
Bioplant
Community Information Forum
Wed 9th March, 7-8pm

Overview

Speaker 1: Bioplant NZ license-holder (Anthony Manu)

Speaker 2: Bioplant Manawatū team (Taupo Tani)

- What part of the solution will BPMNZ provide? What steps has BPMNZ taken so far?

Speaker 3: Guest independent scientist – Prof Jim Jones, Massey University

- Science of pyrolysis, how pyrolysis plants work and the type of feedstocks that are pyrolyzed to produce a range of products. How pyrolysis differs from other thermal processing techniques. Where pyrolysis sits in the debate on emissions reductions compared to other thermal processing techniques.

Speaker 4: Scientific Advisor to BPMNZ (Dr Peng Hong Koh)

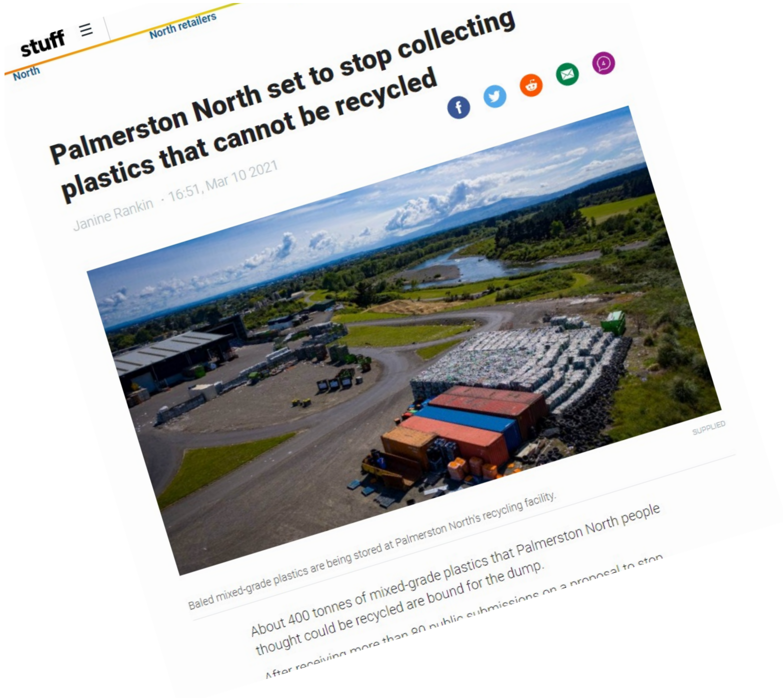
- Waste stream profile for BPMNZ. How does the BPMNZ technology work? What safety standards has BPMNZ's pyrolysis met?

Speaker 5: Technical advisor to GGII (Dr Erfan Ibrahim)

Responses to Q&A

Wrap up

SOURCE: Photo credit Laura Richards


stuff
North
North retailers

Palmerston North set to stop collecting plastics that cannot be recycled

Janine Rankin · 16:51, Mar 10 2021

SUPPLIED

Baled mixed-grade plastics are being stored at Palmerston North's recycling facility.

About 400 tonnes of mixed-grade plastics that Palmerston North people thought could be recycled are bound for the dump.

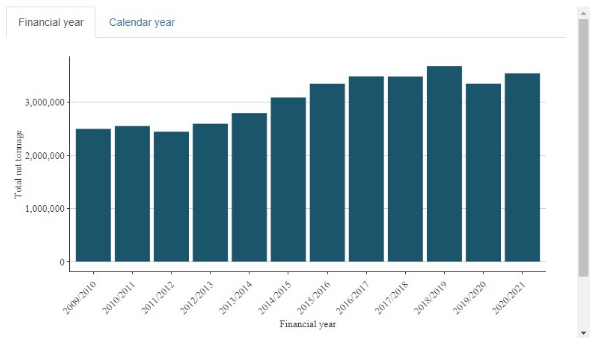
Scale of the problem

- 3.6 million tonnes/year of waste going to Class 1 landfills in NZ
- Overseas market for NZ's plastic recycling dried up
- Manawatū region sends 125 tonnes of waste per day to Bonny Glen landfill
- Total waste to Bonny Glen landfill averages 671 tonnes per day

