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# **SACRIFICE ZONES: 50 OF THE MOST POLLUTED PLACES ON EARTH**

 **Baotou, China**



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**This publication is based on a report presented to the Human Rights Council, A/HRC/49/53, by David R. Boyd, the Special Rapporteur on human rights and the environment, in collaboration with Marcos Orellana, the Special Rapporteur on Toxics and Human Rights.**

**A call for inputs was circulated in January 2021. Submissions were received from Argentina, Austria, Azerbaijan, Brazil, Cambodia, Chile, Costa Rica, Côte d'Ivoire, El Salvador, Finland, Greece, Guatemala, Malta, the Marshall Islands, Mauritius, Mexico, Montenegro, the Niger, Poland, Qatar, Singapore, Switzerland and Togo, and from youth, Indigenous peoples, students, academics, civil society and human rights institutions. In addition, more than 80 individuals and organizations participated in a virtual researchathon to identify and describe potential sacrifice zones (see Appendix I).**

**The health and environmental problems associated with the sacrifice zones included in this publication were verified through peer-reviewed scientific articles, as reflected in the endnotes.**

TITLE IMAGE: [EBENART / SHUTTERSTOCK](#)

# SACRIFICE ZONES




 **Cerro de Pasco,**  
**Peru**

IMAGE: SOURCE INTERNATIONAL

Pollution and toxic substances kill more than 9 million people per year, damage the health of billions, and inflict costs measured in trillions of dollars. Everyone in the world is affected by the pervasive pollution that characterizes life in the 21st century, even newborn infants. However, the burden of contamination falls most heavily upon communities that already are vulnerable or marginalized because of race, poverty and other socio-economic factors. This phenomenon is known as environmental injustice.

Among the most extreme examples of environmental injustices are communities located near the most intensely polluting and dangerous facilities, including open-pit mines, smelters, petroleum refineries, chemical plants, coal-fired power stations, oil- and gas fields, steel plants, garbage dumps and hazardous waste incinerators, as well as clusters of these facilities. These contaminated communities are a contemporary form of sacrifice zone.

The phrase "sacrifice zone" originated in the cold war era, when it was used to describe areas rendered uninhabitable by nuclear weapon tests, conducted by the United States, the Soviet Union, France and the United Kingdom, that caused high and lasting levels of radiation.

**UN Special Rapporteur on Human Rights & Environment**

# SACRIFICE ZONES



IMAGE: [RICARDO MARTÍNEZ / UNEARTHED / GREENPEACE](#)

Residents of today's sacrifice zones suffer devastating physical and mental health consequences and human rights violations as a result of living in pollution hotspots and massively toxic areas. Rates of cancer, heart disease, and respiratory illness are elevated, access to adequate health care is often limited, and life expectancy is substantially shorter than the national average.

A wide range of human rights are compromised, from the rights to life, food, water and health to the right to a clean, healthy and sustainable environment, ostensibly for "growth", "progress" or "development" but in reality to serve private interests. Shareholders in polluting companies benefit from higher profits, while consumers benefit through lower-cost energy and goods.

The people who inhabit sacrifice zones are exploited, traumatized and stigmatized. They are treated as disposable, their voices ignored, their presence excluded from decision-making processes and their dignity and human rights trampled.

Today there are thousands of sacrifice zones located throughout the world, in nations rich and poor, North and South, East and West. This report highlights, through photographs and Google Earth images, the terrible conditions in which 55 of these disadvantaged communities are living today. The 55 examples are not necessarily the worst of the worst, for no exhaustive comparative analysis has been conducted. However, they are representative of the shocking and unconscionable inequality that exists in our societies, both between and within nations. Sacrifice zones also demonstrate the vast gap between today's environmental conditions and the utopian vision of Agenda 2030 and the Sustainable Development Goals.

# SACRIFICE ZONES

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Current approaches to managing the risks posed by pollution and toxic substances are clearly failing, resulting in widespread violations of the right to a clean, healthy and sustainable environment. The deeply disturbing evidence – millions of premature deaths, impaired health for billions of people and lives lived in the purgatory of sacrifice zones – demonstrates a systematic denial of dignity and human rights.

States and businesses must vigorously pursue zero pollution and the elimination of toxic substances, rather than merely trying to minimize, reduce and mitigate exposure to these hazards. To ensure that human rights obligations are fulfilled, prevention, precaution, polluter pays and non-discrimination must be the paramount principles in environmental policymaking. People living in sacrifice zones must be prioritized, not left behind. Air, water and soil in contaminated communities must be remediated, rehabilitated and restored. Today's environmental injustices must be rectified, and tomorrow's prevented.

The continued existence of sacrifice zones is a stain upon the collective conscience of humanity. Society has the requisite knowledge and ingenuity to fulfill the right to a clean, healthy and sustainable environment, but must overcome powerful vested interests in order to do so. A human rights-based approach to preventing exposure to pollution and toxic chemicals could save millions of lives every year, improve the health of billions of people and generate trillions of dollars in economic benefits. A rights-based approach could be a catalyst for the systemic and transformative changes needed to achieve a cleaner, greener, healthier future for all.



**Dhaka, Bangladesh**



IMAGE: [UNICEF](#)

**UN Special Rapporteur on Human Rights & Environment**

**AFRICA**

**SACRIFICE ZONES**

# 1. KABWE, ZAMBIA

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IMAGE: [LARRY C. PRICE / PULITZER CENTER](#)

In Kabwe, Zambia, 95 per cent of children suffer from elevated blood lead levels caused by lead mining and smelting.<sup>1</sup> Experts described the situation as a severe environmental health crisis,<sup>2</sup> and Kabwe was named as one of the most polluted places on Earth. Exposure to lead during childhood impairs neurological development, causing lifelong cognitive deficits. Extremely high levels of exposure, such as those seen in Kabwe, can cause blindness, paralysis and death.

**SACRIFICE ZONES**

## 2. NIGER DELTA, NIGERIA

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IMAGE: [PIUS UTOMI EKPEI/AFP/GETTY IMAGES](#)

The people of the Niger Delta in Nigeria have lived with oil pollution and gas flaring for decades, resulting in extensive physical and mental health problems caused by contaminated air, water and food.<sup>3</sup> Adverse health effects of exposure to oil pollution include abnormalities in blood, liver, kidney, respiratory and brain functions, as well as asthma attacks, headaches, diarrhoea, dizziness, abdominal pain and back pain.<sup>4</sup> Average life expectancy for residents of the Niger Delta is only 40 years, compared to 55 years for Nigeria as a whole.<sup>5</sup>

**SACRIFICE ZONES**



# 3. ABIDJAN, CÔTE D'IVOIRE

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IMAGE: [ALCHETRON](#)

In 2006, thousands of people in Abidjan, Côte d'Ivoire, were harmed and 15 killed by the illegal dumping of toxic waste containing high levels of hydrogen sulfide offloaded from the vessel *Probo Koala*.<sup>6</sup> A review of the hospital records of more than 10,000 patients determined that the main impacts included respiratory problems (such as coughs and chest pains) and digestive symptoms (such as abdominal pain, diarrhoea and vomiting).<sup>7</sup>

## 4. MPUMALANGA, SOUTH AFRICA

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IMAGE: GROUNDWORK SOUTH AFRICA

The Anosy region in Madagascar is one of the most biodiverse areas in the world, with unique forests and high rates of endemic species, including the well-known lemurs. In 2006, Rio Tinto partnered with the Malagasy government to establish an ilmenite mine in the region (ilmenite is a mineral that contains titanium oxide, used in myriad consumer products). This operation “has been harshly criticized by Malagasy and international environmentalists and human rights activists for basic rights violations, exclusions and violence, and of executing a ‘double land grab’ – one for mining activities and one for spatially separate biodiversity offsetting – causing economic and physical displacement of Malagasy farmers, pastoralists and fishers.”<sup>25</sup> The mine has damaged forests and contaminated water with toxic substances. Downstream from the mine, uranium levels are 350 times higher than the local average, while lead levels are ten times higher.<sup>26</sup> These heavy metals are known to cause organ damage and developmental delays in children. The loss of forests has affected residents’ ability to hunt and grow manioc, their staple food source.

