Methane Mitigation Project Phases, Practical Solutions, and GHG Emission Quantification

5 March 2024, Virtual Event

Matt Hamilton:

Welcome everybody to today's webinar on methane mitigation project phases, practical solutions and greenhouse gas emission quantification. My name is Matt Hamilton, and I want to welcome you to this global methane initiative event. This is the second webinar. And many of you may have joined us in the first.

The second one in a series where we're going to delve into some of the practical dimensions of methane mitigation at larger or open dumpsites. With a focus on things like the phases of success and what it takes to bring some of these projects to fruition.

Today we have some great speakers lined up and we're excited to get started with that. We have a few introductory polling questions that we wanted to run. I'm just taking a look here to see. We've got about 45 participants at this point. Maybe we'll start to go through some of the opening slides there, Katherine, and then we can do the polling questions after that as more people have come in.

Katherine Rush:

That sounds good. Thanks, Matt. Before we start, I'm just going to go over a few of the webinar software tips. First, there are two ways to connect with the audio today. You can either listen through your computer speakers, or you can use the number that is posted on this webinar slide.

All participant lines are muted for the duration of the webinar, regardless of the audio method that you choose. Okay, we'll be using three panels for today's webinar, the participant panel, the Slido panel and the question-and-answer panel. All of these can be found on the right-hand side of your screen.

You may need to click the arrow next to the desired panel to expand and see all of the content. And if, for some reason, one of them does not appear, you can navigate to the bottom right of your screen and click on the panels that you are missing.

We'll be asking several poll questions during today's webinar and some are open right now. The Slido panel will appear when we open the first poll and you can select your desired answer and hit send.

I believe right now, if you can see that there are multiple rooms please just click on the introductory questions one. We will also have feedback questions at the end of today's webinar, and we appreciate your feedback and we'll use it to inform future webinar planning.

And throughout the duration of the webinar, you can enter questions into the Q&A panel. When submitting questions, please select all panelists from the dropdown menu before hitting, send as this will ensure that all of the speakers can see your question. We will be moderating these questions at the end of the webinar during the Q&A session. And final materials will be posted to the GMI website. And with that, I'll pass it back to Matt.

Matt Hamilton:

Thank you. I see some people are starting to answer some of those questions we have. We're just trying to learn a little bit more about our audience today. What kind of organization you represent and what motivated you to attend today, thanks for that.

I think while people are answering those, we should proceed with the first presentation if we could get that one loaded up. The first speaker we have today is Mariel Vilella. She's currently leading development and implementation of GAIA's global climate program, which includes GAIA's, global campaigns and strategies around climate change with a focus on methane and organics management, zero waste solutions to climate change, carbon markets or other international sources of climate finance, engaging in policy advocacy at the U.N. FCCC and other key international climate policy spaces in collaboration with the wide GAIA network and regional offices. Previously, she also held senior global leadership roles such as driving the global work of Zero Waste Europe as Director of Global Strategy.

During 2014 to 2019 she was the managing director of Zero Waste Europe during its foundation in early development. Prior to 2014 she was the lead climate policy advisor for GAIA, and she has extensive experience in research, publication development, and project management. She holds a Bachelor of Arts in sociology from the University of Barcelona, a Master's in Discourse Analysis and Argumentation from University of Amsterdam, and a Master's in Social Communication Studies from the University Pompeu Fabra in Barcelona. So, with that, Mariel I'll pass it over to you.

Mariel Vilella:

Thank you so much, Matt, and hello, everyone. Thank you so much for the invitation of joining us today. And thanks everyone, for being here. My name is Mariel Vilellia. As Matt was saying, I'm the director of the Global Climate Program in GAIA. And today, I'm going to talk about environmental justice and dumpsite closures. We're going to look at the economic and social impacts, barriers and benefits.

For those of you that don't know us, I'm just going to briefly mention that GAIA is a global network of grassroots and national organizations in 92 countries from around the world working together on waste and justice. And one of our main strategic priorities in the coming years is to support organizing and policy work for methane reduction.

Our members have deep expertise working on zero waste solutions that involves reducing pollution from organic waste and implementing composting, biogas and other zero waste

solutions. To give you a sense of our scope of work and where we are in the world, we are organized in regional teams in US, Canada, Latin America, Europe, Africa and Asia Pacific.

And we also have a global team that is the one where I belong looking at the global policy and global campaigns. Today's overview, today's presentations. I want to walk us through a number of points, starting with a statement that I believe we will all agree that dumpsites are a health and environmental hazard with severe consequences to the environment and to human lives.

And as much as climate change will increase the pressure to phase out dumpsites and move on, we will also have to take into account that when closing dumpsites we need to give careful consideration for the social, economic and environmental reasons.

As by experience, we've seen that in many cases the transition from open dumpsites to sanitary landfills has had severe consequences for the communities living in the dumpsites and has displaced thousands of waste picker families that depend on recycling in recyclable materials in the dumpsites.

I want to offer this perspectives of dumpsites as the result as well of political decisions. And we need to look at the root causes of these political decisions to make sure that we find the right solutions. And for us, the right solution is precisely to support cities in developing integrated sustainable solid waste framework with an emphasis on waste reduction, reuse, recycling, and redesign with an environmental justice perspective.

Understanding that ultimately the key to addressing methane emissions challenge lies in diverting the organic waste from dumpsites and landfills and making sure that there is no untreated organic waste that goes into landfills or dumpsites.

This is the main point that we're going to cover in this presentation and I'm going to go into detail into this. Starting with giving you a bit more insight into the social and economical reality of dumpsites. As we know there's millions of waste pickers, mainly women, that make a living collecting, sorting, reusing, and selling valuable recyclable materials.

We know that their working conditions are appalling, unhealthy without adequate compensation, without any health insurance, lacking training, and worst of all, in most cases, facing a very strong social stigma. And yet, despite these challenges, they achieve really high rates of recovery, up to 80% in some cities.

We can see that the informal recycling community is really the global backbone of the recycling system in most countries. When we look at the dumpsites, we have to see that this is the place where waste pickers are often collecting these recyclable materials when there hasn't been the chance to organize outside the dumpsite. I think in most cases when this chance is offered that really happens.

But in many cases when the situation hasn't allowed for that the most cost-effective place for waste pickers to be doing their work is in the dumpsite but that becomes as well a space of community. This becomes home, it becomes the place where all these families are living.

