



*EVALUATION OF EMISSIONS PRODUCED BY  
TRADITIONAL DIESEL BURNERS (SO<sub>2</sub>, PM<sub>2.5</sub>,  
CO, AND CO<sub>2</sub>)*

## Introduction

The program Energising Development (EnDev) is an initiative funded by the Federal Republic of Germany, the Netherlands, Norway, Australia, the UK, and Switzerland, which aims to provide sustainable access to modern energy services to 14 million people by 2015. In Peru, EnDev has been executed since 2007 by the German Cooperation (implemented by GIZ) under the name Energising Development Project (EnDev – Peru), introducing lines for improved stoves, lighting, productive uses, and water heaters, with a focus on rural areas.

## Problematic

Worldwide there are about 1,400 million people without access to electricity (OECD). Of these, it is estimated that 500 million people still use fossil fuels, among them mainly kerosene, to produce light (Lam et al. 2012). In Peru, about three million people lack access to electricity (MEM 2013), so needing to use burners, candles, and batteries. Unlike in other countries, in Peru no one is using kerosene-fuelled burners because its use has been prohibited by law since 2010 since it is used in the production of illegal drugs (narcotics). However, there are many families in rural areas of the rainforest which have replaced kerosene with diesel, using it as fuel for burners.

EnDev - Peru, in partnership with the National Service for Training of the Construction Industry (Servicio Nacional de Capacitación para la Industria de la Construcción - SENCICO), decided to conduct a study to assess the health risks created through exposure to the gaseous emissions produced by the burners, as well as the risk of their parallel use with wood cooking stoves.



## Methodology

- Two burners with different types of wick (Type A: cotton and Type B: cloth) were collected from households in the towns of San Juan de Abiseo (San Martín) and Mamallaque (Amazon) and used as polluting sources.
- Tests were conducted on indoor air pollutant concentration (CO, CO<sub>2</sub>, PM<sub>2.5</sub>, and SO<sub>2</sub>), resulting from the use of two types of burners with diesel fuel. These tests were conducted in SENCICO's improved stoves certification laboratory in Lima.
- The environment chosen has a ventilation rate of 4.29 h<sup>-1</sup>, which was determined with the window and door closed, as recommended by the new protocol for IWA's improved stoves (February 2012).
- During the trials for each type of test, variables were homogenized such as: start and end time of each test, environment, fuel (diesel and firewood), technical evaluation, and the approximate level of light emitted by the burners.
- The concentration levels of the pollutants mentioned above by each type of burner were evaluated for 3.5 hours a day, on 3 consecutive days during similar hours respectively (D1-D6).
- Similarly, during days D7-D9, the emissions of the traditional stove were evaluated in the mornings, and, in the afternoons, parallel with the most polluting burner according to the results of tests on D1-D6. The testing time with the operation of both polluting sources was 1 hour.

- To control the environmental variables that could influence the results of the tests, the Davis Vantage Pro Weather Station was used.
- To measure the concentration of pollutants generated by diesel-powered burners, the following equipment was used:
  - i) Indoor Air Pollution Meter (IAP, second generation 2012) for measuring PM<sub>2.5</sub> and carbon monoxide CO.
  - ii) Aeroqual (NDI sensor and GSE) for the measurement of carbon dioxide CO<sub>2</sub> and sulfur dioxide SO<sub>2</sub>.

## Results

The tests only with diesel burners showed that the concentration of sulfur dioxide SO<sub>2</sub> emitted by a traditional burner exceeds up to seven times the limit allowed by the World Health Organization (WHO). It was also noted that the concentration of PM<sub>2.5</sub> particles emitted from a diesel burner reaches approximately 60% of the emission levels of a traditional one.

The severity of the use of a diesel burner simultaneously with a traditional stove was confirmed through the observation of a minimum increase of 30% in PM<sub>2.5</sub> levels compared to traditional stove emissions as the only source of pollution.