## 5. AGBOGBLOSHIE, GHANA

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IMAGE: [MUNTAKA CHASANT / WIKIMEDIA](#)

**Agbogbloshie is a notorious electronic waste (e-waste) scrapyard in Accra, Ghana's capital city. Thousands of workers collect, dismantle, and burn electronic equipment to access valuable materials, including gold, silver, copper, brass, iron, and steel. Soil, water, and air in Agbogbloshie are highly polluted because the extraction process releases large amounts of toxic chemicals, such as polybrominated diphenyl ethers (PBDEs), polychlorinated biphenyls (PCBs), chlorinated paraffins, lead, chromium, cadmium, zinc, nickel, and mercury.<sup>11</sup> Soil samples at Agbogbloshie contain extraordinarily high concentrations of persistent organic pollutants (POPs), including dioxins, furans, and PCBs.<sup>12</sup> Workers at Agbogbloshie are generally disadvantaged persons, including migrants from the rural areas of northern Ghana and members of ethnic minority groups.<sup>13</sup>**

# 6. LEGA DEMBI, ETHIOPIA

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IMAGE: GOOGLE EARTH

Pollution from the Lega Dembi gold mine in Ethiopia has harmed the health of thousands of people by exposing them to dangerous levels of cyanide, arsenic and mercury. For example, mercury levels in the mine's tailings ponds were nearly 500 times WHO guidelines, while arsenic levels were ten times higher than WHO guidelines.<sup>14</sup> Mothers and children are particularly affected by high rates of miscarriage, stillbirth, infant mortality, birth defects, and childhood disabilities.<sup>15</sup> Many people are afflicted with other chronic and debilitating illnesses. It was reported that mine employees "do not buy livestock products from the community in suspicion of the safety of the livestock in the vicinity of the company as the area is environmentally polluted with toxic waste from the mine."<sup>16</sup> For the Indigenous Guji Oromo peoples of Ethiopia, whose way of life has been agro-pastoral for centuries, water pollution from the mine has harmed and killed livestock and reduced crop yields.<sup>17</sup> An elder said that because of the mine, "we faced many problems: our cattle died after drinking water from the tailing dams, women lost pregnancy [miscarriage] and children have been disabled."<sup>18</sup> The mine was closed in 2018 due to concerns about environmental and social impacts, but discussions are ongoing about re-opening the mine.<sup>19</sup>

**SACRIFICE ZONES**

## 7. THAR JATH, SOUTH SUDAN

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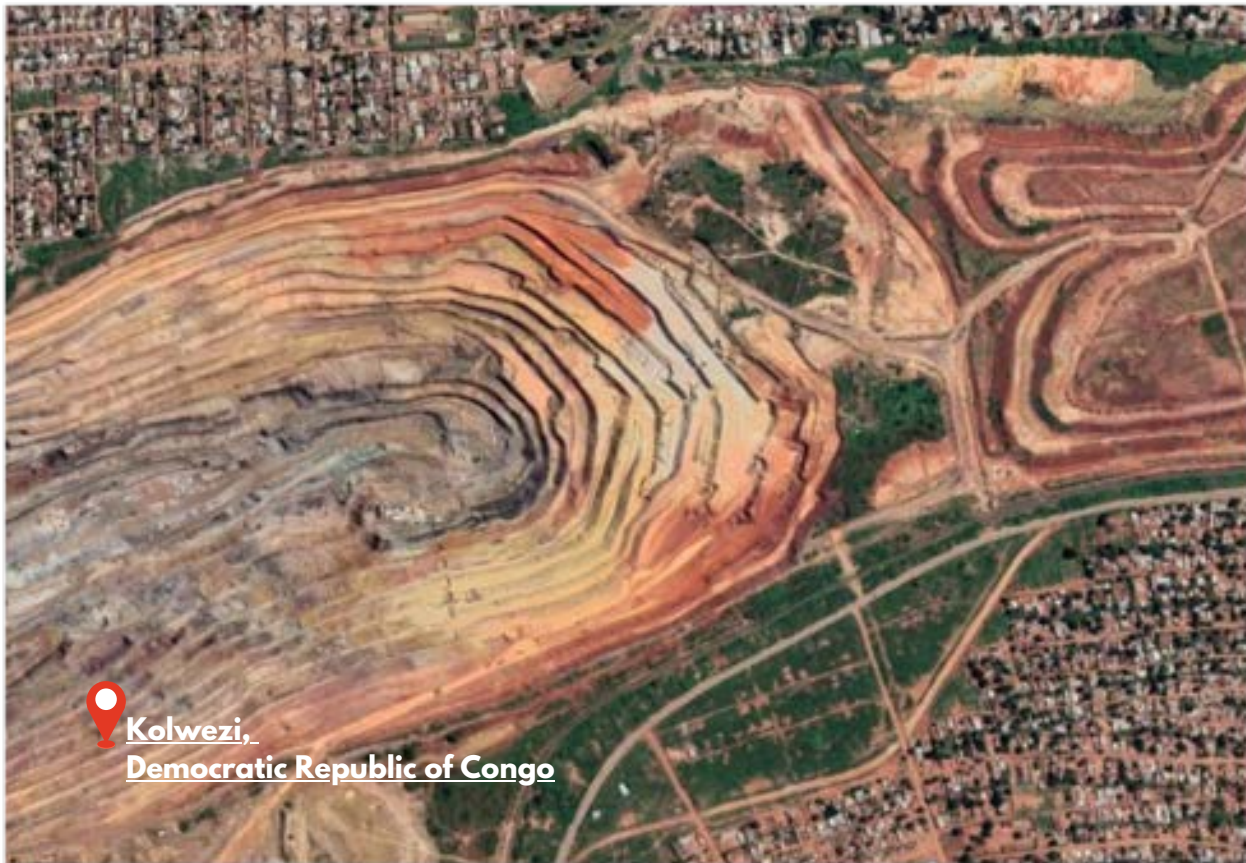


IMAGE: [AL JAZEERA](#)

The Thar Jath oilfield in South Sudan has been ravaged by civil war and neglect, resulting in oil contamination of streams, groundwater and wells. The water is polluted with dangerous levels of heavy metals, including lead and barium, and these toxic substances are accumulating in the bodies of local people, as proven by hair samples.<sup>20</sup> Residents near the oil fields have experienced extensive gastrointestinal illnesses, premature births, and birth defects. According to scholars, “There is a perceptible fear that rather than being the source of life, these water systems have become sources of misery, disease and death.”<sup>21</sup>

## 8. KOLWEZI, DEMOCRATIC REPUBLIC OF CONGO

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Kolwezi,  
Democratic Republic of Congo

IMAGE: GOOGLE EARTH

More than half the world's cobalt, an essential component of lithium-ion batteries for electric vehicles, comes from the Democratic Republic of Congo, with a substantial proportion (estimated at 15-20%) being extracted by artisanal miners. Both industrial and artisanal cobalt mining lead to high levels of pollution.<sup>22</sup> The Kasulo district of the city of Kolwezi is located near industrial cobalt mines and was home to extensive artisanal cobalt mining until residents were forcibly relocated and their land sold to a Chinese mining company. A biomonitoring study found that the bodies of residents of Kasulo, especially children, were heavily contaminated by cobalt.<sup>23</sup> Children's urinary cobalt levels were more than a dozen times higher the safe level for miners established in the United States. Dust was the main pathway of exposure. High doses of cobalt can affect the heart, lungs, blood and thyroid. In addition, DNA damage among children points to elevated cancer risks later in life. Miners often work without basic protective equipment and experience dangerous exposure to dust, chemicals, and potential mine tunnel collapse.<sup>24</sup>

**SACRIFICE ZONES**

## 9. ANOSY, MADAGASCAR

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IMAGE: GOOGLE EARTH

The Anosy region in Madagascar is one of the most biodiverse areas in the world, with unique forests and high rates of endemic species, including the well-known lemurs. In 2006, Rio Tinto partnered with the Malagasy government to establish an ilmenite mine in the region (ilmenite is a mineral that contains titanium oxide, used in myriad consumer products). This operation “has been harshly criticized by Malagasy and international environmentalists and human rights activists for basic rights violations, exclusions and violence, and of executing a ‘double land grab’ – one for mining activities and one for spatially separate biodiversity offsetting – causing economic and physical displacement of Malagasy farmers, pastoralists and fishers.”<sup>25</sup> The mine has damaged forests and contaminated water with toxic substances. Downstream from the mine, uranium levels are 350 times higher than the local average, while lead levels are ten times higher.<sup>26</sup> These heavy metals are known to cause organ damage and developmental delays in children. The loss of forests has affected residents’ ability to hunt and grow manioc, their staple food source.