Looking at the closure of a dumpsite is not only thinking about the economical activity that they are doing, is it actually access to a place that it's become home for millions and millions of people. This is the kind of negative impacts that we can see when we are looking at closing a dumpsite, if we are not taking into account the social and economical considerations: physical displacement, direct effects on housing, land, property, economic activities and access to recyclables.

This is the kind of things that we really need to be talking about when closing a dumpsite, so that we don't exacerbate the inequalities, marginalization, and further vulnerability of these communities. This is the question that we are facing as how can we ensure a fair, just, and sustainable implementation of solutions?

We know, sadly, that actually environmental justice principles are often neglected and that means that those social divisions are exacerbated. As we are all looking more into circular economy and sustainability in the waste sector and reducing the methane emissions. There has to be a prioritization to make sure that all these vulnerable communities are put at the front of political decisions.

Because otherwise embedding an environmental justice perspective may not happen just by default. And we are aware of some of the barriers that we are facing in lack of alignment, lack of a strategy, failure to engage issues, issues of justice and even some solutions that come under way if you allow this general reference to very complex barriers that that we are all aware of.

And the need is also very clear, because right now we also know that the positive benefits related to the reduction of greenhouse gas emissions are more important than ever. Where we talk about effective climate action, we cannot just talk about greenhouse gas emission reductions. We really need to address many of the most fundamental ways in which society functions through all these environmental, economic, social and political institutional benefits.

Actually, if we include an environmental justice perspective in the work of closing dumpsite and many other environmental issues, the benefits are critical. And in this case, we're looking at better air quality, better employment, better food security, better political, institutional benefits, which all are fundamental to make sure that climate change give us an opportunity for mitigation and also adaptation and making sure that all these aspects are improved.

What we are doing in GAIA, we have been working with leaders from 41 countries and we have developed a framework of environmental justice principles for fast action on methane in the waste sector. And we are inviting other organizations, including all of you, in joining us in putting these principles into action. We are working with groups in more than fifty countries that are eager to take action and we are aiming to bring in technical and financial support for their efforts.

These environmental justice principles that we offer to all of you are providing guidance for policy makers in developing methane reduction policies, including also dumpsite closures.

They're also providing support to work on the and this is the nationally determined contributions and also including community members, waste workers, etcetera.

We are in the process of translating the document up to 12 languages and we launched it at COP 28 last December. And in the coming months, we will be sharing with many institutions and organizations promoting the adoption of these principles. The principles provide a vision, a vision for systems change still worthy of waste, climate justice, and quick action on methane reduction.

And with the belief that the successful implementation of organic waste diversion in line with environmental justice principles can build community waste workers and local government buy-in. And demonstrate that there's a practical effectiveness of these strategies, including all these co-benefits that I was mentioning for the livelihoods and environmental health.

Now I'm going to go through these principles and we're going to look at each of the principles and we're going to see how it can be applied in a process of closing a dumpsite.

Starting with the first principle, the first principle talks about respecting planetary boundaries to ensure intergenerational equity, recognizing ecological limits, the waste hierarchy must be applied to reverse climate change and drive a just transition that ensures intergenerational equity. The bottom line of this principle is that we must give priority to upstream solutions.

And we know that upstream solutions, when it comes to the food waste hierarchy, really looks at organic waste prevention as the most powerful tool for reducing methane emissions. Organic waste prevention, food waste, food lost, all of these strategies in the upstream must be completely prioritized and you can have a lot more detail of you can you have all the detail about these in in our report methane matters which I have added reference to it at the end of the presentation.

You will have the links to all the publications where most of this content is explained in more detail. So waste prevention at the top and then for the organic waste that cannot be prevented in our zero waste practices what we see that is most successful is to ensure that there is a source separation of organic waste that is what guarantees it's going to be quality waste stream so that can be then taken into composting into bio gas.

Very important to have source separation and even better with door-to-door collection, separate collection and that can then be brought to composting to biogas as I was saying. And for the organic portion that stays in the residual waste, we can do bio stabilization. There's a drying process that will neutralize the potential methane emissions that would come up with from this residual waste.

And for the landfills and dumpsites we can provide bio cover. This is a technique that it's increasingly being researched and CCAC just launched a report recently that gives a lot more insight into this. These are basically the pathway that we presented in our report and that gives us as much as 95% of methane emission reductions from the waste sector by 2030.

Basically, as we look at dumpsite closures, it's really important that we look at and support cities to precisely transform the whole waste management system to make sure that we divert the organic waste from the dumpsite and the landfills. But also that we make sure that there's a system in place that will make the most of that waste, it will be prevented or will be given the highest used.

The second principle is about waste pickers, respect for waste pickers and waste workers. Upholding and strengthening human rights, we must center equity and justice in all our actions, protecting the livelihoods of waste pickers and waste workers and ensuring no harm in the first place.

As I was saying at the beginning, we know that there's millions of people worldwide making a living out of the recyclable materials in the informal economy. But what we need to see here is that there's been incredible efforts to support the organizing of waste pickers and that where they've been given appropriate support, they've been able to organize themselves.

And right now, there's organizations already existing at the global, regional and national and local level. The first idea, the general idea is that basically and what they are advocating for is a just transition. A just transition would mean that in any process of closing a dumpsite, livelihood plans should be an integral component of such process.

And this is what the organizations that are already existing of waste pickers are advocating for. At the global level, we have the International Alliance of Waste Pickers. In Latin America there is Red LACRE. In Asia Pacific, there's been a recent meeting actually with many of the organizations of waste pickers.

In many countries there's national alliances that bring together local organizations, local associations, and competitors. First of all, I would say that the waste pickers are increasingly organized. We urge everyone to engage directly with them. In any case, looking at engaging with the waste pickers, it definitely needs a specific approach to vulnerable communities, because significant numbers of waste pickers are women, are people from ethnic minorities, definitely low income, there's lots of children, and so this requires a specific approach that makes sure that we that restore this balance because otherwise we may be under the risk of exacerbating these vulnerabilities even more.

And in general, the bottom line is that we need to recognize and support the waste pickers to join together in competitors and associations. Because this has proven to be the way that is more effective for them to be better organized, for them to have higher income, to facilitate a pathway to formalization when that is what's desired from the community of waste pickers. And essentially that really ensures a lot more stability and sustainability to the whole waste management system.

I want to give you a sense of the positive stories that we find all over the world when the waste pickers receive proper support to organize. One that comes, that jumps out is the competitive

SWaCh in Pune, India. This is the largest competitive in India, fully owned by self-employed, informal waste pickers.

