



Subjects

Geography,
Sciences,
Technology
& Maths

Total time

60-90 mins

Age range

11-14 years

Photo source: Melanie Dreyse/iaif



Clean Cooking: Ensure Access to Affordable, Reliable, Sustainable and Modern Energy for All

Learning Outcomes

- Students will learn to distinguish between traditional and modern cook stoves
- Students will learn to distinguish between primary and secondary energy
- Students will learn about the impacts of using different types of energy, especially on health and the environment
- Students will identify the SDGs that benefit from the provision of access to clean cooking
- Students will identify the main issues related to access to clean cooking/heating facilities and learn about the range of solutions available
- Students will learn about solar radiation by building a solar cook stove

Preparation

- Ensure that you have all the handouts required for the class printed and ready with you
- Read through the lesson plan and the tips thoroughly

Materials

- See **Appendix 7** for list of materials to build a solar cook stove

Acknowledgements

With special thanks to **Pia Løvengreen Alessi**, WAME Project Coordinator

Step 1: Different Fuel Types in the Home

5
mins

Ask students *what technologies and/or fuel types do you use at home for cooking?*

Write down all student suggestions and ask them to identify whether they think they are primary or secondary energy sources.

Tip: Prepare copies and distribute **Appendix 1** for support

Step 2: Introducing Clean Cooking

10
mins

Show the number **3 billion** on the board. Ask students *what issue might affect this many people worldwide?*

It is the number of people who do not have access to **clean cooking**.

Note for educators: Clean Cooking facilities are considered safer, more efficient and more environmentally sustainable than the traditional facilities that make use of solid biomass (such as a three-stone fire). This refers primarily to improved solid biomass cookstoves, biogas systems, liquefied petroleum gas stoves, ethanol and solar stoves. (Source: <https://www.iea.org/>)

Show the image from **Appendix 4** Traditional Three Stone Fire – Have a class discussion asking students: *What hazards might arise from cooking in this way?* Remind students to think about social, economic, health, gender and environmental issues.

In groups ask students to discuss the following three questions:

1. Which Global Goal do you think clean cooking refers to?
2. Identify the Global Goals that are facilitated by having access to clean cooking and fuel
3. Discuss why you think clean cooking is getting less political attention than access to electricity?

Ask students to feedback to the class.

Tip: prepare copies and distribute **Appendix 2** and **3** for support

Step 3: Types of Technologies and Fuels Used for Cooking

20
mins

Show the the WAME video "Clean Cooking" <https://www.youtube.com/watch?v=qdpttpSwC-4&t=1s> and distribute

Appendix 4, 5 and 6.

Activity 1: Divide the class into groups and handout **Appendix 4 and 5.**

Tell students they can use these resources to help them answer the following questions.

1. Identify the main processes that differentiate an improved cook stove from an advanced cook stove
2. Identify the main obstacles to using modern cook stoves and fuels in poor rural areas
3. Using **Appendix 5**:
 - a. Identify the three worst stoves from an environmental perspective
 - b. Identify the three worst stoves from a health perspective
 - c. Determine whether kerosene or biogas is better from a health perspective

Activity 2: Then direct the students to this link: <http://cleancookstoves.org/technology-and-fuels/facit/> and

1. Compare the availability of biomass/firewood and LPG in India, China and Uganda and discuss the results that you find.
2. Compare the availability of coal/charcoal in India, China and Nigeria and discuss the results that you find
3. Explain why achieving access to clean modern cooking and fuel is dependent on locally available energy sources, family income as well as local traditions, habits and beliefs.

Present the results to the class and have an open discussion about the importance of identifying the most suitable cooking technology and fuel type for a given location. Consider environmental, social & cultural and economic perspectives. A step-by-step approach to achieving access to modern cooking technologies and fuels is the way forward to achieving the Global Goals by 2030.

Optional Extension Activity: Then direct the students to this link: <https://www.iea.org/energyaccess/database/>

1. Compare the national electrification rate and the share of the population without access to clean cooking in China and India respectively.
2. Using **Appendix 6** ask students to explain the effect of population growth on achieving Global Goal 7 on access to electricity and access to clean cooking respectively.

