



**HOUSEHOLD BIOGAS UNIT:
A CLIMATE MEASURE THAT
CONTRIBUTES TO HEALTH, WEALTH,
AND WOMEN EMPOWERMENT**

Executive summary

Biogas is a smokeless and cost-free cooking fuel that leads to cleaner air, better health, and more household wealth. When biogas units are installed in a home, women are freed from collecting the wood used in traditional stoves. Meals can also be prepared faster, enabling more work to be carried out in other areas and allowing for more time with family members. These benefits are being felt every day by 40,000 households in India – spread across Maharashtra, Karnataka – that have replaced their wood-burning stoves with biogas units, thanks to the work of implementation partners being supported by the Infosys Foundation.

Positive impact on 40,000 households across 12 districts, 2,795 villages. About 2,40,000 tCO₂e emission reduction

The need for biogas stems from a depressing statistic: Each year, there are approximately 600,000 premature deaths in India stemming from exposure to household air pollution. Most of this pollution is generated by wood-burning stoves, which expose people in households – particularly women – to harmful toxins that contribute to multiple health challenges. The smoke emitted from the stoves also triggers the creation of carbon dioxide and methane, both of which are key contributors to climate change.

Homes throughout the country typically show little or no evidence of the smoke, as household members – typically women – regularly scrub the walls to remove the accumulated soot. This takes time and money (to pay for the cleaning solutions), both of which are often in short supply in these homes. It's labor-intensive work and it means additional exposure to the toxins in the soot.

To better understand the impact of biogas units, we traveled to Jambhadapani, a village in the Bhandara District of Maharashtra. It is about 70 kms east of Nagpur and getting there involves driving through a series of small towns and eventually transitioning to unpaved roads. The village is composed of about 100 households, all of whom are engaged in farming, growing paddy.

When we arrived, on a mid-November morning, a few days after Diwali, we were taken to the center of Jambhadapani. Soon, 10 women from the village joined us, as well as a few men, and one young girl. With cows nearby, and goats bleating in the background, the women talked to us for 30 minutes about how daily life has improved since their wood-burning stoves were replaced by biogas units.

Mira is a lifelong resident of Jambhadapani. Like many women in rural India, her daily responsibilities have always included cooking for family members on a wood-burning stove. As a result, she and five other family members have been subjected to harmful toxins emitted by the smoke. Another responsibility has been to hunt around the village each day for firewood to heat the stove. Cooking and collecting wood would take her at least two hours per day.

For some of her cooking, she's used liquefied petroleum gas (LPG), drawn from government-subsidized cylinders. But these cylinders are typically insufficient to sustain the household, forcing them to spend up to 9,000 rupees each year on their own supply.

In 2021, everything changed – for the better. A grant from the Infosys Foundation enabled Mira's household, and others in Jambhadapani, to stop relying on LPG, and replace their wood-burning stoves with a stove powered by a renewable energy source known as biogas.

Today, Mira is no longer collecting wood – nor cooking with it, which means she is no longer being exposed to harmful toxins. And she's not using LPG, which means a sharp increase in household savings. With the extra time, she can give more attention to the household's paddy crops, which is helping to increase yields and bring in more income. And she's using the biogas unit not just to cook, but to heat up water for bathing.

Mira's household, like all others receiving biogas units through Infosys Foundation grants, can keep them indefinitely. But to gauge the value Mira assigns to the unit, we asked her how she would react if the biogas unit was going to be removed from her household. She frowned and said, defiantly, that she wouldn't allow it to happen. And if the unit broke and couldn't be fixed? "We would build our own replacement."

Mira's reaction speaks of the transformative impact of biogas units. They are helping the recipients realize better health and more wealth, while also contributing to women empowerment and a cleaner environment.



Biogas stove.

