

## Climate Emergency

### Generating clean energy from vegetable waste

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*If you ever visit a vegetable market late in the day, you will see mostly rotten vegetables and leftovers thrown around everywhere. Some of it is stored in cold rooms, but most of it unfortunately ends up in champions. But one such exception is the Bowenpally Market yard in Hyderabad. It got mentioned in the Prime Minister Modi's Man Ki Baat recently, 'Hyderabad ke Bowenpally me ek sthaniya sabzi mandi kis tarha apne daitwa ko nibha rahi hai ye padh kr hi mujhe bahut acha laga.'*

***Translation:*** Reading how a sabzi mandi in Hyderabad's Bowenpally is handling their social responsibility made me very happy.

*In this episode we talk to Shruti Ahuja, Director of Engineering Services Private Limited from Hyderabad, who has been instrumental in developing the biogas plant, which helps in generating energy with this vegetable waste.*

**Host:** Welcome Shruti!

**Shruti:** Hi I'm Shruti Ahuja and I'm the director of Abuja, engineering services Private Limited over the last 10 years or so, that is from 2010-11, we started venturing into the field of renewable energy. So I am a graduate of electrical engineering. And I also did my Master's in electrical engineering from sunny Buffalo. So I returned to India with the idea of doing something on my own. And I wasn't exactly interested in continuing the electrical business. So I did some research in the field of waste to energy for almost one and a half to two years. And we initially we worked on understanding problems that are faced by the poultry industry in India specifically. So that's where we found that there was a huge amount of wastage available, that is poultry litter, that is nothing but the wastage of birds. And there was there is and there was a huge problem in getting this waste disposed off. So that's how our journey of waste to energy actually began as a company. And we collaborated with the CSR Institute IICT, which is called the Indian Institute of Chemical Technology, it's based out of Karnataka in Heidelberg. So we got together with our chief scientist there, his name is Dr. Gangadhari Rao, he, at that time was working on some cutting edge technology that was based on biogas and biomethane emission, specifically for treating poultry litter and converting it into usable energy. So we got together with them and being an engineering company and having decent setup in terms of manpower and resources, we thought, you know, why not, you know, work on these technologies that are available that are indigenously made that are made in India, and why not try to work on them and build on them and scale them for industrial purposes. So that's how we began and we sort of then try to work on other substrates as well. And slowly went on to work on vegetable waste and food waste, as

well.

**Host:** Nice. I was wondering specifically about the bio-poly plant that got mentioned in the Mann Ki Baat by Prime Minister Modi recently, right. So, if you can give me the technical specifications of what it is and how it is different, I mean, we have had biogas plants for really long ages right, how is this different?

**Shruti:** So this plant at Bowenpalle vegetable market yard is set up at a scale of 10 tonnes per day that is we treat 10 tonnes of vegetable waste on a daily basis, and we convert it into biogas and then the biogas is cleaned, and that again, is converted into power and biofuel. So this project, first of all, was conceived in 2017. And this was actually a research based project which was floated by IICT and ourselves, Ahuja Engineering Services and we pitched this project to the Department of biotechnology. So, the Department of biotechnology is at the center, that is the center of the central government comes under the central government, New Delhi, and the Department of biotechnology was looking for some innovation and innovative solutions in the field of solid waste management. So yes, you have rightly said that biogas projects do exist in India. In fact, gober gas is a very old concept that has existed in India for a really long time in our villages. But a lot of projects have also happened, let's say for using other substrates of animal waste and even, you know, vegetable and food waste for that matter, but there have been some successes, there have been some failures. So our technology, which is the IICT technology that has been taken up by us, is different in many ways. And that is exactly what we wanted to scale up and prove with the Department of biotechnology being in the picture. So, first of all, in this entire process, the heart of any biogas technology is an anaerobic digester. You know, anaerobic digestion is the process of degrading waste in the absence of air. And these digesters are initially seeded with some micro cultures and bacterial consortium, which helps in the degradation. You know, this is actually where the complete biochemical processes take place. And the waste gets acted upon by the bacteria and biogas gets generated. In a nutshell, I mean, this is very broadly speaking. So the design of these anaerobic digesters have been under work under process for a really long time. And like I mentioned, you know, the Google Cast technologies have been around for a really long time, but they are specifically for substrates like gober jo ki bolte hai hum, jo ki aisa hota hai already Amerigo buffaloes or cows, unke pet me khana digest ho kar nikalta hai So, hum ab dekh rahe hai.. now, we are now looking at different kinds of wastes which are completely organic in nature, like vegetable waste, or food waste or agricultural waste or any other type of animal waste for that matter, which is not degraded yet it is all in its, you know, organic form and it needs to be now worked upon. So, the main, you know, the innovation here is the design of the digester that is the first part. In this design of the digester there are multiple innovations that have taken place, because of which the biogas production is higher when compared to the conventional designs. And the quality of biogas is also much better, that is a biogas consists of methane and carbon dioxide. So the biogas quality that we are getting with these technologies is much better in terms of a higher nutrient content. Therefore, we get a higher calorific value from this biogas. And other than the digester design, there are also, again, a lot of different work that has been done from the engineering side as well. We have worked on customized a lot of our waste reduction units like shredders and grinders and pumping equipment as well, specifically to suit vegetable waste.

