CleanAir

SANITARY AIR SOLUTIONS

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Overview

Over two billion people globally rely on open-flame cooking as their primary source of food preparation, presenting challenges with fuel source instability, health concerns from toxic smoke inhalation, and the release of excessive amounts of greenhouse gas emissions. CleanAir aims to provide necessary water vapor quality testing methods and a clean cooking system alternative, enabling access to sanitary cooking and living environments while reducing greenhouse gas emissions. We plan to accomplish this mission by manufacturing novel miniature water vapor sensor systems which will aid in the identification of vapor toxins across communities. By identifying communities most at risk, we will be able to effectively distribute low-cost fuel-efficient cookstoves, providing a safe and sanitary cooking method alternative to conventional open-fire cooking. Through greenhouse gas emission reduction with efficient cookstoves, we will finance the cost of the stoves through the sale of carbon credits to investors.

The Problem

Two problems exist with conventional open-fire cooking. The first problem pertains to the pulmonary health concerns of toxic smoke inhalation. The second problem regards the environmental impact of biomass vaporization around the world. The collection process and burning of these materials

for use in open-fire cooking leads to environmental damage through deforestation and the release of greenhouse gas emissions..

While industrialized nations can afford the luxury of sanitary cooking conditions, the “use of wood and charcoal in heating and cooking are the main energy sources for more than two billion people” in 2020 [1]. Relying on conventional cooking methods, many of these people are required to source fire material on a weekly basis. As a result of fire material source instability, it is often an after-thought of what kind of contamination the material has been exposed to and if it is no longer of food-grade quality. Biomass (e.x. wood material) that has been treated or salvaged from existing structures, often containing carcinogens from lacquer, paint, or chemical exposure is one example of a contaminated source material. When these biomass sources are burned, their carcinogens become airborne and risk contamination of the air quality of the living space or of the food source that is being prepared.

At room temperature, about 20 mL of water resides in one cubic meter of air [2]. The average human breathes nearly 8 cubic meters of air in a day [3]. This is the equivalent of drinking 160 mL (6.5 fl. oz.) of untreated and unpurified water per day. This poses a serious threat for families who live in shared spaces and may be breathing unsanitary water vapor as a result of food preparation with no alternative fuel sources readily available. "Often when you visit remote villages, they're shrouded in haze for many miles from all the fires used for cooking," says NCAR scientist Christine Wiedinmyer, an atmospheric chemist overseeing the project. "We need to better understand how these pollutants are affecting public health as well as regional air quality and even the climate." [4] The fires also emit carbon dioxide and other greenhouse gasses that, when mixed into the atmosphere, can affect weather patterns and create climate change.

The Solution

There are two necessary steps in achieving a solution to this problem. The first step is providing dwelling owners with a toxin identification sensor to monitor water vapor toxicity levels. The toxin identification sensors will measure the dwelling air toxicity levels across entire communities. This data

will allow community officials to identify which homes are most at risk. Awareness is key in the first step to first educate the dwelling owners and families about the harmful cooking methods they are currently using. The second step is providing a low-cost fuel-efficient cookstove to the dwellings where toxic vapor levels have been identified. Our solution provides clean air and sanitation by providing a safer method of cooking. With our cookstove solution, families will not consume toxic air inside their dwellings, promoting good health and wellbeing. The rest of the world will benefit from reduced greenhouse gas emission through a more efficient fuel source. The solution provided by our company directly aligns with a number of the United Nations (UN) Sustainable Development including **UN Goal #6: Clean Air and Sanitation**, **UN Goal #3: Good Health and Well-Being, and UN Goal #13: Climate Action.**

One necessary step in achieving a solution to the identified problem is through the deployment of water vapor toxicity sensors. The sensors will monitor the presence of toxic material present in water vapor. For example, by mounting a test pad and vapor condenser near the ceiling of a dwelling, it is possible to independently test for the presence of all the potential contaminants outlined in the problem section. Once the water vapor has condensed, droplets can then be free to move across the sensor surface, revealing the presence of toxins. The chemical test pad will be visible from the bottom of the product, as seen in Fig. 1. In order to make sense of the test results, users will be able to manually observe the color intensities on the sensor device and refer to a printed manual that deciphers what each test color means.

