



Avani Bio Energy

Transforming Uttarakhand's Pine Needle Problem into an Innovative Energy Solution

According to the India State of Forest Report 2017, India witnessed a 38% jump in forest fires between 2003 and 2016, an ever increasing and dangerous threat that can substantially impact India's chances of meeting the emission commitments set at the Paris Summit. A warming climate, degradation of forests, the inability of the soil to retain moisture and better reporting are all contributing factors to this considerable increase. India loses about INR 550 Crore every year due to the damages as a result of forest fires.

Primary commitments made by India at the Paris Climate Agreement in 2016

Reduce the emissions intensity of GDP by **33%–35%** by **2030** below **2005** levels

To increase the share of non-fossil-based energy resources to **40%** of installed electric power capacity by **2030**

To create an additional (cumulative) carbon sink through additional forest and tree cover by **2030**

In mountainous regions such as Uttarakhand, forest fires can be attributed in large part to pine needles. Of the total forest area in Uttarakhand; approximately 3,99,329 hectares is covered by the chir pine trees; the pine needles from which are highly inflammable due to the high resin content.

Seeking a solution to the problem and recognizing the potential of pine needles as a viable renewable energy source; Avani – an NGO based in Uttarakhand launched its' Bio Energy Programme which is an innovation in energy supply and sustainable livelihoods for the central Himalayan rural communities.

Pine Needle Gasification Technology

Avani believes that ecological conservation is a must for economic development, renewable energy generation is a very important aspect of this; and region specific small-scale ventures can provide clean and reliable homegrown electricity while also generating local economic opportunities.



The central component of Avani's Bio Energy Programme is the pine needle fuelled power station, the first of its kind globally. To power the station, Avani employs local men and women who gather and deliver the pine needles as raw materials, providing livelihood to the local communities while also reducing the risk of pine needles contributing to and aggravating forest fires. The raw material is then fed into a 10 kW or 28 kW biomass gasification plant that generates electricity, which is shared with the Uttarakhand electricity grid, powering local village households. The by-product of the process residue is good quality charcoal, which is briquetted to make cooking fuel for the local rural communities.

Avani began exploring Pine Needle Gasification as a viable renewable energy technology in 2006 and in 2009 piloted with a 9 kW pine needle power station on Avani's campus, which is now grid connected and also serves the energy needs of the entire campus in case of grid outage. With the aim to scale their innovation to the surrounding communities, Avani Bio Energy was established as an independent power company in 2012 and began setting up their first village level 120 kW commercial power plant in Chachret, Uttarakhand.

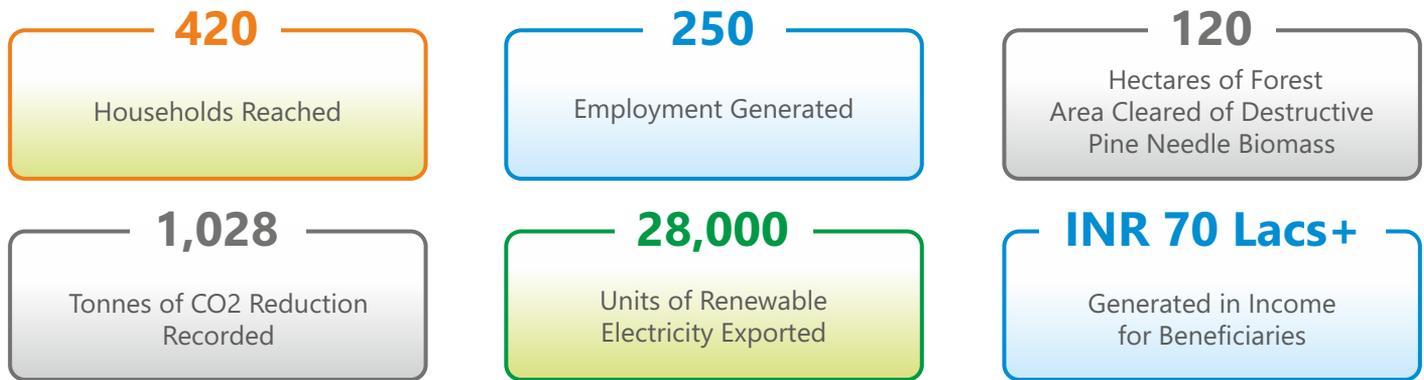
Based on the pilot, Avani received a Stage 2 grant amounting to INR 60,00,000 from the Millennium Alliance program in 2015-16 to set up 8 plants with a projected generating capacity of 500kW in the region by June 2019. The project is currently on target and all 8 projected plants are now up and running.