They have, they provide good sustainable livelihoods for, especially for disadvantaged women, that are producing compost. They have this really big competitive, they handle a lot of dry recyclables. But I just want to put a special emphasis on the fact that they are handling the organic waste, they are collecting it door-to-door and they are managing 7,000 kilos of organic waste per day that they are taking to the composting site.

This is a really great example and we'll put the link to our case study. But also, in the region in Asia Pacific, what I was referring to before, the waste pickers just held their first meeting in Kathmandu. This is to give you a sense as well that the organizing of waste pickers is definitely ongoing, it's increasing.

I would really encourage all of us to engage and support this process that is so meaningful and that provides such a good opportunity for all of us in the waste sector and in terms of environment, social and economic well-being. I also want to refer to a really interesting publication from Instituto Polis in Sao Paulo.

This is a publication that has looked at competitives of waste pickers in Brazil that are handling organic waste. And I'm saying that this is a sort of novelty because waste pickers have traditionally handled the dry recyclables, which is what has the best value in the informal economy.

And in this sense, it's sometimes, it's a bit more challenging to deal with the organic waste because it's more difficult to give it the value. And yet there's places where there's been already positive experiences and Instituto Polis has good data in this regard and has been looking at some of the best examples in Brazil.

Also, this publication from the Zero Waste Alliance in Ecuador that has been published just last week, Crecer a Cielo Abierto. This is a research conducted over five years in one of the dumpsites in Ecuador looking at the impacts on children. This gives a real good insight into all these specific circumstances in which the communities of waste pickers live and that needs to be taken into account when we address a dumpsite closure.

And of course to give some final regional balance, I want to mention the experience of Nipe Fagio in Africa in the city of Dar es Salaam in Tanzania where Nipe Fagio, this organization that has been supporting a cooperative of waste pickers to lead the zero waste system for several neighborhoods in the city.

And it's one of the pioneering examples in the regions to the point that we're hosting, co-hosting, the Global Zero Waste Conference in July 2024, that I take the chance to invite you all. And I put the link here because it's going to be great that we are able to invite all the participants to see the site and with the work that they are doing.

I hope that this gives you a sense that the waste pickers are getting increasingly organized, that they are definitely a stakeholder that needs to be fully involved in any of the processes when we're looking at dumpsite closure.

The third principle is about inclusion and building from local knowledge. In decision making processes, enhancing inclusion and meaningful participation is a must, along with building from local knowledge and expertise and kind of links to that to the last slides. That is including waste pickers but also including the local organizations and making sure that there is a participatory and representative decision-making process to avoid inappropriate measures to be applied which would ultimately increase the cost to society.

The challenge here is that often, despite local residents and civil society organizations have significant expertise and contextual knowledge, often we see that input from technical teams may be given precedence over the views and experience of local communities and residents.

And basically, it is just critically important to make sure that those views from the local level are not put on the site, and that there is communication that is cultural-sensitive and locally appropriate, and that there is facilitation for the involvement of the local organizations that are able to engage in dialogue with all of the stakeholders.

It's just a matter of informing. It's actually a matter of facilitating and making possible that local organizations are on board of the process and that essentially will result in more cohesion and more, say, more guarantee that the process that is designed is appropriate for the local level.

Definitely it should be a win-win for all parts to engage at the local level. The fourth principle is about responding to pollution and environmental harm with accountability. Any pollution or environmental harm caused must be addressed with accountability, putting means in place to compensate for damages and prevent further harm. So how we apply these to a dumpsite closure?

I want to make reference to some of the things that we've seen that our community, our global community have said this should not happen. If this has happened, this needs repair.

And the first one that comes up when this question is made is the privatization of waste management systems and the restricted access to recyclable materials, which, for the obvious reasons, will be very negative for the communities that are depending on recycling materials.

And this, especially if this process is made without any consultation, without any involvement, the more division that it causes, the more opposition that it will linger. It often happens that the privatization and the restricted access goes together with an investment in thermal treatment of waste.

That is, the waste to energy incineration are similar, which definitely there's very good reasons not to go for in sense of the contribution to climate change. The CO2 emissions that come out of burning waste, the air pollution that comes out of burning waste in incinerators, the high

cost that it takes, especially over the next decades where climate action is most needed and where climate finance is so wanted and needed.

Definitely a red line, very clear in our global network is that no climate finance should go to waste to energy incineration. Or similar, there's other technologies that are similar to that, say, pyrolysis gasification, some of this. Mechanical biological treatment (MBT) is also something that has been experienced and definitely has caused negative consequences for environmental, and economics, and social reality.

In this case, because this is mixed waste, so basically, the whole upstream pollution has been unaddressed and so MBT can basically deal with mixed waste, retrieving some recyclables and then neutralizing the biological component but reducing the refuse-derived fuel which then emits pellets that can be sent to incineration or cement kilts. And the experience that I hear from the organizations on the ground is that perhaps a few jobs will be given to some waste pickers.

But essentially, this is again another way of making waste inaccessible to most of the waste pickers which will be displaced. And essentially basically misses the point, as I say, misses the point of the upstream and basically gives steel produces pellets that will be given to a thermal treatment polluting industries.

And essentially any end of pipe disposal infrastructure without upstream intervention, that would be something that should be avoided. As we were saying at the beginning, the priority has to be given to the upstream intervention. OK, the final principle is about supporting holistic solutions through system change.

A systemic point of view must be used to find solutions for interrelated crises like climate, public health, poverty, gender, racial and class injustice, inequality, conflict and war, and to ensure solutions in the waste sector meet and exceed Sustainable Development Goals and climate targets.

Definitely we need to find holistic solutions. At this point, we can no longer just look at waste from a technical point of view, just looking at only the infrastructure, technological point of view. We need to look at it all these social, economic, political dimensions and make sure that the solutions that we bring forward bear in mind all the other interrelated crises.

How do we apply this to a dumpsite closure? As in a general recommendation, we would definitely have multi stakeholder alliances, engaging in dialogue to transform the linear system, waste to disposal, towards a circular zero waste local and justice-centered economy.

Bringing together all the people involved, government officials, zero waste implementers, waste pickers, climate finance advocates, environmental health experts, agroecology and food system advocates and many more that I'm not bringing in here but many of you all here that have definitely valuable expertise to bring on the table.

Definitely important to have a pluri-diverse team of people to be engaging with these processes to make sure that we have a systemic approach. And so finally some final conclusions for an environmental justice and human rights-based approach to dumpsite closure.

