



THE COST OF UPHOLDING PEMEX

Human lives and the environment

The cost of upholding PEMEX



SUMMARY

The Mexican federal government has strengthened its strategy to benefit the internal market of production of petroleum products, especially gasoline and diesel. However, in its effort to achieve this, it is generating long-term negative externalities in the economy, environment, and most hazardously, people's health.

This happens because by increasing the production of petroleum products, the production of fuel oil increases. This is a highly polluting residue from the same refining process, which can flood the domestic market. For this, the Ministry of Energy tries to ensure that CFE absorbs the monopsony of said fuel without

losing its market share since the marginal costs for its use are incremental.

PEMEX EVEN IN THE AIR

The lack of information in regards to the environment and the delay of the publication about production and energy consumption documented by Signos Vitales -especially related to emissions of particles less than 10 and 2.5 microns and the energy balance- have impeded a yellow alert for what is to come.

The generation and monitoring of information in regards to these particles is the responsibility of the federal entity, SEMARNAT (Secretariat of Environment and Natural Resources by its acronym in Spanish). It also must make said information public following the current regulatory framework, nonetheless, the most recent data in the information system of said Secretariat, has not been updated since 2016.

However, the oil production policy announced in recent days, allows us to understand the reason for the lack of information. The drop in oil prices and the losses faced by Mexican Petroleum (PEMEX for its acronym in Spanish), seem to not leave many options for the federal government nor the company, to continue on the path of hydrocarbons. From its perspective, it faces a dichotomy: exporting crude oil or increasing its presence in Mexico, while decreasing oil imports.

The Federal Executive has opted for the second option, which leads to an increase in oil refining, resulting in gasoline, diesel, liquefied petroleum gas, and fuel oil. It is intuited that within the logic of the Executive, it is better to process crude oil and transform it -mainly into gasoline- than to import said products. In other words, energy security is implicitly superimposed using the concept of aggregation.

However, the path towards this choice may not be as easy as it was presented in his discourse. The implications of such a decision are only as profound as the radicalization of the measure. It remains to be seen if the administrative and strategic decisions taken by the company are the most appropriate for the country. However, the most important consequences are those of the energy policy regarding the environment and, in turn, the health of Mexicans.

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exporting crude oil or increasing its presence in Mexico, while decreasing oil imports.

Increasing the production of petroleum products not only faces limitations in its oil production (or imports) for its subsequent refining process but also faces the restrictions imposed by the company's infrastructure. The obsolete conditions of said infrastructure, impose indirect costs associated with the production of gasoline and diesel, above all.

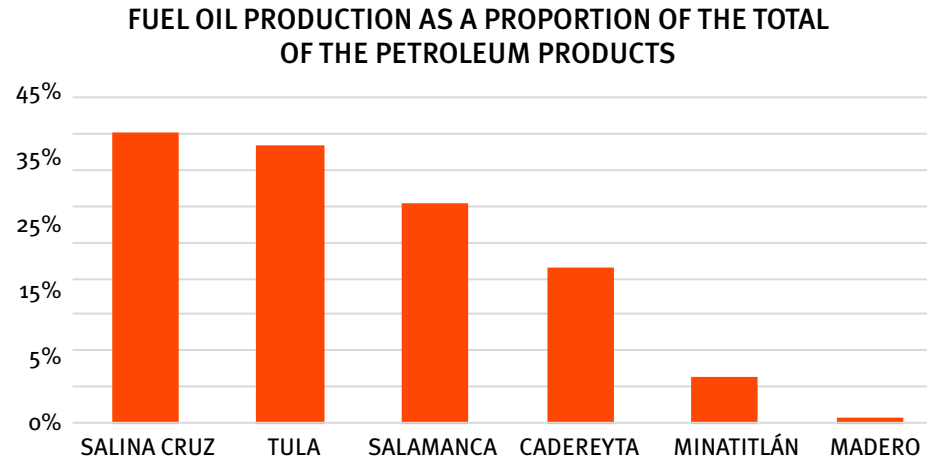
Internalizing these costs in the company can lead to a higher level of fuel oil inventories given its low demand in the industry, which means, excess supply is generated. For this reason, to implement this policy, the Federal Electricity Commission (CFE by its acronym in Spanish) was chosen to protect it from the competition. As a result of the increase in crude oil refining, proposed by the federal executive, a greater amount of fuel oil will be generated (a residue from the same refining process). This is due to the fact, that refineries in Mexico do not have sufficient technology to refine crude oil and convert it into gasoline with smaller portions of fuel oil, as is the case of the refineries in the United States of America.



