Q&A Via Chat at Online
Bioplant Manawatū Community Information Forum 9th March 2022

Bioplant Manawatū New Zealand Limited (Bioplant Manawatū) held an online community information forum on 9th March 2022, to share information related to its application to Horizon's Regional Council, New Zealand, for resource consent for discharge to air. A media release and the PowerPoint from the forums for the Bioplant presentation can be found here. During the event, with more than 100 were in attendance and questions were posted to speakers via the chat, not all could be responded to. This document provides themed responses from Bioplant Manawatū (second column) to the verbatim questions (right hand column).

Theme	Theme Response	Actual Questions asked through Chat
GENERIC QUESTIONS		
Where the technology is already operating	Pyrolysis technology is gaining traction. For example, a 2022 article, in the peer-reviewed journal *Energies*, concludes that pyrolysis should be implemented on a large scale in Poland to improve the indicators of municipal waste management.	• Is this plant practically working currently anywhere in NZ?

	It is noteworthy that in the same week this community information forum was held, the European Commission announced that their rules on fertilising products (to be implemented in July 2022) is being extended by adding pyrolysis and gasification materials. The Ministry For Environment guidelines for Waste to Energy in New Zealand refers to pyrolysis as a waste-to-energy technology (and defines it as distinct from incineration) for New Zealand waste industries. Bioplant Manawatū project complies with the principles and guidelines laid down by the Ministry for Environment. GGII pyrolysis plants have been operational since 2009 across Korea and Japan. The CONVERTING WASTE PLASTICS INTO A RESOURCE report commissioned by the United Nation Environmental Program (UNEP) highlights samples of pyrolysis plants in Japan. Bioplant Manawatū will be the first GGII pyrolysis plant in New Zealand.	
Economic viability	Bioplant Manawatū is a private company with private investors, across suppliers, license holders, local community groups and individuals. GGII are insured for performance guarantee and Bio Plant Manawatū NZ will insure against borrower default and credit enhancement insurance bond from a AA Rating Insurance company. Our off takers are rated AA and will hold insurance of non-payment of invoices. Economic viability has been independently assessed by Black & Veatch and the financial stability of the company has been confirmed.	• I am worried about private companies "going bankrupt" and walking away from any mess they have made. How can we be reassured on this? Will there be an advanced payment of a bond to cover this?
Working with mana whenua	Honouring mana whenua is important to Bioplant Manawatū. Engagement with mana whenua started when the concept was first discussed with MDC,	• Horizons has allowed the pollution of our whenua and awa for

	they were informed through their officers of the project progress as well as about other areas of common interest. Bioplant kept mana whenua contacts informed about the process updates, technical assessments of emissions and proposed mitigation activities - including the Horizons' Assessor's report on the Air Quality which concluded, based on the data, that there would be no adverse effect on health and the environment. Bioplant project has a Cultural Engagement Protocol with Ngāti Kauwhata, the document is available on Horizon's list of documents released.	generations. How do you envisage working with mana whenua? • Have any of the iwi stakeholders in the Manawatu identified any issues with this project? What are these (if any)?
Consultation process	As part of the Section 92 requirements issued to Bioplant in 2021, Horizons required Bioplant to consult with 4 named iwi (the requirement was for written agreement to the project). Now, as a publicly notified process under the Resource Management Act, the general public are invited to write submissions before 31 March 2022. This Community Information Forum was offered by Bioplant to provide better information to the general public on the project. No recording was done for privacy considerations, but enquiries for more information from the project team can be directed to ttaupo@bioplant.co.nz .	• Can you advise when public consultation occurred by Horizon? • Is anyone recording this privately, so we might all view it later?
FEEDSTOCK AND INPUT QUESTIONS		
Inputs	At each start-up (up to 6 times a year), LPG is used for up to 20 minutes to heat up the pyrolysis chamber. After this start-up, the heat exchanger takes over to facilitate the continuous heating of the pyrolysis chamber. Water is required as part of the pyrolysis process, but the water used is recycled, treated water which has been extracted from the MSW. Bioplant will have its own wastewater treatment facility as part of the plant. Up to 30,000 litres of water per day will be extracted from the MSW waste stream,	• What natural resource inputs are required and to what quantity eg water?