The indoor air pollution challenge

More than half of all households in India rely on wood-burning stoves to prepare their meals.¹ But these stoves are a major health hazard. As a lung health advocacy group points out,

*The smoke from wood-burning devices . . . contains fine particle pollution, and hazardous air pollutants such as carbon monoxide, volatile organic compounds, nitrogen oxides, benzene and formaldehyde. Particle pollution is especially dangerous because these tiny particles can get deep into the organs, harming not just the lungs, but also blood vessels, the heart and brain. Wood smoke can cause coughing, wheezing and asthma attacks, and lead to serious health issues, such as heart attacks, stroke and premature death.*²

These health threats are magnified in India, given that smoke from indoor stoves can penetrate every room in the small homes that are typical across the country's rural areas. This put children, adults, and elders at risk.

In 2019, approximately 600,000 premature deaths in India stemmed from exposure to household air pollution (6.5 percent of all deaths in India

that year), according to a study published in *The Lancet*, a medical journal.³ This pollution, say the study authors, "is caused mainly by the use of solid fuels for cooking, such as wood, dung, agricultural residues, coal, and charcoal."

There can be severe health consequences for those who have prolonged exposure to indoor pollution. A pulmonologist based in Nagpur has observed that in the previous decade, half of the patients he's seen with chronic obstructive pulmonary disease have been non-smokers:

*It is mostly caused due to indoor pollution in slums in and around the cities, where firewood is burnt for cooking inside a house without much ventilation. Women are disproportionately affected because they are the ones cooking for the family.*⁴

One resident with whom we spoke recalled how the smoke from a wood-burning stove would cause eye watering and excessive coughing.



1 <https://en.gaonconnection.com/cooking-gas-lpg-firewood-ujjwala-scheme-rural-india-women-health-risks-air-pollution/>

2 <https://www.lung.org/blog/wood-burning-stoves-and-heaters>

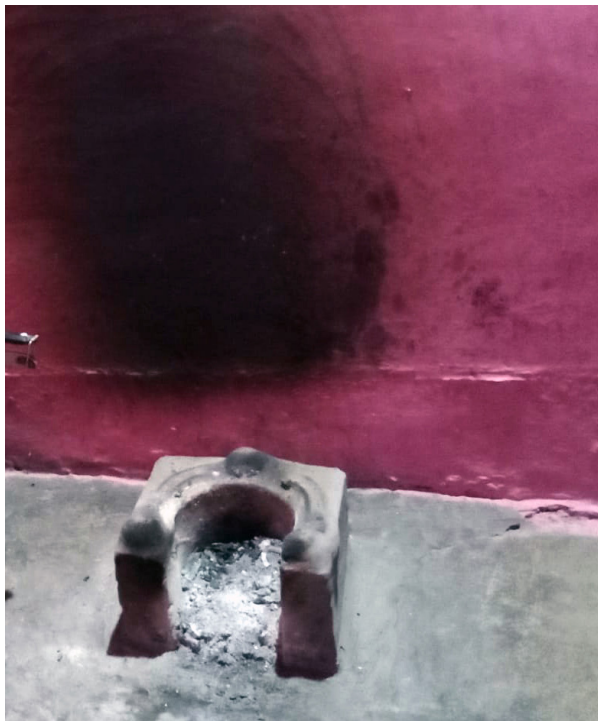
3 [https://www.thelancet.com/journals/lanph/article/PIIS2542-5196\(20\)30298-9/fulltext](https://www.thelancet.com/journals/lanph/article/PIIS2542-5196(20)30298-9/fulltext)

4 <https://ruralindiaonline.org/en/articles/in-the-chokehold-of-a-wood-fired-stove/>

Women bear a double burden. In addition to having the most prolonged exposure to indoor air pollution, they also tend to be responsible for finding the wood that will be burned in the stoves. This physically taxing work can consume 1-2 hours, daily, and often leaves women vulnerable to animal attacks as they venture into forested areas.

There is also a broader environmental challenge presented by wood-burning stoves: the smoke generated by the burning of wood triggers the creation of carbon dioxide and methane, both of which are key contributors to climate change. As the United Nations points out:

*Household combustion emits more than half of all global black carbon emissions, a major component of fine particulate matter. Black carbon also has a per-unit warming capacity 460 – 1,500 times greater than that of carbon dioxide making it one of the largest contributors to climate change after carbon dioxide. When they interact with outdoor air pollutants, household combustion emissions contribute to the formation of ground level ozone – a short-lived climate pollutant that decreases crop yields and affects local weather patterns.*⁵



Soot deposited on the wall.