Image: <https://vanguardia.com.mx/articulo/gobierno-de-amlo-quemaria-combustoleo-que-no-se-ven-de-para-generar-energia-es-danino-para>

However, it is convenient to specify that not all the refineries in Mexico produce the same amount of fuel oil as a proportion of their total oil production. As of April 2020, those of Salina Cruz and Tula stand out in this case, where approximately 4 out of every 10 barrels produced in said refineries, are fuel oil, followed by Salamanca with 3 out of 10. It is also convenient to clarify that the situation that the refineries undergo, is largely due to the low investment that was made in these, in previous governments.

Also, it should be noted that international trade regulations have prohibited the use of fuel oil on ships, due to the high levels of pollution that it generates, which partially reduced the demand for fuel oil three years earlier. Its production had been declining for years, especially from January 2017 until November 2018, a reduction of 42.1% can be observed. This reduction in domestic consumption was the result of replacing the use of fuel oil with natural gas for the production of electrical energy and the effort to comply with international agreements regarding the reduction and mitigation of climate change.



Source: In-house product with data from SENER.

This implies that PEMEX could not easily place such a surplus in the national and international markets. Consequently, given the increases in gasoline production (with high sulfur content), the federal government has chosen to concentrate fuel oil surpluses in the domestic market. For this, it is necessary for the largest fuel oil consumer in the country to use such energy. CFE will absorb this fuel oil for the production of electricity, which turns out to be more polluting than gas and with greater health effects, due to the emission of particulate matter less than or equal to 2.5 micrograms, better known as PM2.5.

The range of health effects of such particles is wide but, they particularly affect the respiratory and cardiovascular systems. The entire population is affected, but susceptibility to contamination can vary with health or age¹. These contaminants are mainly deposited in the tracheobronchial region (trachea to the terminal bronchiole), although they can enter the alveoli due to their tiny size (approximately between 1/20 and 1/30 the diameter of a hair).

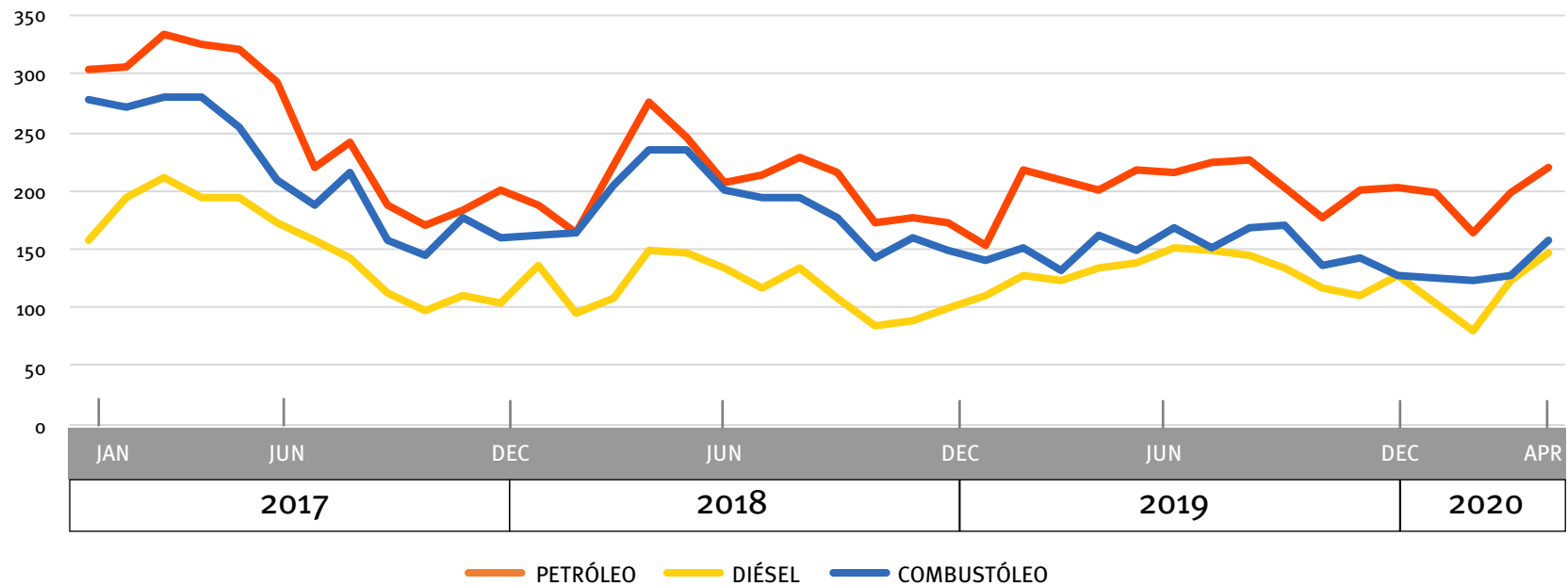
So, for said highly polluting value chain to be effective and in practice, the Mexican government resorted to actions in violation of international treaties on the matter. As well as a violation of the federal laws of the electric industry, transition energy, and climate change. This means that investment in new projects for the generation of renewable energy in Mexico has stopped. Consequently, this has reduced Mexico's participation in the electricity market.