Because vegetable waste tends to be very difficult, sometimes it's very heterogeneous. Sometimes vegetable waste has a lot of fiber in it, sometimes it's a big loss in terms of size in terms of its you know, the matter itself tends to be very different every day. So, we had to work on the entire engineering setup as well, in order to make sure that every day becomes easy in terms of processing this waste. And there are some more challenges that we have in fact, overcome things like you know, our parasitic load that is a biogas plant by itself does not consume a lot of energy, a lot of projects that have happened in the past in biogas field have been very energy intensive, you know, so, for example, if we are generating energy out to waste, you know, if we are expensive about that is if we ourselves are utilizing a lot of energy in running the biogas plant, then the net energy is becomes extremely less. So, here with the from the engineering side, you know, we have tried to make our equipment very, very efficient, so, that we don't utilize too much energy, but we should have a good net balance of energy available, so that, you know, projects become financially viable.

**Host:** Is the ratio of the two can say, like, how much energy is consumed by the plant compared to how much it is generated?

**Shruti:** Oh, yes, absolutely. So, like I mentioned, this project is treating almost 10,000 kgs of waste per day, and we are generating close to 400 to 500 electrical units every day. That is kWh 400 to 500 kWh per day. And in addition to this energy, we are also dedicating almost 60 to 70 cubic meter of biogas to the kitchen inside going police so that's an extra you know, a source of energy that we are deriving and consuming at the vegetable market yard. And in terms of energy utilization, we are utilizing not more than 60 to 70 electrical units per day. So it's, you know, the net energy available for usage is is very high and That's what makes the project financially viable yeah.

**Host:** What is the return on the project like in terms of the investment, the ROI, return on investment?

**Shruti:** So there's not a very simple way to answer this because the calculation of waste management is done differently by different departments. Now, for example, this particular department of Department of Agriculture marketing which is basically handling all vegetable mandis and right to bazaars, they usually spend money on waste disposal. So that's one cost that they were incurring initially at Bowenpally as well. So they were sending this waste. So there is labor involved in loading, unloading and transportation involved in sending this waste out of the mandi and sending it to Jawahar Nagar, which is our dump site Hyderabad's dump site. So that is one cost that they are saving. And, of course, like I mentioned, the power saving is also there, they are saving close to 70% of their electrical consumption, and about 30 to 40 kgs of LPG is also saved that they can teach. So overall, the idea is that these projects should return the money in about four to five years. But sometimes, you know, these numbers depend upon the cost of waste disposal and the cost of energy that the particular setup is a recurring so that could that could sort of change or vary, but typically, yes, it's less than sometimes it's been less than four years, sometimes less than three years also. Then we talk about large

kitchens treating food waste and you know, wastes that are highly organic in nature. So, it varies.

**Host:** I've seen it in Panjim Goa when they do composting of their organic waste from the market. How is it different from that? I mean, what do you think are the pros of the plant that you have compared to a composting plant that is there in any other city.

**Shruti:** So again, you know, composting, or occasionally is done at different scales, you know, we have in waste enthusiasts who are composting based on home scale basis as well. And there are some products available in the market today that are claiming to compost at mid scale and large scale as well you know, at high scale also. My personal take as a technologist here is that composting is a great solution when it comes to small scale waste management specifically when we only have vegetable waste. You know, when we have let's say, even a little bit of food waste where in you know, there is cooked rice or roti or anything that is cooked or starchy, that cannot be composted, as well as you know, the vegetable and fruit peels can be composted. And again, when we go higher in scale, let's say when we are going that five times or 10 times scale, a lot of composting technologies don't actually work as well as biogas technologies in different ways. Firstly, they are energy intensive, like I was mentioning, they actually need a lot of heat etc to first dehydrate the waste, and then the bacteria works on it and it becomes like either a 15 day process or a 20 day process to convert this waste into compost. And secondly, when we look at the returns, compost is of course, something that can be you know, monetized because it can be again utilized for farming or it can be sold and packaged and sold and even fortified further. But when it comes to large scale biogas plants, we get two products first of course, waste gets managed second, biogas gets converted into usable energy. And thirdly, we again get a bio fertilizer as a byproduct, which is an additional income to the project. So I feel that from a technical viewpoint, waste handling viewpoint. And even when we consider different types of wastes, biogas projects and biogas technologies have a higher bandwidth. And even from a returns point of view, bio bio methanation does better when compared to composting. So I'm just you know, talking about both of these at large scale and, and I have mentioned these points very broadly. But there are a lot of technical advantages of using biogas over composting. But at small scale composting works, really, it's really a great thing to do.