	70% of which is re-used for the pyrolysis process. The remainder is used for other on-site amenities (for example, ablutions) and any surplus run-off is directed to the nearby Manawatū wastewater treatment plant.	
Tyres feedstock	Tyres pyrolysis, as mentioned in a recent review article, "has emerged as a clean and promising technology for tyre recycling, as it can break down very large volumes of tyres to higher-value products while producing relatively low emissions" (Murillo et al,. 2006, cited Jones et al, 2021). The GGII pyrolysis technology is used by Hankook tyre factory in Korea. The narrative that tyres was removed from the application because tyre pyolysis has not been successful elsewhere is incorrect. The Horizon's technical assessor only assessed the data relating to MSW.	• Someone (I think at EPA) said pyrolysis of tyres had been attempted in NZ many times but never successfully. This is why tyres were removed from the application. • So Bioplant wanted to pollute with tyres but was told that it would be too toxic. So does Bioplant really care about the environment? • Why did the assessor say that you could not process tyres?
Types of feedstock (general)	In Manawatū, only sorted municipal waste is currently being proposed. All PVC and any plastics that can be recycled will be extracted first.	• Is that mixed waste? Or just tyres? • Pipes were included in the list. These are usually PVC. Will these chlorinated plastics and other potential nasty-forming materials be included in the feedstock?
Where feedstock comes from	Bioplant is modular and scalable, which means it does not require large amounts of feedstock to be transported from across New Zealand. The size of the plant has been chosen according to the needs in the Manawatū region for diversion of non-recyclable waste from the regional landfill. Feedstock waste will come primarily from the broader Manawatū, but the facility would be able to receive feedstock from neighbouring regions which would otherwise be taken to the regional landfill.	• So will this plant will be converting waste from how many areas? Just ours? Or from around the country?
Processing feedstock	The newly developed Manawatū Resource Recovery Park is the context in which this Bioplant sits. Whether Bioplant establishes here or not, the sorting	• So the local jobs include working in a dirty MRF hand sorting materials

	of waste is already happening in this resource recovery centre. In addition, there will be both manual and automated sorting systems in operation. The Bioplant project will create employment (software & mechanical engineers), training, educational and research opportunities for the region.	that can't go into the pyrolisis plant from the food scraps and dirty nappies? • Manual sorting in the BPMNZ plant to remove tyres, PVC and inorganic materials
SAFETY & CONTROLS QUESTIONS		
	An independent technical Air Quality Assessor's report (Paddle Delamore Partners), commissioned by Horizons, concluded that any environmental impacts are "less than minor". This means any contaminants in the air discharge are well under the national standard requirements in the NESAQ (National Environmental Standard-Air Quality). Unfortunately, Horizons has not included this report in the public notification documents. However, the excerpted table of data below indicate very low contaminant values.	• The major public concern is air disc harges from the Plant, affecting the l and. surroundings and people in clo se proximity. • What data do you have for plants bu rning similar wastes to that propose d at Feilding? PM and acid gases ar e all very well, but emission rates of toxic organics and heavy metals are very important. Does this data exist ?