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¹ World Health Organization (WHO) air quality guidelines for particulate matter, ozone, nitrogen dioxide, and sulfur dioxide (2005).

On the other hand, when executing such action, the National Energy Control Center (CENACE by its acronym in Spanish) exceeded its faculty as an operator for those of a regulator of the Electric System and the Wholesale Electricity Market, which corresponds to the Energy Regulatory Commission (CRE by its acronym in Spanish).

GASOLINE, DIESEL AND FUEL OIL PRODUCTION. MBD



Source: In-house product with data from SENER.

All of the above mentioned is necessary so the CFE could make use of the fuel oil produced by PEMEX in its power plants without losing its market share. The key criteria for assigning power plants for the generation of electricity is based on their variable production costs, which are mainly determined by the cost of used fuel oil. This process assigns the lowest cost plant first, then the generating plant with the next best offer up to its maximum capacity at the associated cost, and so on, until all the demand estimated and modeled by CENACE is covered. In this sense, the last assigned plant sets the market price, since it is a marginalist market. The use of fuel oil to generate electricity raises the cost of production, making it less competitive compared to other energies such as wind and solar in a dispatch center. For this reason, the dispatch rules have had to be modified to advocate towards the reliability of the system - a highly debatable issue - regarding the criteria of costs and efficiency.

It should also be mentioned, that the transformation of fuel oil into electrical energy can be carried out in plants that use a combined cycle, conventional thermal, or internal combustion technology. In Mexico, 36.5% of electricity is generated in combined cycle plants and 17% in plants with conventional thermal

technology. This means that more than half of the electricity consumed by Mexicans is generated with technologies that make intensive use of fossil fuels such as fuel oil and natural gas. However, as previously mentioned, given the excess of fuel oil, it will have to replace the use of natural gas in the electricity transformation process, once the demand for electricity returns to its peak of use, as it was prior to the health crisis.

The aforementioned, without considering the coal-fired plants that generate 7.7% of the total electrical energy which, likewise, are a fixed source of contamination in the communities where they are located.

LIGHTS, OF CONTAMINATION

Among the set of power plants to be highlighted are those that strengthen linkages in the PEMEX-CFE production chain, such as the plants in Tula (Hidalgo), Tuxpan (Veracruz) and Salamanca (Guanajuato). This is due to the closeness they maintain with the

The increase in the use of fossil fuels will generate great pressure on other ecofriendly technologies such as wind power and photovoltaic, which represent 9.4% of the total generators of electricity. Their presence may be reduced due to the agreement in mention, which restricts the entry of new investments in the matter. This implies that if the supply of electric energy increases, the participation of the two mentioned technologies will be less as a proportion of the total. It is important to note that the greater dependence on fossil fuels the greater the subsequent effects on the environment.

TABLE: POWER PLANTS IN MEXICO

POWERPLANT	STATE	MUNICIPALITY	TECHNOLOGY*	FUEL**	MW***
Manzanillo	Colima	Manzanillo	CT, CC	FO AND GAS	2754
Tula (Francisco Pérez Ríos)	Hidalgo	Tula	CT, CC	FO AND GAS	1881
Tuxpan (Adolfo López Mateos)	Veracruz	Tuxpan	CT	FO	1750
Presidente Juárez	B. California	Rosarito	CT, CC	FO AND GAS	1063
Salamanca TC y Cogeneración	Guanajuato	Salamanca	CT, TG	FO AND GAS	1023
Samalayuca I y II	Chihuahua	Cd. Juárez	CT, CC	FO AND GAS	838
Villa de Reyes	San Luis Potosí	Villa de Reyes	CT	FO	700
Puerto Libertad	Sonora	Pitiquito	CT	FO AND GAS	632
Mazatlán II (José Aceves Pozos)	Sinaloa	Mazatlán	TCT	FO	616
Río Bravo (Emilio Portes Gil)	Tamaulipas	Río Bravo	CT, CC	FO AND GAS	511
Guaymas II (C. Rodríguez Rivero)	Sonora	Guaymas	CT	FO	484
Altamira	Tamaulipas	Altamira	CT	FO AND GAS	465
Topolobampo II (Juan de D. Bâtiz)	Sinaloa	Ahome	CT	FO	320
Lerdo (Guadalupe Victoria)	Durango	Lerdo	CT	FO	320
Francisco Villa	Chihuahua	Delicias	CT	FO AND GAS	300
Valladolid (Felipe Carrillo Puerto)	Yucatán	Valladolid	CT, CC	FO AND GAS	295

* CC: Combined Cycle; CT: conventional thermal; IC: internal combustion

FO: Fuel Oil; DIE: Diesel; GAS: Gas. *Effective capacity in Megawatts

Source: In-house product with information from PRODESEN 2019-2033.