Present your finding and conclusions to the class and have an open discussion about the vast difference in actual numbers between the lack of access to electricity and clean cooking.

Step 4: Turning Theory into Practice

20
mins

Ask students *whose responsibility is it to achieve Goal 7?*

Suggested possible response: The responsibility for meeting the SDG 7 lies in the hands of everyone and with all spheres of society: Governments must install the right policies and rules, the producers of clean cooking devices must implement the most appropriate technologies to propose the best possible products to the market at affordable prices, NGOs must help the most vulnerable, media must address the untold stories. Explain to students that individuals also carry some of the responsibility, both in terms of their own usage of energy, and also in standing up for what is right so that everyone plays a part in making the future better.

Explain to students that there are many different ways of cooking but only a few are 100% renewable and sustainable. The technologies needed to efficiently cook with renewable sources of energy still needs to be further developed, however the solar cook stove is one of the front runners.

Explain to students that they are now going to try out for themselves cooking with a solar cook stove!

While building the solar cook stove think of the following questions:

1. *How efficient is the solar cook stove compared to an electric/gas cook stove?*
2. *Would you classify the solar cook stove as a modern form of cooking?*
3. *How far would you compromise on efficiency for environmental concerns?*
4. *What steps could you take at home to assure more environmentally friendly cooking (think of both primary and secondary energy sources)?*

See **Appendix 7** for student hand out with instructions.

Tip: This step could be elaborated into a school project or set homework.

After creating the solar cook stoves, **ask students** *what actions might you be able to take to achieve Goal 7?*

Suggested ideas for student action: For students living in a situation where **100% access to clean cooking has been achieved** some possible actions could be to **write a letter to the minister responsible for development cooperation** highlighting the problems (health, social, environment and economic) related to the lack of access to clean cooking and heating worldwide and ask them to increase the attention and budget allocated from the state budget to address these problems:

1. Map the extent of the problem in a given location (a continent, a specific country or a specific local community).
2. Identify initiatives that have done a good job of addressing these problems in other countries or communities demonstrating there are solutions to be applied.
3. Prepare a written report summarizing the observations and proposing the kind of solutions you have identified.

Another idea is to host a fundraising event to raise money/donate to <http://cleancookstoves.org/>

For students living in a situation where **100% access to clean cooking and fuel has not yet been achieved:** Explain to students that they could prepare a letter to their minister for health and the minister for development highlighting the problems (health, social, environment and economic) related to the lack of access to clean cooking and heating in their country and ask them to increase the attention and budget allocated from the state budget to address these problems. The steps to be taken include:

1. Quantifying and map the % of the population that does not have access to clean cooking and heating facilities.
2. Identify the national and local plans for providing access to clean cooking including identifying any shortfalls regarding meeting the SDG 7 by 2030.
3. Identify local initiatives that have done a good job of addressing these problems demonstrating there are solutions to be applied.
4. Prepare a written report summarizing the observations and proposing the improvements you have identified.
5. Write a letter to the minister for health and the minister for development explaining that the SDG 7 goals on clean cooking will not be reached by 2030 unless everyone contributes to making it possible. Highlight what they can do in this process and inform them that your class, and many like-minded young persons, are concerned about the unnecessary health impacts of lack of access to clean cooking and that you would support increased Government attention on this topic for the next decade.

Share your lesson with us:

