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### Title

**City of Smoke:** Air Pollution in the Land of the Eternal Blue Sky

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Bittner, Peter James

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Peter Bittner  
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## UC Berkeley Graduate School of Journalism

### **Abstract:**

Ulaanbaatar is the world's coldest capital, and one of the most polluted cities on earth during winter. One in ten residents die of air pollution. Explore the public health crisis' causes, surrounding political controversy, and future outlook in this rapidly-developing Asian city. This web package introduces audiences to complex challenges of urbanization which cities across the world face.

### **Text:**

### **Introduction**

The world's coldest capital, Ulaanbaatar, Mongolia suffers each winter from some of the worst levels of air pollution on the planet. Explore the public health crisis and its causes, the controversy, and what the future may hold for this rapidly developing Asian city.

### **Chapter 1: Crisis**

"It feels like an allergic reaction," said Batchuluun Jurai, 54, of Ulaanbaatar. "Throughout the day when the pollution is high, my nose gets stuffed up and I have trouble breathing."

"When you drive around, you cannot see the car in front of you," said Jurai, who admitted he is very worried about the health of his two sons, Purevdorj, 19, and Bayaraa, 17. "Sometimes I think about leaving the city and moving back to the countryside."

Jurai's experience is by no means unique. Many who live in the nation's sole metropolis suffer from similar health problems each winter. It's a bitter irony that the capital of the Land of the Eternal Blue Sky suffers from abysmal air quality.

"Air pollution now sounds like a part of the season to us, like snow," said Bat-Erdene Purevnyamjid, a resident who lives near downtown Ulaanbaatar.

"UB," as the city is commonly known, is the coldest capital city in the world, with winter temperatures dipping below -35 degrees Celsius. But the cold isn't the only worry for the city. Winter also means the stubborn return of stifling air pollution largely absent during the warm summer months. Each winter, UB's nearly 1.5 million residents, roughly half Mongolia's population, endure terrifying levels of airborne pollutants.

"I get a bad cough, it's a type of asthma," said Badamhand Tumurbaatar, 52, who lives in UB's Bayangol district.

“Everyone has the same problem as me because of the smoke. You can go to the supermarket, to the store—everyone is coughing there.”

Tumurbaatar was hospitalized in winter 2013 for pneumonia, which she attributes to “coal flu”—a byproduct of households burning low-grade coal to survive the bitter freeze. She spent two weeks on heavy antibiotics before she was able to return home. And Tumurbaatar is among the fortunate. She recovered.

According to a 2010 study by Ryan Allen, an environmental health researcher at Simon Fraser University, in Vancouver, B.C., one in ten of UB’s residents die of air pollution-related causes. The mortality rate spikes in the wintertime, mirroring the levels of particulate matter that routinely plague Beijing and Delhi.

Beginning as early as October and extending through March, a thick, choking haze regularly occupies the narrow valley in which UB is nestled, obscuring buildings and enveloping entire neighborhoods in dark shrouds of ash. The seasonal variation in UB makes it different from other places more infamous for air pollution, Allen explained.

Particulate matter spikes in January and February. The floating particles of dust, soot, and byproducts of burning other materials such as rubber and plastics are too small to be seen by the naked eye. Although the levels of airborne contaminants decrease during the summer months, the average PM2.5 measurement—the smallest and most harmful class of particulate—is seven to 20 times above the World Health Organization’s (WHO) guidelines.

“That’s dramatically higher than what we’d like to see in order to protect public health,” said Allen.

“The air pollution in UB in the winter rivals anywhere in the world. At some points, the air is comparable to fighting a wildfire, say somewhere in California,” said Christa Hasenkopf, an atmospheric scientist who studied the city’s air pollution on a Fulbright Scholarship. Hasenkopf more recently founded OpenAQ, a global open-source platform for public air quality data.

The extraordinarily high levels of air contaminants are caused by what Hasenkopf refers to as a “super storm of conditions.” Among the pollution’s contributors are UB’s extremely cold weather, the presence of surrounding mountains, and the city’s unfortunate location underneath the Siberian high, a pressure system that eliminates wind during the winter and leads to very stagnant climatic conditions. The result each year when the cold arrives is entirely predictable: a dogged inversion traps the warm, polluted air close to the ground and contains it within the dale.

