NEPAL e-COOKBOOK

ELECTRIC COOKING VS. OTHER FUELS

WHY IS ELECTRIC COOKING THE FUTURE FOR NEPAL?

EPC RECIPES

HOW TO MAKE THE MOST OF YOUR ELECTRIC PRESSURE COOKER

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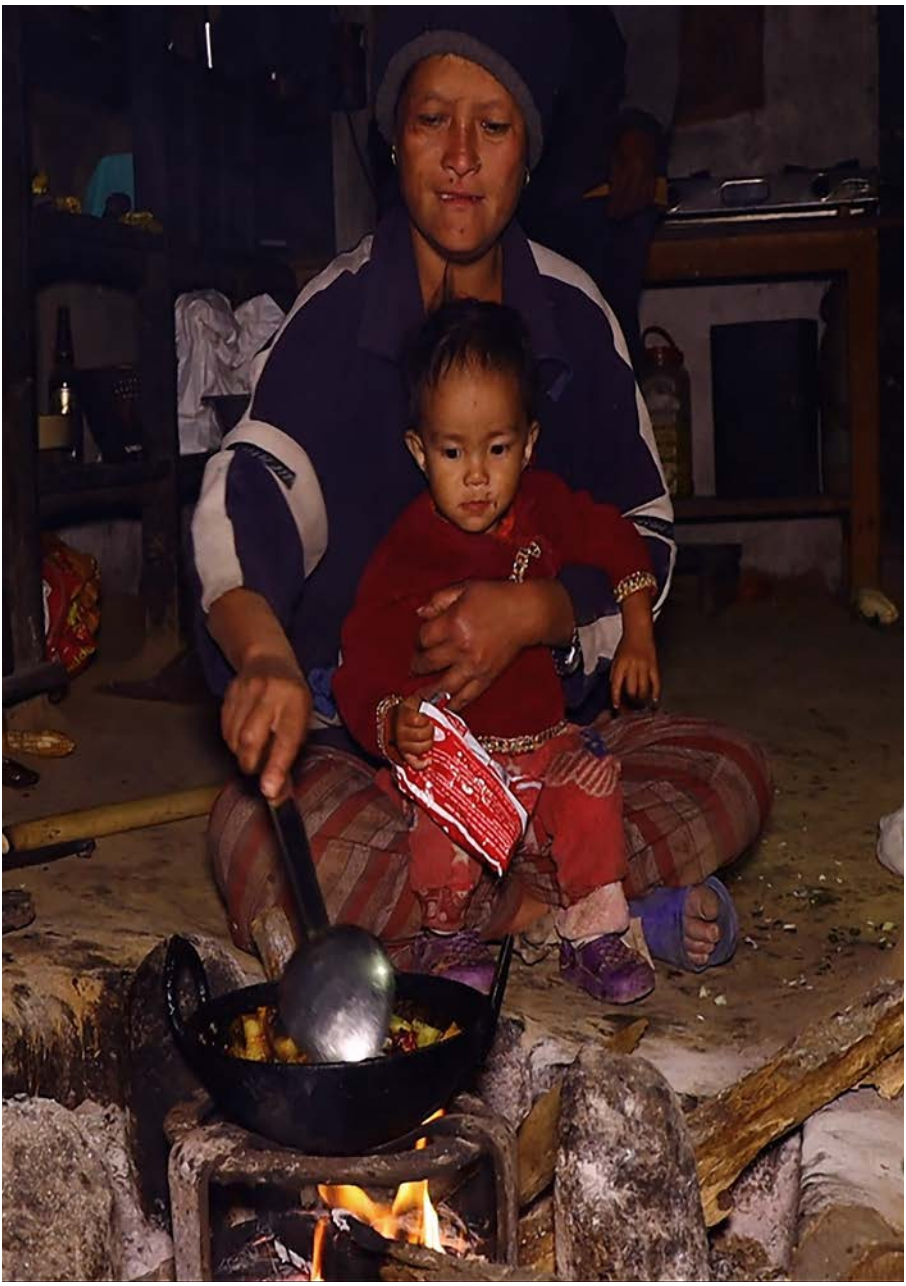
PREFACE

Each year 24,000 Nepalis lose their lives to chronic illnesses caused by indoor air pollution. Every year, thousands more Nepalis, especially women and children, begin to suffer from these air-borne illnesses, including pneumonia, lung cancer, asthma, cardiovascular disorders, tuberculosis, acute respiratory infections, chronic obstructive pulmonary disease, etc. This is a tragedy constantly unfolding across Nepal, and every minute people suffer because of it. To address this intolerable situation, the Government of Nepal has prioritized access to clean cooking for all citizens. However, past interventions were primarily based around wood-fueled cooking, which is not as clean as was initially hoped. Therefore, efforts to promote electric cooking in the country are now beginning from the infant stage.

As per its Nationally Determined Contribution (NDC) commitments, Nepal aims to promote electric cooking as a primary cooking method in 25% of households by 2030. This commitment also supports Nepal's aim of increasing national forest coverage to 45% and reaching net-zero deforestation by 2030.

To support electric cooking promotion in Nepal, PEEDA - with the support from the University of Bristol and Modern Energy Cooking Services (MECS) Program, Kathmandu Alternative Power and Energy Group, and many other experts - has been conducting research to understand precisely how electric cooking should be rolled out to Nepali kitchens. This research has examined the relative cost of cooking methods, cultural attitudes towards electric cooking, issues affecting grid power supply (both for the national and micro-hydro grids), and the effect of existing cooking behaviors. This e-cookbook is one of the outputs of the aforementioned works around electric cooking. I hope this book will be helpful to all who are interested or invested in the electric cooking transition within Nepal.

Biraj Gautam
Chief Executive Officer
PEEDA



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BACKGROUND

The emerging technology of e-cooking has the potential to revolutionize cooking habits within Nepal. A reduction in the air pollution created by traditional cooking methods promises to deliver significant health improvements to millions of Nepalese. However, the success of e-cooking is not yet guaranteed. Although electricity generation has increased in recent years, the transition away from biomass to electric cooking has not yet occurred. Most Nepalese lack the required awareness of the benefits of e-cooking: doubts remain over the affordability, availability, performance, and safety of e-cooking appliances. However, there is good news on this front: the People, Energy & Environment Development Association (PEEDA) has shown that with correct intervention e-cooking can become an essential component of a household's cooking process. This e-cookbook serves to spread awareness of the benefits of e-cooking even further.

This edition of the Nepal e-cookbook has been produced by PEEDA as a part of the project "Understanding the Suitability of Electric Pressure Cookers in Nepalese Households". This project was implemented in Nepal under the Modern Energy Cooking Services program (MECS). The project aims to support the national effort in transitioning from biomass towards clean cooking solutions. This e-cookbook has been prepared as a supplementary document for use by research participants, policy makers, and e-cooking manufactures, along with general users interested in switching to e-cooking stoves.

This document is divided into 4 sections. The first section, Cook stoves and Fuels, assesses the various cooking stoves used in Nepal.