The Infosys Foundation's focus on replacing wood-burning stoves with biogas units which advances health, wealth, women empowerment, and environmental protection. These achievements are directly aligned with our mission of expanding opportunity while also enabling a more equitable society, particularly in India's remote regions.

We have chosen to support the NGOs that identify biogas beneficiaries, and install the units, because these projects have a long track record of facilitating progress – in India and in other parts of the world. (One of the implementation partners with whom we work has installed biogas units in 12 other countries, spread across Africa and Latin America.) And the concept of using biogas to promote societal development has been endorsed by multilateral institutions such as the United Nations.⁶

The biogas initiative can also be scaled throughout the country. It depends on having access to cattle, which are plentiful in India – there were nearly 200 million as of 2019.⁷ The key materials, such as the digester, are relatively low cost and can be delivered and installed easily and affordably. The units are also reliable and safe.

India's households have also shown that they are willing to modify their cooking habits. The number of people in India primarily cooking with LPG increased by nearly 300 million from 2015 to 2022, according to a recent report by the International Agency.⁸ But LPG is not a perfect solution, as noted elsewhere in this paper. And wood-burning stoves are still prevalent throughout India, where about two-thirds of the population lives in rural areas, spread across more than 600,000 villages.⁹

The biogas project can serve as a force multiplier – with cleaner air leading to better health and more wealth, while also empowering women to discover new opportunities. Enabling those changes throughout the country can be a catalyst for sweeping progress throughout India, with people enjoying higher living standards and longer, healthier, happier lives.

⁵ <https://www.unep.org/news-and-stories/story/seven-things-you-should-know-about-household-air-pollution>

⁶ <https://www.unep.org/news-and-stories/story/sustainable-bioenergy-use-clear-path-biodiversity-and-sustainable-economic>

⁷ <https://vikaspedia.in/agriculture/agri-directory/reports-and-policy-briefs/20th-livestock-census>

⁸ <https://iea.blob.core.windows.net/assets/75f59c60-c383-48ea-a3be-943a964232a0/AVisionforCleanCookingAccessforAll.pdf>

⁹ https://wiki.openstreetmap.org/wiki/Villages_in_India

Liquefied petroleum gas

Some states in India provides rural residents with 14 kg cylinders of liquefied petroleum gas (LPG), at no cost. The government in Maharashtra provides three cylinders per year. But many families report that they would need ten cylinders annually to meet all of their heating needs, and the cost of purchasing such cylinders would be prohibitive. (The price for a 14 kg cylinder, which would last for about 45 days, is 1,000 rupees.) There are also fears of not being able to obtain replacement cylinders. For those reasons, most households view firewood as the most reliable and affordable heating option.



Collection and use of wood.

Background on biogas units

The biogas advocates knew they would encounter obstacles as they tried to persuade rural Indian households to shift away from wood-burning stoves. The stoves had been in use for generations and there were stories of other replacements in the past either breaking down quickly or failing to provide adequate heat. Thus widespread adoption depended on providing a replacement that was simple, safer, healthier, reliable, and more cost-effective.

