

Section VI.C.

Guidance by source category: Annex C, Part III Source Categories

Residential combustion sources

Coordinated by

Ms. Vandana Naidu (Fiji),  
Ms. Indhira de Jesus Salcedo (Dominican Republic)  
and Mr. Zoltan Csizer (United Nations Industrial Development Organization).

## 1.0 Introduction

Heating and cooking in residential households with biomass is common practice in many countries. In most cases the fuel of preference is wood, however, other biomass fuels may be used. Biomass for residential heating and cooking is burned in a wide array of devices ranging from small, open pit stoves and fireplaces to large elaborate highly sophisticated wood burning stoves and ovens. PCDD/PCDF are formed as a result of incomplete combustion, typical in small devices with no or limited combustion controls.

Fossil fuel is also used extensively for domestic heating, especially in developed countries and in countries with economies in transition. Coal, (light fuel) oil and natural gas are the main sources for fossil fuel used for domestic heating.

The air emissions of the residential sources can be significantly higher than all industrial sources including power plants. According to the data of chemical analysis, residential sources may emit about three times more PCBs than industrial sources (excluding manufacturing industries), about two times more HCB, and about 25 times more PCDD/PCDF in countries with economies in transition (Table 1-3). It clearly shows the importance of the residential sources that are basically without any control.

**Table 1: HCB emissions to the air in 2000**

Residential sources	Quantity in Gg	Emission factor in g/Gg	Emission in kg
Hard coal	8102.8	0.125	1.01
Wood	6901.0	0.06	0.41

**Table 2: PCB emissions to the air in 2000**

**Table 3: PCDD/PCDF emissions to the air in 2000**

Residential sources	Quantity in Gg	Emission factor in g/Gg	Emission in kg
Hard coal	8102.8	31.6	256.05
Brown coal	140.5	183.2	25.74
Fuel oil	710.3	3.6	2.56
Wood	6901.0	9.0	62.11
Coke	410.0	9.7	3.98
Residential sources	Quantity in Gg	Emission factor in g/Gg	Emission in kg
Hard coal	8102.8	18	145 850.4
Brown coal	140.5	10	1405.0
Fuel oil	710.3	1	710.3
Wood	6901.0	5	34 505.0

## **2.0 Biomass/Wood for Cooking and Heating in Developing Countries**

Nearly 75-80% of the population in the developing world relies on wood and waste biomass as fuel for cooking and room heating. In most cases, the agricultural and forestry waste biomass is used as fuel, but in certain regions of the world, the demands of the domestic energy sector have put a severe pressure on the precious forest resources. This in itself is a cause for environmental concern. However, a more critical issue is that of the pollution of the indoor air due to the soot and smoke produced by inefficient combustion of biomass fuels inside the house.

Several studies conducted over the last couple of decades have revealed that poor indoor air quality is one of the major factors contributing to the poor state of health of rural women and children in the developing countries. In India 1.5% of the total deaths among women can be attributed to chronic diseases of the respiratory system.

The percentage of blindness and tuberculosis is the highest among women using traditional stoves, as compared to any other population group. Through several recent studies, a direct correlation is emerging between deaths and diseases in infants and young children, and use of wood and biomass as fuel in the house.

An important factor to be noted in this context is this: the number of untimely deaths is just one side of the coin. A general and chronic state of poor health or a disability like blindness adversely affects the way of life and that too must be borne in mind while assessing the health impact of poor indoor air quality. The seriousness of the problem is underlined when we note that the dependence of the global rural population on biomass energy is not expected to reduce significantly for at least a century or so. In fact, if studies of energy usage trends are anything to go by, the number of people relying on biomass energy is expected to increase over the next few decades.

### **2.1 BAT for Using Biomass/Wood for Cooking and Heating in Developing Countries**

Biomass/wood stoves used in developing countries are not well designed. This leads to inefficient use of fuel during cooking and other heating purposes and in addition contributes to polluting the atmosphere due to incomplete combustion, which leads to many types of respiratory illnesses.

The simplest solution to the problem is to promote the so-called improved stoves. Some studies have indicated that improved designs save 50 to 80% fuel when compared with traditional ones. Possible designs for improved stoves would save fuel, reduce air pollution, be easy to manufacture/install and operate, and yet would be affordable to the rural users.

There are many kinds of designs of improved stoves and it is difficult to recommend any one particular type in this paper. Further research is needed in this area.

### 3.0 Vented and Unvented Appliances

**Vented** appliances are appliances designed to be used with a duct, chimney, pipe, or other device that carry the combustion pollutants outside a house. These appliances can release large amounts of pollutants directly into a house if a vent is not properly installed, or is blocked or leaking. **Unvented** appliances do not vent to the outside, so they release combustion pollutants directly into the house.

The table below identifies some typical appliance problems that cause the release of pollutants. Many of these problems are hard for a homeowner to identify.