The second section provides an overview of the various e-cooking stoves that can be used as primary cookstoves in Nepal.

The third section provides results from Controlled Cooking Tests (CCT) conducted by PEEDA and provides the cost of cooking for various stove types, traditional and modern.

The final section provides recipes and step by step instructions for the use of the EPC in cooking common Nepalese foods such as rice, daal and meat. A vegetable recipe is not discussed because cooking methods differ from household to household due to differences in traditional preparation methods and the locally available vegetable varieties. Because this document is an outcome of an EPC project, only recipes for the EPC are mentioned.

We hope the readers will be enlightened by the comparison of various cooking fuels/stoves and develop a positive perception towards cleaner cooking methods.
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COOKSTOVES AND FUELS

COOKING WITH FUELWOOD

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Fuelwood is the primary energy source for cooking and heating in rural areas of Nepal. According to CBS (2017), around 63.6% of the total households of Nepal use biomass for cooking, out of which 52.4% solely use fuelwood as the main cooking fuel. The fuelwood used for cooking is obtained from private farmlands and forests. Cooking with fuels like fuelwood, cow dung cake, agro-waste etc., in inefficient, traditional stoves induce indoor air pollution. This results in critical health issues primarily related to respiratory and eyesight diseases.

In Nepal, women are traditionally responsible for domestic labour, including cooking. This makes women more vulnerable to air pollution induced illnesses such as lung cancer, asthma, and heart disease. World Health Organization (2016) survey reveals 24,000 people annually die due to indoor air pollution in Nepal.

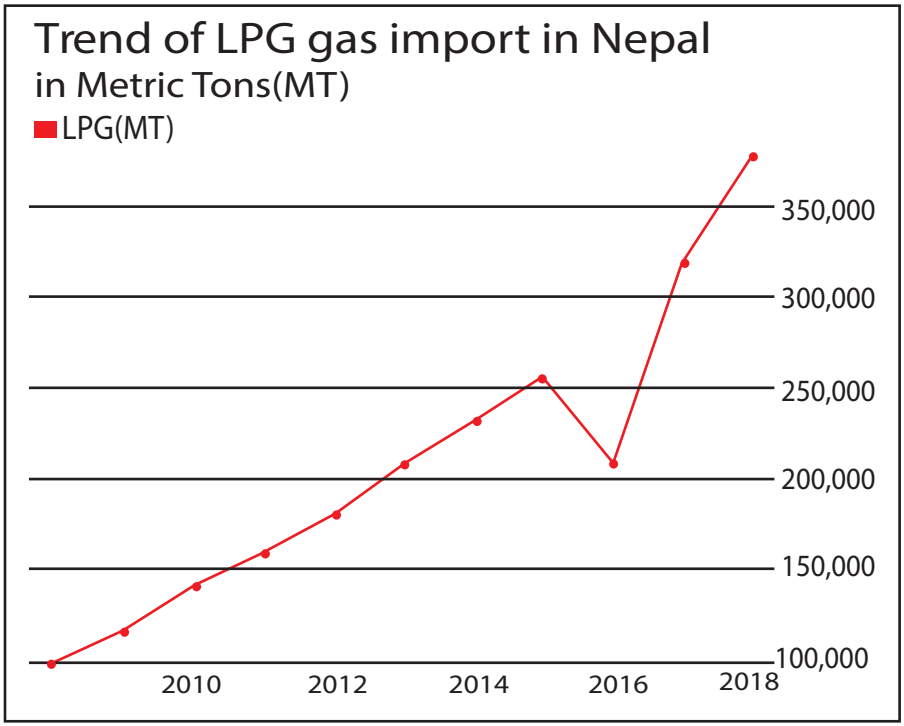
Community forest and Parma System

Community forests are the parts of the national forest owned by the government but managed and used by the local users organised by the community forest user groups (CFUG). The community forestry program was introduced in Nepal in 1978 A.D with the objective to reduce forest degradation and promote sustainable harvest of forest products to improve the livelihood of the community.

Communities in the rural year harvest the fuelwood once or twice a year from the forest areas. To reduce the cost of the fuelwood collection, communities practice the Parma system. The Parma system is the indigenous practice of exchanging labor while harvesting and cultivating agricultural products and collecting the fuelwood. Despite parma system, our study showed direct and indirect cost involved while collecting fuelwood, making fuelwood costlier.

COOKING WITH LIQUID PETROLEUM GAS (LPG)

Liquefied petroleum gas is non-toxic, highly flammable liquefied mixture of propane and butane which is used all over the world for cooking, transportation, and heating. The calorific value of LPG is 2 to 3 times larger than that of fuelwood. It also emits less CO_2 and particulate matter than either coal or biomass. This explains the popularity of LPG as a cooking fuel in Nepal. Studies show LPG use reduces indoor air pollution by 90% compared to a traditional biomass (WHO, 2011). Furthermore, the use of LPG aids in minimizing deforestation and desertification. With this in mind, the major and unavoidable downside of LPG is its negative environmental impact due to excess CO_2 emissions. Reliance on LPG is not sustainable in the long term due to its non-renewable nature as a fossil fuel.



Source: NOC 2018, GoN,2017 (Nepali times)

Figure 1: Trend of LPG gas import in Nepal (in MT)

Line of LPG cylinder during blockade in 2015/16

Source: Nature Khabar

In Nepal, around 53.3% of urban and 8.7% of rural populations use LPG for cooking, making it the second most used fuel. As per the report of Ministry of Finance, Nepal had imported about 4,51,029 metric tons of LPG, worth NRs 30.73 billion, in the fiscal year 2019/20 (2076/77). These imports arrive exclusively from India. This dependency of Nepal on fossil fuel created massive disruption in the everyday lives when the border blockade in 2015 caused an acute shortage of LPG. The subsequent crisis highlighted the fragility of Nepal's dependence on imported LPG

COOKING WITH ELECTRICITY

Currently, Nepal has around 1,900 MW of installed electricity generation capacity. This is a result of Nepal's ambitious focus on electricity production in recent years. Furthermore, Nepal has set a 15,000 MW electricity production target by 2030 in its revised Nationally Determined Contributions (2020). With such an increase in electricity generation it is hoped that electric cooking proliferates in order that power demand keep up with supply.

Electric cooking offers the benefits of efficiency, convenience, affordability, safety and availability. Unlike firewood, electric cooking does not produce smoke and so indoor air quality is not affected. The convenience of e-cookers is unmatched. For example, cleaning e-cookers is incredibly simple, and features such as automatic off, keep warm, pre-set cooking, and delay cooking add flexibility during cooking.