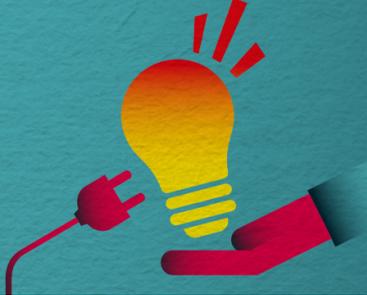
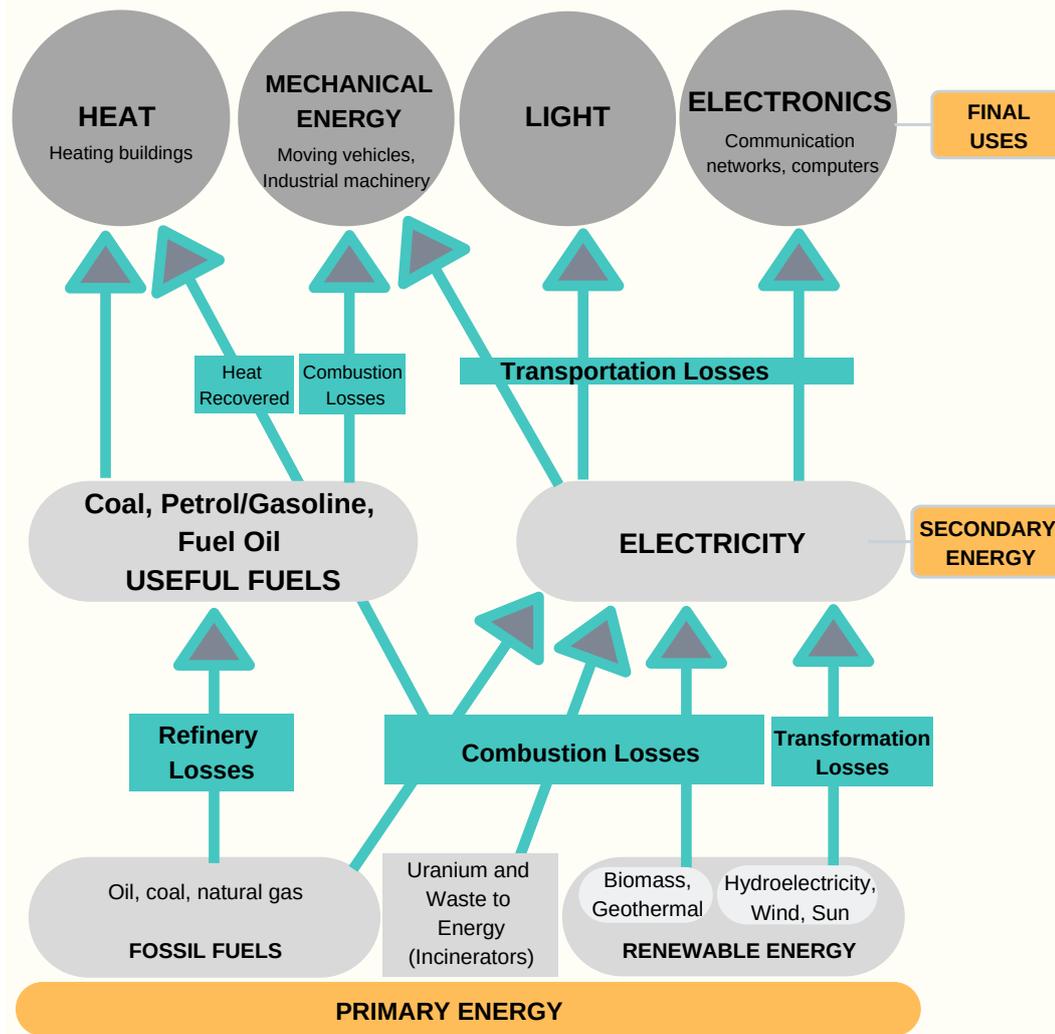
Send photos of your SDG 7 Clean Cooking work to lesson@project-everyone.org or info@wame2015.org **Tweet us** @TheWorldsLesson, **Facebook** @TheWorldsLargestLesson or **Instagram** @theworldslesson! **Tweet**@wame_2015

If you would like to have more resources for Global Goal 7 head to <http://www.wame2015.org/>

And don't forget to add yourselves to our interactive global map!