To say that we need to recognize that we have a human right, which is to have access to a clean, healthy, and sustainable environment. And this means that everyone has equal access to sound management, including regular collection and safe disposal sites that do not threaten human health or the environment.

And in order to have this, we need affirmative action to protect the rights of waste workers in the informal economy, as they are the backbone of the global recycling system. And that means that the livelihood plans have to be an integral component of any dump closure process.

Ultimately, we want a just transition from a mindset that is more focused in making burying of waste efficient towards a system that prevents and diverts organic waste as the main strategy, prioritizing recovering, recycling and composting systems with a zero-waste vision that is making sure that we reduce waste as a first priority along the way with always environmental justice principles.

And in this sense, I hope that the environmental justice principles that we have elaborated in our network are helpful and give guidance and will remain at your disposal to engage in further conversation and see how this can be used in your context. Which we hope is going to be a game changer for all of us in making sure that we reduce methane emissions.

And we as well provide all these core benefits for social and economical and environmental health that we all need so much. That's it for me. Thank you so much for inviting us to present today. And please, I look forward to your questions. Please have a look at our publications in our website. We can give you more details about everything that I have explained. Thank you so much.

Matt Hamilton:

Thank you, Mariel. That was a wonderful presentation. I really enjoyed that and I hope everyone else on the line did as well. I wanted to just drop people's attention to the Slido. We do have some polling questions that are open and they're related to this presentation.

You should be able to go to the right-hand side of your screen and click on the Slido drop down and you'll be able to what what's called "select a room". You can see there's some questions on environmental justice perspectives. I'd encourage you to do that. And if you haven't done so already, the introductory questions as well are there. We'd love to hear your responses to those.

With that also the Q&A drop down, you can feel free to put your questions into the Q&A section and we'll try to address them as best we can. Mariel, I'll start with the one question I'm seeing there now.

The first question, so it has to do with they'd like to know how does landfill gas and biogas and composting technologies how can they be used in communities at small scale dumpsites? Have you have you seen that, is that an experience you've had? And then how are local government agencies involved? So maybe there's sort of two questions there.

Mariel Vilella:

Yes, definitely thank you for the question. Really important one especially I believe that the small scale is where we see a lot of good practices getting started and then we really want for them to upscale and go bigger. But definitely at small scale, especially the composing site and the biogas, there's a lot of positive experiences.

Especially the composting I would say is the kind of easier and most widespread because it definitely doesn't require so much capital to get started. It just requires basically the organizing and the and the labor force to make it happen.

And the space, I would say the space for the composting. That is definitely supported by many local municipalities. Like the example that I said for Pune, Pune has the local cooperation, the local municipality has a contract with SWaCh, the competitive and that they have a contract it's a formal relationship that happens. It's all good.

I have to say that as well in Kerala it's the other place where the small scale biogas has been very successful. And here as well is the government of Kerala and the state government and the government of Thiruvananthapuram, the capital, that have given a lot of support to biogas at the small scale as well.

Very good because it provides a source of energy that can be used at the household level. But also in Mumbai there's another organization of waste pickers that have been doing as well, the collection of organic waste. And these are the same waste pickers that are managing the biogas at a small scale.

I would say there's definitely in the places where there's been support for the organization of waste pickers and there's been a good relationship with the municipality. Then basically it's just a natural extension to see like OK the waste is collected, what can we do with the waste. Composting and biogas are definitely some of the most positive experiences

I have to say in Ecuador there's a really wide network of local composting. Composting is definitely widespread. We have lots of in Indonesia as well, we have lots of case studies in our website. I would definitely encourage you to go to the case studies and you will see there a lot of positive stories of collaboration of the local communities, local organizations with the municipalities that are really showing the way of how it how it can be done.

Matt Hamilton:

Thank you for that. That's great and I encourage people to go check out those resources. I wanted to ask you a question. I suspect when we target let's say good environmental justice

outcomes that we can also get good economic outcomes. But could you comment on that? And generally where do you see some of that, by doing the work you're talking about, where do you see some of the economic benefits coming out as well?

Mariel Vilella:

Well, the economic benefits are clear when in the first place the income of waste pickers increases as soon as they are able to be organized because they are able to overcome the middle man intermediaries. That as well the organization it will give them a stability to the prices that they are able to negotiate. Otherwise like individual by individual, it's going to be like a very weak way of trading.

The organization ensures that there is a more stable pricing, ensures that and not only is the pricing, it's also then the quality of life because you know competitives of waste pickers will make sure that there's a scholarship for children.

Children don't have to go work and they can go to school so that they can change the generational nature of this work. It goes like economics understood as in beyond the income it definitely goes far and wide. But also I would say that for the municipalities, the fact that the zero waste systems with waste pickers are also very cost effective.

In comparison to what it would be to be maintaining a sanitary landfill to maintaining even a dumpsite even an incinerator, it's definitely an obvious of cost in comparison to the cost of creating a more decentralized local and labor intense system that manages to reduce waste to do more reuse and more recycling.

And I would refer to some of the zero waste experiences in Philippines, San Fernando, Tacloban. We have case studies in our websites where you can see how much these two factors, the fact that the waste pickers have increased their income very much as much as the savings that have been provided to the city.

How affordable and how cost effective it has been to engage in a zero waste strategy. The latest study that we have is from Durban.

Actually, the organization Grand Work together with the University of Durban have been doing a zero waste project pilot. But now they're working to expand it to the whole city of Durban, and they are collecting organic waste from the market and doing compost with it.

And they've done this cost-benefit analysis for the city showing the savings that they have provided for the city. So again, it's sometimes it's not so much the income that is the profit that is made. But actually, the savings is where we see a great benefit.

Matt Hamilton:

Yeah, that's wonderful. I had read some similar stories like that around the world where municipalities were realizing they're actually saving millions of dollars a year in some cases

because of this work that was being done informally. There was an impetus to go out and try to be more helpful, help organize etcetera. I thought that was quite interesting. We have another question coming in. You had already spoken about an example of small-scale biogas, but the question is can you elaborate on some countries or locations where there's policy support for small scale biogas? I think you were talking about Kerala in India. Are you familiar with any other places where you've seen that?

Mariel Vilella:

I mean this is definitely the place where I know that the organizational funnel has been really engaged in Kerala and Mumbai. These are the two places where we have documented case studies and there is interest in many other places. I'm sure that there's other experiences and there's definitely interest and opportunity.