THE HIDDEN LIABILITIES OF PEMEX-CFE, DEATHS BY PM2.5

It should be mentioned that only for 2014, The National Institute of Ecology (INECC by its acronym in Spanish) estimated that the preventable deaths caused by PM2.5 ranged between 8,464 and 9,767² for the central region of the country. Additional to this, both the Health Effects Institute and the Institute for Health Metrics and Evaluation, estimated that during 2017, in Mexico, the deaths attributable to PM2.5 were 32,800 and the death rate per 100,000 inhabitants was 30.³ That is a higher rate than the deaths caused by COVID-19 so far.

One issue that contributes to aggravate the situation, is that, according to the National Air Quality Report from 2018 carried out by the INECC, of 191 monitoring air stations distributed in 83 cities and metropolitan areas of the country, only 118 of them, distributed in 60 cities, have the ability to measure PM2.5 suspended particles, and of these, only 4 met the Official Mexican Standard (NOM by its acronym in Spanish), 45 did not meet the NOM and for the remaining

² The variation in the calculation depends on the applicable Standard, either the NOM (Official Mexican Standard) or the one proposed by the World Health Organization.

³ Health Effects Institute. 2019. State of Global Air 2019.

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Fuente: <https://www.univision.com/noticias/politica-ambiental/mala-calidad-del-aire-favorece-la-muerte-de-55-millones-de-personas-cada-ano>

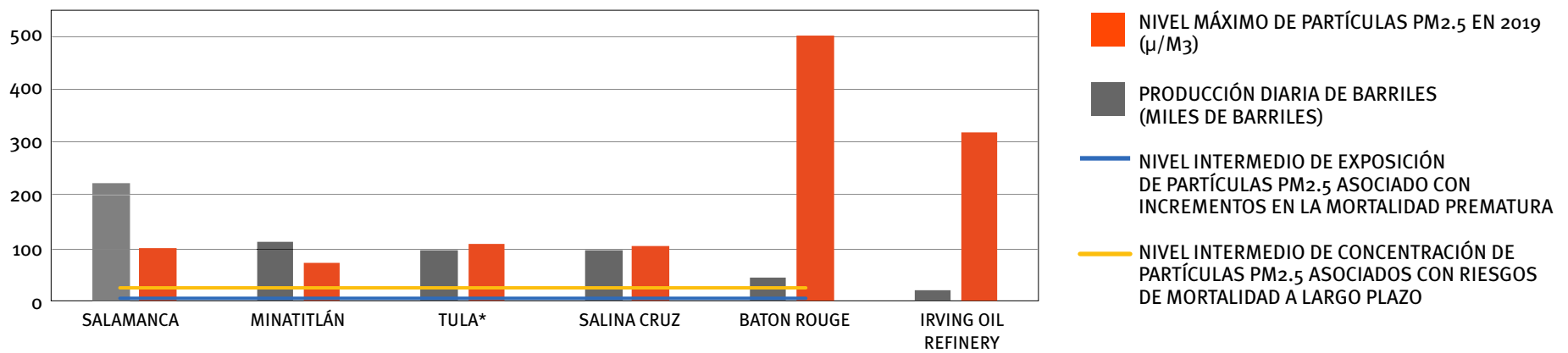
69 it is not possible to assess the compliance with the NOM due to insufficient data or because they were not in operation. This implies that regardless of the results— which in principle are not encouraging—only 41.5% had sufficient information. The results are as serious as the fact that the State does not have the capability to make decisions that safeguard the health of the inhabitants in the municipalities that may be at high risk.

The verdict to rescue PEMEX through the increase in refining is questionable if it has consequences on the health of Mexicans due to the increase in emissions of atmospheric pollutants PM_{2.5} (among some others), the reduction in competitiveness and finally, the monetary costs associated with the impact of said policy.

Consequently, if the refining volume increases, a large part of imports will be replaced by domestic production, which implies ensuring the placement of national gasoline and diesel in the domestic market. (Where PEMEX continues to lose market at an accelerated rate as shown in the energy section.) To close this combination of elements that ensure income for PEMEX, it will be necessary to increase the price of gasoline and diesel imports, and the following two measures would come in handy:

1. Cancelling permits to service stations other than PEMEX
2. Cancelling import permits altogether. Although this implies, once again, the violation of the regulatory framework, however in this context it would not be surprising.