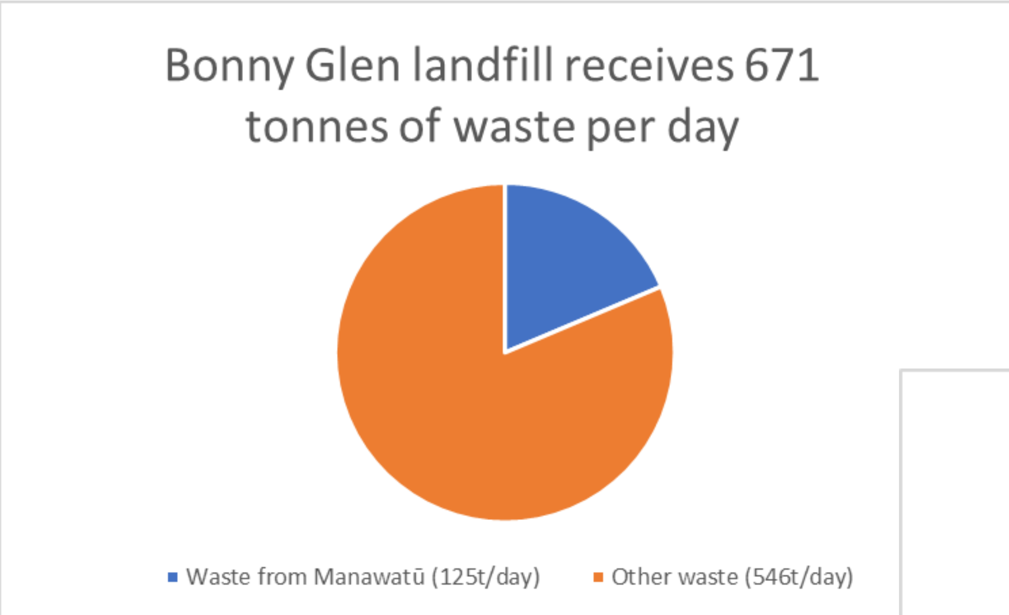
Click to add text

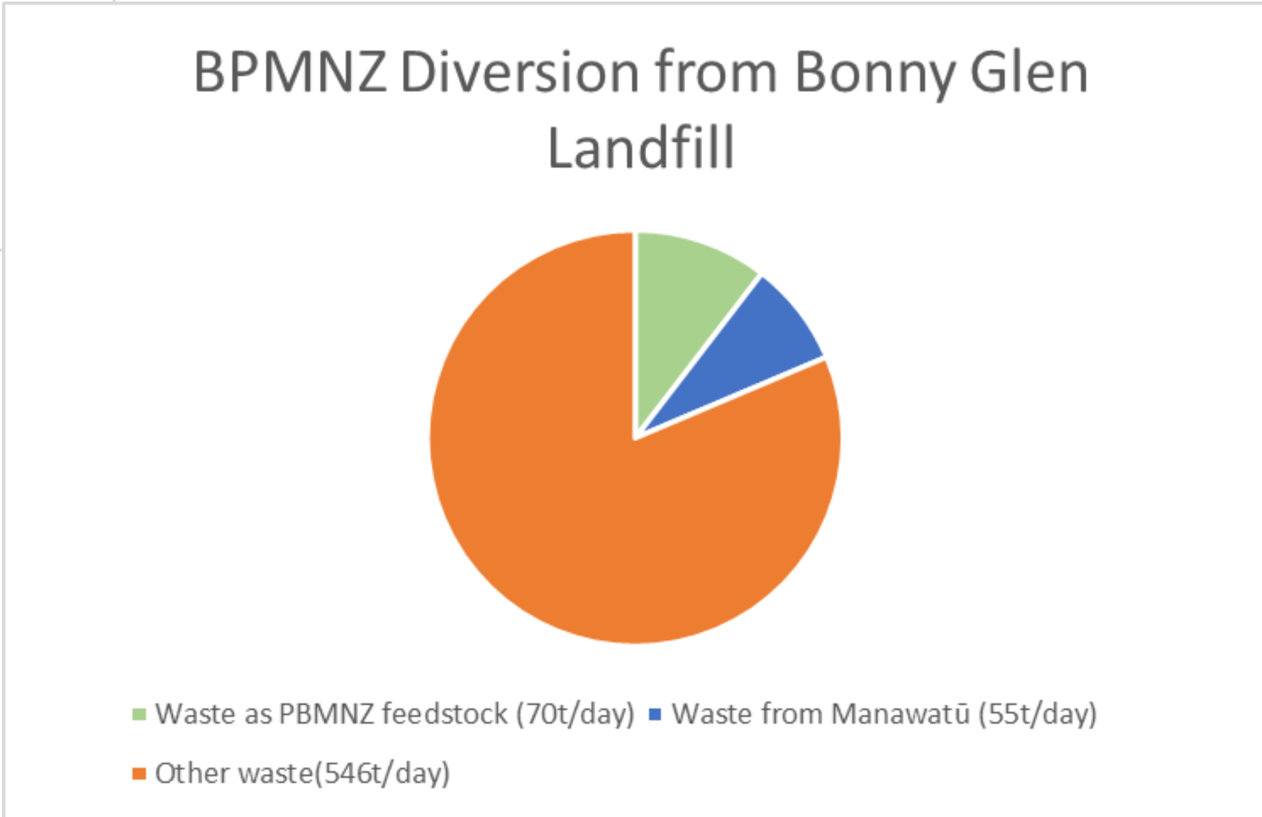
SOURCE: Photo credit Bevan Conley

Total tonnage of waste to Class 1 landfills



Source: Online Waste Levy System


Bonny Glen landfill receives 671 tonnes of waste per day
Waste from Manawatū (125t/day)
Other waste (546t/day)


BPMNZ Diversion from Bonny Glen Landfill
Waste as PBMNZ feedstock (70t/day)
Waste from Manawatū (55t/day)
Other waste(546t/day)

What BPMNZ pyrolysis offer Manawatū?

- Energy and resource recovery and net emissions reduction
  - Integrated waste management approach – takes non-recyclable waste
  - Operation from a site already zoned and set up for waste management
  - Modular design so waste not transported overseas or across NZ
- Rate-payer burden lightened with private investment valued at $27m
- Collaboration with stakeholders

Figure 2: Waste minimisation hierarchy and resource recovery and disposal infrastructure (Te Waihanga, New Zealand Infrastructure Commission, 2020, adapted from s44 Waste Minimisation Act 2008 and Auckland Council, 2018).

SOURCE: https://infracom.govt.nz/assets/State-of-Play-Resource-Recovery-and-Waste-Discussion-Document-March-2021.pdf

RECENT EUROPEAN ROUNDTABLE CONCLUSION:

"For complex plastic waste streams, chemical recycling including pyrolysis for fuel recovery can be considered as a valid option… to achieve EU recycling targets"

https://cinea.ec.europa.eu/system/files/2021-12/ECOMONDO%20-%20Chemical%20recycling%20-%20summary%20report%20rev%20%282%29.pdf


Cornell engineers propose new recycling method for medical PPE waste

The method, called pyrolysis, is a medium-temperature reaction that can reduce the PPE back into an original form.

January 31, 2022
Posted by Haley Rischar

SUBSCRIBE

Medical Waste
Sustainability

NEW RESEARCH:

"Fast pyrolysis is proven to effectively convert waste PPE into value-added products. The pyrolysis method can replace PPE incineration or sending it to landfills, which is what happens now."

Zhao et al (2022) Energy and environmental sustainability of waste personal protective equipment (PPE) treatment under COVID-19. *Renewable and Sustainable Energy Reviews*, 153 (111786).