	Table 1: Assessment of NESAQ Compounds | Parameter | Units | GLC | Background | Cumulative GLC | Percentage of Standard | | PM_{10} | µg/Sm³ | 0.121 | 33.22 | 33.35 | 66% | | $PM_{2.5}$ | µg/Sm³ | 0.121 | 10.96[1] | 11.08 | 44% | | NO_x | µg/Sm³ | 2.7 | 58 | 60.7 | 30% | | SO_2 | µg/Sm³ | 0.216 | 3.72 | 3.94 | 1.1% | | CO | µg/Sm³ | 0.324 | 135.3 | 135.6 | 1.3 | *Notes:* *1. Based on Guidance from Auckland Council which indicates that in rural areas $PM_{2.5}$ is 37% of PM_{10}* | | Units | GLC | GLC % | BG | BG % | NESAQ | Cum. GLC | % of NESAQ standard | | **PM10** | µg/Sm3 | 0.121 | 0.242% | 33.22 | 66.44% | 50 | 33.34 | 66.7% | | **PM2.5** | µg/Sm3 | 0.121 | 0.484% | 10.96 | 43.84% | 25 | 11.08 | 44.3% | | **NOx** | µg/Sm3 | 2.700 | 1.350% | 58.000 | 29.00% | 200 | 60.70 | 30.4% | | **SO2** | µg/Sm3 | 0.216 | 0.062% | 3.72 | 1.06% | 350 | 3.94 | 1.1% | | **CO** | µg/Sm3 | 0.324 | 0.003% | 135.3 | 1.35% | 10000 | 135.6 | 1.4% | Ground Level Concentration of pollutants from BPMNZ, compared to NESAQ. Background concentration of pollutants at Feilding, Manawatu. The data used in the above assessment came from the three different pyrolysis plants using the same GGII technology in Korea to pyrolyse municipal solid waste (MSW). The tables above show the level of background pollution compared to the NESAQ requirement which is already in Fielding in the BG% column. The column on the far right shows the difference with the plant operational.	
Plastics	Pyrolysis for dealing with plastic waste is widely accepted as a viable option in addition to waste prevention and reduction, reuse and recycling measures. According to comprehensive global analyses undertaken by Boston Consulting Group: "Pyrolysis has some distinct advantages… It is adept at handling a variety of plastic types that mechanical-recycling centers typically reject. While pyrolysis uses heat, the only carbon dioxide it emits is from the	• Don't all plastics have additives? How would you be able to discern which plastics have chemicals of concern and which do not? • My understanding is that PVC and PS have high baseline toxicity, but no plastics are pure oil feedstock,

	energy source that generates the heat. As a result, its carbon footprint is much lower than that of incineration." The Boston Consulting Group review concludes that: "Within the current hierarchy of solutions, plastics conversion—specifically pyrolysis—can play an important role in mitigating the environmental impact of plastics in the near to medium term. The more companies, governments, and institutions invest in or support conversion technologies, the greater their ability to contribute to solving this global environmental problem." In the Manawatū, plastic in MSW waste stream is averaged to be 13% at landfill, according to the data from local governments in the region. Bioplant Manawatū will minimise PVC in the feedstock through a manual and a customized automated sorting system (Artificial Intelligence).	they all have additives... including food contact materials, and many of these are chemicals of concern and persistent organic pollutants.
Controls to manage toxins	The GGII Pyrolysis employs a triple contaminant management process as explained by Dr Erfam's video (item 13), including Scrubbing and Air Pollution Control Devices (APCD). Data for the resource consent application came from existing MSW plants in Korea using the GGII technology, which shows the optimised temperature range to operate is between 650-850 degrees to minimise contaminant formation. The following processes which are part of GGII pyrolysis technology also help with contaminant management: • The Preventative Emission Monitoring systems (PEMS) - this is an in-built monitoring system • Customized automated sorting system on the front end to remove known "excluded items" from feedstock	• What temperature will the plant run at? I understand this is too low to deal with dioxins. So what happens to the scrubbers etc once they are spent and full of dioxins? Go to landfill? • PAhs and toxic metals into the air? • It contains a lot of hazardous materials - would you pull that out cadmium lead etc • What data do you have of actual measurements of heavy metals and toxic organics from similar plants elsewhere? • How will you manage (Non intentionally added substances)