A lot less than composting as I was saying because composting is kind of more easier. But I could go to my to as I say, I work with regional teams and regional teams are often more connected to the specific cases. Definitely I could ask for more examples if that was something that I can provide later.

Matt Hamilton:

Yeah, that's great. I know like with GMI I could say there's a few places we're familiar where small scale like Vietnam is one place where it's been worked on. You see it in Philippines as well. There are different experiences, right. You were saying composting it tends to be more popular for a number of reasons. One, it's a little less sophisticated, let's say and complex and managing some of these even really small scale systems they get off to a good start but sometimes they fall into disarray because they're hard to maintain. It's one of those things where it's worth examining all the options right to suit the scenario. OK. So that's great.

I'm just looking to see if there's any more questions. Maybe what we'll do is I'll kind of finish on one last question from me. You were talking about systems change and I think that's something that we are also interested in is, we can talk about biogas technology all day and that's great. But it has to fit into a system where there's political buy-in, there's community buy-in, etcetera. Could you just kind of elaborate a little bit around the kind of work your organization does in that space on that system thinking or integration?

Mariel Vilella:

Yes, right. Basically as I say the organization works for supporting the organizations working at the local level. Our theory of change is very much supporting organizations to empower themselves. Then we follow very much the lead of these organizations will tell us at the local level.

I think in the first place we have to make sure that we see what's locally appropriate and what system change means in that specific circumstances. But essentially it's kind of trying to see all

the conditions that will make a system change. It's not just looking at the- we look at the environmental conditions in the waste hierarchy, the abstinent solutions, we look at the people that are working on waste making sure that the solutions are based on inclusion and looking at the at the workers and the livelihoods that are in the waste management system.

We look at the local organizations and what is the lead, what they are telling us about what needs to happen at the local level and also kind of trying to see as well the sort of faults or the polluting, the polluting solutions that we don't want to see.

Our work is very much to engage with local organizations and support them and understanding what are the opportunities in the local level supporting cities to commit to the zero waste goals and making sure that the process for implementing those zero waste goals have taken into account all these social, economical, and environmental aspects.

So it's going to be slightly different in each place necessarily because there's no such formula that will be the same in every place and it's not the same of Latin America than Africa than North America but I think that basically precisely and that's why our environmental justice principles have been really instrumental in providing guidance is that these are the key factors that we understand need to be seen to apply a systemic perspective.

Matt Hamilton:

That's great. Thank you so much. There is one last question I think I'll pose to you, it's in the chat but it has to do with a specific technology which is about converting methane into methanol. But the crux of the question is really around opportunities for waste pickers to share in the revenues from the various whether it's you know producing biogas, producing this other product. Do you see that as something that's taking place are the waste pickers like participating in the let's call it the profit side of things if it's there?

Mariel Vilella:

OK. I'm not familiar with the specific technology that this company say that they have just received the US patent and it's great to see that someone is thinking that this could be beneficial for waste pickers and that's great and definitely I would encourage to get in touch and to explain how that could take place. So yeah, sorry I cannot say more about that but I would, yeah, I would say that this is a good start. This is what we want basically like any ideas definitely if we can think that this could be beneficial for waste pickers absolutely engage, talk to them, talk to the organizations and that's the start. That's definitely a positive start to get going.

Matt Hamilton:

That's great. Thank you so much. We'll give a round of applause to this presentation. Thank you so much. That's great. I think we'll get ready now for the second presentation if we could move forward. Our second speaker today is Dr. Ali Abedini. He's a distinguished landfill gas expert

with several decades of hands-on experience in landfill engineering and solid waste management sector.

He's renowned for his expertise in these areas and he serves as a faculty member at the Solid Waste Association of North America's British Columbia group and actively contributes as a technical member of the to the International Waste Working Group.

As part of his advisory roles, Dr. Abedini also collaborates with my organization, Environment Climate Change Canada, and offers his expertise to World Bank Group as a technical consultant for solid waste management projects in more than 25 developing countries. His expertise extends to specialized areas within landfill gas engineering, from methane emission quantification to landfill gas management system design, operation and troubleshooting.

He's credited for developing the precision focused UBC integrated landfill Gas Generation model or UBCI model and has pioneered the surface scan emission quantification technique, a patented innovation in both Canada and the United States.

Dr. Abedini, I'll hand it over to you. And just to say there will also be some questions in the Slido which I think Dr. Abedini will be pointing to as we go, but you'll find them in the Slido as well. OK, thanks. Over to you.

Dr. Ali Abedini:

Thank you very much Matt, first of all for getting me involved in participation of this workshop. Also for the introduction. It's such a pleasure to join this second workshop of GMI. I guess I will get right into the slide.

This is basically a full day workshop that I tried to squeeze in, in 25 minutes or so. We're really scratching the surface when it comes to this topic. Landfill gas methane generation estimates, quantification, dealing with accuracy of different methodologies, what are alternative methodologies or unconventional methodologies. Speaking a little bit about different options when it comes to landfill gas management and some financial aspects of it.

Before I get into the actual part of the presentation, I want to share a few statements here that I basically gathered from just quick browsing the Internet. This one is from Reuters 2022 that states landfill waste is responsible for about 11% of global methane emissions.

Or the second statements is about Mumbai Landfill in Mumbai emits about 85,000 tonnes of methane per year. Disclaimer this most of these pictures that I show, it's my own pictures and not related to the statement. This one is a landfill in India but not in Mumbai.

A Buenos Aires landfill releases approximately 250,000 tonnes of methane annually. Or this one from USEPA, it just states in 2021, US landfills emitted around 122 million tonnes of carbon dioxide equivalent of methane. And this last one which is from actually Environment and Climate Change Canada, the graph shows projected methane generation from Canadian landfills.

Of course, discussing different scenarios how we can bend the curve if we do, what different strategies in regulating landfill gas emissions and etcetera. The reason I shared these statements is to open up the discussion on how do we know how much methane is actually generated from a landfill or from a dumpsite.

And that takes me to this graph, which I'm sure many of you have seen before. This is a typical methane generation modelling projection that shows throughout the landfill lifespan, how much methane is generated. Now let's try to pull up the question #1 from the poll.

Matt Hamilton:

I think Ali, we only have about 5 responses to the poll, 7 oh yes. Some people are starting to give responses.

Dr. Ali Abedini:

And I don't see the questions on the Slido so maybe I'm not in the right.