NEW RESEARCH:

"the proposed optimal PPE processing system **avoids 41.52 percent of total landfilling and 47.64 percent of the incineration processes**. This method shows an **environmental advantage by reducing total greenhouse gas emissions by 35.42 percent emissions from conventional incineration and energy saving by 43.5 percent from landfilling**"

Zhao et al (2022) Energy and environmental sustainability of waste personal protective equipment (PPE) treatment under COVID-19. *Renewable and Sustainable Energy Reviews*, 153 (111786).

BPMNZ key events so far...

- Nov 2018 – Bioplant Sub-Licence for NZ acquired by Anthony Manu
- Sep 2019 – Bio Plant Manawatū NZ Limited incorporated
- Dec 2019 - Project presentation to MDC
- Jan 2020 – Project presentation to 3 office holders of Ngāti Kauwhata and Ngāti Raukawa
- Feb 2020 – Courtesy call to Ngāti Apa headquarters
- Aug 2020 – Discussion with Massey University pyrolysis scientists
- Mar 2021 – RC application to HRC
- May 2021 – s92(1) additional information requested by HRC Technical Air Quality Assessor plus requirement to get written feedback from 4 iwi

BPMNZ key events so far…*[cont]*

- Aug 2021 – Horizons independent Air Quality Technical Assessor concludes:

  "the discharge to air will not result in any adverse off-site effects"

- Oct 2021 – lease, waste and fuel off-take agreements confirmed
- Oct-Nov 2021 - Letters of support received: Ngāti Kauwhata (7 Oct), Rāngitane o Manawatu (20 Oct), Ngāti Apa (30 Nov).
- Nov 2021 – HRC notifies s92 requirements fulfilled and decision deadline 17 Dec
- Dec 2021 – HRC requests s37 extension to 17 Dec; 16 Dec HRC provides draft resource consent approval document with conditions and which concludes:

  the air quality effects of the discharge to air are "less than minor" and the cultural effects are "less than minor"

- Jan 2022 – BPMNZ agrees to draft resource consent conditions
- 3 Mar 2022 – Public notification