The composition of the pollutants is noteworthy as well; UB’s pollution differs from pale gray-blue industrial smog or brown dusty billows seen in other polluted cities throughout the world. The smoke in Ulaanbaatar is grey, at times nearly black. In the twilight hours, the smog acts as a floating canvas for an array of ghostly water colors.

The particulate matter originates from many sources. Coal-fired power plants, sub-standard automobiles, and heat-only boilers used in workplaces and small industrial buildings all

contribute. But more than anything the winter menace emanates from the tens of thousands of coal-burning stoves residents rely on for heating and cooking in the city's sprawling low-income settlements. Nearly 80 percent of UB's *annual* average outdoor particulate matter is due to stove usage in these "ger districts," whose name comes from the Mongolian word for yurt. Over 800,000 people live in these informal settlements on the outskirts of the capital. </p>

"It's a bad situation with half a million people burning coal," said Kirk Smith, an air quality and environmental public health expert at the University of California, Berkeley.

Once a sub-Siberian cold front sets in during the fall, UB's outdoor air pollution can reach nightmarish levels. In October 2015, air quality monitors in the Amgalan district recorded levels of PM10, particulate matter with a diameter of 10 microns or less, that reached 1,010 parts per cubic meter—a rate over 500 times the WHO guidelines.

Although outdoor air pollution in Beijing and Delhi consistently capture headlines, Ulaanbaatar is usually ignored, even though its average pollution levels are on par or worse than both Asian megacities. According to the WHO's 2014 data, Mongolia's annual airborne particulate matter levels exceeded China's and India's.

"One of the things that makes UB unique—and other places similar to UB that are smaller and face extremely severe air pollution levels—is that they just fall completely off the radar," said Hasenkopf.

It's a complicated problem, made worse by the fact that the Mongolian capital's air quality issue is simultaneously a demographic and urban development challenge. Over 60 percent of UB's population lives in the ger districts and an estimated 50,000 new rural-urban migrants move to the capital each year, most in search of employment.

"Around 10,000 households are coming to UB city each year," said Nyamsuren Bayarsaikhan, of the Ulaanbaatar Clean Air Project, a program of The World Bank. Rural-urban migration is a major driver of the dramatic increase in wintertime pollution over the past two decades.

The majority of the new settlers are former nomads who, as they bring more gers and stoves, add to the city's expansion and further compound the air quality issue. Much of the city's infrastructure, a Soviet-era relic after decades of heavy influence by the former USSR, is obsolete and unable to handle the city's booming population.

"That source of pollution is increasing year by year," said Bayarsaikhan.

Ironically, while Mongolia is the world's least-densely populated country, over 70 percent of Mongolians live in urban areas, with that number quickly growing. Ulaanbaatar is the nation's only major city and represents roughly two-thirds of the country's GDP.

It's been well over 20 years since Jurai moved to UB from Ömnögovi, the southern-most province in Mongolia in the unforgiving Gobi Desert. Raised as a herder, all seven of his siblings still live nomadically—along with roughly a quarter of the population. When he first arrived in

Ulaanbaatar's Songinokhairkhan district in 1996, there were only ten families total. Now there are thousands.

"There was virtually no air pollution back then," said Jurai. When more and more herders migrated from the countryside to the city in the early 2000s the pollution escalated dramatically.

"The pollution then became very severe."

Many of the migrants have no choice but to burn cheap, poor-quality coal in their cook stoves.

"This year, I have one truckload full of coal," said Tuya Purevjav, a single mother of two boys who lives in Bayangol district. Purevjav works as a cook, but employment is often sporadic in Mongolia's ailing economy. She and her boys receive support from Asral, a Buddhist community center and charity in her neighborhood.

"Every day I fill up the coal bucket four times." Purevjav normally stokes the stove five times a day, including waking at 3:00 AM in order to keep the ger warm. Her routine is typical of ger area residents. When she is forced to leave the boys at home alone, they stoke the fire.