Matt Hamilton:

Yeah, and forgive me because I'm not sure how I can determine what the responses are, the summary of responses. Would somebody else in the group be able to help with that?

Alexis St. Juliana:

Yeah, we would be happy to help. Just as a reminder to folks, you may need to switch rooms to get to this particular poll question. And this should be kind of the third room in the list.

And it's labeled Poll 3 when you get there. So you know you're in the right spot. And right now we have about 17 votes, but that is slowly ticking up and we'll leave it open a little bit longer. But for the first question, have you seen a landfill gas generation estimate, either a graph table or report with 21 votes, 62% of the audience says yes and 38% of the audience says no. I can move on to the second question.

Dr. Ali Abedini:

Yes please.

Alexis St. Juliana:

Great. OK. So the second question with 24 votes, have you ever used a model to estimate methane generation from a landfill or dumpsite? 42% of the participants say yes and 58% of the participants say no. And if we're ready for the third question, we have 25 votes. And the question is, have you ever used an advanced site specific LFG generation model and 20% of the participants say yes and 80% of the participants say no. Thank you everyone for participating

and we'll leave it open a little longer for folks that maybe had trouble navigating to that screen, so we can get more complete results over the course of the webinar.

Dr. Ali Abedini:

Perfect. So about 50% of us have not used the landfill gas generation model. I will describe very quickly how when you see this graph what it means. As you see on this example, this landfill has started receiving waste in 1975.

That's where the curve shows us the opening year of the landfill. Normally this methane generation continues to increase until it peaks at the year that you stop putting additional waste into the landfill or I should say organic waste into the landfill. The peak shows the landfill closure year or dumpsite closure year.

Then the tail end indicates the declining gas generation, which happens after we close the dump for the rest of its post closure period. Now these models are developed for different purposes. They are used for GHG emission inventories as national or global level.

Those statements that we were reviewing together are basically based on a model that has been used to do those estimations. These models are also used for with by regulators.

If there is a country or community with landfill gas regulation in place, the regulator used these models as a screening tool to see which landfill is generating methane above a certain threshold, which would make them regulated or which landfills are exempt from that regulation.

And us engineers use these models as a design tool. When you're designing the gas management system, we want to have an understanding of how much methane is generated, what would be the landfill gas flow rate for which then we will design the gas management system. I don't intend to go too much into the detail of the equation but this shows at one of the first order decay methodologies which is used by these models.

But I do want to discuss here is that these models are based on three major parameters. One is how much waste we put into the landfill, the waste tonnage basically. Two is the decay rate, how fast and how quickly the organics gets decayed. Hence the gas is generated which decay rate mainly depends on the climate, amount of precipitation, the waste composition and how the landfill is operated.

And then the last is the methane generation potential, which again mainly depends on the type of waste or the waste composition and also how the landfill is operated. As a simplified version of how the landfill gas generation takes place, I would show it as shown here.

When you put the waste into the landfill, all those organic waste, paper, food, waste, textile, with all those cellulose, fats, carbohydrate and proteins are hydrolyzed and fermented by acid former bacteria. And then those organic acids generated from this first phase of the process are

consumed by different type of bacteria, we call them methanogenic bacteria, to produce landfill gas which is mainly methane, carbon dioxide and water.

And the takeaway from this slide is that this second phase, or last stage, of gas generation can only occur in absence of oxygen, meaning that if there's an anaerobic environment then these metallogenic bacteria can actually function and generate methane. If it's aerobic environment, you will not see any or any significant methane generation taking place.

How does that anaerobic environment take place at the landfill? This picture shows a properly operated landfill. On the right top corner, you can see the active phase of the landfill where the waste is being deposited. It's beautifully compacted. And you see at the top deck here where the compactor is sitting, they're ready to place a layer of soil, either daily cover or intermediate cover, over that layer of waste.

By adding a layer of garbage over the previous layer, or by covering it with soil, the minimum quantity of oxygen which has entered into the landfill by placing the fresh garbage, that will quickly get consumed by aerobic bacteria and then the environment become anaerobic situation.

And that's where the methane generation basically takes place. And depending on the situation, it may take a few months or if it's really dry condition, it may take up to a year until that methane generation condition takes place. This is another example.

The previous picture was from a landfill in Canada, but this one is actually from one of the developing countries that with some training and some capacity building, they were beautifully running this sanitary landfill.

On the right side you can see the active phase of the landfill. Very small portion of the landfill is open, the rest are covered by intermediate cover and you can actually see they have already gas collection system in place.

The challenges with modeling. First of all, there are a few challenges when you use a model to estimate methane generation from a landfill or from a dumpsite. And the first goes to the model itself. Those who have experience with doing landfill gas generation modelling know that depending on what model you use, you may get different results.

Second challenge, which mainly goes to dumpsites and landfills in developing countries, is the issue with the data quality. In many cases you don't have the historical waste tonnage that has been placed into the landfill or you don't have information about waste composition, which makes it challenging to do a good job in doing the landfill gas modelling practice.

The third is the poor operation at the landfill, which may change the situation from a typical landfill operation that you would assume during the modelling exercise. So that poor operation can result in aerobic decomposition of the organics. And as I mentioned, in that situation the decomposition and byproducts of the decomposition are different.

If there's an anerobic situation, you would expect the typical landfill gas generated. But in aerobic situation, aerobic landfill operation, there's a lot less methane generated than you expected. And the last issue with the modeling challenges is the typical landfill fires that they take place in poor operation situation and when the landfill is experiencing landfill fires, which I will show you a few pictures very soon, lots of organics will basically get consumed in this fire process, hence they don't participate in methane generation.

The models typically don't have a way of taking these into consideration, hence the inaccurate estimation that you can expect from these models. Modeling inaccuracies, to just showcase what I was mentioning, this is an exercise that I did for one single landfill using different type of models, different landfill gas generation models.

This landfill, as you can see, all models understand that the landfill opened in 1999, but when you compare the peak methane generation using different models, the numbers range anywhere between 10,000 tonnes per year of methane all the way to 34 thousand tonnes of methane. Quite a big range when you compare different models.

What model to use? Which one is more accurate when it comes to estimation of emissions of methane or methane generation from this site? This aerial photo shows a poor landfill operation and also you can see that there's no scale house at this site.

When it comes to modelling methane generation from this site, you have to make some assumption and estimations about how much waste has been deposited at this site to begin with. And typically, you use the number of trucks per day and you make some assumptions on how much each truck may have had as the load of waste and you go with those numbers.