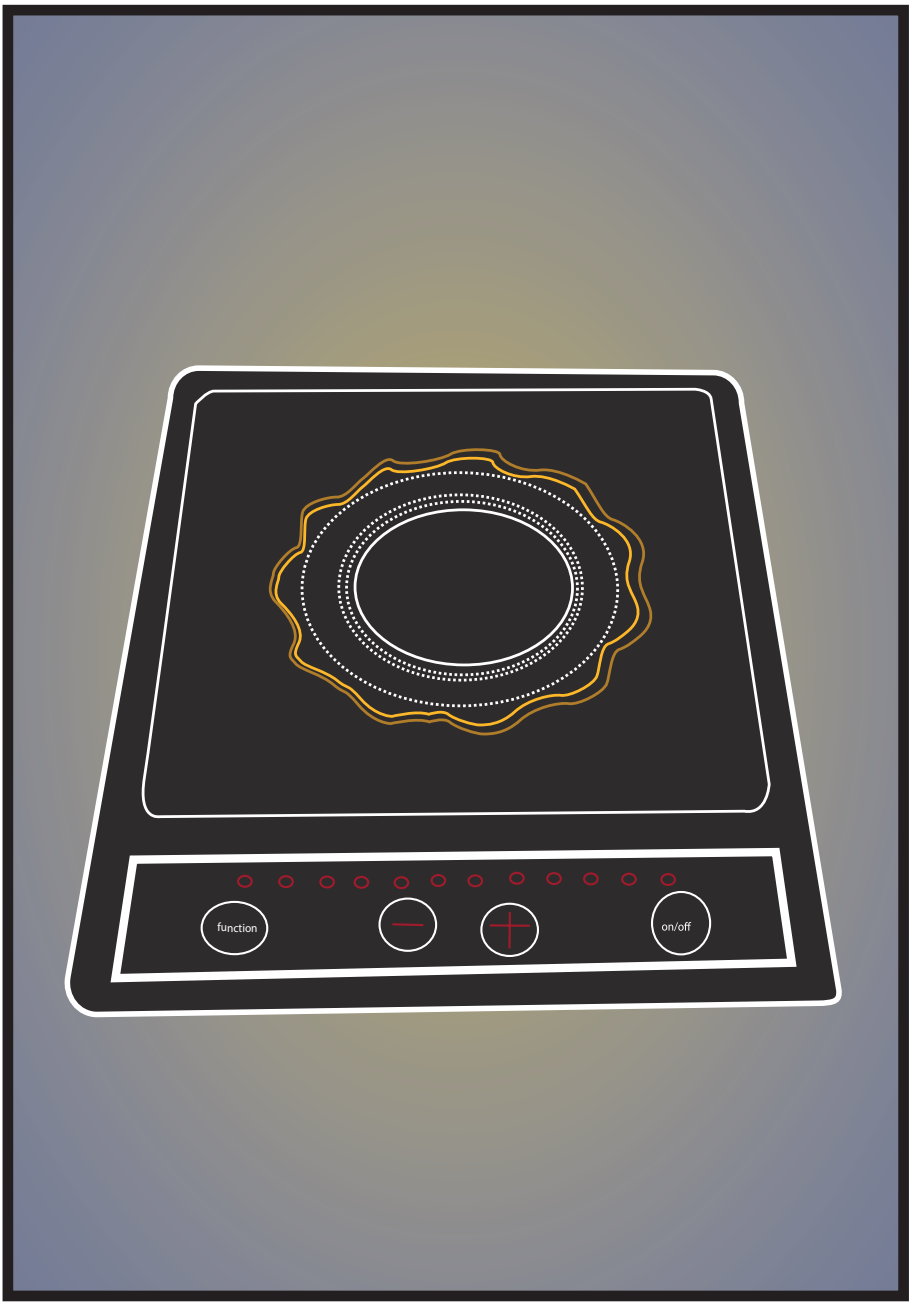
There are a variety of electric cooking devices available in Nepalese market which include the following:

- Induction Stoves
- Electric Pressure Cooker
- Electric Ovens
- Hot Plates
- Microwave Oven
- Electric and Gas Hobs
- Roti Maker
- Infrared Stoves
- Rice Cooker
- Slow Cooker
- Electric Frying Pan
- Air fryer
- Electric Kettle

Figure 2: Electric cooking appliances used in Nepal

PRIMARY USE ELECTRIC STOVES

To be used as a primary cooking stove, cooking devices must be able to cook at least 50% of commonly prepared local dishes. In the Nepalese market there are three common devices that meet this standard. They are the induction stove, infrared stove, and electric pressure cooker, all to be discussed in more detail within this section.



INDUCTION

Induction stoves heat a cooking vessel using magnetic induction instead of the traditional method of thermal conduction using a flame or electrical heating element. Electromagnetic induction acts directly on the pot, causing the pot itself to heat up to achieve heating of food. Only specific types of cooking pots respond to induction heating, limiting flexibility of these types of stoves.

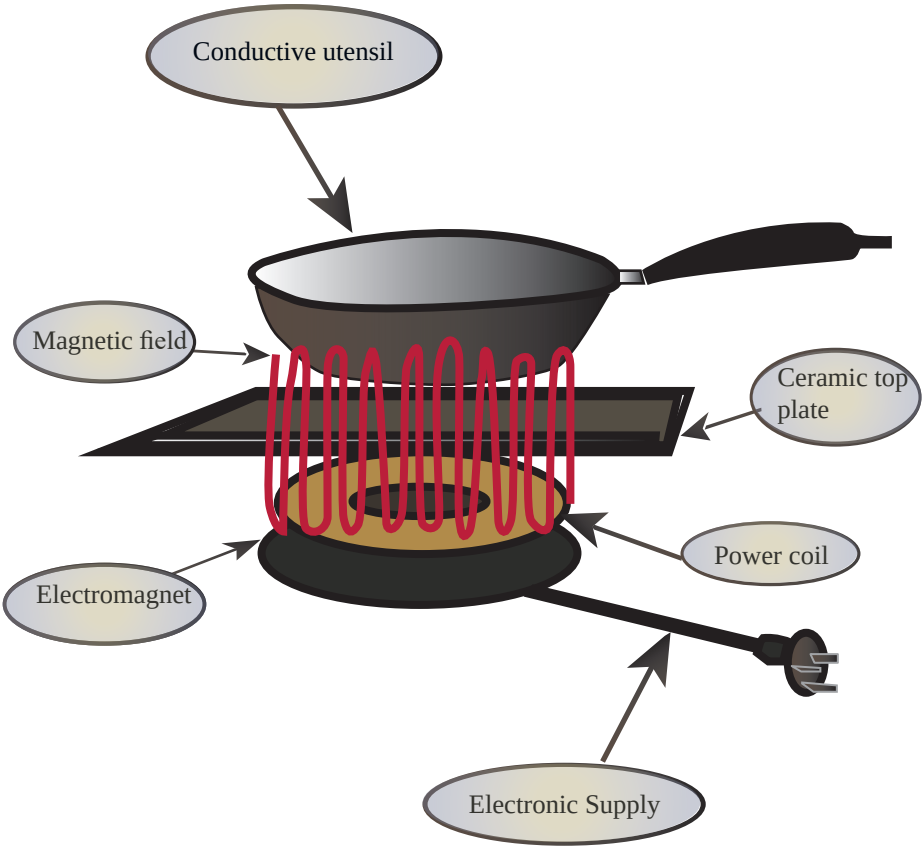
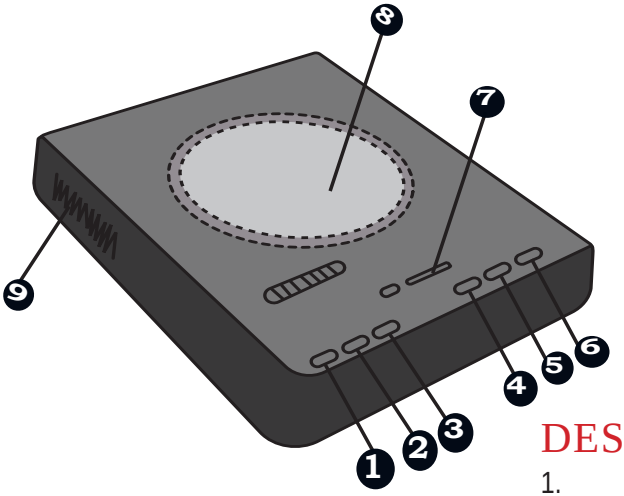