**SACRIFICE ZONES**

# ASIA & THE PACIFIC

SACRIFICE ZONES



# 10. NEW DELHI, INDIA

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IMAGE: [ARHIVA / AFP](#)

**Astronomical levels of air pollution have harmed the health of billions of people in Asia. The majority of the world's most polluted cities are in China and India. In New Delhi, thick smog provoked a weeks-long closure of all schools in November 2021, with levels of fine particulate matter (PM2.5) 20 times higher than the maximum daily limit recommended by WHO.<sup>27</sup>**

# 11. BAOTOU, CHINA

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IMAGE: [EBENART / SHUTTERSTOCK](#)

China extracts the majority of the world's rare earth minerals, elements used in products including electric vehicles, wind turbines and mobile phones. These minerals are mined in Bayan Obo and processed in Baotou, a nearby city. Air quality is very poor, and toxic emissions cause a substantial lifetime risk of lung cancer for local residents, especially children.<sup>28</sup> Residents have elevated levels of rare earth minerals (lanthanum, cerium and neodymium) in their blood, urine and hair.<sup>29</sup> Elevated concentrations of heavy metals in dust and soil threaten people's health.<sup>30</sup>

**SACRIFICE ZONES**

## 12. MARSHALL ISLANDS & KAZAKHSTAN

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IMAGE: [SCIENCE HISTORY IMAGES / ALAMY](#)

People in the Marshall Islands, in Kazakhstan, in Chernobyl, Ukraine, and in Fukushima, Japan,<sup>31</sup> continue to suffer the adverse effects of radiation from nuclear tests and disasters at nuclear reactors. Between 1946 and 1958, the United States tested more than 60 nuclear weapons on or near Bikini and Enewetak atolls in the Marshall Islands, resulting in elevated levels of cancer, birth defects and psychological trauma that continue to this day.<sup>32</sup> Marshallese women and girls suffer disproportionately from thyroid and other cancers and from reproductive health problems.<sup>33</sup> The former Soviet Union conducted 456 nuclear testing explosions in the former Semipalatinsk region (now Semey, Kazakhstan). People in the region, living in poverty and not informed about the tests, were exposed to high levels of radiation, leading to large numbers of birth defects, elevated rates of cancer and extensive psychological trauma.<sup>34</sup>

**SACRIFICE ZONES**

# 13. JHARIA, INDIA

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IMAGE: [JOHNNY HAGLUND / NPR](#)

In Jharia, India, fires burning in underground coal mines for a century continue to cause elevated levels of air pollution. Experts describe the air quality as “very poor”, “severely polluted” and “critically polluted” because of coal mining and underground coal fires.<sup>35</sup> The underground fires also cause subsidence (collapse of surface land), leading to deaths and loss of homes.<sup>36</sup>

# 14. AHVAZ, IRAN

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IMAGE: [MOHAMMADREZA SALEH / ISNA](#)

Ahvaz, Iran ranks as one of the most polluted cities of the world in terms of particulate matter concentrations. Annual concentrations are many times higher than the guidelines established by the World Health Organization for good air quality.<sup>37</sup> Exposure to these excessively high levels of particulates causes heart disease, stroke, respiratory illnesses and cancer, leading to thousands of premature mortalities in Ahvaz every year.<sup>38</sup> Poor air quality in Ahvaz is also linked to premature births and low birth weight.<sup>39</sup>

# 15. JAKARTA, INDONESIA

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IMAGE: [JURNASYANTO SUKARNO / GREENPEACE](#)

**Air quality in Jakarta, Indonesia, is among the worst in the world's capital cities. Emissions from coal-fired power plants and motor vehicles create significant health risks to its residents, causing an estimated 7,390 deaths each year.<sup>40</sup> Covid-19 has exacerbated this already grim picture. An American study found that a  $1\mu\text{g}/\text{m}^3$  increase in  $\text{PM}_{2.5}$  was "associated with an 8% increase in Covid-19 death rate".<sup>41</sup> The Government of Indonesia and the Province of Jakarta have both made efforts to reduce air pollution in Jakarta including ambient air quality standards, emissions regulations and monitoring requirements for industries, investments in renewable energy, and efforts to curb open waste burning and forest clearing. However, a lack of implementation and enforcement has limited the effectiveness of these measures.<sup>42</sup> In 2021, following a lawsuit brought by local residents, an Indonesian court found a violation of the right to clean air and ordered governments to take immediate action to improve air quality in Jakarta.<sup>43</sup>**

**SACRIFICE ZONES**

# 16. BEREZOVKA, KAZAKHSTAN



IMAGES: [NATA LI](#) & GOOGLE IMAGES

Pollution affecting communities near the massive Karachaganak oil field in Kazakhstan has been a concern for many decades.<sup>44</sup> Residents of Berezovka complained about gas flaring, sulfur smells and pollution, indicating that they and their children were suffering from breathing difficulties, skin rashes, nosebleeds, headaches, and other health ailments.<sup>45</sup> The oil field is operated by Karachaganak Petroleum Operating BV, an international consortium comprised of Shell (the Netherlands), ENI (Italy), Chevron (US), Lukoil (Russia) and KazMunaiGaz (Kazakhstan). Businesses operating at Karachaganak routinely violated emission standards and were fined millions of dollars.

In 2008, the Supreme Court of Kazakhstan ruled that residents of Berezovka were entitled to information about emissions from Karachaganak that had been withheld as 'confidential business information.' On November 28, 2014, as a result of toxic emissions from an accident at Karachaganak, 25 children from Berezovka suffered severe medical problems, some of which continue to the present day. A number of these children were diagnosed with toxic encephalopathy, a range of brain dysfunctions caused by exposure to toxic chemicals.<sup>46</sup> These events, combined with pressure from the community and international organizations, led to the relocation of the entire community of Berezovka to a nearby village called Aksai, over a period of three years from 2015-2017.<sup>47</sup> Hydrogen sulfide emissions from Karachaganak are also linked to high levels of cardiovascular disease in nearby communities.<sup>48</sup>

**SACRIFICE ZONES**

# 17. KIM KIM RIVER, MALAYSIA

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IMAGE: [BERNAMA](#)

The Kim Kim River is one of the most polluted rivers in Malaysia.<sup>49</sup> In 2019, there was a terrible incident of hazardous waste being dumped into the river near several schools in Pasir Gudang. More than 5,000 children suffered breathing difficulties, nausea, vomiting and dizziness because of exposure to toxic chemicals including acrylonitrile, benzene, hydrogen chloride, methane, toluene, xylene, ethylbenzene and d-limonene.<sup>50</sup> Another study confirmed high concentrations of polycyclic aromatic hydrocarbons on the surface of the Kim Kim River, raising the risk of cancer.<sup>51</sup> The long-term effects of these toxic exposures are unknown, but must be placed in the context of recurring pollution problems in this region of Malaysia. Similarly, illegal dumping of toxic waste containing lead from a battery recycling facility in Jenjarom, Malaysia, jeopardized the health of thousands of children in the area.<sup>52</sup>



## 18. ARAL SEA, KAZAKHSTAN/UZBEKISTAN

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IMAGE: [ZHANAT KULENOV](#)

The Aral Sea region is widely regarded as an ecological disaster, especially in Kazakhstan and Uzbekistan. Levels of toxic substances, including dioxins and beta-hexachlorocyclohexane ( $\beta$ -HCH), in women's breast milk and children's blood are among the highest ever documented.<sup>53</sup> Children in the Aral Sea region suffer from a range of conditions caused by exposure to toxic substances, including impacts on brain and motor skill development, respiratory illnesses, anemia, diarrheal diseases, hypercalciuria and renal tubular dysfunction. Muynak (Uzbekistan) has among the highest estimated prevalence rates of childhood anemia in the world.<sup>54</sup> Children are also suffering from growth retardation, heart disease and kidney disease. Adults suffer from elevated rates of cancer, including liver, esophageal, lung and stomach cancer.<sup>55</sup> The dramatic shrinkage of the Aral Sea has increased salt concentration in the water tenfold, while also contributing to massive dust storms that wreak havoc on air quality. Perhaps not surprisingly, surveys show that the majority of people in this region believe the environmental disaster is contributing to their poor health and would like to emigrate.<sup>56</sup>

# 19. LAHORE, PAKISTAN

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IMAGE: [K.M. CHAUDARY / ASSOCIATED PRESS](#)

**As is the case for other countries in South Asia, air pollution is a terrible problem in Pakistan. Pakistan experienced a sharp rise in air pollution levels since 2010 and now endures very high  $PM_{2.5}$  concentrations.<sup>57</sup> Air pollution causes approximately 235,700 premature deaths annually in Pakistan from heart disease, stroke, respiratory illnesses and cancer.<sup>58</sup> Vehicles on the road in Lahore doubled between 2012 and 2019, the number of industrial facilities grew to more than 15,000, and there is some transboundary pollution from India. Over a 5-year period, the average annual levels of fine particles ( $PM_{2.5}$ ) in Lahore were 14 times higher than the WHO air quality guidelines. In 2016, a severe smog episode occurred in Lahore, with nitrogen oxide levels 17 times higher than usual, causing a range of adverse health effects. Hundreds of people suffered such severe eye irritation from the smog that they went to local hospitals for treatment.<sup>59</sup> Scientists wrote that “Lahore has once again been engulfed by a disturbingly heavy blanket of smog, shrouding the entire city and taking a toll on people’s lives.”<sup>60</sup>**