<https://worldslargestlesson.globalgoals.org/map/index.html>

PRIMARY & SECONDARY ENERGY

WAME2015.ORG

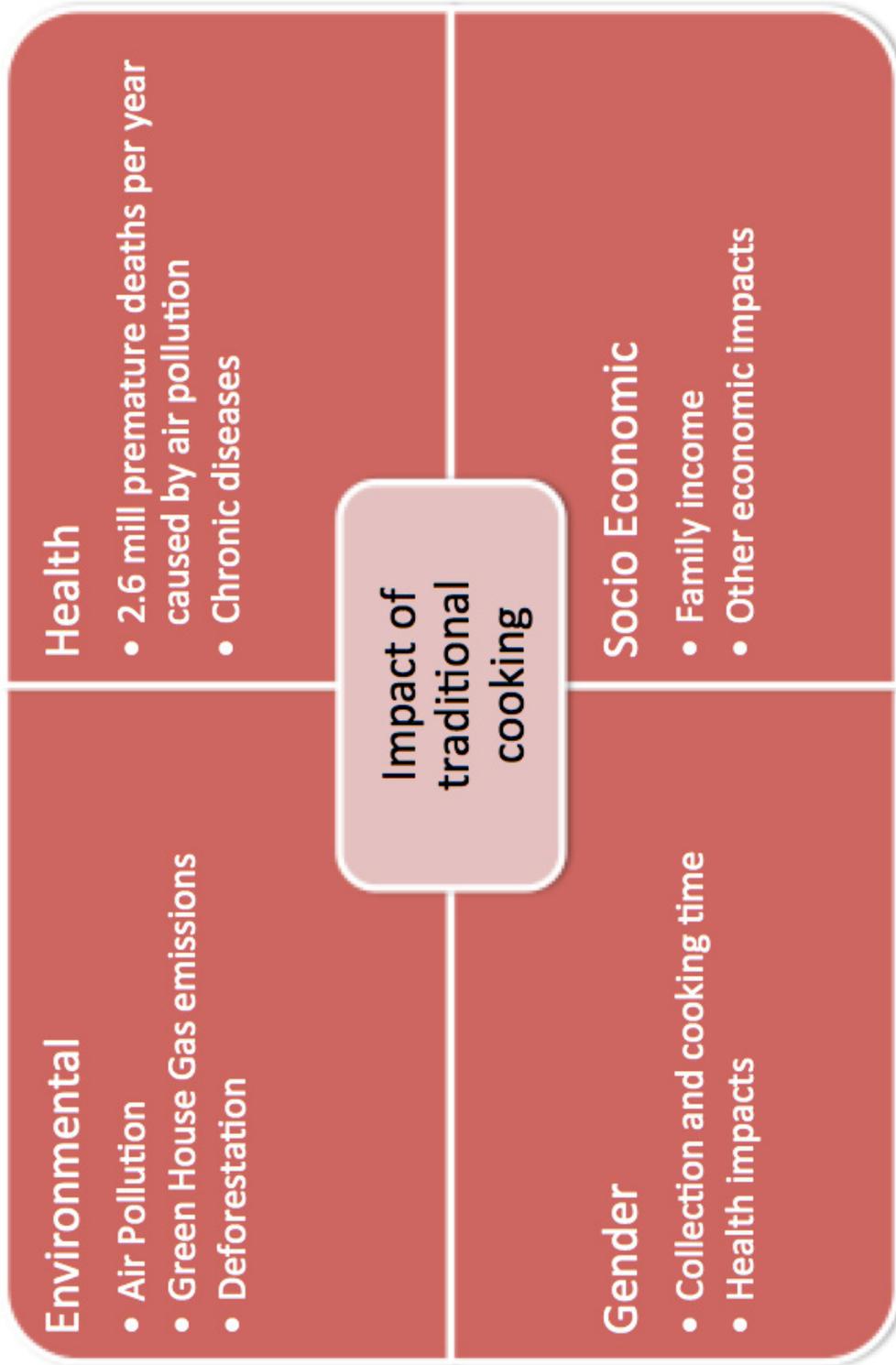
A primary source of energy is one that occurs naturally. Fossil fuels (coal, oil and gas), and renewable fuels (biofuels, wind, waves, solar radiation) as well as nuclear fuels and waste for incineration are all primary sources of energy.

A secondary source of energy is one that is made using a primary resource. Electricity is a secondary resource, and can be generated by a number of different primary sources, with or without combustion. It is important and largely used because it can provide a variety of energy services, moving elevators or surgical bistouries, charging mobile phones and computers, illuminating homes and streets, cooking meals. For cooking and heating we can use both primary and secondary energy.