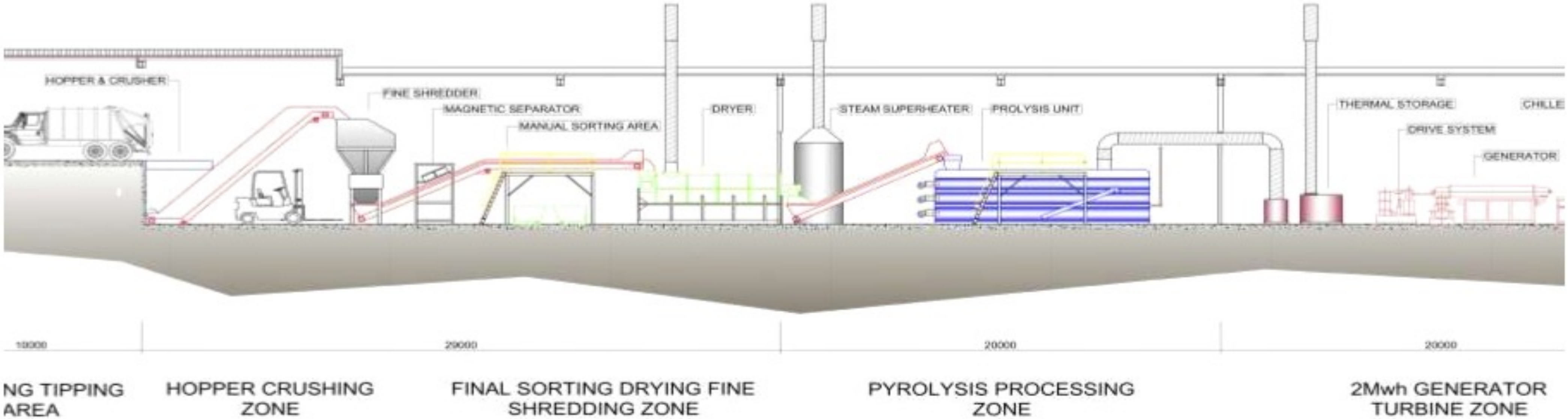
Prof Jim Jones

Professor and Research Lead, School of Food and Technology, Massey University

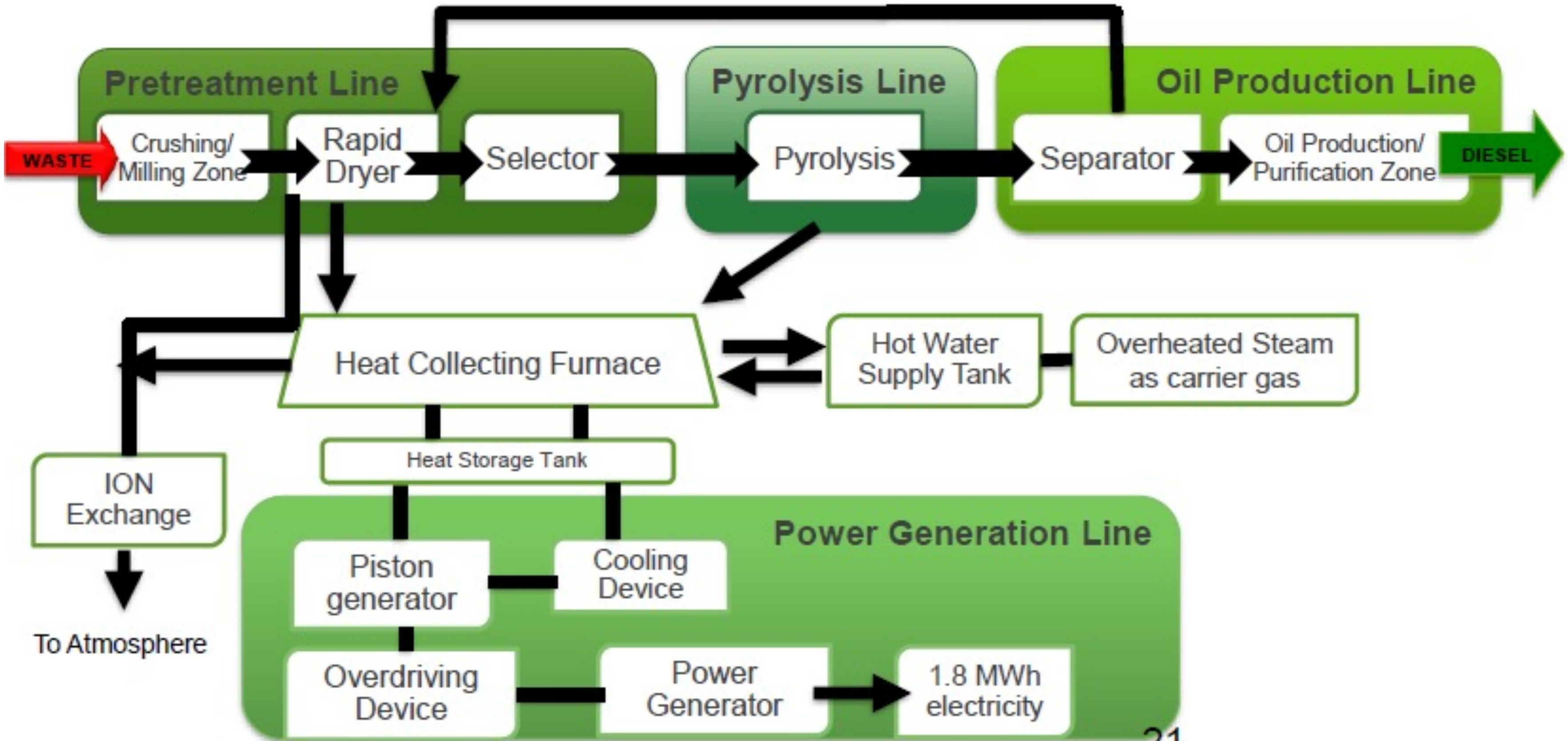
Dr Peng Hong Koh

Scientific Advisor to BPMNZ

Technical & Process Flow – BPMNZ Bioplant


HOPPER & CRUSHER
FINE SHREDDER
MAGNETIC SEPARATOR
MANUAL SORTING AREA
DRYER
STEAM SUPERHEATER
PROLYSIS UNIT
THERMAL STORAGE
CHILLE
DRIVE SYSTEM
GENERATOR
10000
29000
20000
20000
NG TIPPING AREA
HOPPER CRUSHING ZONE
FINAL SORTING DRYING FINE SHREDDING ZONE
PYROLYSIS PROCESSING ZONE
2Mwh GENERATOR TURBINE ZONE

Overview



Pretreatment Line
WASTE
Crushing/ Milling Zone
Rapid Dryer
Selector
Pyrolysis Line
Pyrolysis
Oil Production Line
Separator
Oil Production/ Purification Zone
DIESEL
Heat Collecting Furnace
Hot Water Supply Tank
Overheated Steam as carrier gas
ION Exchange
To Atmosphere
Heat Storage Tank
Power Generation Line
Piston generator
Cooling Device
Overdriving Device
Power Generator
1.8 MWh electricity

Bioplant

Process Description

1. Feedstock Pre-treatment
   - Waste Feedstock Storage
   - Waste Pre=sorting, tipping
   - Waste Crushing
   - Final sorting, drying and shredding
2. Waste Treatment (Pyrolysis)
3. Power generation
4. Oil Refinery (Synthetic diesel production)

Bioplant

Refinery for the Pyrolysis Oil

- Output: 14,000 litre of synthetic diesel daily
- Standards: NZ Fuel Regulation Standards SR 2011/352
- Process: catalytic hydrocracking
- Processes : UOP Honeywell & Tipton Ceram

Air Dispersion Modelling for BPMNZ

Bioplant

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 NESAC 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.

NESAQ Standards & Guidelines for Ambient Air Quality

"Overall PDP is comfortable that the combustion related emissions will not result in any exceedance of the NESAQ".

"PDP considers that this approach represents ***best practice*** *for odour control and should minimise the potential for fugitive odours from the process"*

Built-in Pollution Control System

- Semi-dry ion exchange scrubbers
- Baghouse filters for particulates
- Advanced Air Pollution Control Devices (APCD) – including additional activated carbon sandwiched between filters.