Figure 3: Diagrammatic view of induction stove

INFRARED COOKER

Infrared cook stoves use electrically heated coils to emit radiant heat, which is the same heat transfer mechanism used in traditional cooking methods. The benefit of using infrared cookers is that any type of cooking pot can be used, unlike induction cookers, provided that they have a flat base.

PARTS OF INFRARED COOKER



DESCRIPTION

1. Timer
2. Lock
3. Decrease Temp
4. Increase Temp
5. Function
6. On/Off
7. High Temp indicator
8. Cooking Area
9. Air Vent

Figure 4: Parts of Infrared stove

ELECTRIC PRESSURE COOKER

TECHNOLOGY DESCRIPTION

An electric pressure cooker is often called a multi cooker because it can perform multiple cooking operations: frying, boiling, steaming, pressure cooking and baking. Electric pressure cookers are comprised of three main components:

- The inner pot
- The cooker base
- The lid

THE INNER POT

The inner pot is a removable vessel. When heated, the liquid inside the inner pot boils and turns into steam. Without an escape route, the build-up of steam creates pressure. The pot material is normally made of food grade stainless steel and three-ply base with an aluminium core for even heat distribution.

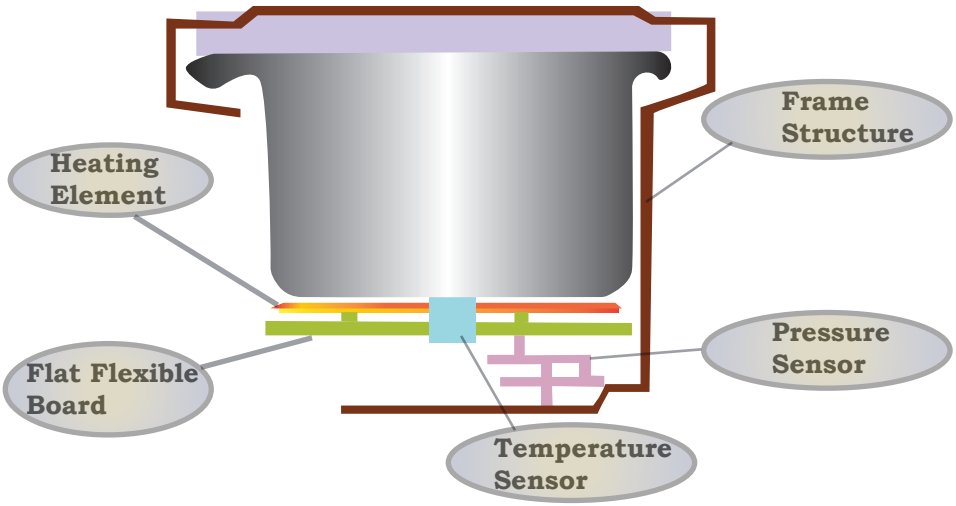
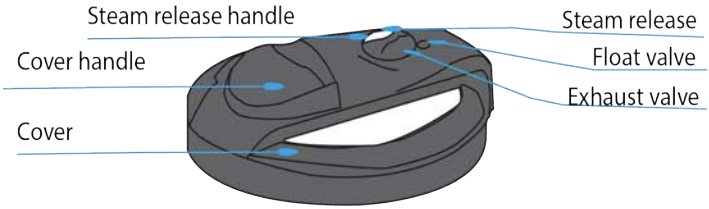
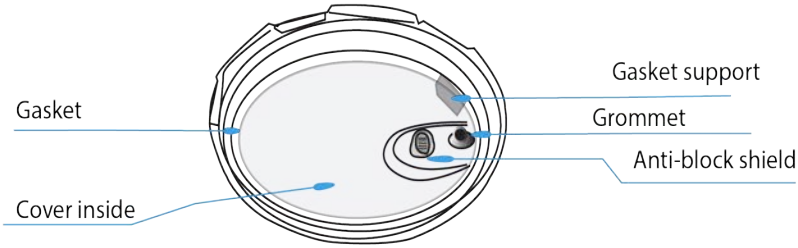


Figure 5: Structure of EPC





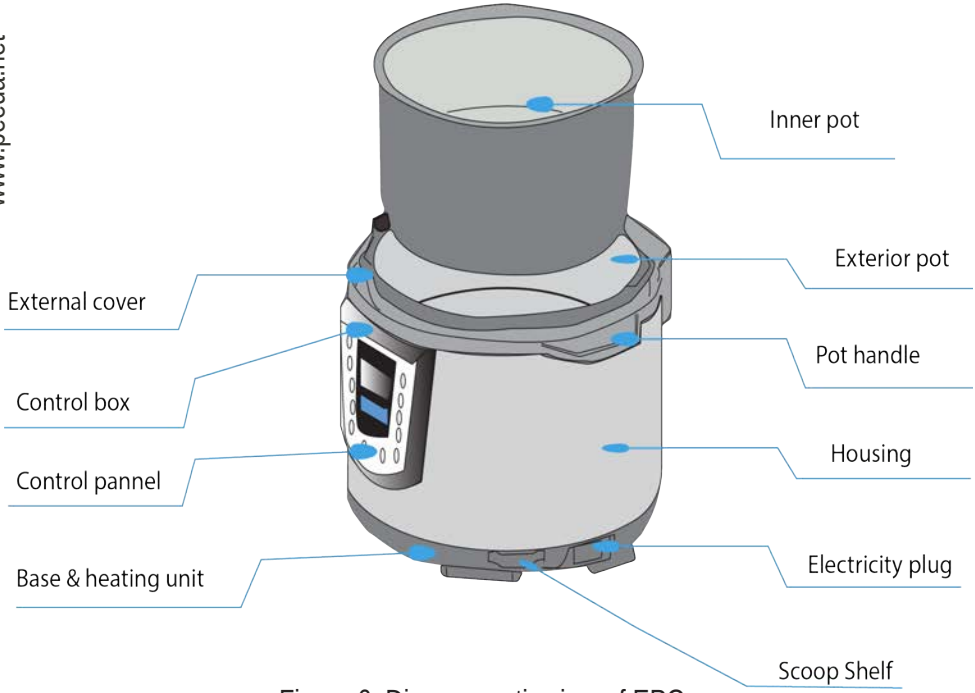


Figure 6: Diagrammatic view of EPC

THE COOKER BASE

The cooker base houses include microprocessor, pressure and temperature sensors, a heating element, and the control panel. Microprocessors are the heart of the 3rd generation electric pressure cooker - these work with built-in sensors to monitor and automatically regulate the cooker's pressure & temperature based on the cooking program selected.