OIL REFINING AND POLLUTION LEVELS

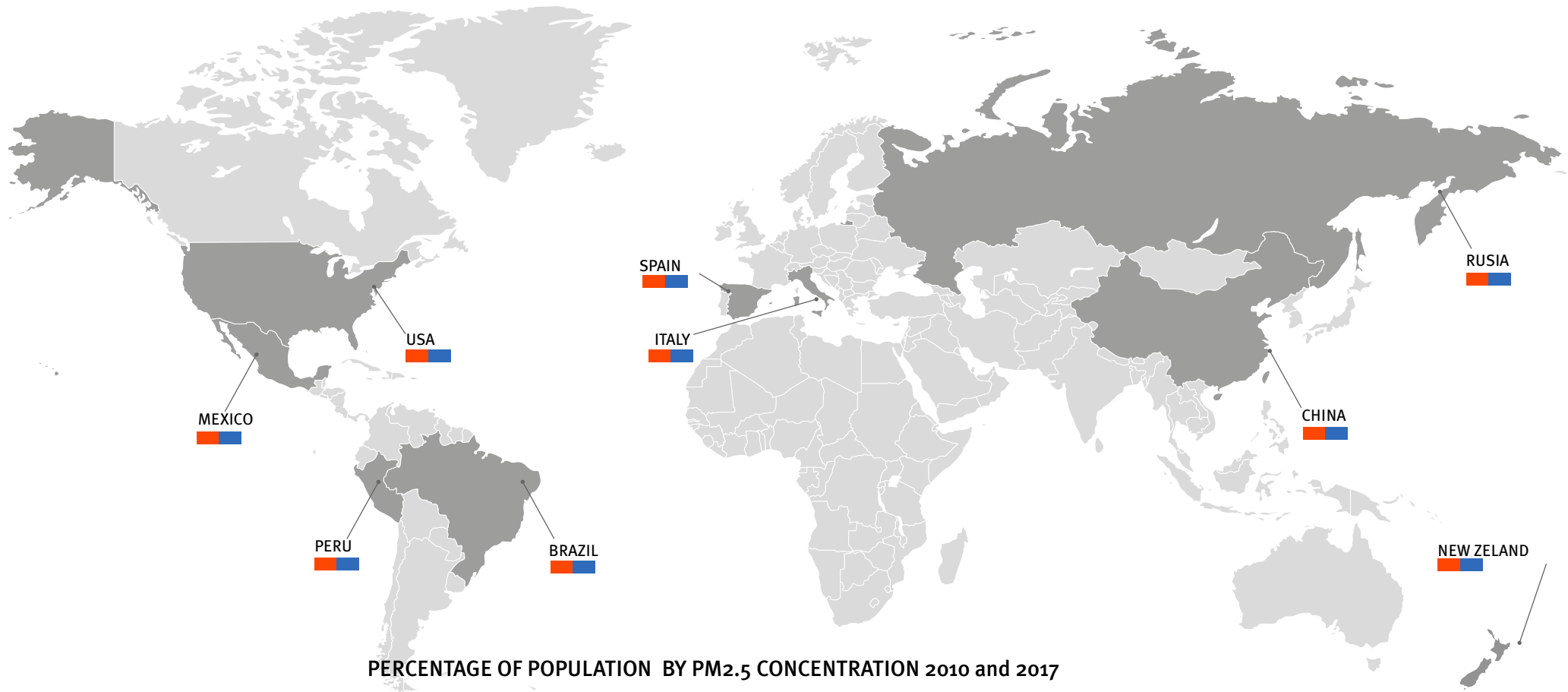


Source: Wilson Center

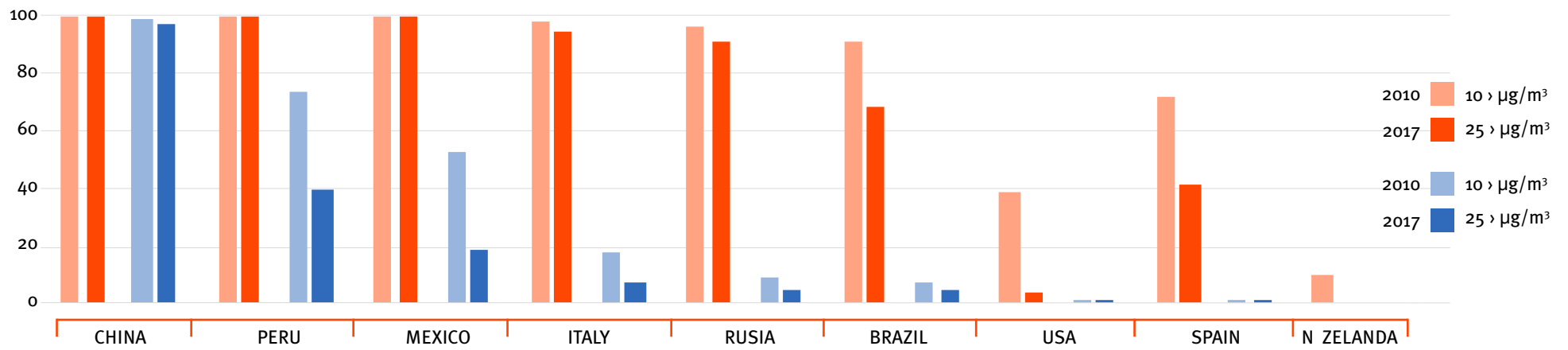
On the other hand, although we do not know precisely how lethal the combination of COVID-19 with the pollutants we are talking about can be, the central region of the country is the one that concentrates the largest number of people infected by the virus and the one that reports increased air pollutants. Furthermore, we know from a revealing study from Harvard University (<https://tinyurl.com/ycb5e8te>) that the $1 \mu\text{g}/\text{m}^3$ increase in $\text{PM}_{2.5}$ is associated with an 8% increase in the mortality rate caused by such a virus, that is, the virus becomes more lethal under certain pre-existing conditions. Other results of this research mention:

1. Population with $\text{PM}_{2.5}$ concentrations greater than or equal to $8 \mu\text{g}/\text{m}^3$ have an average mortality rate per 100,000 inhabitants almost 3 times higher than the population with a concentration less than $8 \mu\text{g} / \text{m}^3$;
2. In a previous study carried out by the same researchers, it was found that an increase of $1 \mu\text{g}/\text{m}^3$ of $\text{PM}_{2.5}$ was associated with an increase of .73% in the mortality rate (from all causes) for the elderly population 65 years or older. This means that an increase of the same magnitude leads to an increase in the mortality rate of COVID-19 almost 11 times more.

In addition, we can observe in two time periods, the exposure to these particles for a group of selected countries, where the progress of some nations in terms of the percentage of the population that is exposed to concentrations greater than $25 \mu\text{g}/\text{m}^3$ is appreciated, a situation that is extremely harmful to health. It is not surprising that New Zealand was one of the first countries to lift the health contingency (without neglecting the