Location and Output Capacity of Avani's Plants*

S No.	Location	Plant Output (Kilowatt per hour)	Plant Output (Kilowatt per day) ⁴
1.	Bana	28 kW	140 kW
2.	Dwarahat	28 kW	140 kW
3.	Tripuradevi	10 kW	50 kW
4.	Simalta	10 kW	50 kW
5.	Dangigaon	10 kW	50 kW
6.	Bhetijer	10 kW	50 kW
7.	Seli	10 kW	50 kW
8.	Lingurani Chankana	10 kW	50 kW
Total Generating Capacity		106 kW/ hr	530 kW/day

*Per day estimate has been made basis average 5 hour work day in Uttarakhand (Ministry of Labour & Employment, GOI)

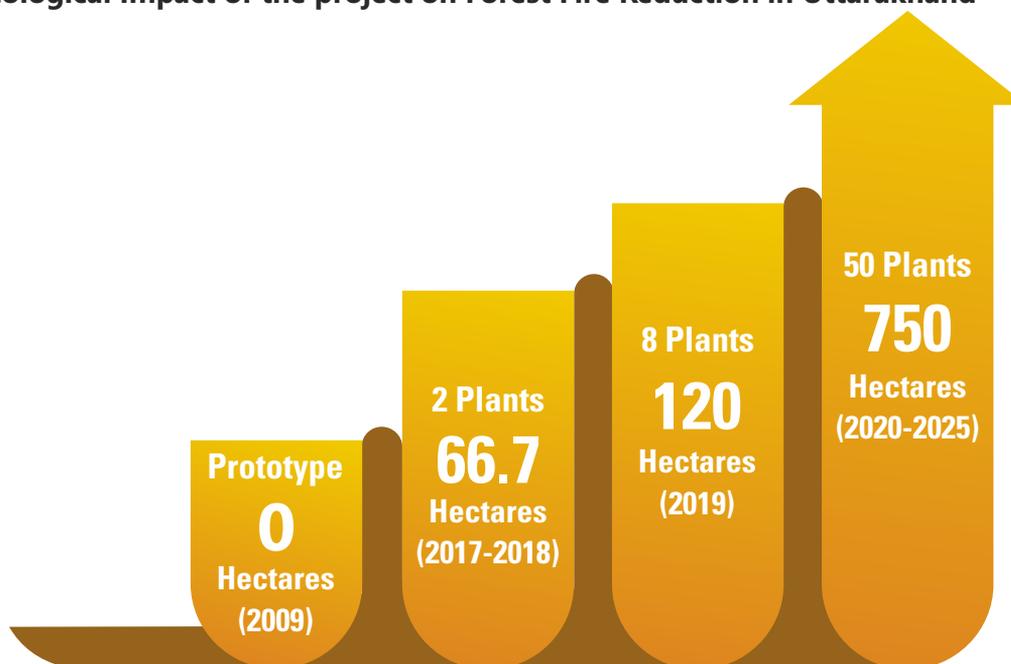
The Impact of the 3 E's - Environment, Energy and Employment



Environment

The annual forest fires in the Indian Subcontinent cause an estimated economic loss of INR 90,000/hectare. The resin present in the pine trees make them highly flammable leading to them contributing significantly to forest fires. The pine needle collection for the operation of all 8 plants operated by Avani, has positively contributed towards reduction in forest fires in the area, clearing in excess of 120 hectares of destructive pine needles.