An unexpected result was observed in that a traditional stove, as the only source of pollution, reaches levels of sulfur dioxide far exceeding the permissible exposure values from various organizations, such as the WHO. The diesel burners showed no health risks in regards to their concentration of CO and CO<sub>2</sub> emissions.

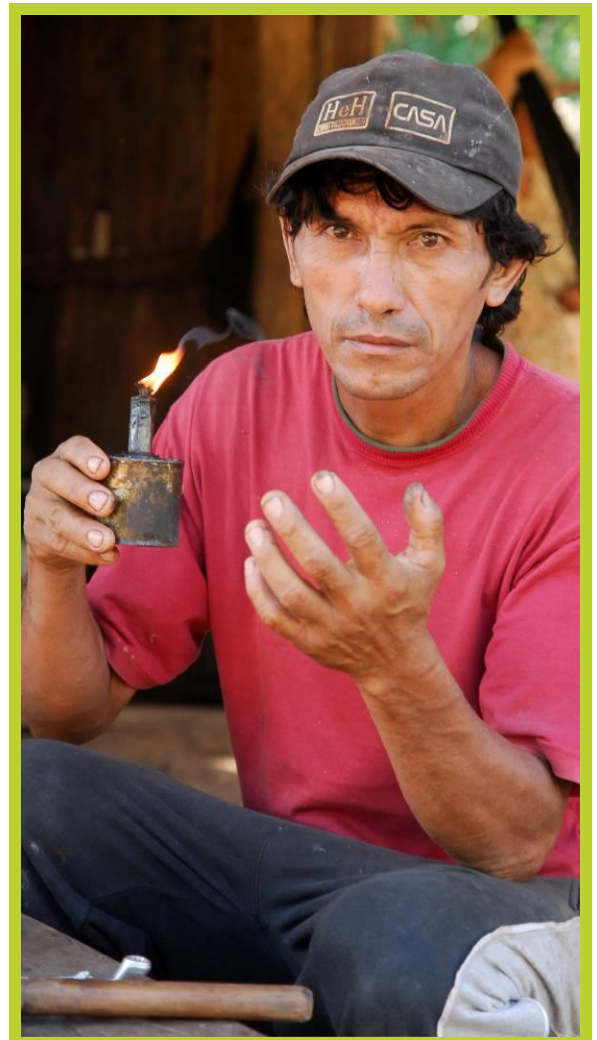
## Discussion

This study invites further research on indoor air pollution, taking into consideration sulfur dioxide SO<sub>2</sub> and its health implications, either through diesel burners or traditional cooking stoves. In relation to the burners, it is suggested to carry out evaluations with the same type of burner and with different types of comburent agents (wicks) since it has been observed that different varieties of wicks emit larger or smaller amounts of fine particles.

In the absence of complete simultaneous measurement of pollutants during the tests on burners and traditional stoves, it is suggested to perform this test with equipment that allows for a wider range of measurement and records other pollutants, such as nitrogen oxides and sulfur. It is also advisable to measure on different days, following similar time schedules, in order to control environmental variables.

The tests performed have also shown the existence of high levels of SO<sub>2</sub>, emitted only by wood stoves. For this reason, it is suggested to consider the levels of SO<sub>2</sub> emitted during combustion when validating improved stoves.

It is understood that the high pollutant concentration levels recorded (especially PM<sub>2.5</sub> and SO<sub>2</sub>) pose a risk to people who use these traditional devices for lighting and cooking in their homes. So, being the most likely means of exposure to sulfur dioxide and toxic particles by breathing contaminated air from the burners or traditional stoves, people should be warned about the risk of carrying out activities within a closed environment due to the presence of these polluting sources.





# Energising Development – EnDev Peru

Pasaje Bernardo Alcedo 150, Piso 4  
San Isidro, Lima 27, Peru

T +51-1 442 1999 / 442 1998

F +51-1 442 2010

E [proyecto.endev@gmail.com](mailto:proyecto.endev@gmail.com)

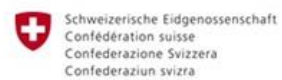


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