**SACRIFICE ZONES**

# 20. SUKINDA VALLEY, INDIA

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IMAGE: GOOGLE EARTH

Chromite mining in the Sukinda Valley produces the majority of chromite in India but comes at a high cost for residents of the valley because chromite mining causes the contamination of groundwater with hexavalent chromium, a known carcinogen.<sup>61</sup> The mining process also causes elevated levels of air pollution, harming people's health and leading researchers to describe the region as one of the most polluted places in the world.<sup>62</sup>

# 21. KLITY CREEK, THAILAND

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 Kanchanaburi, Thailand

IMAGE: [HUMAN RIGHTS WATCH](#)

In 1998, a massive volume of lead-contaminated mine tailings spilled into Klity Creek in Kanchanaburi Province, Thailand. Children in nearby villages were exposed to lead through water, food and soil. All children who were subsequently tested were suffering from blood lead levels above 10 microg/dl, the recommended threshold for government intervention. These children frequently reported nausea, vomiting, abdominal pain, constipation, concentration problems, muscle pains, headaches, insomnia, and memory loss, all of which are symptoms of lead poisoning.<sup>63</sup> Blood lead levels were associated with substantially lower IQ levels compared to non-exposed children, leading researchers to conclude that “The children in this study who were exposed to environmental lead had an accumulation of lead in their bodies. This resulted in a great impact on intellectual development.”<sup>64</sup>

Residents in the Klity Creek area filed lawsuits seeking remediation because the government was relying on natural regeneration, which was not working.<sup>65</sup> The Supreme Court of Thailand ruled in favor of the villagers in 2013, ordering the government to reduce levels of lead contamination to acceptable levels in water, sediment, aquatic animals, soil, and vegetation in and around the creek. In 2016, 18 years after the spill, lead concentrations in the affected waters and sediments were still extremely high. Researchers determined that this was because lead was continuing to leak out of the tailings ponds into surrounding waters and soils. The budget for the restoration project is \$US15 million, and all stakeholders agree that remediation targets will not be easily achieved. Experts have concluded that in order “to achieve the remedial action goal ordered by the court, proper tailing ponds management is imperative.”<sup>66</sup> In the meantime, villagers continue to drink water and eat fish contaminated with lead because their options are limited.

# **EASTERN EUROPE**

**SACRIFICE ZONES**

## 22. BOR, SERBIA

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IMAGE: [WIKIPEDIA / CUROVICS](#)

Bor, Serbia, is one of the most polluted European cities, largely because of a huge copper mining and smelting complex that emits massive amounts of sulfur dioxide, particulates, arsenic, lead, zinc and mercury.<sup>67</sup> UNEP described a devastating legacy of environmental problems, with sulfur dioxide concentrations occasionally exceeding the measuring range of monitoring equipment.<sup>68</sup> The Borska Reka River is so contaminated with heavy metals that experts described it as without any trace of life.<sup>69</sup> Metallurgical workers have high levels of arsenic in their hair and urine, with nearly 80 per cent suffering from an average of two chronic diseases.<sup>70</sup>

## 23. NORILSK, RUSSIA

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IMAGE: [GELIO LIVEJOURNAL](#) / [POLAR JOURNAL](#)

Norilsk is among the most polluted cities in the Russian Federation, suffering very high levels of air pollution, acid rain, water pollution and soil contamination.<sup>71</sup> The main source of pollution is the mining and smelting company Norilsk Nickel, which caused a catastrophic diesel spill in 2020 affecting the Pyasina River. Very high levels of heavy metals have been found in fish, moss, soil and snow in the region.<sup>72</sup> The most adversely affected communities are Indigenous peoples from Taymyr, who face high rates of respiratory diseases, cancer, weakened immune system, premature births, reproductive failure, increased childhood morbidity and life expectancy 10 years below the national average.<sup>73</sup>

## 24. CLUJ-NAPOCA, ROMANIA

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IMAGE: [GEORGE POPESCU / EJATLAS](#)

Although the Pata Rât landfill in Cluj-Napoca, Romania, closed in 2015, thousands of marginalized Roma people still live in the area, regarded as one of the worst waste dumps in Europe. They lack access to safe drinking water, sanitation or decent housing, leading researchers to describe Pata Rât as a desolate scenario of dehumanization.<sup>74</sup> People are exposed to arsenic, benzene, cadmium, chromium, creosote, dioxins, hexane, hydrogen sulfide, lead, mercury, styrene and zinc. Residents report suffering from infections of the ears, eyes and skin, asthma, bronchitis, high blood pressure, cancer, and heart, liver and stomach ailments.<sup>75</sup>



## 25. SKOPJE, NORTH MACEDONIA

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IMAGE: JOI LEE / AL JAZEERA

Skopje, North Macedonia is one of the most polluted cities in Eastern Europe, and “has historically experienced frequent episodes of heavy pollution”.<sup>76</sup> Annual concentrations of fine particulate matter ( $58\mu\text{g}/\text{m}^3$ ) are more than double the European Union (EU) annual limit value ( $25\mu\text{g}/\text{m}^3$ ) and more than ten times higher than the limit recommended by the World Health Organization ( $5\mu\text{g}/\text{m}^3$ ). Skopje has a large number of industrial facilities, high traffic volumes, and relies heavily on biomass burning. In recent years, the 24 hour EU limit was exceeded on 77% of days.<sup>77</sup> Air pollution reduces the average life expectancy of the residents of Skopje by 2 to 3 years.<sup>78</sup> In 2012, long-term exposure to fine particulate matter in Skopje caused an estimated 1,200 premature deaths, 1,500 hospital admissions and costs of between 570 million euros and 1.47 billion euros.<sup>79</sup> Complying with the EU air quality directive for fine particulate matter would slash these figures in half.<sup>80</sup>

SACRIFICE ZONES

## 26. SILÉSIA, POLAND

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IMAGE: GOOGLE EARTH

**Thirty-six of Europe's 50 most polluted cities are located in Poland, largely as a result of coal-fired power plants and residential heating with wood and coal.<sup>81</sup> Air quality is particularly bad in Silesia, where exposure to elevated levels of particulate matter, benzo(a)pyrene and other toxic substances has contributed to significantly shorter life expectancy for both men and women.<sup>82</sup> Mining and smelting in Silesia have discharged so much lead, cadmium, zinc and other heavy metals that soils are contaminated to the point where vegetables grown in allotment gardens pose a significant health risk to their consumers.<sup>83</sup>**

# 27. IDA-VIRU, ESTONIA



IMAGE: GOOGLE EARTH

Estonia is among the largest per-capita emitters of CO<sub>2</sub> in the European Union (EU) and one of the most carbon-intensive economies in the OECD, with over 90 per cent of Estonia's greenhouse gas emissions from burning oil shale for electricity.<sup>84</sup> Oil shale is the primary contributor to extensive contamination of ground and surface water supplies, soil, and harm to the health of residents in the mining region of Ida-Viru county. As of 2017, Estonia generated 35 times the EU average in hazardous waste per capita, predominantly because of the oil shale industry.<sup>85</sup> The levels at which oil shale residue has accumulated in some Estonian landfills has resulted in risks of self-ignition and leaching, with consequent negative impacts on air quality and groundwater.<sup>86</sup> The city of Kohtla-Järve in Ida-Viru often has to deal with elevated concentrations of hydrogen sulfide and sulfur dioxide in the air due to its location downwind from a major shale oil processing facility.<sup>87</sup> Wastewater from the shale oil mines has altered the chemical composition of both the surface water and groundwater, with high sulphate concentrations being of particular concern.<sup>88</sup> A government study on the health impacts of the oil shale sector concluded that the overall health of residents of Ida-Viru county is worse than people living elsewhere in Estonia, "principally due to environmental pollution originating from the oil shale sector".<sup>89</sup> Because of poor air quality, the rates of respiratory disorders diagnosed in children and mortality from heart disease are higher.<sup>90</sup> Rates of lung cancer are higher in the oil shale regions of Estonia than elsewhere in the country.<sup>91</sup> Compared to individuals from non-industrial areas in Estonia, residents of Ida-Viru more frequently reported wheezing, chest tightness, shortness of breath, asthma attacks, long-term coughs, hypertension, heart disease, stroke, and diabetes. The life expectancy of a child born in Ida-Viru is four years shorter than a child born elsewhere in Estonia. Workers in the oil shale sector experience much higher levels of "respiratory diseases, hypertension, stroke, heart diseases and diabetes".<sup>92</sup>