efforts made to control the COVID-19 pandemic), where the levels of such particulate matter are 0. On the other hand, little progress has been made by different countries such as China, Italy, Russia, Peru, and Mexico; in regards to the reduction of the concentration of these particles greater than $10 \mu\text{g}/\text{m}^3$ to a greater proportion of their populations. Thus, it is surprising that in the case of Mexico, just over 99% of the population is exposed to concentrations greater than $10 \mu\text{g}/\text{m}^3$ without observing any progress between 2010 and 2017, but have reduced by 65%, concentrations greater than $25 \mu\text{g}/\text{m}^3$ in the same timeframe.



PERCENTAGE OF POPULATION BY PM2.5 CONCENTRATION 2010 and 2017



Source: Signos Vitales with information from World Bank

FOR THE RIGHT TO A HEALTHY ENVIRONMENT, LOCAL GOVERNMENTS AND CITIZENS

The governments of the federal entities will play an extremely important role here since the monitoring of pollutants that affect the quality of life of their populace can avoid more serious outcomes shortly. The following map shows the behavior of PM₁₀ – particles up to 4 times the size of PM_{2.5}– in Mexico during May for the period 2003-2018 (on average). As can be seen, there is a greater concentration in the central, western, and southeast areas of the country. This, like some other maps, can be consulted on the portal <https://tinyurl.com/ybbm3brb> developed by the European Commission. So, it remains to be seen what will be the measures that the states of the center of the country especially: Hidalgo, State of Mexico, Mexico City, Querétaro, Puebla, Morelos, Guanajuato, and Tlaxcala, will undertake in favor of preserving the right to a healthy environment. However, other states should also be interested in their environmental situation given the high levels of pollutants reported, such as Jalisco, Colima, Veracruz, and Oaxaca.