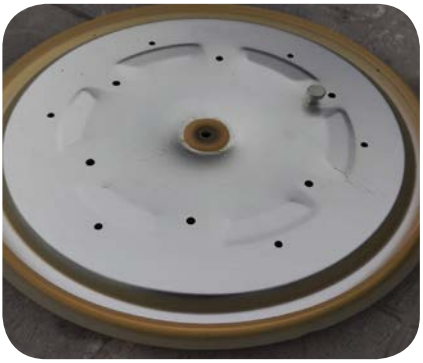
THE LID:

EPC lids are normally made of strong 201 food grade stainless steel and use steel braces as well as a lid locking mechanism to prevent the lid from being opened while the cooker is pressurized. If the lid is not fully closed, the microprocessor detects this and will cut power to the heating element.

Other Features:

- Steam Release: Although these differ in appearance across models, the steam release has two positions—"venting", which allows steam to escape, and "sealed", which traps steam in the inner pot in order to build pressure. If pressure increases beyond the safe operating range, the excess steam will physically push up the steam release valve to release pressure.

- Sealing Ring: When the lid is closed and the steam release is set to the “sealed” position, the lid and the inner pot exert pressure on the sealing ring to create an airtight seal. The sealing ring is made from durable silicone rubber which allows pressure to safely build once heat is applied.



- Float Valve & Silicone Cap: When enough pressure builds up in the inner pot, the float valve is pushed up and the silicone cap fully seals the cooker. Once pushed up, the float valve serves as a latch lock and prevents the lid from turning, even when force is applied.

- Anti-Block Shield: This stainless-steel cover prevents food particles from clogging the steam release pipe, facilitating the steady release of steam when venting.

COOKER USAGE GUIDELINE

IR COOKER- THINGS TO REMEMBER

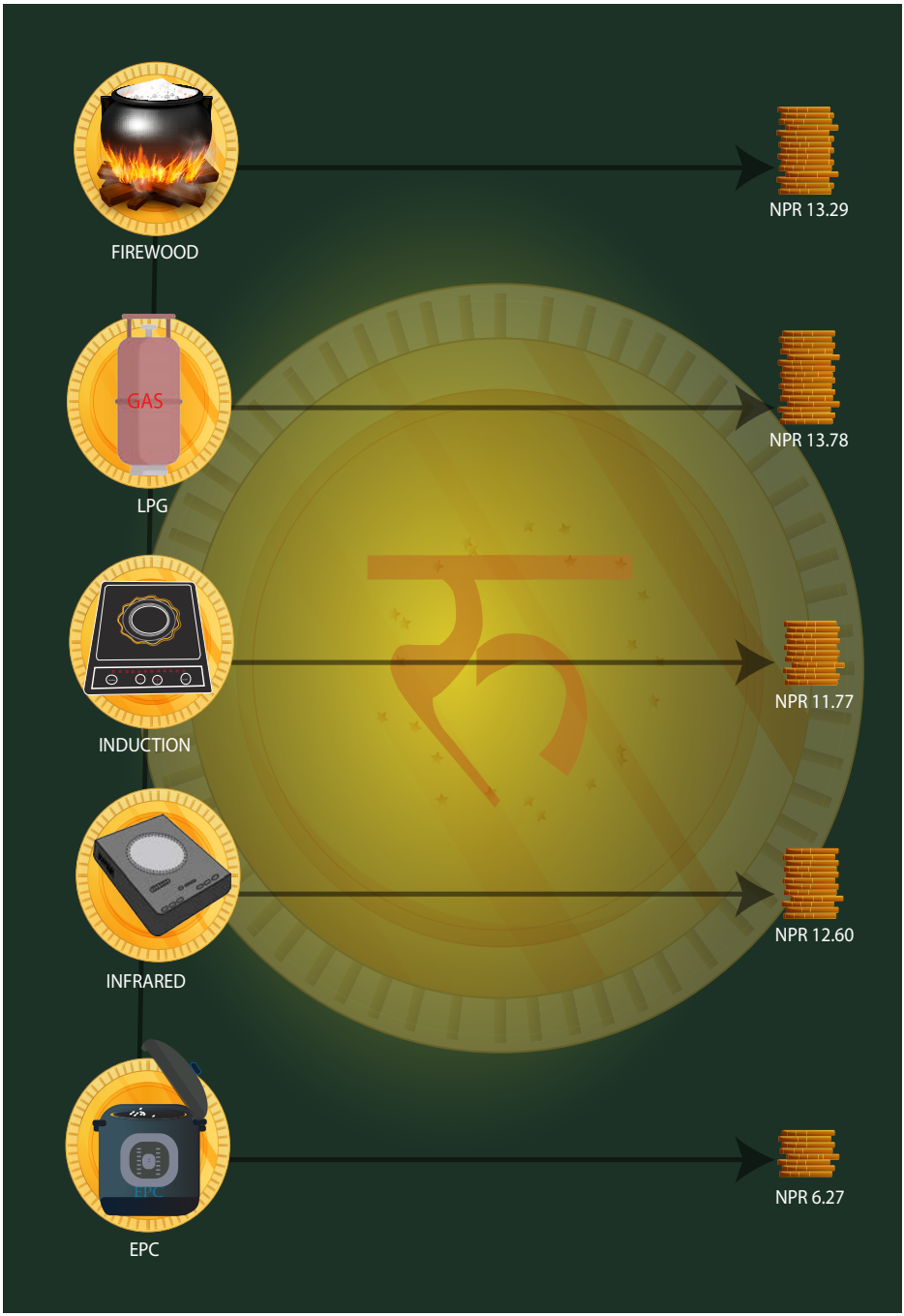
- Double touch the blinking signal to turn the cooker on.
- Lower the power immediately from 2,000W to 1,000W- as soon as the cooker is turned on as it draws heavy current in 2,000W mode (>8 amps).
- While boiling milk or tea it is recommended to cook using low heat to prevent spillage onto the glass top that can result into damage.
- While cooking chapati it is recommended to cook on low heat.
- Do not spill water or any other liquids.
- Clean the cooking surface with a damp cloth at the end of the use.
- Do not clean cooking pots with wire. Use a soft sponge for cleaning the pots if they are non-stick.
- The stove should be connected to a power source for 10 minutes after turning off the stove to release the residual heat from the fan.
- Don't keep the cooker ON if not cooking.