## 28. SLAVONSKI BROD, CROATIA



IMAGE: GOOGLE EARTH

Slavonski Brod is a city of 60,000 people in eastern Croatia near the border with Bosnia and Herzegovina. Air quality in Slavonski Brod is notoriously poor, especially in the winter months, when particulate levels have reached as high as  $240 \mu\text{g}/\text{m}^3$ , sixteen times higher than the short-term limit recommended by the World Health Organization.<sup>93</sup> The main sources of particulate matter (~45%) in Slavonski Brod are an oil refinery across the border in a Bosnia and Herzegovina and domestic heating, while vehicle traffic makes a minor contribution. The primary source of sulfur dioxide (99%) and nitrogen oxides (~80%) is the oil refinery, while traffic contributes the remainder of the nitrogen oxide emissions. The oil refinery also is a major source of toxic hydrogen sulfide emissions.<sup>94</sup> In 2008, an accident contaminated this community's drinking water supply with heavy oil. Residents complained of symptoms such as diarrhoea, stomach cramps, vomiting, rashes, eye burning, chills, and gastric disorders.<sup>95</sup>

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# 29. PLOVDIV, BULGARIA



IMAGE: GOOGLE EARTH

Plovdiv, Bulgaria is a pollution hotspot, with poor air quality, contaminated water, and soils polluted by heavy metals including lead, zinc, cadmium and mercury. In 2008, Plovdiv was ranked as the worst European city for air quality, while a 2019 report by the European Environment Agency noted that levels of particulate matter still exceeded European Union limits.<sup>96</sup> Major sources of pollution include heavy industry, traffic and the large KCM lead-zinc smelter near Plovdiv.<sup>97</sup> In 2019, exposure to particulate matter caused an estimated 10,600 premature deaths in Bulgaria.<sup>98</sup>

# 30. OSTRAVA, CZECH REPUBLIC

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IMAGE: GOOGLE EARTH

Coal mining, coal-fired power plants and associated infrastructure have caused the relocation of more than 100 communities and 90,000 people in the Czech Republic since 1949. Since achieving independence in 1989, the Czech Republic has required reductions in pollution from coal-fired power plants and has set some limits on coal mining. However, air pollution continues to threaten human health. A study published in 2014 found that coal-fired power plants tended to be located in regions with higher proportions of ethnic minorities and people with less education.<sup>99</sup> Residents of these regions suffered from the highest concentrations of air pollution, higher levels of infant mortality and lower life expectancy.<sup>100</sup> Ostrava, the third largest city in the Czech Republic, is the most polluted city in the country and one of the most polluted in the European Union.<sup>101</sup> Coal mining, the use of coal to generate electricity, domestic heating, steel production, chemical plants and heavy industry are to blame. Toxic substances of particular concern are particulate matter, benzene, and benzo[a]pyrene, which are contributing to high levels of infant mortality, bronchitis, heart disease and lung cancer, as well as premature deaths.<sup>102</sup>

**SACRIFICE ZONES**

# LATIN AMERICA & CARIBBEAN

SACRIFICE ZONES

## 31. QUINTERO-PUCHUNCAVÍ, CHILE

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IMAGE: [GREENPEACE](#)

Quintero-Puchuncaví, the most notorious sacrifice zone in Chile, is home to the Ventanas industrial complex, comprising more than 15 industrial businesses (oil refineries, petrochemical facilities, coal-fired power plants, gas terminals and a copper smelter). In 2018, a major air pollution incident in Quintero-Puchuncaví made hundreds of schoolchildren ill. In the universal periodic review process, the United Nations country team recommended that Chile investigate the negative effects on the inhabitants of sacrifice zones, accelerate the implementation of remediation programmes and develop environmental quality standards in accordance with WHO international standards.<sup>103</sup> The Supreme Court of Chile concluded that the egregious air pollution in Quintero-Puchuncaví violated the right to a pollution-free environment and ordered the Government to take steps to address the problem.<sup>104</sup>



## 32. LA OROYA & CERRO DE PASCO, PERU

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IMAGE: [AIDA AMERICAS](#)

**In La Oroya, Peru, generations of children have been poisoned by a huge lead smelter. A shocking 99 per cent of children have levels of lead in their blood that exceed acceptable limits. Despite interventions by the Constitutional Court of Peru and the Inter-American Commission on Human Rights, levels of contamination in La Oroya remain hazardous. Also located in Peru, in Cerro de Pasco, is a massive open-pit mine adjacent to an impoverished community exposed to elevated levels of heavy metals. In 2018, the Government of Peru declared a state of emergency in Cerro de Pasco because of the pollution, but children in the region continue to suffer adverse health effects.<sup>105</sup>**

# 33. MARTINIQUE, FRANCE

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IMAGE: [THE BORGES PROJECT](#)

Water and soil in Guadeloupe and Martinique, France, are contaminated by unsafe levels of the pesticide chlordecone. Although the manufacturing and use of this pesticide was banned in the 1970s in the United States, it continued to be used in the West Indies into the 1990s. Residents are still exposed to chlordecone through drinking water and the food that they grow because of the pesticide's persistence in the environment. Ninety per cent of people living in Guadeloupe and Martinique have been found to have chlordecone in their blood, raising their risk of cancer.<sup>106</sup>

## 34. TRUITIER, HAITI & RIVERTON, JAMAICA

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IMAGES: [HAÏTI LIBERTÉ/MILO MILFORT](#) & [JAMAICA OBSERVER](#)

Garbage dumps in numerous Caribbean nations are regularly set on fire, despite the presence of plastics, used tyres and other items that generate extremely hazardous chemicals when burned. This practice creates massive, lingering clouds of toxic smoke that envelope neighbouring residents and jeopardize their health. Examples include the landfills at Parkietenbos in Aruba, (Netherlands), Riverton (Jamaica) and Truitier (Haiti). A major fire at the Riverton dump in Jamaica in 2015 led to 50 schools being closed and hundreds of persons hospitalized.

## 35. EL CERREJON, COLOMBIA

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IMAGE: GOOGLE EARTH

Colombia's massive El Cerrejon open-pit coal mine has had devastating consequences for neighbouring Wayuú Indigenous communities. According to the Constitutional Court of Colombia, the mining operations have caused: emission of large volumes of hazardous air pollution (including fine particulate matter, nitrogen oxides, polycyclic aromatic hydrocarbons, sulphur, chromium, copper and zinc) in excess of Colombian standards and WHO guidelines; noise pollution exceeding Colombian standards; and damage, contamination and exhaustion of the local water supply.<sup>107</sup> Residents near the mine suffer from high rates of respiratory illness and have elevated levels of toxic substances in their blood. Transnational mining companies have generated billions of dollars in revenue at El Cerrejon, but adjacent Wayuú communities live in extreme poverty. For example, roughly half of Wayuú children suffer from malnutrition and stunting.<sup>108</sup> Workers at El Cerrejon also face elevated risks due to exposures to toxic substances.<sup>109</sup>

**SACRIFICE ZONES**

# 36. VACA MUERTA, ARGENTINA

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IMAGE: GOOGLE EARTH

The Vaca Muerta oil and gas megaproject in Argentina is causing a huge amount of environmental destruction in the Province of Neuquén. Fracking for oil and gas consumes vast quantities of water. Yet Argentina's Second Nationally Determined Contribution under the Paris Agreement identifies major concerns about potential water shortages, droughts and desertification in the Vaca Muerta region.<sup>110</sup> Fracking has caused earthquakes and discharged immense volumes of toxic substances into the air, water and soil. Particularly impacted are the Mapuche Indigenous peoples of Neuquén. Water that flows to the surface from oil and gas wells, called produced water or production water, can contain a wide range of toxic chemicals, from heavy metals to polycyclic aromatic hydrocarbons. These substances can contaminate groundwater. Potential health impacts of fracking include respiratory illnesses, heart disease and cancer, including childhood leukemia.<sup>111</sup> In 2018 the UN Committee on Economic, Social and Cultural Rights warned Argentina about the potential climate change impacts of Vaca Muerta: "The total exploitation, with hydraulic fracturing, of all the shale gas reserves would consume a significant percentage of the global carbon budget to achieve the goal of a 1.5 degrees Celsius warming".<sup>112</sup> On that basis, the Committee recommended that Argentine should reconsider the exploitation of unconventional hydrocarbons in the Vaca Muerta region.