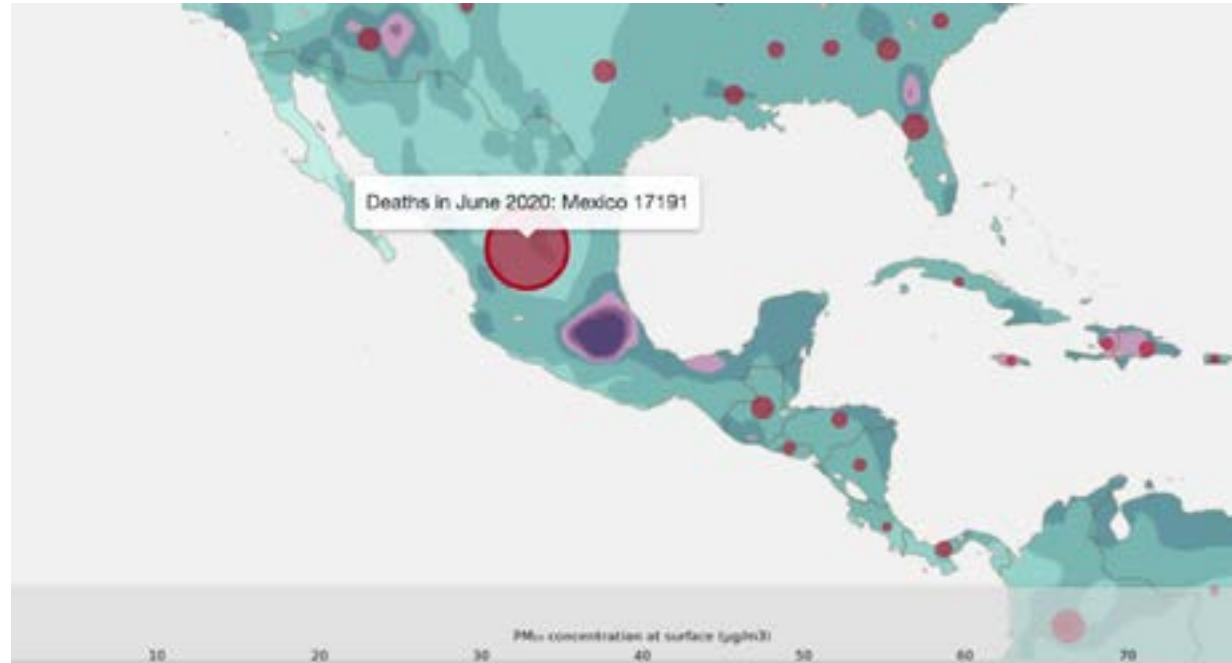


Imagen: niveles de contaminación en México, consultado el 30 de junio 2020 en <https://tinyurl.com/ybbm3brb>.

It is of utmost importance that citizens are informed about the risk involved in carrying out outdoor activities in the presence of various pollutants (including PM_{2.5} and PM₁₀) and to assess the risk to which each one is exposed. An instrument that can serve as a guide is The World Air Quality Project <https://tinyurl.com/yb3098jm>, where anyone can check the air qual-

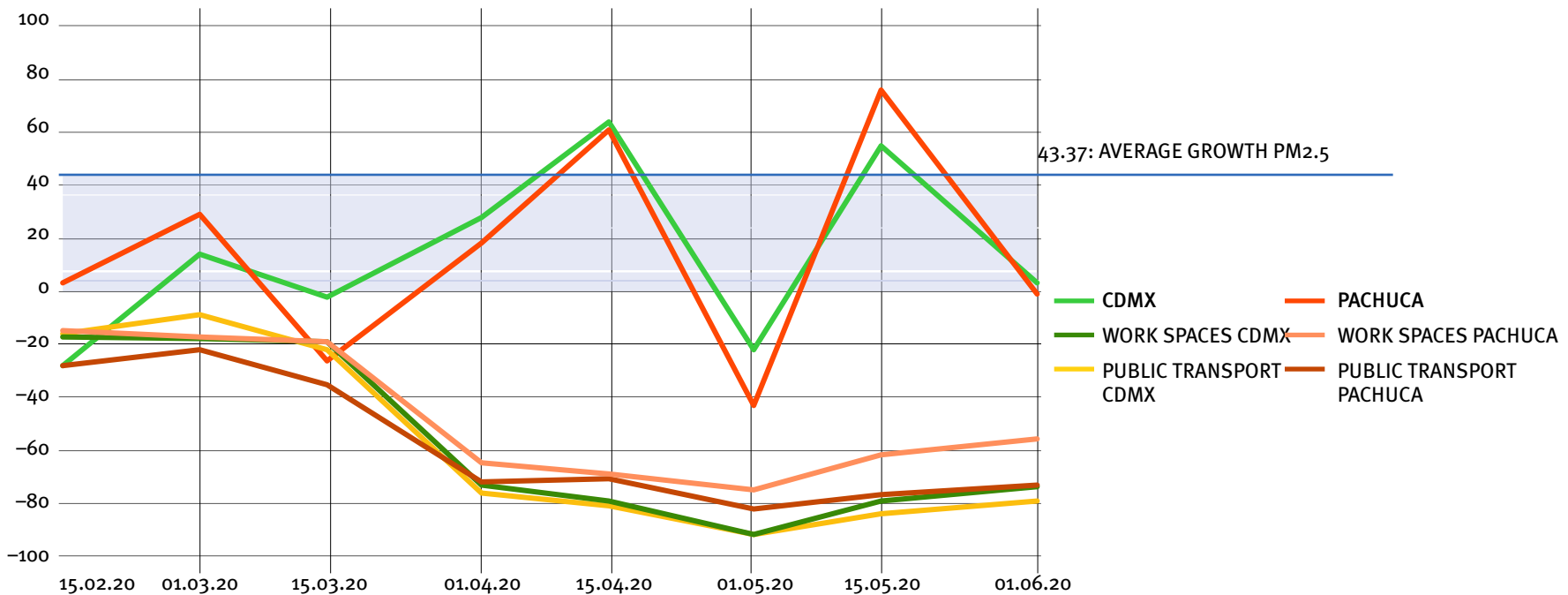
ity in their city in real-time. It is time to rethink as a society if what we really need is more fossil fuels, especially in Mexico, due to the indirect costs associated with the generation of gasoline and diesel and not necessarily because of the consumption of fuels for other uses such as transportation.