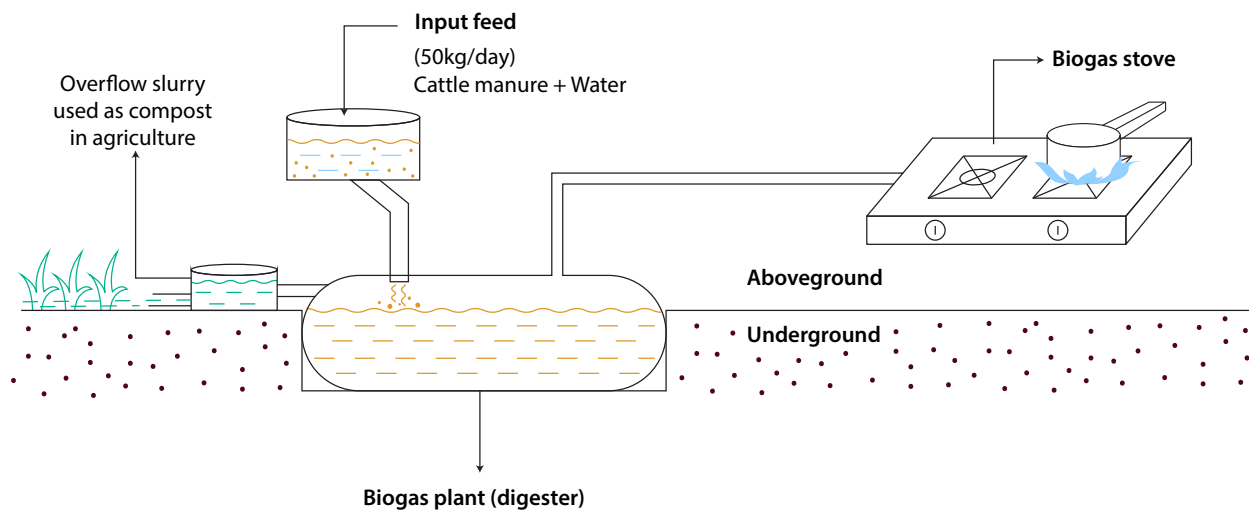
Biogas was a natural alternative. It is produced through a process called anaerobic digestion in which organic matter, such as food or animal waste, is broken down by microorganisms, in an oxygen-free setting. The process happens naturally, but it can be accelerated through so-called digestion plants, which have been in existence since the

first one in the world began operating in 1859, in Mumbai.¹⁰

For the present-day initiative, the biogas units generate heat through the processing of cow dung. Thus for the biogas units being proposed for individual households, they needed to have enough cattle to produce an adequate supply of cow dung to power the digester (sometimes described as a “mechanical stomach”). The digester synthesizes a mixture of cow dung and water – and the end product becomes the gas that’s used to heat up foods and liquids.

Once the unit is operational (see below), activating the gas involves nothing more than turning a knob on one’s stove.