**Host:** I see a lot of these trucks nowadays, waste to energy trucks in Hyderabad, how efficient are those? I mean, I know here you have one specific kind of waste which gives you a good calorific value and, you know, your energy quality of energy that's produced is pretty good. Compared to what you think about the general waste energy plants that are coming around the city more.

**Shruti:** Personally I feel that, you know, waste is a very complex scenario. And cities like ours, like great cities, are generating tons and tons of waste every day. For example, Hyderabad itself generates close to 5000 tons of waste per day, this number could actually be much higher. This is what I know of 5000 tonnes of waste every day. And again, it's you know, completely unsegregated, mostly unsegregated. And, I feel that a lot of technologies have to work together

to bring about some solution, and, you know, prevent the continuous landfilling that's taking place and, you know, various other unscientific methods of disposal that are taking place. So, I feel that like composting, bio methanation and waste to energy in terms of even incineration, these technologies also need to come into play. And in fact, they are getting set up in various cities in India, in order to manage the complex kind of waste that is collected from around the city. So, I think, when we talk about, you know, sabji mandis and hotels, restaurants were based is already available. And it's largely segregated, I feel that distributed waste management should take place, that is, transportation of waste to dump sites and then dump sites and having to manage this waste becomes a very ugly process at large scale. So wherever waste is available, and wherever it is possible to set up these projects, whether it's composting or biogas, it should be taken up on an immediate basis. But on the other hand, like I mentioned, there are lots there is lots of waste that's being collected from residences, industries, commercial setups, and you various other places like even temples and gurudwaras, where in the waste finally gets mixed up with a lot of plastic and other inorganics and it's taken to the dump site. Now, I can tell you, as a matter of fact that there is a big waste to energy plant, which has been set up in Hyderabad. It's based on the concept of incineration. And it's a scientific form of incineration, where the entire waste can be disposed of altogether to generate electricity, almost maybe 1516 megawatts of electricity.

**Host:** I have seen in Kota in Rajasthan, there was a survey that was done where the segregation of waste happens. I mean, however inefficient that might be because of the kabadiwalas or you know, ragpickers continuously segregating it from the source I mean, right from the source where people are removing their newspapers and selling in smaller cities to the dump site. Even in dumpsites there are people who are segregating, technically speaking. I mean, if there's a whole ecosystem that is there what I felt when I've seen this incineration waste energy plants is that the whole system gets affected instead of making it efficient, we are eliminating the system is what I failed to I don't know I mean, if the quality of waste is good for generating electricity is the system, so efficient that without segregating wet and dry waste without segregating anything, if we are burning it.

**Shruti:** Yeah so, this is actually the reality, you know, we as citizens of you know, not just India I would say, this is a reality in most countries, even developed countries, a lot of developed countries, we are not very mindful about our waste. I think now, people are really sort of talking about it and trying to be conscious at individual levels or at their own, you know, I would say commercial levels also, were in they are saying, okay, let us be responsible about our ways, but so coming back to your question, so incineration technologies actually have not been very efficient. In the past, you know, there have been a lot of issues with pollution like a lot of flu gases, a lot of ash that gets generated, obviously, because there is, you know, a lot of contamination waste that is like full of everything. So there have been issues with these incineration plants as well. What I have heard or what I've come to understand now is that these incineration technologies have improved and the flu gases and the ash and various other harmful byproducts that are generated in the process of incineration, are actually supposed to again be treated before disposal. Like for example, a lot of chemicals, scrubbing, etc, is being done. To these flue gases so that they are not just let out in the air and you know, at least some