**SACRIFICE ZONES**

## 37. ATOYAC RIVER, MEXICO

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IMAGE: [BNAMERICAS](#)

The Atoyac and Santiago River basins in Mexico both suffer from extreme levels of industrial pollution, jeopardizing the health and human rights of residents in these watersheds.<sup>113</sup> The Atoyac River is home to approximately two million people and hosts more than 20,000 textile, petrochemical, automobile, agriculture and food businesses.<sup>114</sup> Water quality in the two rivers is classified as extremely poor, or even “dead”.<sup>115</sup> High levels of cancer biomarkers in children, high prevalence of gastrointestinal diseases, kidney failure, osteoporosis, cardiovascular disorders, poor cognitive development in children and poor organ development have all been linked with the consumption and use of heavily contaminated water by local residents.<sup>116</sup> Further, the mortality rate for cancer in the basin is 13.5 times higher than Mexico’s national average. In response to a series of complaints from local organizations, in 2017 Mexico’s independent human rights institution issued a report recommending that governments take urgent action to clean up the Atoyac River.<sup>117</sup> In 2021 the area was declared an Environmental and Health Emergency Region, under the National Strategic Programmes on Toxic Substances and Polluting Processes (Programas Nacionales Estratégicos de Agentes Tóxicos y Procesos Contaminantes) that focus on health and water.<sup>118</sup> The Santiago River watershed is the subject of a recent decision of the Inter-American Commission on Human Rights requesting that Mexico implement precautionary measures to protect human rights from being harmed while the Commission adjudicates the case.<sup>119</sup>

# 38. PIQUIÁ DE BAIXO, BRAZIL

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IMAGE: GOOGLE EARTH

Piquiá de Baixo is a community of 1,100 people in the state of Maranhão in north-east Brazil that is suffering from extreme industrial pollution from mining and steel facilities located “in unimaginably close proximity”, meaning right across the fenceline for some residents.<sup>120</sup> The UN Special Rapporteur on Toxics and Human Rights conducted a visit to Piquiá in 2020, publishing a highly critical report about the government’s failure to protect the human rights and health of residents. A study examining the respiratory functions of hundreds of Piquiá residents found unprecedented levels of impairment, attributable to air pollution from the neighbouring steel plant.<sup>121</sup> The terrible conditions led the Special Rapporteur to support the community’s plea for resettlement in a location where the air is safe to breathe.<sup>122</sup>

**SACRIFICE ZONES**

## 39. GULF OF PARIÁ, TRINIDAD AND TOBAGO

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IMAGE: GOOGLE EARTH

Along the western coast of Trinidad and Tobago there is a major concentration of industrial facilities, including an oil refinery, petrochemical plants, a cement plant, an oil shipping facility and iron and steel plants. Fossil fuel burning, gas flaring, and oil spills are causing very high levels of polycyclic aromatic hydrocarbons in the environment, posing a risk of cancer. As a result, scientists concluded that “the general population is exposed to high cancer risk from the consumption of seafood derived from this coastal area”.<sup>123</sup> There have been hundreds of oil spills in the Gulf of Paria in recent years, including a major spill in 2021, with devastating consequences for the health, livelihoods and human rights of fisherfolk in the area.<sup>124</sup> Beaches and rivers in this same area are suffering extremely high levels of fecal contamination, raising the risks of disease. A recent study concluded that “The high incident (*sic*) of fecal pollution of water bodies in Trinidad associated with human and bird fecal pollution is particularly alarming and represents a serious public health risk on the island.”<sup>125</sup>

**SACRIFICE ZONES**



## 40. PULEOWIME, SURINAME

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IMAGE: [AMAZON CONSERVATION TEAM / MONGABAY](#)

**Artisanal and small-scale gold mining is creating an environmental health disaster in Suriname, with thousands of kilograms of toxic mercury entering aquatic environments and the atmosphere annually.<sup>126</sup> The mercury bioaccumulates in the food chain and then poisons people who eat fish caught in local rivers and streams. Individuals in poor, predominantly Indigenous communities in Suriname that are downstream from mining activities and dependent upon local fish as a major element of their diets are the hardest hit. Hair samples taken from residents of Puleowime, for example, indicate mercury levels 10 to 20 times higher than what is considered safe.<sup>127</sup> These individuals display symptoms of neurological disorders caused by mercury exposure. Newborns in the community likely suffered prenatal damage due to mercury poisoning.<sup>128</sup>**

**SACRIFICE ZONES**

# 41. PARAGUANÁ, VENEZUELA

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IMAGE: GOOGLE EARTH

Coastal oil development has devastating consequences for artisanal and small-scale fishers, including displacement, habitat destruction, pollution, reduced catches and the lack of a fair share of benefits from oil development.<sup>129</sup> Unmaintained oil infrastructure in Venezuela is resulting in thousands of oil spills annually, from minor to catastrophic.<sup>130</sup> In recent years major oil spills have occurred at the Paraguaná refinery complex, Piriál de Punta de Mata in Monagas State, Rio Seco, and the El Palito refinery in Carabobo State, releasing oil into Morrocoy National Park. Oil spills can be disastrous for the health, livelihoods, culture and human rights of persons living in coastal communities. Fish and shellfish can be contaminated, threatening an important food source. Exposure to toxic oil can cause symptoms including trouble breathing, heart problems, headaches, and irritated eyes. Women may be disproportionately affected, because they often spend more time in the water than men, are more likely to be excluded from social safety nets, and the shellfish they often collect tend to accumulate toxic substances.<sup>131</sup> The Paraguaná Peninsula in Venezuela is home to one of the world's largest oil refineries, generating massive volumes of air and water pollution, including polycyclic aromatic hydrocarbons, oil spills, particulate matter, sulfur compounds and heavy metals (e.g. cadmium, lead and mercury). The high levels of pollution are contaminating fish and other aquatic species, posing a risk to coastal communities that depend on them for food and livelihoods.<sup>132</sup>

## 42. GUATEMALA CITY, GUATEMALA

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IMAGE: GOOGLE EARTH

One of the largest garbage dumps in the western hemisphere is found in Zone 3 of Guatemala City, the capital of Guatemala. Thousands of people work in the dump under extremely difficult conditions, looking for discarded items with value, such as recyclable materials, food, and household goods.<sup>133</sup> The following health issues are common to persons living in and/or working in large open garbage dumps: coughing, shortness of breath, asthma, burning in the eyes, itching, nausea, weight loss, anemia, abdominal pains, chronic headaches, dengue fever, helminthiasis, hepatitis, tuberculosis, cholera and mental health problems.<sup>134</sup> There have been periodic landslides and fires in the Zone 3 garbage dump that have caused deaths and injuries.<sup>135</sup> A civil society organization called Safe Passage is working to provide children who live in and around the Zone 3 garbage dump with educational opportunities and access to health care.<sup>136</sup>