Also, you can see the waste is not covered at this site. There's a lot of aerobic decomposition or say similar to composting. Basically, the organics are being composted aerobically and not going into anaerobic phase for methane generation. And another example, this is another dumpsite which we can see the landfill is on fire and this basically results in a loss of organics that would have otherwise undergo anaerobic decomposition and methane generation.

Another example of a dumpsite operation, you're looking at 3 to 4 hectare of open dump and no cover in place. Similar site, you can see this picture is a bit far back and you're looking at probably 8 to 10 hectare of this site and you can see the whole place basically open without having any cover placed. A zoomed in picture of the same site. And when we do the modelling, we do consider some factors to take into consideration how the landfill is operated and some others call it methane correction factor that they would say, okay, because this has operated as like a poor operation or a shallow landfill, we consider this discount factor for developing a better or more accurate methane generation.

But these are all based on the assumptions. A landfill like this, if you have one meter of garbage open to air for a month, for few months to a year, basically most of I would say all the food waste would be aerobically decomposed and maybe some papers and wood waste will still be

there. And then if the next lifts of garbage comes over to cover the previous lift they may go into anaerobic phase.

Otherwise, you can assume way less methane actually generated from a site like this than any model would result in. Another example of dumpsite operation, decides because they don't have a heavy equipment in place, the garbage trucks basically dump the load wherever they can access.

And maybe once a year a bulldozer will come to this site to get things organized a little bit and open some room for additional use of the site and trucks to be able to access the area and unload. A situation like this, I would say very little methane is generated and these are the things that in the models, you have a hard time to make a proper assumptions and accurate estimations of the actual situation.

Another picture shows again poor operation, landfill fire and a very large presence of cows at the site. When I visited this site, I thought maybe I should add to the model a cow factor because these animals also are feeding off the organics that we are assuming will be participating in methane generation when you use the model.

That takes us to alternative quantification approaches. If not the conventional techniques of modelling, how else can we quantify methane emissions or methane generations from a site? And since I'm not able to see the polls, if one of the colleagues can help with pulling up the question #4 and question #5.

Alexis St. Juliana:

Of course. Folks just as a reminder, you may need to go back to the Slido page and navigate to the correct poll. But Pole 4 is now open, so that should be the fourth room in the list, and you should see two questions.

The first question is, have you ever used an alternative technique for methane generation quantification? I'll give folks another couple seconds to answer that.

And then the second question is which of the following do you think will be a more practical and viable approach with the answers as advanced modeling or field measurement and testing. I'm still seeing the votes tick up, but I will display kind of the real time responses.

For have you ever used an alternative technique for methane generation quantification? Right now we have about 24 votes and 35% of participants have said yes and 67% have said no. Sorry, I know those don't add up to 100, but we're getting kind of real time responses.

About 1/3 say yes and about 2/3 say no. And then for the second question, which of the following do you think will be a more practical and viable approach? About 40% say advanced modeling and about 60% say field measurement and testing.

Dr. Ali Abedini:

Very good. Your answers are, I mean, at least to the second question or question #5 to keep you all happy. All answers are correct. The alternative approaches can include advanced modelling or I call it site specific modelling. And there are other approaches, two of them are included in here and generally speaking terms field testing and methane emission measurement.

One of the very commonly used field testing is a landfill gas pump test. USEPA has a methodology called Method 2E that you basically drill a gas well and you pump the gas and then you measure the gas quality and quantity and then you go back to the model and then you adjust the model based on the actual results you get from the pump test.

Actually, I should go to the next slide. So I just explain them in order. Advanced modeling or site specific modeling, this one is of course much quicker than the other two methodologies and this is the only way that you can do when you're looking at national inventories because you can do field testing in all every single landfill or dumpsite in a country.

And this is something that the federal Government of Canada basically is following. They have developed a more precise model to have a better understanding of methane emission from the landfills across the country. The thing with the models is that we have this expression, we say garbage in, garbage out.

You feed this with low quality data, you get bad estimates, poor estimations. But the more accurate data you can feed into the model, if it's a good model, then a better understanding and better more accurate understanding of the actual methane emissions you can get as an output from the model.

Typically, if it's even for a site specific for one single project, one site. What I personally try to do is to do interviews with the site operators. Find the guy who has been there for 20-30 years and I just talked to him about historical fires, about his observation about changes in waste composition. The best that you can get as a data to feed the model, the more accurate you can have the methane generation estimation.

From a financial point of view this is the cheapest way of doing the estimations. But from an engineering point of view, if I am going to invest a million dollar $2,000,000 in landfill gas collection or gas utilization project, I would not rely specifically on the model only. I would do some field testing as well.

The second alternative approach is field testing. As I mentioned US EPA Method 2E is one of these tests in which you drill one to four gas wells depending on the size of the site and you collect the gas basically using pump and you quantify how much the known mass of waste is generating how much gas.

And you run the test until you get to stabilize situation. And then based on that understanding you can adjust your modelling projections based on the actual field data that you gained from

this test. These tests usually takes about two to three months and a bit more pricier than just modelling a range 50 to 150 thousand.

Again depending on where you're talking about the cost of drilling the gas wells and how long it would take us to get to the stabilized situation in terms of the gas collection, the quantities and composition of the gas.

The beauty about this one is that not only you quantify how much gas is collectible or generated from that known area, which we call it a radius of influence of that well, it also gives you some information about the gas composition. If you're looking into gas energy initiative, you want to have some understanding about, for example, level of hydrogen sulfide in the gas or siloxide in the gas. It allows you to do some additional testing than just the gas quantity.

Disadvantages of this technique is you have to be really careful where you do the test because landfills are very heterogeneous, so one location can be completely different from another area. So even though the test gives you very good understanding of the location that you did the test on, but if it's say 100 hectare landfill, this result can be completely different from different areas of the landfill which has historically used in a different time with different waste composition or different even operator using that area of the landfill.

And the third is methane emission measurement. Basically you conduct a full scale fugitive methane emission measurement from the site and typically what is emitted from the site is what you can definitely collect by implementing a landfill gas collection system.

There are several techniques out there in the industry, anywhere from a ground based technique that you can measure on the ground to remote sensing. Nowadays aerial techniques using drone or airplanes or even satellites, but typically the lower end cost of the techniques range anywhere from $10,000 to $100,000 per site.

Again, it really depends on the size of the site. It's again, it doesn't have this advantage of the field testing, landfill gas pump testing that you get information from one location of the site right there you collect information from the entire facility that how much methane is being emitted from the site.