lected sample of states. contrary to the change in urban mobility patterns in the main cities of these entities, which began to drop in mid-March going forward, due to the closure of non-priority activities. This translates into greater contamination or presence of PM2.5 (among others) and less mobility in Mexico.

In recent dates, the increase in PM2.5 particles was 43.4%⁴ on average from February 15 to June 7 in a se-

⁴ The index for PM2.5 is estimated based on the same methodology used by Google in the case of mobility.

PM2.5 AND URBAN MOBILITY



Source: In-house product with information from Google and The World Air Quality Project

Given the above, the fact that despite the world has stopped its activities, which implies a decrease in the use of private and public transportation (due to its high dependence on fossil fuels), the level of pollutants stands out. In some cities in Mexico, it has not decreased. One of the great lessons of this health crisis can be strongly linked to the environment and the impact of human activities on it. Perhaps, it is time to rethink this strategy taking into consideration the air quality. This can be a turning point that results in a wakeup call for the government in regards to environmental policy closely related to the use and destination of energy.

This leaves us as a result a focus of our analysis on fixed sources of pollutants such as refineries and power plants.

It is clear why, the environmental conditions in the cities that host such infrastructures, have presented increases in air pollution, but it is also appropriate to point out other causes such as forest fires. The current situation of the world offers us a controlled experiment that could not have been seen or experienced at any other time.

THREE QUESTIONS ARISE FROM THE ABOVE:

1. Is it necessary to process the 1.8 million barrels a day⁵ that the Executive suggests satisfying the internal demand? At least those fuels related to high sulfur content.
2. Is the taken measure cost-efficient? Does the benefit of rescuing two companies offset the human and economic losses that this entails?
3. It is of utmost importance to know what local governments are doing in terms of decision-making about opening economies, under environmental conditions that do not correspond to the NOM.

⁵ Goal, that by the way has been adjusted and is much more reasonable than the 2.6 mbd that were initially suggested.

CONCLUSIONS: LOSSES ARE ALSO BREATHE

Mexicans have in their hands the decision to define their near future, as everything seems to indicate that it is more expensive to produce fossil fuels than to use them in their transportation. If imports decline and domestic fuel production increases, the results on the environment and above all, on health, point to be devastating in the midst of the health crisis. In other words, we will breathe the losses of PEMEX from when Mexicans let the electric current pass through their houses up till when they move in vehicles that use fossil fuels.

For now, the Tamaulipas state government has taken a step in the direction of discouraging the use of fuel oil in the electricity industry, by proposing to tax the generation of electricity when using fuel oil, given the carbon dioxide it generates. This is a solid argument because it is in accordance with the Paris agreement, however, from the economic point of view, it is worrying that said increase in the cost of production falls on the final consumers, so, politically it may also be counterproductive.

For its part, the Climate Change Council, which has the power to advise the Inter-Secretarial Commission

on Climate Change, which holds said power under the General Law on Climate Change (LGCC for its acronym in Spanish), has spoken on the matter, urging the Ministry of Energy to reconsider the actions taken in recent days⁶.

On the contrary, the federal government has announced the construction of a greater number of combined cycle power plants, which perpetuates this situation and sends a clear signal: the rescue will deepen even if the costs are internalized in the health of Mexicans and debt must be paid with human lives.

It should be clarified that with the public series of decisions the Mexican government is transferring an issue of energy security to one of health, and, incidentally, contravening the Sustainable Development Goals in environmental matters. On the other hand, this problem can be aggravated over time since it will increase our dependence on fossil fuels. In other words, fire is fought with more fire.

The federal government demands taxes and the Mexicans, without knowing it, in many cases, pay with their lives.

⁶ <https://tinyurl.com/y8o5vwvb>



SIGNOS VITALES
EL PULSO DE MÉXICO

JULY 2020