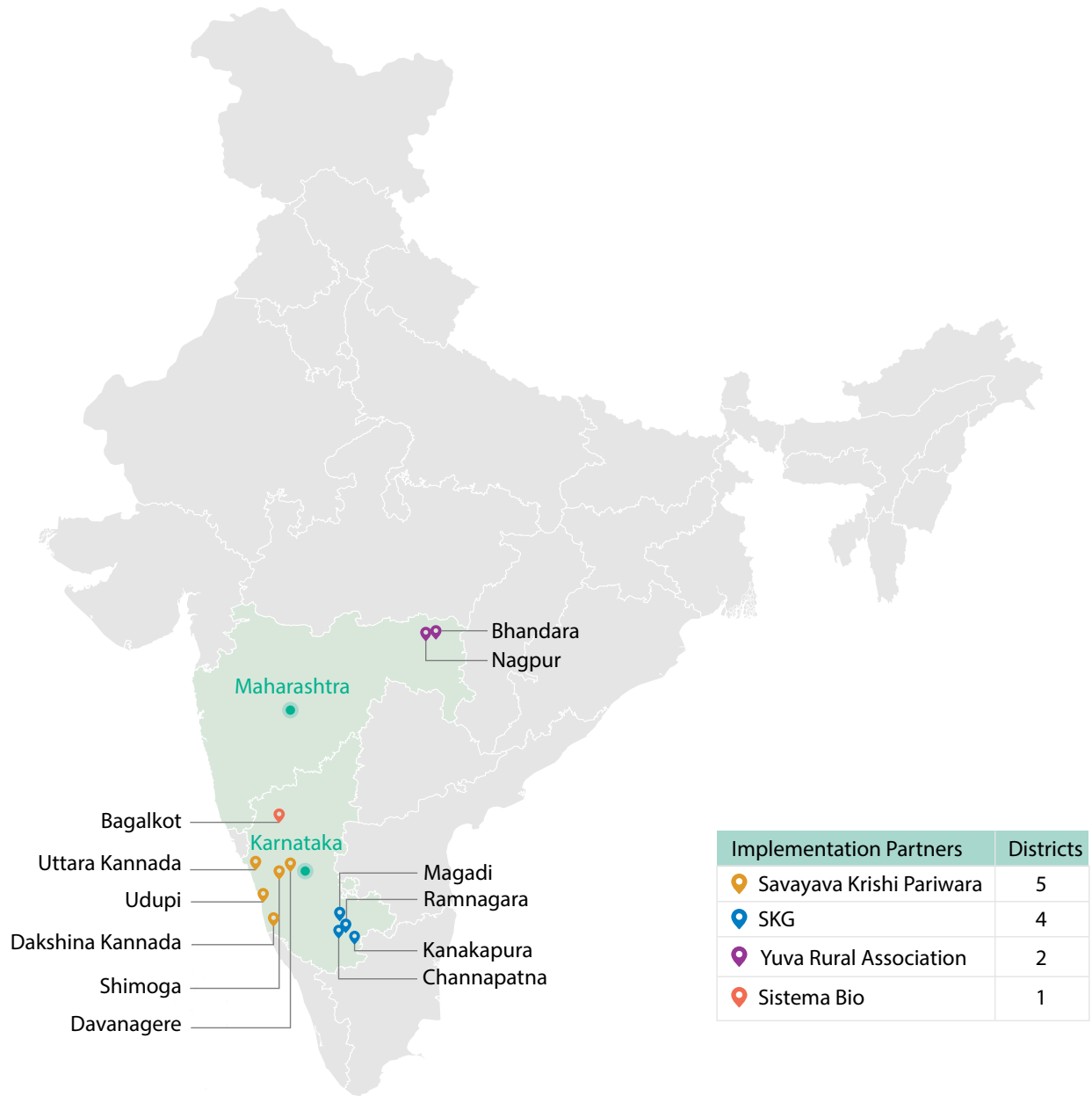
Biogas unit - Working model



¹⁰ <https://extension.psu.edu/a-short-history-of-anaerobic-digestion>



Biogas unit and stove for the Biogas at famers homes.



Source: Infosys

The implementation partners

The Infosys Foundation has given grants to four implementation partners (primarily NGOs) to fund the installation of biogas units in India: Together, the implementation partners have installed over 40,000 biogas units since 2016. What follows is a summary of the process used to identify potential beneficiaries and install biogas units.

Typically in a biogas project, the staff of the local NGO identify areas that could be recipients of the biogas units based on digital sensors showing areas with plenty of livestock. The selection criteria is typically a family with 3-4 cattle needed to produce the 50 kgs of daily dung needed to power the digester. The homes also needed to sit on enough land to accommodate the digester and the owner needed to be a small-scale farmer. The NGOs shortlist beneficiaries who would be able to maintain the unit if it needed repair or upkeep.

The NGOs also look for blocks where there could be large clusters of biogas units, figuring that demand for the units would grow once people living in these villages saw their neighbours benefiting from them. Once a block is approved, the field operators approach individual families about installing the units. Many of those conversations are with the women in households, and the NGOs have found

that there was often greater openness to (and acceptance of) the units when they were proposed by women field operators. (The field operator who has signed up the most homes for biogas units is a woman).

Once households agree to have a biogas unit installed, a pit must be dug that will serve as the home to the digester (and the cow dung inside it). Each beneficiary was encouraged to do the digging, so as to provide a sense of ownership for the units – a key provision encouraged by the Infosys Foundation.

Each pit needs to be large enough – about forty five square foot and three feet deep – to accommodate the 500-600 kg of dung needed to start the processing. Once that dung had been collected and the units were installed, biogas delivery would commence within 20-25 days.