Some residents aren't even able to afford low-quality coal.

"Poor families that don't have any income, they have to burn tires," said Tumurbaatar, the asthma survivor.

"The public health impact is tremendously high," said Allen, who published a 2011 study in *Air Quality, Atmosphere & Health* which found that, by conservative estimates, 10 percent of the city's total mortality was due to ambient air pollution.

"This isn't just smoke. There's CO<sub>2</sub>, particulate matter at certain sizes that are floating through the air and going straight through all your body's defenses," said David Chace, a former Peace Corps volunteer and founder of the Mask Project, which promotes public awareness of air pollution and exposure prevention. </p>

<p> "Mongolia, and India and China, are in that rapidly industrializing phase. They are seeing chronic diseases take over as the leading cause of death instead of communicable diseases," said Bruce Lanphear, Allen's colleague at Simon Fraser University.

"Whether it's five percent or 20 percent or 10 percent, you come up to the same conclusion," Allen said, "which is that far too many deaths are occurring as a result of the high pollution levels in UB."

His joint team of local and international researchers concluded that 29 percent of cardiopulmonary deaths and 40 percent of lung cancer fatalities in the city are attributable to outdoor air pollution. Each year an estimated 1,600 deaths and 8,500 hospital admissions in Ulaanbaatar are attributed to pollution-related causes, according to a joint (?) WHO-Mongolian Ministry of Nature study.

Last year, Batbold Sosorbaram, a university instructor, lost his father to lung cancer. Batbold, who lives in one of the more polluted districts of the city, Khan-Uul, believes air pollution was a significant factor.

“It is the biggest issue in Mongolia,” Sosorbaram said.

Ulaanbaatar’s air quality-induced public health disaster poses particularly high risks for certain vulnerable groups, especially those living in the ger districts. A World Bank study found that if air quality was improved even to meet Mongolian government standards, mortality due to air pollution in these areas could be reduced by a whopping 24 to 45 percent.”

“Children, babies, [and] the elderly are most affected by poor air quality,” said Hasenkopf. Those with pre-existing health conditions are also at greater danger of adverse effects from pollution.

“It’s only when you have your own children or someone elderly in your family when you realize that it takes a toll on your health,” said Onon Bayasgalan, who works at the Wildlife Conservation Society Mongolia. “Our younger generations are dying because of the air pollution.”

According to Bolormaa Purevjurev, senior project advisor at the Asia Foundation, one of the biggest concerns among the people she works with in the ger districts is the increased rate of pregnancy loss during the winter, which many experts believe is due to the dramatically higher particulate matter. A 2014 report by the Saban Research Institute, of the Children’s Hospital of Los Angeles, found “alarmingly strong statistical correlations between seasonal ambient air pollutants” and miscarriages in Ulaanbaatar.

The number of miscarriages jumped from 23 per 1,000 live births in May 2016 to 73 per 1,000 live births in December. Currently, Allen is leading an ongoing randomized, controlled study, aptly named the Ulaanbaatar Gestation and Air Pollution Research Study, focusing on the impacts of particulate matter exposure on neonatal development. His team enlisted a sample of 500 pregnant Mongolian women living in UB; half received indoor air filters for their pregnancy terms and half didn’t. Allen said that, judging from the results, “there is some association between air pollution and impaired fetal growth.”

While the personal and human costs of the air pollution are substantial, the financial costs incurred by Mongolian society are equally significant. According to a World Bank 2011 report, the alarming particulate concentrations in UB lead to health costs of up to \$727 million annually, nearly seven percent of its GDP.

“We pretty much know enough that we need to fix it,” said Smith, the UC Berkeley public health expert.

## **Controversy**

“Every year the air pollution gets worse,” Jurai said. “The government says it’s decreasing, but we’ve seen no effect or change in the situation.”

In an attempt to combat the public health crisis, the city and national governments have started taking action. A variety of policies have been implemented in recent years – with little impact. Ulaanbaatar’s air pollution problem is a daunting, complex challenge. Stove replacement programs, “clean” coal subsidies, electrification, and resettlement programs have all fallen short.