In our research, we identified that 81% of the world's population owns a smartphone in 2021 [5]. This is why we are planning to create a simple web platform for users to submit a periodic photo of their CleanAir product for online computation using machine learning models. These models will be able to make a prediction about the presence of specific toxins in the tested water vapor. There are two apparent benefits of this technology implementation. The first is that users will be able to confidently interpret the results of their CleanAir product. The second benefit is that user results can be cataloged and compiled, forming a network of test results to track the presence of aerial toxins around a community.

The next necessary component of our solution is providing a low-cost alternative cooking system that may be used when a toxin is detected by the sensor device. This low-cost alternative system will need

to be transportable, efficient, safe, and have a long shelf-life. From 2011-2020, Inyenyeri, a for-profit company held operations in Rwanda by producing and distributing biomass pellets while leasing a clean-burning biomass micro-gasifier cookstove to individuals. During this time, Inyenyeri continuously updated its business model in order to grow its customer base across Rwanda. Unfortunately, due to the onset of the COVID-19 pandemic, Inyenyeri ceased operations. Since then, the operations of Inyenyeri have been documented in *Energy for Sustainable Development* [6], which will be integral to understanding the potential for a sustainable biomass pellet based solution to be brought to scale.

CleanAir has identified a fuel-efficient cookstove which reduces greenhouse gas emissions by 35 tons/stove over the length of the cookstove which is about 10 years. With gowing investor interest in carbon credits, CleanAir will finance the purchase of cookstoves through the sale of carbon credits. One carbon credit is equivalent to one metric ton of greenhouse gas removed from the atmosphere. A carbon credit is a generic term for a tradable certificate or permit representing the right to emit a set amount of

Figure 1: Bottom view of CleanAir product mounted to the ceiling. The product will be shaped similar to a smoke detector and color indicators will be visible from the bottom of the device for different toxin tests.

Figure 2: Micro-gasification cookstoves used by Inyenyeri.. These stoves are clean-burning and use biomass fuel pellets. Image from [6].

a different greenhouse gas. The global compliance market for carbon credits is massive. According to Refinitiv, the total market size is $261B with an expected CAGR of 11.7%. Because one stove reduces greenhouse emissions by 35 tons over its life, this means 35 carbon credits per stove are produced. At a current market rate of $8-11 USD per carbon credit, the distribution and maintenance of these cookstoves will fund themselves [7].

Target Market

The primary target market for this initiative will be Environmental, Social, Governance (ESG) investors looking to make a positive impact around the world while also growing their investment portfolio. Carbon credits generated from the cookstoves can be sold at a premium given the additional benefits from the stoves, namely clean air and sanitation, good health and well-being. The credits generated can be sold at the end of each fiscal year. The lifespan of these cookstoves are expected to be 10 years. Given the current market price of carbon credits, the cost to purchase and distribute the cookstoves will be recovered in roughly two years, providing great free cash flow for the following 8 years to reinvest in more cookstoves and distribution capabilities.

Population Served

The most notable population served by our company are the Ugandan communities that are served by our primary target market: community advocacy programs, public health organizations, and any support organization whose mission aligns with the advancement of global health. By providing a novel water vapor testing modality for these end-consumers, we can at least begin to enable sanitary cooking and living environments for communities that are unaware of the toxins that exist in their indoor living spaces. The goal of our company is to provide toxin-presence awareness at the household level and data analytics at the communal/governmental level. We anticipate that the distributing organizations will provide necessary prevention measures given the presence of toxins. CleanAir is the first step in the prevention process by identifying the presence of toxins through water vapor testing.

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