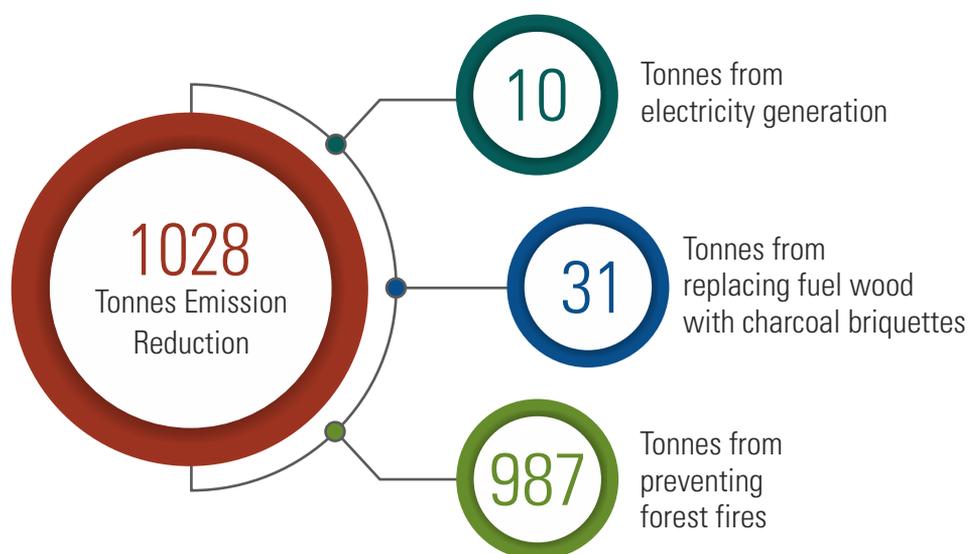
Timeline: Ecological Impact of the project on Forest Fire Reduction in Uttarakhand



Additionally, Avani's pine needle gasification process leaves behind solid residual charcoal. For every kWh of electricity produced, about 1.5 kg of pine needle are used which in turn produces about 150 gm of charcoal; which is briquetted and used to address the household needs of the local community, such as cooking; thereby contributing to the reduction in CO2 emissions.

All eight of Avani's operational plants contribute directly and indirectly towards the reduction in CO2 emissions. The combined CO2 reduction from Avani's Bio Energy Program activities is currently estimated to be ~1028 tonnes achieved by avoiding forest fires (96%/987 tonnes), generating electricity through biomass gasification (3%/31 tonnes), and reduction through the use of bio-charcoal instead of fuel wood (1%/10 tonnes).

Direct & Indirect Reduction in CO2 Emissions of the 8 Plants



Energy

Rural electricity consumption is at an average of 0.5kW load during operational hours. Thus, approximately 20 households are benefitted by a 10 kW plant and 56 households by a 28 kW plant. Over 200 households are being benefitted through all the 8 plants with supplementary funding by the Millennium Alliance. Within the households, approximately 1,000 individual beneficiaries are being reached.

Additionally, as of present day, using subsidized charcoal briquettes (a by-product of pine needle gasification process) has led to smoke-free environment for 420 rural households, thus saving women the drudgery of collecting fuelwood.

Reduced power cuts and stable power supply aids the government's mandate of Rural Electrification and plays a pivotal role in implementation of initiatives such as Digital India. A significant improvement in the quality of life has also been observed, particularly for children who benefit with improved study conditions. So far, a total of 18,160 units of renewable electricity have been exported from Avani's pine needle based power plants to the grid.