“I don’t think there is a long-term solution to the problem until and unless we provide gas or electricity-generated heating and fuel solutions to the population,” said Mongolian Foreign Minister Munkh-Orgil.

High-profile projects have focused on replacing traditional cooking stoves with more efficient models that produce less smoke. Beginning in 2009, the Millennium Challenge Corporation, the World Bank’s Clean Air Project, and the government of Mongolia’s Clean Air Fund all helped finance a clean-stove project in partnership with Mongolian lender XacBank.

Residents of the ger areas purchased a variety of green products at discounted prices including energy efficient gers and stoves. In addition, the program provided subsidized ger blankets—thick layers of felt that serve as insulation for yurts—and vestibules serving as insulating entryways.

In total the joint program allowed about 80 percent of the nearly 200,000 households in UB to purchase one or more of the products (roughly 145,000 stoves, 7,000 vestibules, and 20,000 ger blankets) through the XacBank loan. But despite the impressive reach of the loan program, the project was not exactly a resounding success.

The official Millennium Challenge Corporation report from the project found that particulate matter concentration goals were not met, nor were targets for fuel cost reduction levels.

“We see the improvements, however, these improvements are not so substantial to say that it’s reducing the air pollution levels,” said Purevjurev.

“My stove is one of the project stoves. It keeps the heat better, but it’s still burning coal so it’s still contributing to air pollution,” said Jurai.

Dr. Lodoysambaa Sereeter, of the German-Mongolian Institute of Resources and Technology, said that he estimates only one-third of the families who received the stoves still have them. The reason: many urban residents bought the subsidized stoves and sold them for large markups to herders because they are much more fuel-efficient. He recalled seeing the ger-area “project stoves” as far outside UB as the southern Gobi.

Other measures, such as subsidies for cleaner burning coal, have also been sponsored by the Mongolian government, only to be abruptly discontinued after changes in administration.

<p> “I’ve seen so many interesting solutions but none of them get carried out in the long-term,” said ethnographer Chisato Fukuda, citing a lack of sustained political will. </p>

“Having elections every few years doesn’t lend itself well to trying to tackle a problem,” Allen said.

The problem goes deeper than government commitment, however. “No country in the world has found a way to burn coal cleanly,” said Smith. Even if the per-stove emissions decrease through efficiency measures, the number of stoves is growing along with the population in the ger areas —meaning that the overall air quality could still likely get worse if only stove-oriented policies are employed. More drastic measures are required.

“Long-term, they have to try to move people out of gers and into apartments. They need more people on the electrical grid, more people connected to central heating,” said Allen. In recent years, the government has built apartments and incentivized families to relocate, but they represent a tiny fraction of the total stove-users.

“We’ve been pursuing this policy for a long time,” Minister Munkh-Orgil said. “It’s finding mixed success. It’s prohibitively expensive for the government and for private companies to build a large number of apartments in terms of financing, land allocation, infrastructure, heating arrangements, water supply.”

Cutting air pollution by the roughly 90 percent necessary to meet Mongolia’s own less-stringent air quality standards will take massive amounts of investment, sustained government effort, and strategic cooperation across a variety of stakeholders. It will also require transparency, communication and public participation.

In recent years, the Mongolian government and other organizations have launched websites like [ub-air.info](http://ub-air.info) and [agaar.mn](http://agaar.mn), which provide up-to-date data on levels of particulate matter and harmful gases such as NO<sub>2</sub> and CO. There are even free mobile apps available to Mongolians to monitor UB’s air quality.

“It’s a wonderful site that rivals many different countries’ websites,” said Hasenkopf, whose own website, [OpenAQ.org](http://OpenAQ.org), gathers data from air quality monitoring stations and organizations from all over the world and makes it available publicly for free.

Signs regarding the health effects of air pollution have been erected in public spaces, and TV and radio stations during this past winter ran programs on the danger of air pollution on a nearly daily basis. The impact of this information campaign have been profound. For the first time, discussion about the health impacts of pollution has reached the national level.