All beneficiaries were required to sign an end user agreement, holding them responsible for the biogas and maintenance, with a pledge that the unit would be used for at least 5 years. And once a unit was installed, the field operators of the NGO would show each beneficiary how to operate the unit – and serve tea, using water heated by the new biogas unit.



Infosys foundation donated Biogas unit at a small scale farmers home.

The benefits of biogas

There are several benefits associated with household biogas units, the most immediate of which is the absence of household smoke. That means the individuals in each house – particularly the women – are no longer exposed to harmful toxins and much less vulnerable to respiratory issues and other health challenges.

With no need to collect firewood, those who do the collecting – typically women – can redirect their energies to other, more productive activities. They are also at reduced risk of harm from snakes and other predators that lurk in wooded areas.

Women also benefit by having more time outside the kitchen – time they can devote to other pursuits, from farming to education to childcare. And biogas units provide exposure to the everyday benefits of technology.

Without wood being burned there's no generation of carbon dioxide and methane. It's estimated that the use of each biogas unit translates to reduced carbon emissions totalling 8-10 tons, annually. Thus with about 40,000 biogas units installed across villages, an estimated 320,000 tons of CO₂e emissions are avoided annually. And preserving trees contributes to greater biodiversity, while also protecting habitats for tigers and other animals.

Another environmental benefit stems from the use of cow dung. Left untreated, it decomposes and releases methane, which is the second-most emitted greenhouse gas, after carbon dioxide. But the treatment of dung to create biogas sharply reduces methane emissions.

Safety is another benefit, since wood-burning stoves often trigger household fires. These fires

were responsible for more than 6,300 fatalities across India in 2019.¹¹

Water can also be heated more quickly. That's good for cooking – one mother mentions it as helping her get her child to school on time – but also bathing. One beneficiary we spoke with mentioned the long wait for a hot bath with a wood-burning stove. Asked how she and her family like being able to take a hot bath, she broke into a smile.



Biogas units also contribute to a circular economy. The residue from the digester, known as slurry, is rich in phosphate and can be used as fertilizer to irrigate fields. That allows families to reduce their spending on chemical fertilizers and pesticides, leaving them with more disposable income. And the quality of the slurry generated by the digester is such that there are some cases of it being sold to big farmers.

Families with biogas units also have increased savings as they are no longer dependent on LPG cylinders – translating to extra income of 6,000 rupees or more – and they have reduced household cleaning costs, since there's no need to scrub the soot that's generated by wood-burning stoves.

Finally, biogas units are also enabling the use of new cooking devices, such as pressure cookers, which wasn't possible with a wood-burning stove because it would quickly be covered with soot.

Positive impact on 11 UN SDGs

(United Nations Sustainable Development Goals)



11 <https://www.facebook.com/indianfireservices/photos/a.18713953977394/2665048860412054/?type=3>

How the savings are spent

The individuals and families interviewed by the Infosys Foundation emphasized that their biogas units have reduced their living expenses and allowed them to purchase new products and make investments in health and education.

One family said that not having to spend money on LPG cylinders has allowed them to spend more on education, health, and everyday household items, such as a water filter .

This family also bought a mixer/grinder, a fan, and a refrigerator They also used the savings to support their son's education expenses, such as transportation to the school, and visits to doctor .

Suma says she used the savings from biogas to buy a refrigerator, which her family uses to store fruits and vegetables, as well as milk and curd. She also used savings for the education of her two boys (who are now in college), health, and clothes.

One woman in the village outside Nagpur says she has used the money she was once devoting to LPG and started a saving scheme for her children. Another woman says she is reinvesting in her farm. Women also spoke about how the saving in time and money have allowed the girls of the village to go to school.



Biogas unit in a small scale farmers home.



Conclusion

The Infosys Foundation's focus on replacing wood-burning stoves with biogas units advances health, wealth, women empowerment, and environmental protection. These achievements are directly aligned with our mission of expanding opportunity while also enabling a more equitable society. We take pride in the progress our grants have unleashed and we will continue searching for similar initiatives that can help unlock human potential.

For more information, contact askus@infosys.com



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