- According to the independent assessor this is "Best Practice in the market"

Bioplant

Bioplant plants are Net Carbon negative

Dr Erfan Ibrahim

Technical Advisor to GGII – on contaminants


Bioplant
responses to
Q&A


Bioplant
Wrap Up

How "Green is Bioplant" – The Overall Process is carbon negative

Table A: GHG Emissions - estimates for Bioplant MNZ (MSW) - Twin Chamber

Emission source	Activity data	Activity data unit	Emission factor(s)	Emission factor unit	GHG emission (t CO_2-e)/yr	Notes*
SCOPE 1						
Pyrolysis syngas - CO_2 component	-	-	-	-	1010	Mass balance calculated in *Bioplant WAA_GHG emissions.xls* - (Fig 5 Mass Balance
Syngas combustion in power generation (CH_4 & CO)	-	-	-	-	400	Mass balance calculated in *Bioplant WAA_GHG emissions.xls* - Fig 5 Mass Balance (15% syngas for heating incoming feedstock).
Start-up LPG for burners	3.36	GJ of LPG	0.0602	t CO_2-e/GJ	0.202	LPG for burner start-up only, 12 times/yr at ~ 140MJ per start up. Emission factor from Measuring Emission: A Guide for Organisation - Table 3
Onsite forklift (LPG) emissions	5	kilolitres of LPG	25.7	GJ/kL	-	LPG consumption based on 1 onsite forklift. Energy content factor & emission factor from Measuring Emission: A Guide for Organisation
	128.5	GJ of LPG	0.0602	t CO_2-e/GJ	7.7	
				Total Scope 1	1418	
SCOPE 2						
Site-wide electricity use	2,943,000	kWh	0.0001101	t CO2-e/kWh	324	Measuring Emission: A Guide for Organisation (NZ 2020) - Table 9 Electricity
				Total Scope 2	324	
				Total scope 1 & 2 GHG emissions	**1,742**	
EMISSIONS AVOIDED						
MSW to landfill emissions	28,000	t/yr raw MSW	1.244	MTCE/wet tonne **	(34,832)	MSW emission factor from Measuring Emission: A Guide for Organisation (NZ2020) - Table 31 Wt. Ave.
Crude oil production emissions	4,508	t/yr oil production avoided	0.000004	t CO_2-e/t throughput	(0.02)	Assume floating tank
	23	t fuel flared	3.2	t CO_2-e/t fuel flared	(72.1)	Assume 0.5% by wt of throughput is flared
Electricity production (Vic)	15,768,000	kWh	0.0001101	t CO2-e/kWh	(1,736)	Measuring Emission: A Guide for Organisation (NZ 2020) - Table 9 Electricity
				Total Emissions Avoided	(36 640)	
				NET EMISSIONS	**(34,898)**	Net GHG negative. Equivalent to removing 7,500 cars from the road