THE GLOBAL GOALS

For Sustainable Development





Appendix 4: Types of Technologies and Fuels Used for Cooking

There are a variety of clean cooking technologies available on the market. The first generation of fuel efficient cook stoves were mainly motivated by **deforestation concerns** and therefore focused primarily on improving heat transfer so as to **improve energy efficiency**. More recent **concerns about human health and black carbon** have turned towards advanced-combustion cook stoves, the goal of which is to further **reduce harmful emissions by boosting combustion efficiency**. Adoption of clean cooking technology therefore has the dual aim of reducing the need for wood as fuel and decreasing smoke emissions in homes for health and environmental benefits

The performance of a cook stove is characterized by three processes¹:

1. **Heat-transfer efficiency**, or how much of the heat is absorbed by the pot, depends primarily on the **geometry of the cook stove** and the flow of hot gases around the bottom and sides of the pot.
2. **Combustion efficiency**, or how much of the energy and carbon in the fuel is converted to heat and carbon dioxide, depends primarily on the **temperature in the cook stove** and the characteristics of the combustion chamber that affect the circulation of air.
3. **Overall thermal efficiency**, or how much energy in the fuel is absorbed by the pot, can be raised by **improving either combustion efficiency or heat-transfer efficiency**.

Different types of cook stoves:

TRADITIONAL COOK STOVES

The three-stone-fire is inefficient in transforming solid fuels to energy. In terms of climate concern, incomplete combustion results in the release of black carbon, which is considered a main contributor to climate change. Regarding health aspects, the exposure to household air pollution from the inefficient combustion of solid fuels in low-quality stoves operated in poorly ventilated kitchens is a significant public health hazard.

Traditional three stone fire where any



¹ Venkatraman 2010

FUEL-EFFICIENT STOVES

The fuel-efficient stoves, like the improved cook stove or simple rocket stove, has the primary objective of reducing the volume of fuel wood needed for cooking (usually from 20-50% compared to three-stone fire) and therefore designed to raise overall thermal efficiency by improving heat transfer with comparatively little focus on combustion efficiency. This type of stove is the prevalent type in many developing countries today.

Improved Cook Stove (ICS), usually made from mud or sand, are designed and built in various ways according to local customs to reduce the volume of fuel wood needed for cooking



Source. Martin Wright

Simple rocket stove contains single combustion chamber to ensure better combustion and help direct the heat to the bottom of the pot:



Source: <http://rocketstove.solarhaven.org/>

ADVANCED COOK STOVES

The advanced cook stoves, like the forced-air biomass cook stoves, focus primarily on cleanliness and therefore strive to increase airflow to boost combustion efficiency and reduce emissions. In laboratory tests, advanced-combustion stove fuel savings of 45% or more. They also

Appendix 4: Types of Technologies and Fuels Used for Cooking

reduce carbon monoxide and particulate matter by 95 percent or more and nearly eliminate black carbon.

The costs of advanced cook stoves vary depending on the context in which it is introduced. Stoves may be produced locally at very low or no cost, or they can be purchased. Consideration must be given to the available income of the purchasing families, the customs of the community and to the fuels available locally. Very efficient stoves may have very rigid and specific fuel requirements and be expensive (150-400\$), while smaller locally produced and often less efficient stoves are less expensive (5-50 \$). Technologies vary according to rural and urban contexts.

Advanced improved forced-air biomass cook stoves use a fan powered by a battery, electricity, or a thermoelectric couple that blows jets of air into the combustion chamber for increased combustion and heat and reduced smoke and emissions.



MODERN COOK STOVES USING CLEAN FUELS

CLEAN FUELS

Fuels used make a difference. Even within the realm of fossil fuels, the impact on health may be different. Cooking technologies using cleaner fuels, such as LPG and biogas, or clean primary energy, such as solar, are better alternatives to cooking over a three stone fire or even an improved cook stove. Elevated cost and complicated infrastructure requirements for fuel delivery in remote areas are widely recognized as the main constraints for the mass deployment of such options and go a long way to explain why the emphasis in remote rural areas has often been on changing the cooking technology rather than the fuel type. The situation is different in urban areas where emphasis is on delivering cleaner fuels. There is clear evidence that cleaner fuels, such as LPG, ethanol and biogas, offer greater potential benefit not only in terms of health benefits but also greater progress towards climate goals and other relevant SDGs.