“The greatest long-term prospect is in people’s frustration,” said Dr. Julian Dierkes, a sociologist at the University of British Columbia, in Vancouver. “This has been a topic that has led to more and more agitation in the past several winters.”



“All of a sudden the public discussion on this issue has exploded,” said Chace. “Last year very few media stations were talking about it at the level they’re doing now.”

“It’s just recently that it’s attracting large-scale attention of the nongovernmental organizations and political parties,” said Mongolian Foreign Minister Munkh-Orgil of UB’s air pollution.

Another first took place this winter: a major public demonstration about air pollution. Several hundred protestors gathered with signs, costumes, and megaphones on December 26<sup>th</sup> in front of the parliament building in Chinggis Square. Coverage of the event spread instantly on social media, TV and radio in Ulaanbaatar.

The demonstrations were led by Parents Against Air Pollution, an NGO founded this winter by a group of concerned community members. The group’s leader, Purevkhoo Tserendorj, was inspired to take action after her two children fell ill and were hospitalized due to air pollution. Tserendorj, formerly a journalist, organized a public meeting via Facebook, which took place on December 19<sup>th</sup>. Roughly 20 concerned parents, most with children suffering from respiratory issues, organized the event and drafted a list of demands from the government.

“Not taking any tangible measures on reducing air pollution is violating human rights conventions as well as the Paris Agreement,” said Tserendorj. “They are not moving fast enough.” According to Tserendorj, the drafting of a national program on reducing air pollution by the recently-elected Mongolian People’s Party government only began after the group’s demonstration.

“There’s a quick impulse to say that the public leaders are corrupt, that they just don’t care,” said Chace.

“The attitude to solve this problem shouldn’t be that we blame decision makers, saying that they didn’t do their job,” said Batdorj Gongor of the Ger Community Mapping Center, an NGO based in Ulaanbaatar.

Other community members agreed with Gongor. “We cannot blame only the government for this. We cannot expect the government to do everything. Take part in reducing air pollution,” said Jurai.

“You see that when you first start talking about air pollution with people, blame is a major part of it,” said Chace. However, he continued, “blame distracts us from the small steps we need to take.”

“I’ve been watching [Parents Against Air Pollution] and I hope that they’ll be very successful,” said Onon Bayasgalan, of the Wildlife Conservation Society. “The government needs to realize that they need to step up their game and they do need pressure.”

Bayasgalan says she hopes that the NGO members who are organizing this movement “don’t take on a very hostile stance towards the government.”

<p> Many hope that Parents Against Air Pollution will help keep the issue in public discourse even when air pollution is not perceived as an urgent problem, especially in the summertime when news coverage about the coal-based pollution dies down. </p>

The pressure applied by the NGO has already resulted in government action. The city's first step in response to the heated rhetoric was banning rural immigrants from settling in the city. The only exception is to allow residents into UB seeking urgent medical attention.

“Up until this year it was the right of every migrant to have 1.7 hectares of land in and around Ulaanbaatar. Now their rights have been taken away,” said Chace.

“The Mayor has taken quite a controversial but in my opinion inevitable and important decision,” said Minister Munkh-Orgil.

“We already have indications that the numbers are dwindling significantly. It's important for the population to know that they will be stopped at the city borders, so people are not taking unnecessary risks.”

Munkh-Orgil expects a legal challenge to the migration ban in the constitutional court soon. It is up for the courts to decide the legality, said Munkh-Orgil.

## **Future**

“Pollution cannot be reduced overnight,” said Fukuda. “It is something that is going to take decades.”

“There is no real solution,” said Badamhand. “The economy is down, so in the near future things are going to be the same.”

While long-term solutions may be a ways off, some residents and organizations are taking steps now to promote education and reduce emissions, exposure, and risks.