SACRIFICE ZONES

# **WESTERN EUROPE & NORTH AMERICA**

**SACRIFICE ZONES**

## 43. SARNIA, CANADA

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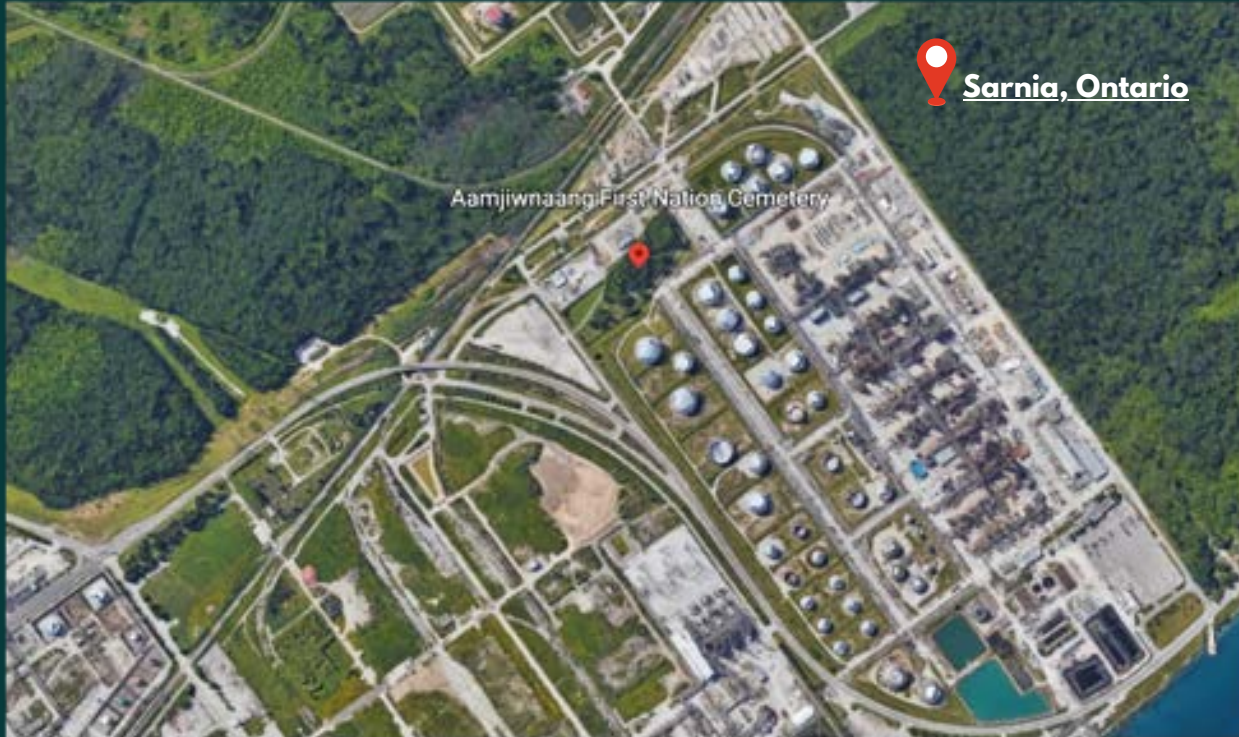


IMAGE: GOOGLE EARTH

One of the most notorious pollution hotspots in Canada – “Chemical Valley”, in Sarnia, Ontario – has disturbing health effects on the Aamjiwnaang First Nation. There are more than 40 large petrochemical, polymer, oil-refining and chemical facilities in close proximity to Aamjiwnaang, as well as a coal-fired power plant. This Indigenous community endures some of the worst air quality in Canada. Physical and psychological health problems are common, including high rates of miscarriages, childhood asthma, and cancer.<sup>137</sup>

# 44. CANCER ALLEY, LOUISIANA, USA

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IMAGE: [JERRY GRAYSON / HELIFILMS AUSTRALIA](#) & [SCALAWAG / JULIE DERMANSKY](#)

In the United States, cancer rates are far higher than the national average in predominantly Black communities such as Mossville, St. Gabriel, St. James Parish and St. John the Baptist Parish, located in Louisiana's "Cancer Alley", which is home to more than 150 refineries and petrochemical plants, including the world's largest producer of Styrofoam.<sup>138</sup> Large polluting industrial facilities in the United States are disproportionately located in communities with the highest percentages of persons of African descent, the lowest household incomes and the highest proportion of residents who did not graduate from high school. A leading scholar wrote that, "[e]nabled by state zoning, a wave of chemical plants dropped on African American communities like a bomb".<sup>139</sup> Cancer Alley contains 7 of the 10 United States census tracts with the highest risk of cancer from air pollution.<sup>140</sup> In 2020, air concentrations of cancer-causing chloroprene in St. John the Baptist Parish were 8,000 times higher than the acceptable level established by the United States Environmental Protection Agency.<sup>141</sup>

# 45. TARANTO, ITALY

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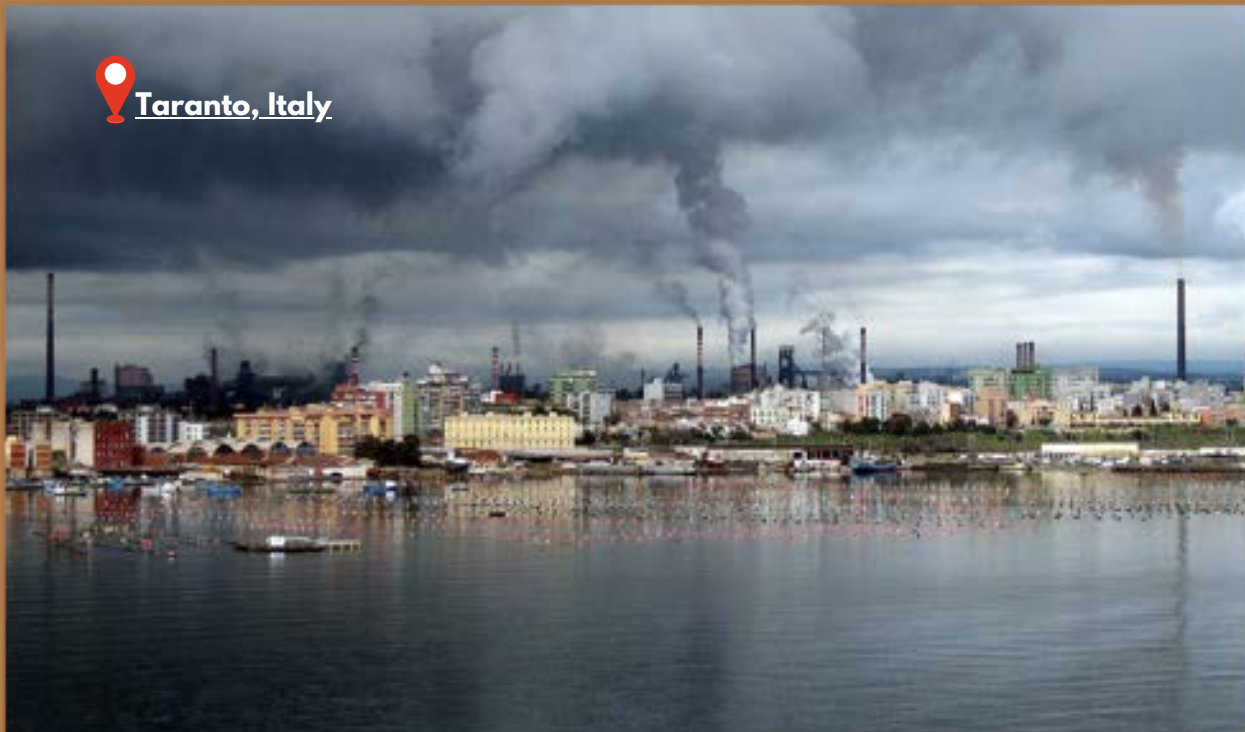


IMAGE: [MAFE DE BAGGIS / FLICKR](#)

The Ilva steel plant in Taranto, Italy, has compromised people's health and violated human rights for decades by discharging vast volumes of toxic air pollution.<sup>142</sup> Nearby residents suffer from elevated levels of respiratory illnesses, heart disease, cancer, debilitating neurological ailments and premature mortality. Clean-up and remediation activities that were supposed to commence in 2012 have been delayed to 2023, with the Government introducing special legislative decrees allowing the plant to continue operating.<sup>143</sup> In 2019, the European Court of Human Rights concluded that environmental pollution was continuing, endangering the health of the applicants and, more generally, that of the entire population living in the areas at risk.<sup>144</sup>

## 46. JOBOS BAY, PUERTO RICO, USA

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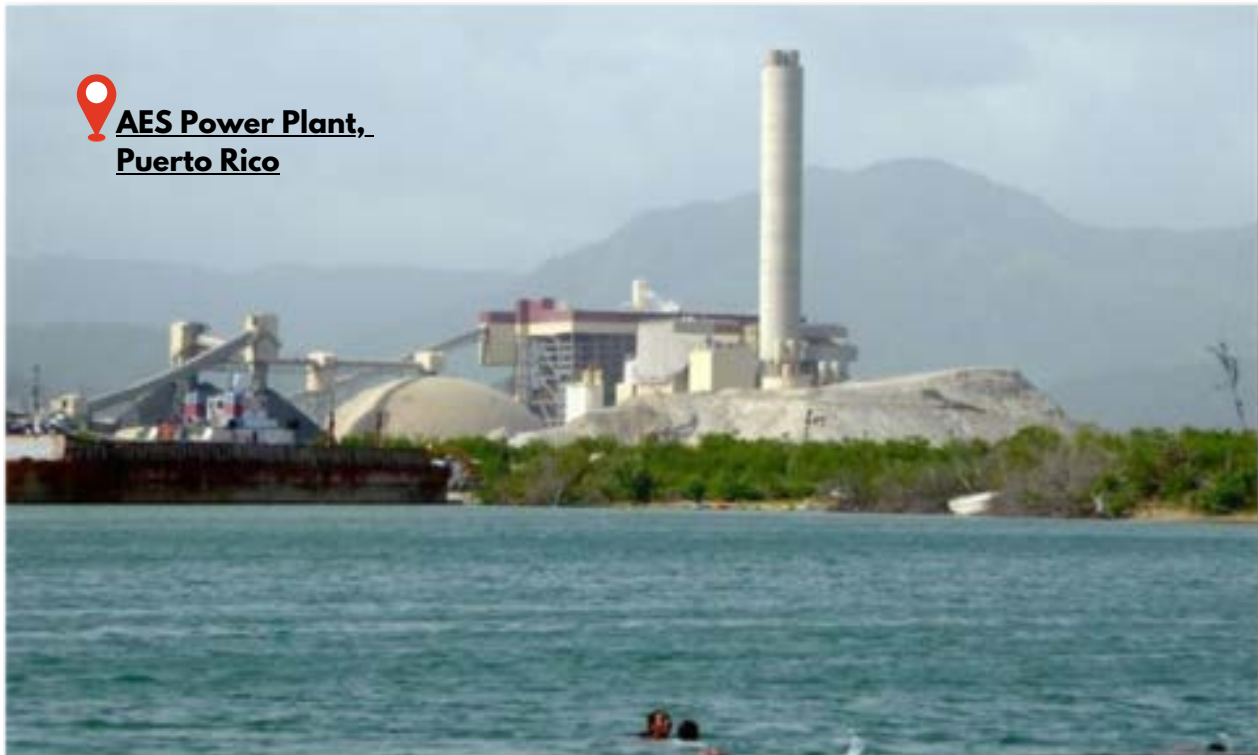


