics, which strongly condition company behavior and often generate tensions between public commitments and operational practices. While the sector as a whole has made significant efforts in this area, there remains room for improvement—especially regarding the influence and participation of key stakeholders such as workers and unions.

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