reduction of these harmful gases NOX, SOF etc is what worked upon unless and until that's done, I think the pollution control board does not give a license to set up these incineration plants anymore. But yeah, but but I feel that yes, incineration is like I said the waste is very, very complex, you know, if our cities were to actually segregate to a large extent, or even if for let's say the large waste generators, like you have, there are many examples like you have temples you have hotels, restaurants, you have these any large kitchen with big canteens, etc. Even if these large generators of waste are to take care of their own wastage, and not send it out to dumpsites and landfill sites and incinerators that itself would reduce about 20% of the load on the dump sites. And that is a huge 20 to 30% perhaps that's a huge saving. And then of course, you know, we like like, like, we all know that. It's a complex concept of segregation and maybe we cannot achieve it 100% So, definitely some waste has to go to dump sites as landfilling will continue, and incineration etc, will be needed to dispose it off. But, you know, if we can at least make a large waste generators conscious about it, and if they can be some mandates that can be given by the government that, you know, if you're generating more than 100 kgs of waste, treat it in your own premises, you know, don't send it out and if you do, you will be charged something. So at least there should be some more responsibility, which should, which should be given to even governments, like municipalities, like local municipalities, that, you know, why don't you let's say like, in the case of Bowenpalley, these guys are treating their own waste. So if all these subcommittees were to come and come forward and do it, it would make a huge difference. Yeah. Yeah. I feel that yeah, that to at least to some extent distributed waste management can be adopted, can be taken forward and the other technologies should be loaded at least a little less than they are today.

**Host:** Yeah so one other question I had could be very basic question was, you say you have around 10 tonnes of waste being generated, right, mostly vegetable waste. Is there no other better way of, you know, storing that so that it doesn't get spoiled? I mean, the government has been talking about adding a refrigerator or not refrigerators. What do you call those rooms? Cold rooms, cold rooms in mandis and stuff. If so, I mean, if the government is sincere, and if those come up, would that affect the waste that is required for the plan? Or how does it work?

**Shruti:** Oh, yes, I saw. It's actually a very nice question. So a lot of big vegetable markets already have cold room. And to tell you the fact Bowenpally market yard also has a cold room, and their cold room runs on biogas energy. So yeah, so cold rooms are definitely in place. And I think that more and more cold room facilities should and are being created by the government. This is definitely something which is happening. But despite that, there is still waste generation, which is taking place like like, I'll give you a small example. There is a tomato, like a tomato, big tomato vendor who sits add going Polly and to me to you know, has as you know, has very low shelf life, and especially in the summers, etc. It cannot, if you come in the morning, to sell it by evening, if you cannot finish it, a lot of it will start going bad. So definitely these cold rooms come into play. But sometimes, even let's say cold rooms are full or their capacity is not good enough, then it it's actually expensive for these guys to actually pick it up and take it back transported back and bring it back the next day. So they prefer to dispose it off. They say okay, let me just sell it at five rupees a kg, or let me just throw it away, because it's going to charge it's going to cost me much more to you know, take it back or bring it here. And by that time its quality is going

to deteriorate. So you know, there are a lot of gaps. But the government surely is working on it. I hope they are. At least that's what we see. But there are lots of other sabzi mandis which don't which are not as organized as Bowenpalley's or Rythu Bazaars. So not every mandi would have this facility. Like for example, even Bowenpally does not generate 10 tonnes of waste every day, there is a smaller mandi outside from where the waste is also picked up. So there is no cold room facility there. So you know that waste definitely gets generated at the end of every day, maybe two to three tonnes almost every day comes from there. And the project goes to the plant.

**Host:** So you said that around 400 to 500 units of electricity is produced every day because of this plant, right? Can you give an understanding of basic understanding for the listeners on? How much would that be?

**Shruti:** So the market yard is utilizing this energy and they have a lot of electrical load, for example, they have offices, so there's a huge lighting load in their office. They have a cold room system, which has almost two to three air conditioners. Then in the night, they have street lights, I don't remember the exact number, but they have a huge number of streetlights. And they also have a lot of pumping equipment wherein, you know, water is pumped from borewells and, you know, taken into their tanks etc for their intermediary tanks for utilization. So there's a huge amount of, like I said, lighting load, air conditioning load on and pumping water pumping load which is being supported by these 400 to 500 electrical units every day. And just to give a clear idea to the listeners, the mandi at the moment is utilizing close to 600 to 700 units and we are generating 100 to 500 so that's how much we are able to replace from biogas power. And typically, you know, one electrical unit is 10 to 12 rupees by charge by the electricity department. So the mandi saving if it's 10 rupees also it's saving around, you know, 5000 rupees every day. That's you know, that's how the saving comes into play.

**Host:** Just out of curiosity, is there a net metering technology just like solaar net or is it independently consumed by the mandi itself?

**Shruti:** Yeah, so here it's independently consumed by the mandi there is no net metering being done as in there is no grid connection in this case. So, the electrical lines are directly laid from the generators, biogas generators to their electrical loads, and their meters wherever their meters, main meters, and there are these switches, wherein, you know, we first utilize our biogas power. And then whenever the biogas electricity is done, whenever we are done with it, or on a certain day, the changeover switches, puts it back puts the load back on the electricity board supply. So, they are just simple changeover switches and direct utilization. No grid connection.

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