	The Horizon's Assessor report provides a lot of the answers regarding the level of contaminants and toxins from the data. Numerous attempts to get Horizon to publish the report has not been successful. Research also supports that pyrolysis is a technology which is capable of destroying and minimising toxins, such as PFAS and Dioxins	NIAS in the feedstocks and produced during pyrolysis? • The question was about NIAS in terms of chemical/toxic contamination. This is particularly problematic with pre-recycled materials. NIAS (toxicants) will also be produced in the pyrolysis process.
CHAR & BIOCHAR QUESTIONS		
Char and biochar toxicity	Bioplant Manawatū is committed to ensure all outputs are safe for the environment and comply with NZ standards as explained by Dr Erfam; GGII Technical Advisor on low level contaminants. Due to the carbonated output in the form of biochar/char from the pyrolysis process there are several benefits such as: • resource for agricultural applications as a soil enhancer • activated carbon for filtration purposes. These are known applications and Bioplant Manawatū has a contracted End-User for the biochar/char products.	• Two of the other speakers have indicated that there is a difference between char and biochar depending on feedstock. What are the differences? Is the non bio char toxic and therefore cannot be sequestered? What is the fate of non bio char? Combustion and release of carbon dioxide into atmosphere? • Is the bio char toxic if toxic plastics are the feedstock? The charcoal in the Amazon would not be the same as the material that will be fed to this machine. • How much by-product that is redistributed is safe for the land? • In Germany, MSW pyrolysis char has been classified as hazardous waste - is the residual char from pyrolyzing plastics and other

		synthetic materials the same as "biochar", and if not, what are some of the key differences? • Good brief presentation tonight. You may want to refer to the IBI standards document. • This is more about chemicals rather than materials
Amount of char and biochar produced	Not all GGII pyrolysis set ups are the same – there are different hybrid systems depending on the output requirements. Some examples of different set ups are: synthetic oil, carbon black and steam, electricity. The setup for Manawatū is for synthetic fuel, electricity and biochar- with estimated output of biochar of up to 2 tonnes per day.	• Clarification, is the claim that from 70 tonnes of materials combusted each day, the residue is 5 kg?
What happens to the char and biochar	Bioplant char/biochar outputs will be passed on to a contracted end-user after regular testing for contaminants.	• How does the char get redistributed, and to where? • How will the char leftovers be redistributed, and to where?
RECOVERY OF FUEL QUESTIONS		
Bioplant fuel recovery as green	The climate emergency calls for different shades "green" to cross borderlands and find common ground. Bioplant Manawatū may represent a particular shade of green, but it is green nonetheless because the fuel the waste pyrolysis produces directly reduces reliance on imported fossil fuels. New Zealand imports almost all its fossil fuel for transportation and industrial uses, which means it imports GHG when the fuel is combusted in New Zealand. In this case, Bioplant Manawatū is providing import substitution. By partly recovering the MSW into synthetic fuel, we are using our own "recovered once" synthetic diesel, renewable energy as well as saving on fuel import costs while avoiding GHG import.	• I am concerned that the process is promoted as green, but the products created are basically carbon-containing fuels that when burned put greenhouse gases into the atmosphere. Why, then, is the pyrolysis being promoted as green? • Also, can the synthetic gases and fuels be considered renewable when one of the key inputs that will be processed is plastic waste which comes from non-renewable fossil