Now landfill gas management options. The previous workshop my friends James and Eddie talked about, when you're rehabilitating a dumpsite, you have different options.

If it's a really shallow landfill dispersed waste or dumpsite dispersed waste shallow, I mean like 1-2 meters of garbage, you basically are better off to remove that waste from the area and put it elsewhere in a sanitary landfill or a different site. If it's quite a bit of waste and the relocation is not justified, you basically can close and cap the site and rehabilitate the site basically. And the third option is that you improve the situation and then you transfer the site to a sanitary landfill or a transfer station for other uses that you can have on that site.

Depending on which approach you take, you have to select a landfill gas management option depending on the site situation. These are 6 common practices, not common it’s mostly used

practices when it comes to landfill gas management. One is a passive system which may or may not result in greenhouse gas emission reduction. The second is active gas collection system which always aim at GHG reduction from the site.

There are alternative solutions such as use of bio-cover systems or bio filter systems. Mariel mentioned briefly about the bio-cover system, which is an innovative technology and very low-cost good solution especially for developing countries if you don't have leachate generation issues I should say.

And then there are other gas management systems which are primarily for safety of neighbors to avoid gas migration from the site. And there's a no control system which is basically technically and practically not feasible to do anything with the gas and the quantities are so minimal that you can just vent it off to atmosphere.

OK, I need to speed up a little bit. I see I'm almost running out of time. So passive system, no mechanical driving forces used. Basically the system relies on concentration pressure or concentration gradient and it's a must if your landfill closure includes your membrane cap to avoid pressure build up beneath the cap that that can damage the closure system or encourage significant lateral migration of the gas to offsite properties. This is a picture that shows the landfill closure has taken place and you can see the gas vent which basically allows the gas to travel from beneath the closure system to atmosphere.

I mentioned these passive systems may or may not result in GHG reduction and this is an example project of a low-cost flare system. It's a passive solar flare system that is tied into a passive gas collection system and basically the combust methane to convert to CO2 that result in significant GHG reduction from this passive system.

The passive system comes at the low cost, capital cost of about 20,000 per hectare for collection and venting. It has a very low operational maintenance cost. It relies on positive pressure system so there is always a risk of gas pressure build up within the landfill and encouraging gas migration off site gas migration.

It does have gas collection inefficiencies because you're not actively collecting the gas and it can be advanced to GHG reduction option using a passive flare system or a biofilter system. I would usually estimate about 50% efficiency in collection and GHG reduction. That additional cost that you need for that GHG reduction component is about 50,000 to 100,000 per project and it does come with an operating, maintenance and operating cost of 10 thousand to 20 thousand per year.

Active gas collection systems. The difference between passive system and active system is the mechanical driving force that you use in active gas collection system to create a vacuum within the landfill and basically suck the gas out of the landfill. It always aims for GHG reduction when it's feasible and finances make sense.

It can also be used for gas utilization initiatives. For a mid-sized landfill, say 15 to 30 hectare landfill, the capital cost ranges anywhere between 100 to 150 thousand per hectare for

collection and flaring for burning the gas. If you want to do gas to energy, there's additional capital investment required.

Operation and maintenance cost ranges anywhere between 10,000 to 15,000 per hectare per year. And typically in my designs, I make an assumption of 75% GHG reduction approximately. Again, it depends on type of the closure system and how the gas collection system is designed.

Yeah, I'm done. I have three minutes, I guess, for questions.

Matt Hamilton:

That's great. Thanks, Dr. Abedini. That was a great whirlwind tour through the various collection approaches at the end there. We do have a couple of questions which I will. The first one is with the models you were talking about- I guess the person's wondering about how are actual data used to ground truth some of the models. I think it varies but I'll let you answer.

Dr. Ali Abedini:

A very good question. I showed the graph with different models used for a single site. Some of the models basically assign one decay rate and one methane generation potential to the model regardless of waste composition, regardless of how the landfill is operated.

This is the least accurate model that I would have used. The more advanced models, they look at the waste composition, they assign different decay rate to different type of organics. They assign different methane generation potential to different type of organics.

Again then when it comes to landfill operation, when it comes to historical fires, when it comes to aerobic condition, this is the modular expertise to take into take those data into consideration. When it comes to things like methane correction factor I made a joke about the cow factor. Basically you can make some assumptions when you do the modeling given that you have reliable data about history of the landfill and how it's operated.

Matt Hamilton:

Yeah that's great. Thank you for that. We have time I think hopefully for one more question. It has to do with the use of drones, but in this particular case we're talking about for total site emission estimates. Is that something that you see that's used regularly? Not at all? This particularly in the US, but I think we could comment more broadly about the use of drones for total site emissions.

Dr. Ali Abedini:

Yes, it's definitely an emergent technology. The picture I showed you that I was scanning the site basically I would measure the surface methane concentration and then using a technology that I have developed, I would convert those concentration to flux. You could do the same thing with drones.

Basically they're drones equipped with certain instruments that you can measure methane concentration at the surface of the landfill or path integrated methane concentration. And then there are models that you can use to use that concentration data and convert them to emission rates. All these methodologies, including my own technique, these are emerging techniques which are now being tested in industry.

There are debates on which one is best. Like now there's satellite techniques that I myself want to learn a bit more about accuracy and resolution of the data. But in brief, yes, there are also drone techniques which are looking into doing not only the surface methane concentration, but also to quantify how much methane is emitted from the site.

Matt Hamilton:

Yeah, thanks for that. I would say like from my myself as well, like I'm aware of several, let's say, methods that are in development to kind of formalize like how these drones can be used in various types of measurements, whether that's for leak detection, type approaches or total site emissions. You should kind of watch this space because I think more methods and formal methods let's say are under development. OK. I think we've reached the end of our time together and it came quickly. I just want to reassure people, there have been a number of questions. Yes, the slides will be available and the recording of today's webinar, you can find it on the global methane.org website. Thank you for that. And I want to thank Dr. Abedini for his wonderful presentation as well. Marielle, so thank you so much for both of you, for the audience, just so you know, we will be planning, we are planning a few more of these webinars. Please stay watching your e-mail. We'll be sending another invite shortly for the third webinar and I believe we have a fourth one in the works as well. Hopefully you're enjoying this as much as I am and getting a lot out of it. And yeah, thank you for your participation and we hope to see you again. With that, we'll say goodbye. Thank you.