Bioplant Pyrolysis Waste to Energy Plant, Manawatu, NZ

Waste Generation and Treatment Destinations (2017)

	Class 1	Class 2	Class 3	Class 4	Farm Dumps	Recovery	Total
(2015)							
Tons/year	3,220,888	2,575,771	64,394	3,799,262	1,362,743	4,288,743	15,311,725
%	21.0%	16.8%	0.4%	24.8%	8.9%	28.0%	100.0%
(2021)	Class1				All Classes		
Tons/year	3,513,000				12,590,000	4,900,000	17,490,000
%	20.1%				72.0%	28.0%	100.0%

Source:
1) The New Zealand Waste Disposal Levy - Potential Impacts of Adjustments to the Current Levy Rate and Structure - Final Report (2017), Eunomia
2)Estimates of Waste generated in Aotearoa New Zealand, MfE 2021

Waste Recovery

Reuse, Repair & Recycle Groups (social enterprise & commercial)			
	Recovery	% recovery	Total
Domestic Kerbside	367,739	24.9%	1,478,171
Residential	253,846	55.2%	460,235
ICI	2,264,909	62.5%	3,625,671
Landscape	130,000	34.6%	375,341
C&D	1,233,819	28.3%	4,356,294
Special	10,128	2.0%	517,214
VENM	0	0.0%	2,997,554
Rural Waste	28,302	1.9%	1,501,247
Total	4,288,743	28.0%	15,311,725