<b>COMBUSTION APPLIANCES AND POTENTIAL PROBLEMS</b>		
<b>Appliances</b>	<b>Fuel</b>	<b>Typical Potential Problems</b>
Central Furnaces Room Heaters Fireplaces	Natural or Liquefied Petroleum Gas	Cracked heat exchanger; Not enough air to burn fuel properly; Defective/blocked flue; Maladjusted burner
Central Furnaces	Oil	Cracked heat exchanger; Not enough air to burn fuel properly; Defective/blocked flue; Maladjusted burner
Central Heaters Room Heaters	Wood	Cracked heat exchanger; Not enough air to burn fuel properly; Defective/blocked flue; Green or treated wood
Central Furnaces Stoves	Coal	Cracked heat exchanger; Not enough air to burn fuel properly; Defective grate
Room Heaters Central Heaters	Kerosene	Improper adjustment; Wrong fuel (not-K-1); Wrong wick or wick height; Not enough air to burn fuel properly
Water Heaters	Natural or Liquefied Petroleum Gas	Not enough air to burn fuel properly; Defective/blocked flue; Maladjusted burner
Ranges; Ovens	Natural or Liquefied Petroleum Gas	Not enough air to burn fuel properly; Maladjusted burner; Misuse as a room heater
Stoves; Fireplaces	Wood Coal	Not enough air to burn fuel properly; Defective/blocked flue; Green or treated wood; Cracked heat exchanger or firebox

## **4.0 Best Environmental Practices**

### **4.1 Ventilation**

To reduce indoor air pollution, a good supply of fresh outdoor air is needed. The movement of air into and out of residential places is very important. Normally, air comes through cracks around doors and windows. This air helps reduce the level of pollutants indoors. This supply of fresh air is also important to help carry pollutants up the chimney, stovepipe, or flue to the outside. This also allows enough air for proper combustion and reduces the level of pollutants.

Use a hood fan, if using a range. Make sure that enough air is coming into the house when you use an exhaust fan. If needed, slightly open a door or window, especially if other appliances are in use. For proper operation of most combustion appliances and their venting system, the air pressure in the house should be greater than that outside. If not, the vented appliances could release combustion pollutants into the house rather than outdoors. If you suspect that you have this problem you may need the help of a qualified person to solve it.

### **4.2 Correct Use of Appliances and Fuel**

It is important to understand the instructions on the manual of all appliances to understand how they work. Most importantly the recommended type of fuel that is needed for that appliance has to be well understood.

Only use water-clear ASTM 1-K kerosene for kerosene heaters. The use of kerosene other than 1-K could lead to a release of more pollutants. Gasoline is not to be used in a kerosene heater because it can cause a fire or an explosion.

Seasoned hardwoods should be used instead of softwoods in wood burning stoves and fireplaces. Hardwoods are better because they burn hotter and form less creosote, an oily, black tar that sticks to chimneys and stove pipes. Green or wet woods should be totally avoided. Never burn painted scrap wood or wood treated with preservatives, because they could release highly toxic pollutants. Plastics, charcoal, and colored paper such as comics, also produce pollutants. Unfortunately, in developed countries people use plastics as fuel.

### **4.3 Inspection and Maintenance**

Combustion appliances are to be regularly inspected and maintained to reduce exposure to pollutants. It is important to clean chimneys and vents especially when changing heating systems.

<b>INSPECTION AND MAINTENANCE SCHEDULES</b>		
<b>Appliance</b>	<b>Inspection/Frequency</b>	<b>Maintenance/Frequency</b>
Gas Hot Air Heating System	Air Filters - Clean/change filter - Monthly As needed; Look at flues for rust and soot - Yearly	Qualified person check/clean chimney, clean/adjust burners, check heat exchanger and operation - Yearly (at start of heating season)
Gas/Oil Water/Steam Heating Systems and Water Heaters	Look at flues for rust and soot - Yearly	Qualified person check/clean chimney, clean combustion chamber, adjust burners, check operation - Yearly (at start of heating season)
Kerosene Space Heaters	Look to see that mantle is properly seated - daily when in use; Look to see that fuel tank is free of water and other contaminants -- daily or before refueling	Check and replace wick -- Yearly (at start of heating season); Clean Combustion chamber -- Yearly (at start of heating season); Drain fuel tank -- Yearly (at end of heating season)
Wood/Coal Stoves	Look at flues for rust and soot - Yearly	Qualified person check/clean chimney, check seams and gaskets, check operation -- Yearly (at start of heating season)

## 5.0 Further Recommendations

- 1) Issues resulting from residential combustion for cooking and heating in developed countries is of great concern. Research shows that health of women in some countries are deteriorating because of exposure to pollutants from improper practices for cooking and heating.
- 2) The concept of “improved wood stoves” has to be part of the National Implementation Plan for developing countries. This will enable countries to possibly access funds to do further research on the type of stove that is most suited to people.
- 3) Countries should strengthen awareness raising and education on residential combustion. These awareness programs have to be country specific.