EPC- THINGS TO REMEMBER

- Clean the inner lid after use.
- Make sure that you never fill more than half of the pot with liquid.
- When using the quick release, push the valve upwards until the pressure is released. Remember to push the valve to closed position for next use.
- Make sure the lid is properly closed – listen for steam escaping as a sign of the lid not being fully closed.
- Use the correct amount of water, as EPCs require less water during cooking than other stoves.
- Frying takes a longer time and requires constant power. Food tastes good without the requirement of heavy pre–frying before pressurizing.
- Stirring is not possible during cooking time.
- Pressing the float valve to release the pressure might burn the hand from the hot steam so, one should be careful while depressurising.

INDUCTION - THINGS TO REMEMBER

- Automatic power turn-off achieved when cookware is removed.
- Power should be continuously supplied for at least 2 minutes after turning off the stove to release the residual heat out from the fan.
- Induction cooker will show error if the cookware is not ferro-magnetic or if the size of the pot is smaller than the size required for the product.
- Child lock feature is also available.



COST OF COOKING IN DIFFERENT STOVES

A variety of stoves can be used to cook Nepalese dishes. However, the cost incurred to cook the same food differs across stove types due to varying prices of fuel. The cost depends on the stoves performance, heat efficiency, the calorific value of fuel, price, and amount of fuel consumption. For this data,PEEDA conducted Control Cooking Tests (CCTs) on five cooking stoves: an electric pressure cooker (EPC), induction stove, infrared stove, traditional firewood stove, and an LPG stove. PEEDA performed CCT in August-November 2020. The same cook with same cooking techniques and same final cooked food condition was used to cook rice, daal & meat using each of the stoves.

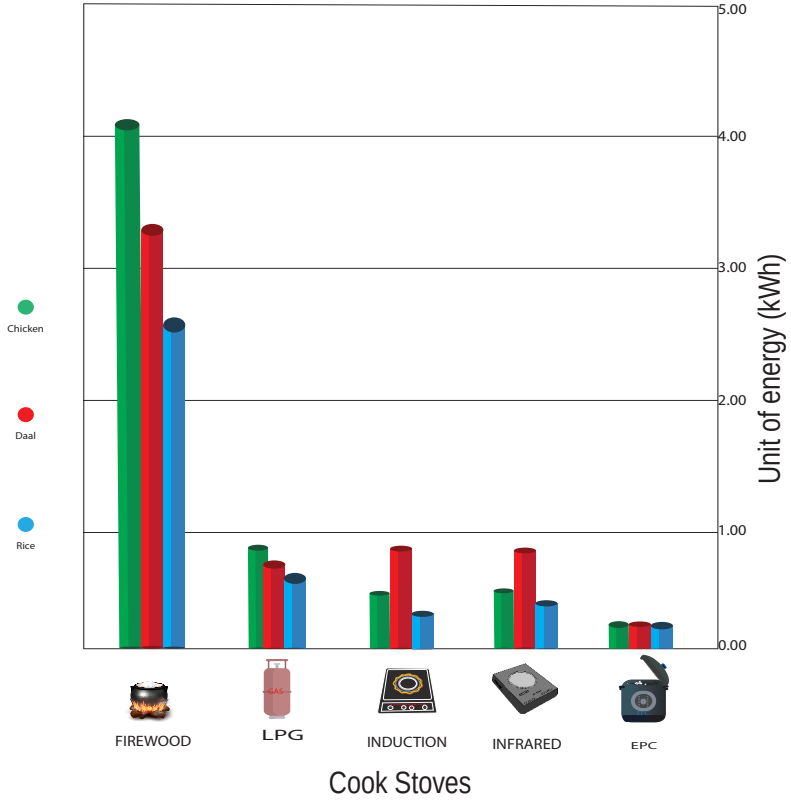


Figure 7: Energy consumption of different cookstoves (in kWh)

For electric cookers, an energy meter was used to measure electric consumption. The equivalent electric consumption has been reported using a calorific value for LPG and firewood.

Being the most inefficient, the firewood stove consumed the highest fuel compared to other cook stoves, whereas the EPC has the least consumption. Except for fuelwood, the energy consumption is less than one kWh (1 unit) for all three dishes for all other stoves.

TIME TAKEN

Total cooking time is calculated from the point that the electric devices were switched to ON and the LPG stove/firewood was lit, and measured until the time that the dishes were fully cooked and removed from the stove.

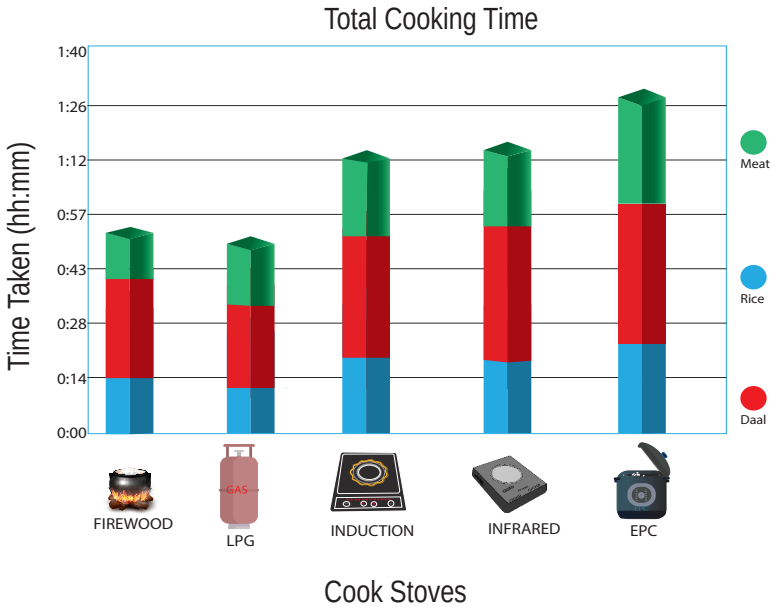


Figure 8: Time taken to cook three dishes in different cookstoves (in hh: mm)

The same pressure cooker was used for cooking in firewood, LPG, induction, and infrared stove to compare the cooking time for three dishes. The Urban EPC has a peak load of 960W. So, to mimic similar working both infrared and induction stoves were used in 1,000W modes. For the LPG stove & firewood there was no restriction i.e. LPG knob fully on and firewood stove fully stacked.

Based on the CCT calculation, cooking using the LPG stove is faster than other stoves provided that the electric stoves run in their 1,000W power mode. The shortest cooking time for the three dishes was 48 minutes using LPG with the longest time being the EPC at 1 hour 30 minutes. All cooking was done using pressurized cookers which decreases the cooking period. Cooking using the EPC is still faster than cooking in an open or non-pressurized cookers. Also, in the 2,000W mode, IR stoves can cook in a similar time as the LPG stove. Cooking in firewood (54 minutes) is also faster than induction, infrared, or EPC which depends on the size of firewood stove used and the amount of firewood used.