Advanced LPG stove



Source:
Nimbar
Agricultural
Research
Institute

Electric stove



Source:
IMUSA
USA. LCC

Bio-gas stove



Source:
Saleem
Shaikh/IPS

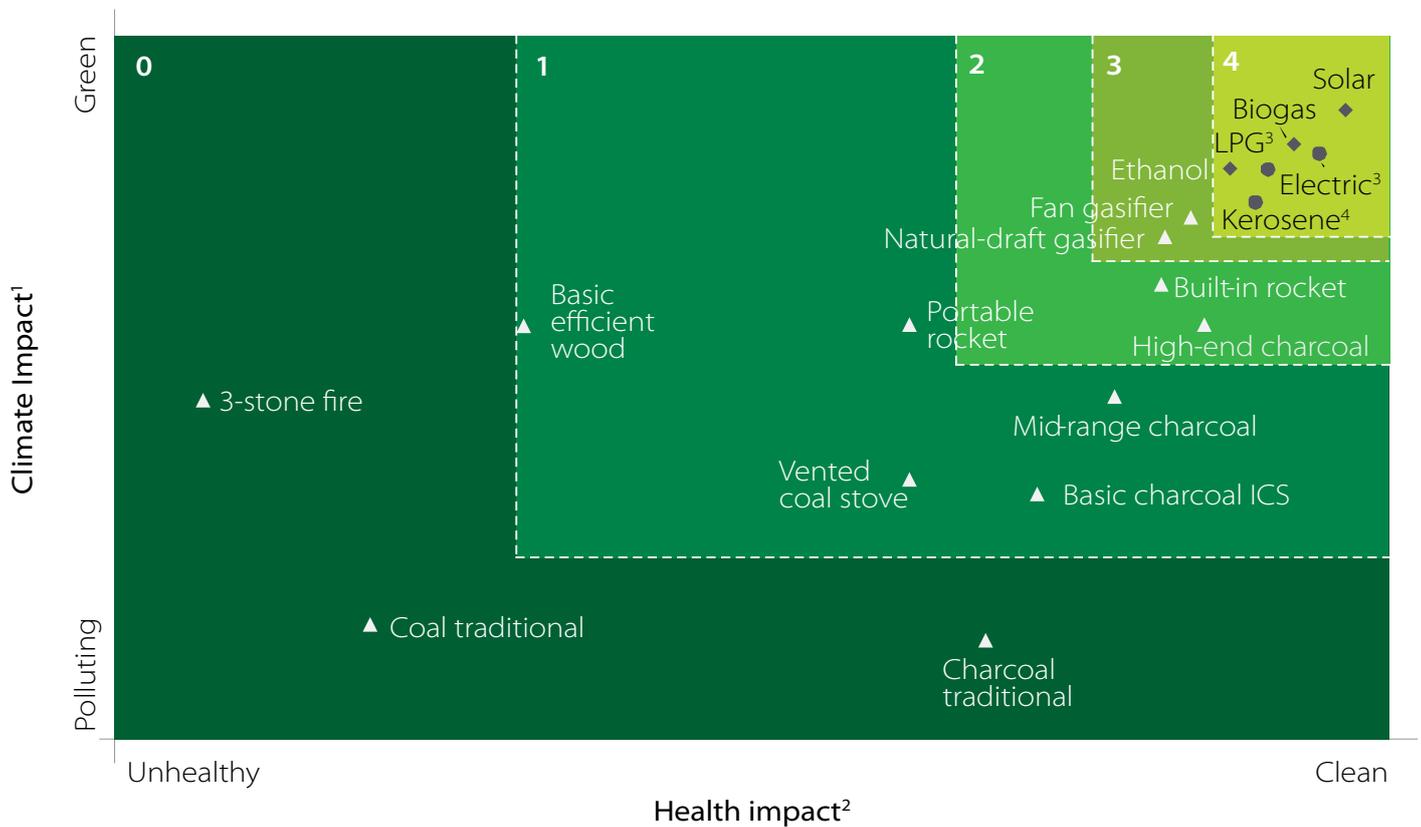
Solar Stove



Source:
Greenpeace

Appendix 5: Benefits of Modern Cooking Technologies

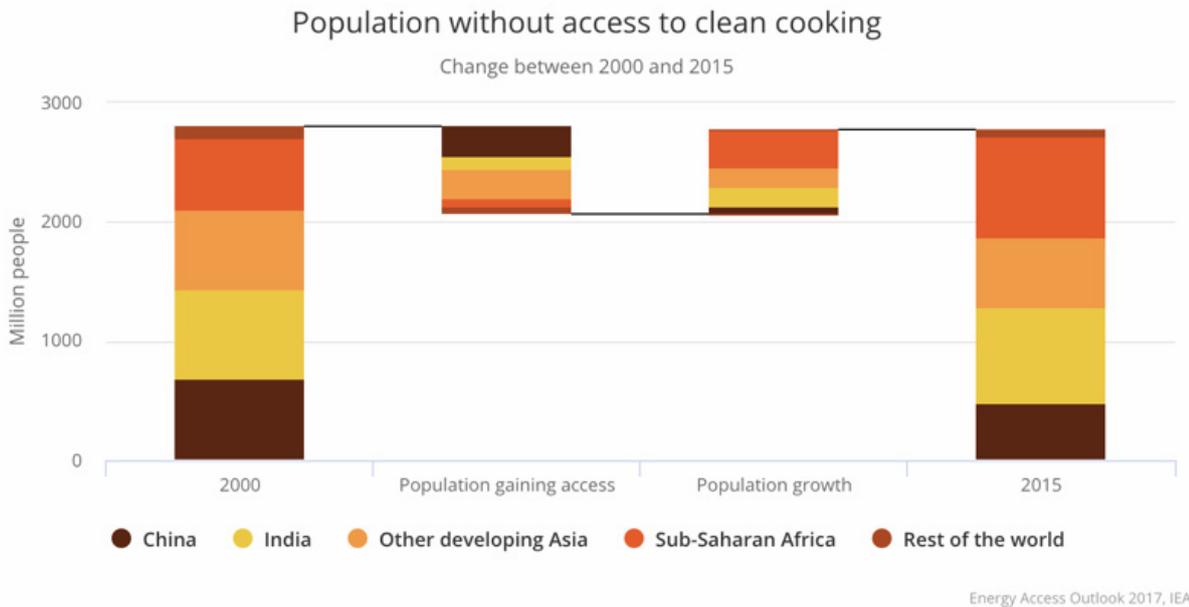
On the horizontal axis you observe an improvement on the health impact of the stove/fuel use, going from unhealthy to clean. On the vertical axis you observe an improvement on the climate impact, going from polluting to green. The further to the top/right corner, the better the stove/fuel on both health and climate.