	While there are philosophically different views about synthetic fuel not being renewable fuel, the fact is that all fuel is currently being imported into New Zealand from overseas (with imported GHG). If the chemical company uses our Bioplant pyrolysis oil (equivalent to crude oil), Bioplant will be called "renewable".	oil, and which otherwise wouldn't be combusted?
Emissions calculations	The Bioplant technology is targeted at recovery of resources being destined for the landfills, those that cannot be economically recycled by our traditional recyclers. The biogenic materials in the MSW mix will decay and start emitting GHG for more than 20 years after the landfills have been closed. Associated with landfills are all the environmental hazards like leachate, fire, and landfill breaches. Bioplant will prevent some of these plastics and rubber waste from decaying over a very long time. The Bioplant processes those wastes into useful resources. Resources produced from the waste include: renewable electricity (from waste heat harvesting); bio fuel (if only biomass feedstock is used), synthetic fuel (if the feedstock is a mixture of biogenic and non-biogenic materials, as is the case for MSW). The refined diesel via the catalytic hydrocracking has been very efficient to convert the pyrolysis oil to refined diesel exceeding EN590 EURO6 standards (please refer to NESTE report on biofuel production via hydrocracking). The quality of synthetic or biofuel that is achieve through the refining process is similar to biofuel, the differentiation is the source of the feedstock – whether they of biogenic material. New Zealand imports almost all its fossil fuel for transportation and industrial uses which import GHG when the fuel is combusted in NZ. In this case it's called import substitution. By partly recovering the MSW into	• Has Bioplant included the greenhouse gas emissions from the synthetic diesel that will eventually be burnt in its carbon calculations? • Kia ora, I have two questions about Bioplant's claims that the technology will offset greenhouse gas emissions and produce renewable energy and fuel. Firstly, does Bioplant include the greenhouse gas emissions that will come from burning the 14,000L of synthetic diesel produced per day when you discuss the carbon footprint of your technology, particularly when evidence shows that synthetic diesel is less efficient and more carbon-intensive than conventional diesel? Surely this would negate any carbon emission savings? • And second, can these fuels be considered renewable when one of the key inputs you will process is plastic waste which comes from

	synthetic fuel, we are using our own "recovered once" synthetic diesel, saving on fuel import cost as well as avoided GHG import. For the accounting of GHG emissions, Bioplant Manawatū does not claim GHG saving from the synthetic fuel. This is in line with Ministry for Environments 2021 GHG Accounting Guideline. According to the guideline' the savings in GHG avoidance using biofuel (at 14,000L biodiesel daily) would have been 13,000 tons Co2 eq/yr. The NESTE report shows that the total life-cycle analysis of well to tank shows that synthetic/bio fuel GHG emissions is between 70% to 80% less than conventional fossil fuel extraction and refining process. The new synthetic and biofuel burns about 10%-15% cleaner than conventional fossil fuel. The off-taker for Bioplant's synthetic /bio-diesel are oil majors. They are very stringent with their qualification and testings.	non-renewable fossil oil, and which otherwise wouldn't be combusted? • Has Bioplant included the greenhouse gas emissions from the synthetic diesel that will eventually be burnt in its carbon calculations?
DECARBONISATION QUESTIONS		
CO2 storage	Biochar can remove CO2 from the atmosphere. It also improves soil quality in many ways: It gives soil structure, stores water and nutrients that plants need and feeds vital soil organisms. Refer to NESTE report.	• How much benefit in capturing and storing CO2 in the charcoal used as biochar in the soil?
Carbon accounting and renewability	Bioplant commissioned a report from Price Waterhouse Coopers to account and confirm the calculations of decarbonisation for this project and we can decarbonize 34,000 tonne of CO2 per year for the next 25 years (equivalent of removing over 7,000cars off the road per year) While reduction in landfilling is a goal, we cannot be certain that future landfill mining would be cheaper as you have already paid to dispose and now you would have to pay again to remove them. There will be "footprints" from that landfill mining process as well. Also got to consider emissions and leachates issues with landfilling.	• Is it recognized that combusting the materials will forever destroy them, in contrast with all current principles of recovery and reuse, and also noting that landfill mining in future could recover them at economic prices. • Is it recognized that destruction of the materials is a signal to the community to not bother with resource recovery, and notably the

	Education and collaboration are key. Bioplant has a corporate social responsibility program to work with recyclers to ensure recovery and reuse activities are supported and enhanced.	option later to recover the resources was landfill mining gets better technologically and cheaply, e.g. ferrous and precious metals etc.? • I'll jump in to the carbon accounting questions, since I have professional experience in this space. When the feedstocks used are predominantly biomass, any condensable fuels coming from the pyrolysis are effectively carbon neutral. They are atmospheric carbon being re-released