COOKING COST

PEEDA observed the varying price for the different meals in the different stoves. The detailed price of cooking for rice, daal, and meat in tested stoves is given below:

Table 1: Cost of dishes in different stoves

	Rice	Daal	Meat	Total(NPR)
LPG	3.36	6.09	4.34	13.78
Infrared	3	6.07	3.53	12.60
Induction	2.47	5.93	3.37	11.77
EPC	2.07	2.13	2.07	6.27
Firewood	3.44	4.41	5.45	13.29

Cooking with EPC is found to be the most cost-effective. The total cooking cost observed in EPC during CCT was NPR 6.27 for a family of five people. The cost of cooking in other stoves is around twice expensive as EPC. Meanwhile, the cost in Induction and Infrared was found to be cheaper than the firewood and LPG stove. The fuel price of the LPG is high in Nepal as it is imported. Hence, cooking using an LPG stove is a costlier option.

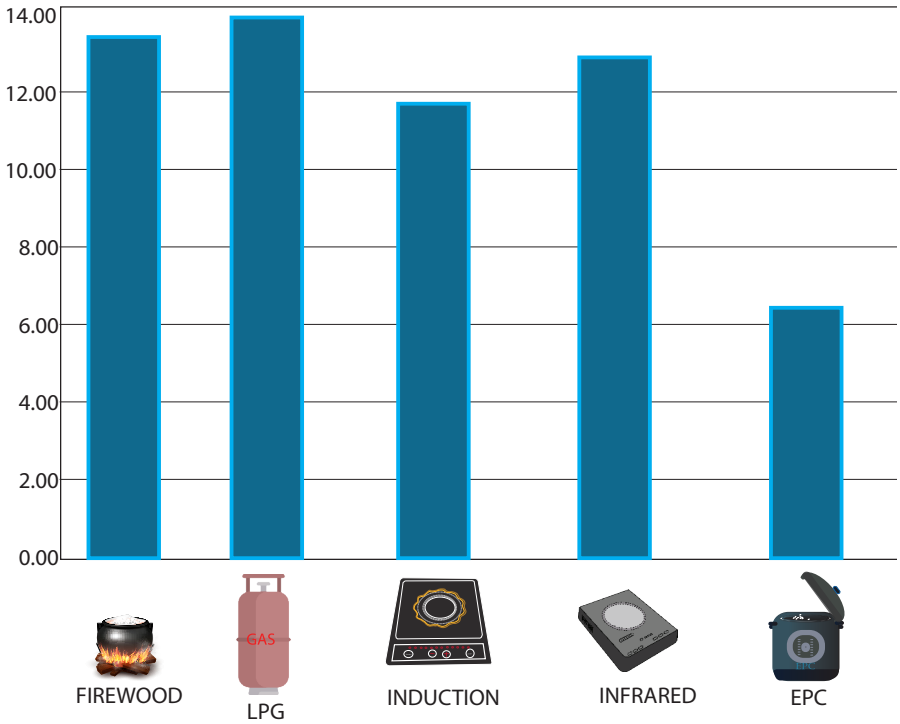


Figure 9: Total cooking cost in different stoves (in NPR)

Electricity cost = NPR 10 per unit

LPG cost = NPR 1440 per cylinder

Firewood cost = NPR 6.3 per kg (refer www.peeda.net for detail information)

COMPARISON OF INDUCTION VS. INFRARED VS. EPC

PARAMETER	INDUCTION HOB
Multiple Cooking Techniques	Steaming, stewing, stir frying, sautéing, baking and other cooking practices
Can be primary cooking stove?	Yes
Cost of Technology in Nepal	NPR 3,000 – 10,000
Requirement of special cook- ware	Only ferromagnetic cook pots can be used with flat base
Additional Cookware cost	Yes
Energy Savings	Hot Start Efficiency of 75- 80%
User Modes	Cooking modes vary from 100W to 2000W.
Max. Temperature	Maximum Temperature of 270 degree Celsius can be reached for Bajaj Induction

INFRARED HOB	EPC
Steaming, stewing, stir frying, sautéing, baking and other cooking practices including grilling	Baking, shallow fry, boiling, stewing and steaming
Yes	Yes
NPR 3,500 – 9,000	NPR 6,000 – 20,000
Flat base is preferable for higher working efficiency but not compulsory	Cooking pot is available within the EPC set
None	None
Hot Start Efficiency of 70%.	Hot Start Efficiency of 82% to 90%
Cooking modes vary from 200W to 2000W	No heat manipulation modes. Cooking modes of rice, daal/ soup, meat, beans, steaming, frying, keep warm and DIY modes are present
Temperatures can reach higher than 600 degrees Celsius	In most Nepalese models the maximum temperature that an EPC can reach is about 160-200 degrees Celsius

PARAMETER	INDUCTION HOB
Response Time of the stoves	Quick to respond to because no heating element is present
Residual Heat (Loss)	Residual heat generated is low
Effect of radiations in food	Visible light, laser, infrared, microwaves and radio waves are non-ionizing. So, there is no damage to food
Heat Loss in cooking pot	Cooking pots are sources of heat loss as household pressure cookers and pans are not insulated
Safety features	Automatic shut down when no cooking pot is placed. No scalding (heat burns) from touching the cook top
Requirement of supervision during cooking time	No automatic functions so supervision is required

INFRARED HOB	EPC
Heating element first needs to cool down to decrease temperature therefore response is slower	Users cannot turn the temperature up/ down for EPCs as such quick response features are absent. But the thin and well-insulated body of EPC makes it more responsive to user commands
Residual heat generated is maximum	Automatic Keep Warm features are present in EPC that uses the residual heat generated for keeping the food warm till it is served
Infrared rays are non-ionizing and so food is not radioactive to be harmful	Heat waves are non-ionizing and it does not harm the food
Cooking pots are sources of heat loss as they are not insulated	The cooking pot is kept inside an insulated chamber so there is negligible heat loss while cooking
Heavy heat burns or scalding can result from touching the heated stove top	Many safety features including float valve, silicone ring, thermal fuse & insulated lid with anti-food block shield
No automatic functions so supervision is required	Presence of fix buttons so no supervision or monitoring required

This information is based on Bajaj Induction Stove (SPLENDID 740075), Electron e Touch Infrared Stove (Serial no : BET2020050604) and Urban EPC (Model No : HD60 – 100N).