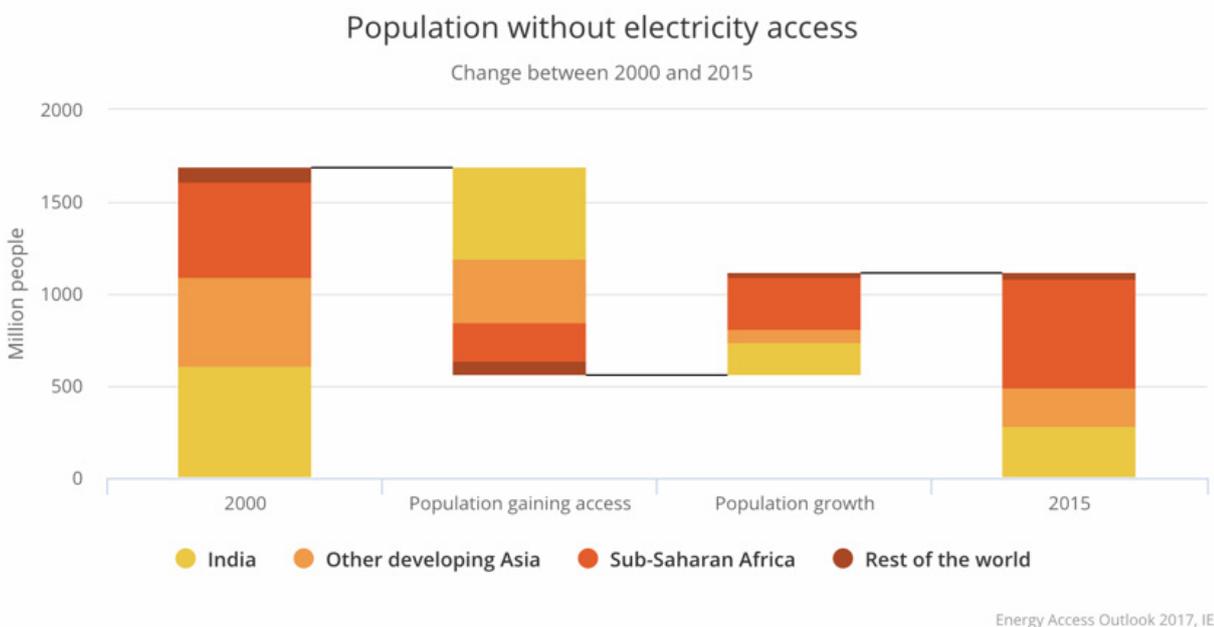
Source: Clean and Improved Cooking in Sub-Saharan Africa, World Bank, 2014

Appendix 6: The Effect of Population Growth

On the horizontal axis the population is growing fast, and what we observe in this graph is that the population gaining access to clean cooking in the period between 2000 and 2015 is very close to the same as the increase in population in the same period. As a result, there is still the same number of persons without access to clean cooking in 2015 as in 2000. You observe an improvement on the health impact of the stove/fuel use, going from unhealthy to clean. On the vertical axis you observe an improvement on the climate impact, going from polluting to green. The further to the top/right corner, the better the stove/fuel on both health and climate.



What we observe in this graph is that the population gaining access to electricity in the period between 2000 and 2015 is higher than the increase in population during the same period. As a result, there are fewer people without access to electricity in 2015 compared to 2000.



Appendix 7: Student Hand Out

SOLAR COOK STOVE – THEORY OF SOLAR RADIATION

Watch and copy:

<https://www.youtube.com/watch?v=xbwliZJiHe8>

Materials needed:

- Large pizza box
- Ruler
- Black marker
- Box cutter
- Aluminum foil
- Glue
- Scissors
- Plastic wrap
- Tape
- Black construction paper

Optional:

Stick or hard plastic straw
Laser pointer

Instructions:

Step 1: Using the ruler and black marker draw a square on the pizza box lid leaving 1 inch/2,5 cm on the edge of each side.

Step 2: With the utility knife cut three of the lines drawn on the sides leaving the line at the rear attached. Fold the flap back.

Step 3: Cover the back of the flap with aluminium foil. Glue the foil to the flap and cut away any access foil.

Step 4: With the scissors cut two square pieces of plastic wrap each one square inch/2,5 cm larger than the pizza flap opening. Open the pizza box and tape one piece of wrap to the hole in the flap.

Step 5: Close the pizza box and tape the second piece of plastic wrap over the hole from the other side. This creates a window that will help keep the sun's heat in the box.

Note: Make sure the plastic wrap is tight to the edges to maintain an airtight seal.

Step 6: Glue/tape a layer of aluminium foil to the inside layer of your pizza box for insulation.

Step 7: Cover the foil layer in the box with sheets of black construction paper and glue them into place. The black base will absorb light and generate more heat.

Step 8: Close the lid and you are ready to start cooking.

Adjust the foil flap to get the best ray-reflecting angle and use a pen or plastic straw to hold the lid. Use a laser-pointer to simulate rays of sunlight for best angle.

Step 9: Leave the oven to pre-heat before use.

Step 10: Re-heat your pizza.