Bayasgalan, of the Wildlife Conservation Society, initiated an online fundraiser through Generosity.com called the “100 Air Purifiers Campaign,” which raised money to purchase the machines for hospitals with children's wards. Bayasgalan decided to focus on children's ward because pneumonia, which is exacerbated by air pollution, is the second highest cause of child mortality in the country. </p>

“One night out of anger and frustration, I decided to write up this campaign,” said Bayasgalan, who suffers from severe migraines due to the air pollution. “I knew that the next day I would be able to buy a purifier for myself but I also knew that there were lots of children especially those who were very sick who wouldn't be able to access these expensive air purifiers.” </p>

Bayasgalan hopes the initiative inspires more Mongolians to donate to philanthropic causes related to the air pollution crisis.

David Chace, the former Peace Corps volunteer, started an initiative last year called Mongolian Air Pollution Solutions, or “Project MASC,” to improve awareness of the health effects of air pollution and ways to prevent exposure. By employing local high school students as peer-to-peer educators, his organization provides trainings on masks and distributes them to program participants free of charge. His program also provides trainings to healthcare providers.

“No one is receiving public education about the scientific facts about air pollution,” said Chace, who is hopeful his programming will soon expand into other schools and workplaces.

The solutions, however, are never straightforward. Even people researching and implementing solutions are not in agreement about the best approach.

“People understand the risks of the air pollution,” said Purevjurev, of the Asia Foundation, which works to engage ger area communities in the process of green urban development planning.

“Everyone knows it’s bad for them and it causes diseases,” said Fukuda, the ethnographer. “But they know that they have to inhale it. People would say there’s no education about masks, but it’s not just that.”

Fukuda aims to break the stereotype among foreigners that because most Mongolians do not wear masks they are apathetic. “They have their own understanding about air and breathing,” she said.

For some Mongolians, the difficulties of breathing with a mask on may outweigh the difficulties of inhaling polluted air. Mongolian cultural beliefs are sometimes difficult for outsiders to comprehend in this respect. Further, many living in Ulaanbaatar’s ger areas cannot afford masks.

“The special masks for smoke are pretty expensive,” said Tumurbaatar. Instead of purchasing air pollution masks which cost MNT 2,500, or just over USD \$1, Tumurbaatar spends half that on normal hospital masks. “I wash them every day, and re-use them,” she said.

Unfortunately, ger area populations are often stigmatized because of the smell of coal that permeates their homes, clothes, bodies, and hair. “Smell could put you in a particular location and into a particular social class. I never really thought about that before: smell having a social stigma,” said Fukuda. “Most middle-class Mongolians have never even touched coal.”

The stigma can have significant consequences. A woman from the ger areas that Fukuda interviewed for her PhD dissertation had lost her job in the prestigious State Department Store in downtown Ulaanbaatar because she was not able to rid her clothes of the coal-smoke smell.

Some local organizations are working to bridge this information and class divide. The Ger Community Mapping Center offers free tours of the ger districts for outsiders. Their goal is to generate productive dialogue to combat some of UB’s most pressing issues, including air pollution.

“Through the tour we talk about all the different kinds of pollution people are facing but also lots of different local solutions and initiatives that community members are taking as well,” said Batdorj.

“Take pride in how you can improve things on our own individual and household, and organizational level – each of us.”

The Ulaanbaatar Clean Air Project, a program of the World Bank, is working to change the behavior of ger district dwellers burning coal by teaching them proper usage of the ger stoves and other eco-friendly practices.