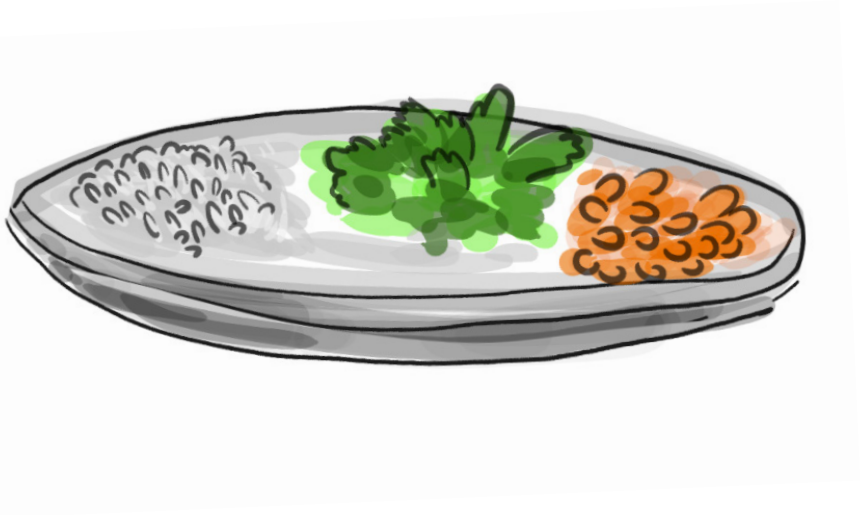
PERFORMANCE OF EPC

www.peeda.net

In terms of power rating, AC electric pressure cookers tend to range from 700W to 1,200W, with the capacity of a pot usually being the key determinant of its power rating. Lower power models may be more desirable for mini grids where peak loading may be an issue.

EPCs are highly efficient cooktops as it consumes low energy. EPC's insulating body reduces heat loss, increases efficiency, and keeps food warm for a long time. Although it's multifunction, some dishes which require deep frying are not possible in EPC. The dishes like chapati and pancakes can be cooked in the EPC, but tossing and cooking both sides is a challenge. However, compared with electric hotplates, EPCs can reduce energy demand by 80 percent for "heavy foods that require boiling for more than an hour) and by 50 percent across the entire range of foods that they are able to cook. For these reasons EPCs are judged the most suitable electric cooking appliance for widespread adoption within Nepal.

EPC RECIPES



DISH NAME : RICE

The following recipe serves five persons

PRE-COOK

Soak the rice for 10 minutes before cooking.

INGREDIENTS

Rice 710 gm or 5 cups
1040gm (1liter) water or as required

COOKING PROCEDURE

- Rinse rice with water and place it into a pot of EPC.
- Add the required amount of water into a pot and close the lid of EPC.
- Press the 'rice' button. (You will see P12 displayed in the display as the indication of cooking)
- Check if the weighted valve of the lid is sealed or not. If not, adjust the valve to a sealed position.

- The rice should cook in 25 minutes (pre-heat +cooking time). The pre-heat time depends on the quantity of rice and the volume of water added to the EPC. But normally it takes about 10-15 minutes and cooking time is 12 minutes for rice.
- After the timer stops, release the pressure.
- For best results, let the pressure release naturally instead of quick pressure release, which takes about 10-15 minutes.
- Remove the lid.
- Serve the rice.

DISH NAME : DAAL

The following recipe serves five persons

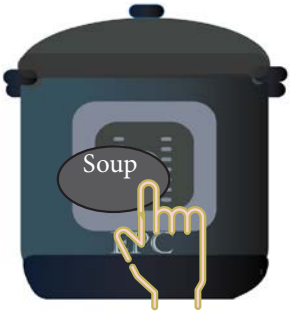
PRE-COOK

Wash and soak the daal for 10 -20 minutes before cooking

INGREDIENTS

Black daal (175gm)
Water(1.2 litres or as required)
Salt(as per required)
Turmeric powder ½ tbsp
EPC mode P25(Soup mode)

Red daal(175gm)
Water(1.2 litres or as required)
Salt (as per required)
Turmeric powder ½ tbsp
EPC mode P12(Rice mode)



COOKING PROCEDURE

BLACK DAAL

- Place the soaked daal and water in EPC with all the seasonings.
- Close EPC lid.
- Turn the EPC on.
- Press the soup button. As per the type of daal, adjust the time using the DIY button if required. (Note: The whole daal needed a longer time to cook)
- After 30 minutes, the daal is cooked.
- Open the lid after the natural pressure release and serve the daal.

RED DAAL

- Follow the same procedure as of black daal. But press the rice button instead of the soup button.

Turmeric powder ½ tbsp

Salt as per required

DISH NAME : CHICKEN GRAVY

The following recipe serves five persons

PRE-COOK

Marinate chicken with listed seasoning for 30 minutes (2-3 tbsp oil, salt, turmeric powder, cumin powder, meat masala, chilli powder, garlic ginger paste)

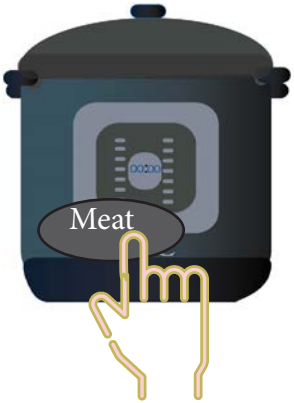
INGREDIENTS

Chicken (850gm)
Onion (100gm)
Tomato (180gm)
Salt (as per required)
Cumin power (2 tbsp)
Turmeric power(½ tbsp)
Meat masala (1½ tbsp)
Chilli powder(½ tbsp)
Cooking oil (6 tbsp)
Garlic ginger paste (1 tbsp)
Water (as per required)

COOKING PROCEDURE

- Turn the EPC on and press the Fry Mode.
- Heat 6 tbsp. oil in EPC.
- Fry the onions till they caramelize.
- Add meat.
- Mix chicken and onion properly for a few minutes and add tomatoes.
- Finish frying procedure in 8 minutes for energy-efficient cooking.
- Add required water and close the lid.
- Press on the meat button to cook chicken.

- Chicken will be ready in about 30 minutes.
- Open the lid with quick pressure release.
- Serve the Chicken gravy.

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DISH NAME : RED KIDNEY BEANS

The following recipe serves five persons

PRE-COOK

Soak the beans overnight or
Use hot water to soak beans
for 20-30 mins

INGREDIENTS

Red kidney beans (500gm)
Onion (100gm)
Tomato (180gm)
Water (1liter)
Salt (as per required)
Turmeric (½ tbsp)
Cumin (1 tbsp)
Garam masala (1 tbsp)
Oil (5 teaspoon)
Garlic ginger paste (1 tbsp)

COOKING PROCEDURE

- Turn EPC ON and press the soup button or beans button whichever is present in your EPC.
- Heat oil in the pot
- Add onion and stir till it caramelizes.

- Add beans and stir for 2-3 minutes
- Finally add the tomato and seasoning. Complete the frying by 8-10 minutes.
- Add Water.
- Then keep the lid and pressurize.
- After the timer stops open the EPC lid with natural pressure release.
- Press the beans with a spatula to form a gravy.
- Serve the beans


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ABOUT PEEDA

People, Energy & Environment Development Association (PEEDA) is an NGO established in 1997 for the enhancement of the renewable energy sector in Nepal. PEEDA aims to mobilize local as well as external resources to harness the indigenous resources of the country and promote rural economic development. PEEDA focuses mainly on institutional development, participation with stakeholders at the grass root level in development activities, research, and lobbying for policy change.

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