IMAGE: [HILDA LLORÉNS / NACLA](#)

Residents of Jobos Bay, a predominantly Black community in Puerto Rico (United States of America), bear the brunt of high levels of air pollution from nearby power plants, including the Aguirre Power Complex, which burns diesel and bunker oil, and the AES coal-fired power plant. There are also high levels of PCBs in the soil, an artefact of heavy industrialization at a time of low environmental standards.<sup>145</sup> According to one scholar, “the lack of access to—and often the outright denial of—community participation in decisions that affect residents’ ecology and quality of life highlights how the government and corporations systematically devalue local knowledge, cultural identity, and ecosystems.”<sup>146</sup> Former Special Rapporteur on extreme poverty and human rights, Philip Alston, reported meeting “with people in the South of Puerto Rico living next to a mountain of completely unprotected coal ash which rains down upon them bringing illness, disability and death.”<sup>147</sup>



## 47. SOUTH LONDON, UNITED KINGDOM

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IMAGES: [ANGELA GLIENICKE / GREENPEACE](#) & THE ELLA ROBERTA ESTATE

Ella Kissi-Debrah was a child who lived near a major road in Lewisham (South London, United Kingdom). For most of her short life she was exposed to high levels of traffic-related air pollution, especially nitrogen dioxide (NO<sub>2</sub>) and particulate matter (PM). She passed away at the age of nine, on 15 February 2013. After hearing extensive evidence from medical and pollution experts, a coroner's inquest into the cause of her death concluded that Ella "died of asthma contributed to by exposure to excessive air pollution".<sup>148</sup> This marked the first time ever that a coroner has identified air pollution as a contributory cause of a specific individual's illness and death.<sup>149</sup> Subsequently, researchers studying air quality and health impacts in South London found that short-term increases in exposure to NO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> were associated with increases in the daily number of doctor visits related to respiratory problems and inhaler prescriptions.<sup>150</sup> This relationship between pollution and breathing difficulties is particularly pronounced in children.

**SACRIFICE ZONES**

## 48. PORT ARTHUR, TEXAS, USA

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IMAGE: GOOGLE EARTH

Port Arthur, Texas, is severely impacted by air pollution emitted by the many refineries and chemical plants in the area, including the largest refinery in the United States of America, owned by Saudi Aramco. Many of the largest emitters of benzene, a known carcinogen, in the USA are located in Port Arthur. Local residents are also exposed to elevated levels of other toxic chemicals including chloroform, 1,2-dichloroethane, 1,2-dibromoethane, and 1,1,2-tetrachloroethane. In 2018, the top toxic air pollutants emitted by weight in Jefferson County were nitrate compounds (2,719,009 lbs), picric acid (1,323,965 lbs), n-hexane (1,086,958 lbs), ethylene (1,008,816 lbs), hydrogen cyanide (841,817 lbs), ammonia (828,867 lbs), 2,4-dinitrophenol (709,284 lbs), propylene (465,494 lbs), 1,3-butadiene (322,505 lbs), and benzene (322,505 lbs).<sup>151</sup> In 2002, a federal judge sentenced two Port Arthur and Port Neches chemical plant operators to 3 years in prison for their role in their plant's exceedingly high benzene emissions.<sup>152</sup> Staggering amounts of pollutants are emitted during maintenance, accidents, unexpected events, and start-up activities. For example, in 2010, an Exxon oil tanker spilled 462,000 gallons of crude oil into the Sabine-Neches Canal, forcing the evacuation of 136 Port Arthur residents.<sup>153</sup> The Texas Cancer Registry shows that African Americans in Jefferson County have ~15% higher rates of cancer and ~40% higher mortality from cancer than the average Texan.<sup>154</sup> Residents suffer from asthma and are hospitalized for chronic obstructive pulmonary disease at twice the rate of other Texans.<sup>155</sup>

# 49. NORTH RHINE-WESTPHALIA, GERMANY

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IMAGE: [COGIDO / IMGUR](#)

It is encouraging that the total number of deaths caused by air pollution in Germany has fallen from 64,600 in 1990 to 29,300 in 2019.<sup>156</sup> However, Germany continues to depend heavily on coal for electricity, generating air pollution that contributes annually to “20 percent of premature deaths, 1800 cases of chronic bronchitis, 1810 hospital admissions, and 79 000 asthma attacks in children”.<sup>157</sup> One of the largest coal mining regions in Europe is the Rheinischen lignite zone in Germany. Since the beginning of the 20th century, more than 370 villages in Germany that were home to a total of approximately 120,000 inhabitants have been relocated due to open-pit lignite mining.<sup>158</sup> In 2020, the decision was made to relocate another five villages (Keyenberg, Kuckum, Unter- and Oberwestrich and Beverath) and their 1,600 residents to expand mining operations. The health of people living in communities adjacent to the mining operations is jeopardized by air pollution, which often exceeds legal limits set by the European Union.<sup>159</sup> In 2021, the European Court of Justice concluded that Germany “systematically and persistently” violated the annual limit for nitrogen dioxide in 26 zones including the Rhineland mining area.<sup>160</sup>

# 50. GRASSY NARROWS, CANADA

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 **Asubpeechoseewagong Netum Anishinabek, Ontario**

IMAGE: [JODY PORTER / CBC](#)

Asubpeechoseewagong Netum Anishinabek, also known as the Grassy Narrows First Nation, is an Indigenous community in Ontario, Canada. During the 1960s and 1970s, the Dryden Chemical Company discharged at least 9,000 kilograms of mercury into the Wabigoon-English River system, causing elevated levels of mercury in the river and throughout surrounding ecosystems, with devastating consequences for the main food source, livelihoods and health of the Asubpeechoseewagong people. In the words of Chief Simon Fobister Sr., “The story of my people, the Grassy Narrows First Nation, weighs heavily on the collective conscience of Canada. For over half a century, mercury poison has contaminated the river that is our lifeblood.”<sup>161</sup> Studies in the area revealed concentrations of mercury 130 times higher than comparable river sections upstream. The average meal of fish (walleye) contained 15 times more than the acceptable daily limit of mercury for adults and 40 times the daily limit for pregnant women and children.<sup>162</sup> Nine out of ten members of the Asubpeechoseewagong First Nation experience symptoms of mercury poisoning, with very limited health resources for the devastated community.<sup>163</sup> Recent research finds that the high levels of mercury exposure among Asubpeechoseewagong individuals is linked to significantly shorter life expectancy.<sup>164</sup> The Governments of Canada and Ontario violated the Asubpeechoseewagong people’s right to information by withholding or misrepresenting information about the extent and consequences of the mercury contamination, leading the community to continue using the contaminated water and eating contaminated fish.<sup>165</sup>

In 2017, the Government of Ontario established an \$85 million trust to fund remediation of mercury contamination in the English and Wabigoon Rivers. In 2020, the Government of Canada announced a framework agreement with Asubpeechoseewagong Netum Anishinabek to build a care home to help community members affected by mercury. Canada also invested in water treatment infrastructure upgrades that ended all boil-water advisories affecting Grassy Narrows First Nation, finally ensuring the community’s right to safe water.

**SACRIFICE ZONES**

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