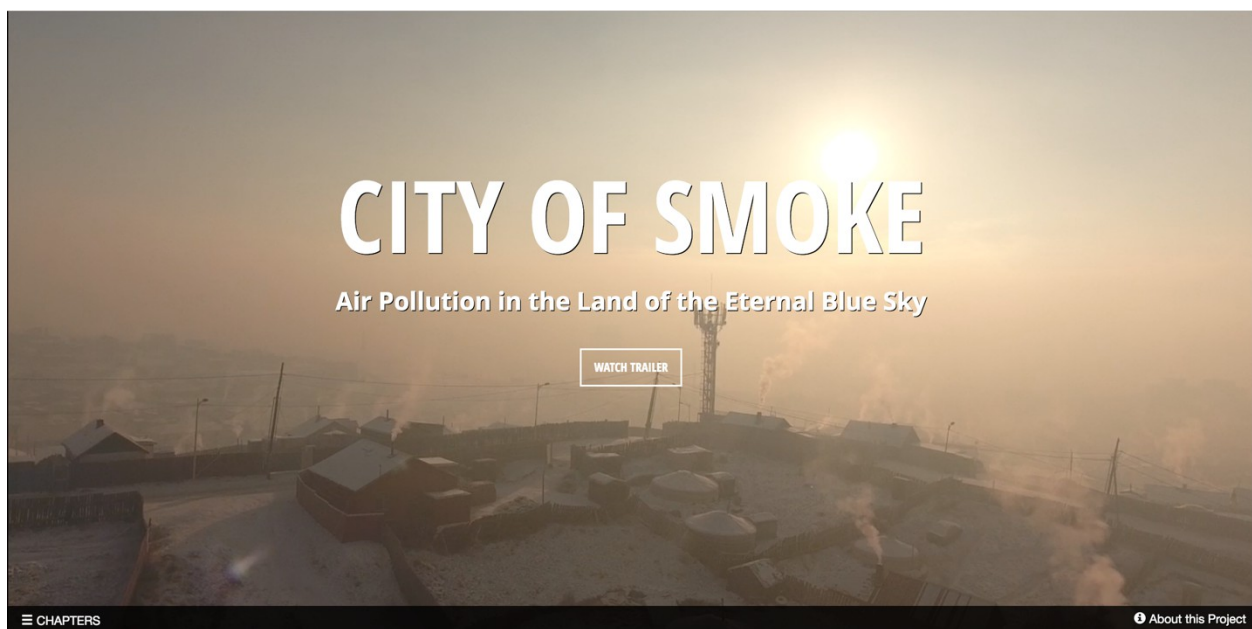
“Change requires time, consistency, information, and participation,” said Nyamsuren Bayarsaikhan, a communications officer with the Ulaanbaatar Clean Air Project. She and her team are tasked with persuading ger area residents to change their daily habits to reduce coal-smoke emissions.

“We have a positive attitude towards change,” she continued. “Of course it will take time. Of course it will require some kind of comprehensive planning. But we believe that we can make a change day by day.”

“The next two to three years will be very difficult,” said Sereeter. “But I’m optimistic because Ulaanbaatar’s pollution is easy to eliminate. It’s only a small city,” he said.

As UC Berkeley public health expert, Smith, put it, “They have their own fate in their hands.”

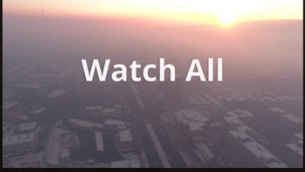
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# CITY OF SMOKE

Air Pollution in the Land of the Eternal Blue Sky

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**Source list:**

<b>Organization</b>	<b>First name</b>	<b>Last name</b>
Institute of Thermal Stove Testing <a href="http://iteie.mn/?p=1569">http://iteie.mn/?p=1569</a>	Jargalsaikhan / Жаргалсайхан	Buriad / Буриад
Community Organizer	Ulziitogtokh / Өлзийтогтох	Sodnomsenge / Содномсэнгэ
Resident	Badmahand	Tumurbaatar
UB Clean Air project: World Bank	Nyamsuren / Нямсүрэн	Bayarsaikhan / Баярсайхан
Resident	Batchuluun / Батчулуун	Jurai / Журай
Foreign Minister	Munkh-Orgil / Мөнх-Оргил	Tsend / Цэнд
Batdorj - Ger Community Mapping Center	Batdorj / Батдорж	Gongor / Гонгор
Batchuluun Jurai's Niece	Khorolsuren / Хоролсүрэн	Namsrai / Намсрай
Doctor - Public Health - Interview	Undarmaa / Ундармаа	Enkhbat / Энхбат
Ethnographer	Chisato	Fukuda
100 Air Purifiers Campaign	Онон / Онон	Bayasgalan / Баясгалан
Mothers and Fathers Against Air Pollution	Утааны эсрэг ээж аавуудын холбоо	Woman: Purevkhuu Tserendorj Man:
Project MASC	David	Chace
Resident	Tuya	Purevjurev