Employment

The removal of pine needles is not easy. It is labour intensive. Unless there is economic value, people do not want to remove it and will just burn it. To tackle this concern and create both "Ecological and Economic Profit", the community was made aware of the benefits of collecting pine needles. Avani has also incentivized the collection process by guaranteeing the villagers INR 1.75 per kg upon the collection of 5 tonnes of pine needles and INR 1.25 per kg for less than 5 tonnes. Once made aware of the benefits, the women in the area have taken to it enthusiastically as the collection period is limited to 3-4 months (April to July). In addition to the seasonal employment of thousands of local women, more than 200 local youth also have access to direct or indirect employment. This is a step towards reversing the migration trends in the region. Till date, a total of INR 70,00,000 has been generated in income for the beneficiaries under the pine-needle gasifier programme.



Deviki Devi has been collecting pine needles for three years. Her husband is a farmer with a small piece of land. He struggles to grow much on that and what he grows is usually destroyed by pests and monkeys. As a result, Deviki bears a lot of the burden of taking care of the family. "Collecting pine needles is hard work", she says "but we have no choice as alternative income sources are limited". She earns approximately INR 7000-8000 for a month of collection and as of this year has already collected seven tonnes of pine needles. Before Avani, she tried to find work under MNREGA, the Government of India's flagship program geared at income generation for rural populations. She only managed to get 15- 20 days of work at INR 175 per day; a fraction of income compared to her earnings at Avani.

A cost benefit analysis shows that though the MNREGA guarantees 100 days of employment in the year, it does not live up to that. Data indicates that less than 2% people completed a full 100 days' work in Uttarakhand with the average number of days being 22.3 days. Another drawback of this scheme is that it can be availed by only one member per household, which implies that the maximum amount of money that can be earned by a household is INR 17,500 (for 100 days). With Avani however, a single person can earn the same in just 2-3 months, and if more family members participate, the earning can multiply.

Influencing State Policy

The Energy Generation from Pine Litter and other Biomass Policies

In 2018, the success of the pine needle gasifier led to the passage of a one of a kind policy by the Government of Uttarakhand focusing on using pine litter and other naturally occurring biomass to generate power. Under the Policy for 'Power Generation from Pine-needle (Pine Leaves) and Other Biomass – 2018', the Uttarakhand Government made pine forests a medium of income generation for the locals, especially women, and initiated targets for electricity generation & habitat preservation.

Avani was instrumental in making this happen. A major contributor was also the funding received from the Millennium Alliance that led to the expansion of the program in the region, thereby showcasing the program's ability to protect the environment and generate employment. Currently, Avani Bio Energy is incubating 30 rural energy entrepreneurs and is aiding them as their technology partner.

Sustainability and Scalability

“ The future should not just be about job creation, but job creators ”

Avani is currently incubating 30 rural energy entrepreneurs to set up self-sustaining renewable energy enterprises in their villages. Apart from being their technology partner, Avani also works towards enabling supporting infrastructure including profitable tariffs and subsidies negotiated as a result of constant engagement with government agencies. This will not only build capacities of the entrepreneurs on topics like finance, technology, and bureaucracy, etc. but also provide support for scaling up through further technical development of the plant and bridge financing.

Scaling further

Over the next 5 years, Avani aims to reach 3,200 beneficiaries through its livelihood generation programme. As each beneficiary is, on average, a member of a 5-person household, this translates to roughly 16,000 individuals impacted in the region. The effects of financially empowering these many thousands of women will be significant, opening the door to further gains in gender equality and women's empowerment in the area while generating sustainable, environmentally-sound economic growth.

Partnerships & Funding

Source of Funding	Amount (INR)	Type	Objective
National Mission on Himalayan Studies	1 Crore	Grant	Establish two 28kW power plants and conduct capacity building and training
Hans Foundation	1.30 Crore	Grant	Partnership and funding non-technical aspects of Avani, including capacity building, government relations and proposal writing for additional funding
UNDP	0.23 Crore	Grant	Scaling up through the UNDP Small Grants programme
Acumen Fund	1.03 Crore	Equity	Create 20 more plants over a 5-year period
DOEN Foundation	2.5 Crore	Grant	Set up 500 kW of power generation capacity through development of rural micro-entrepreneurs