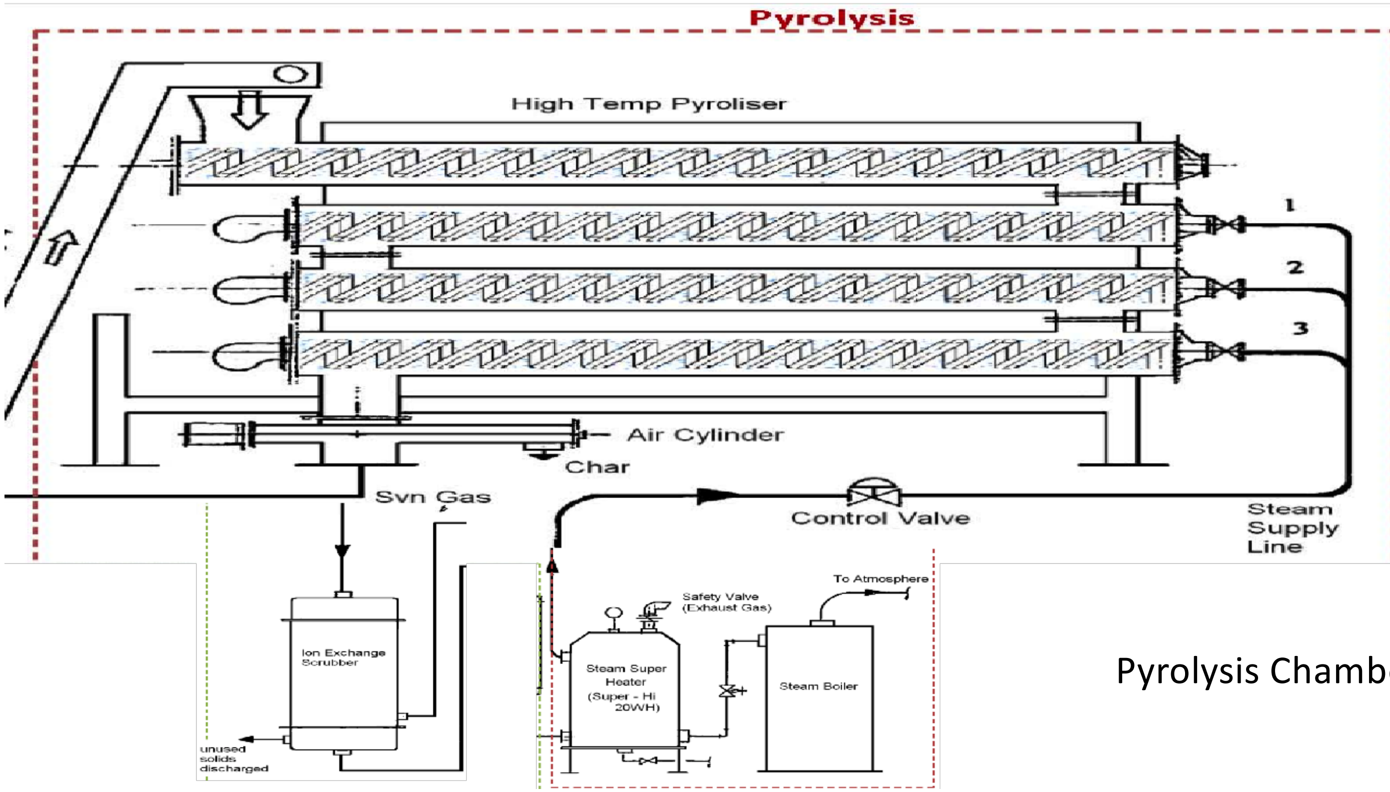
Table 1-12: Composition of Total Waste Generated by Activity Source

Material	Domestic Kerbside	Residential	ICI	Landscape	C&D	Special	Rural
Paper	20.8%	3.9%	11.4%	0.4%	0.3%	0.1%	1.8%
Plastics	10.5%	4.4%	4.2%	0.4%	0.3%	0.0%	17.6%
Putrescibles	41.6%	24.9%	28.6%	53.9%	1.4%	1.0%	54.6%
Ferrous metals	2.2%	25.2%	12.7%	0.3%	1.1%	0.1%	4.0%
Non-ferrous metals	0.9%	1.2%	1.3%	0.0%	0.1%	0.0%	0.0%
Glass	10.5%	3.7%	3.1%	0.2%	0.2%	0.0%	0.1%
Textiles	2.9%	7.0%	2.0%	0.2%	0.2%	0.0%	0.1%
Nappies and sanitary	8.0%	1.1%	0.8%	0.1%	0.0%	0.0%	0.2%
Rubble	1.2%	14.9%	28.4%	39.7%	84.1%	55.3%	0.0%
Timber	0.5%	12.6%	5.0%	4.8%	12.1%	5.7%	16.6%
Rubber	0.2%	0.4%	2.2%	0.1%	0.1%	0.1%	0.0%
Potentially hazardous	0.8%	0.4%	0.4%	0.0%	0.0%	37.7%	4.8%
Total	100%	100%	100%	100%	100%	100%	100%

Source: Calculated from landfill and recovery data. Rural composition taken from: Environment Canterbury (2013) Non-natural Rural Wastes -Site Survey Data Analysis, October 2013, https://ecan.govt.nz/your-region/your-environment/waste-management/rural-waste-minimisation/

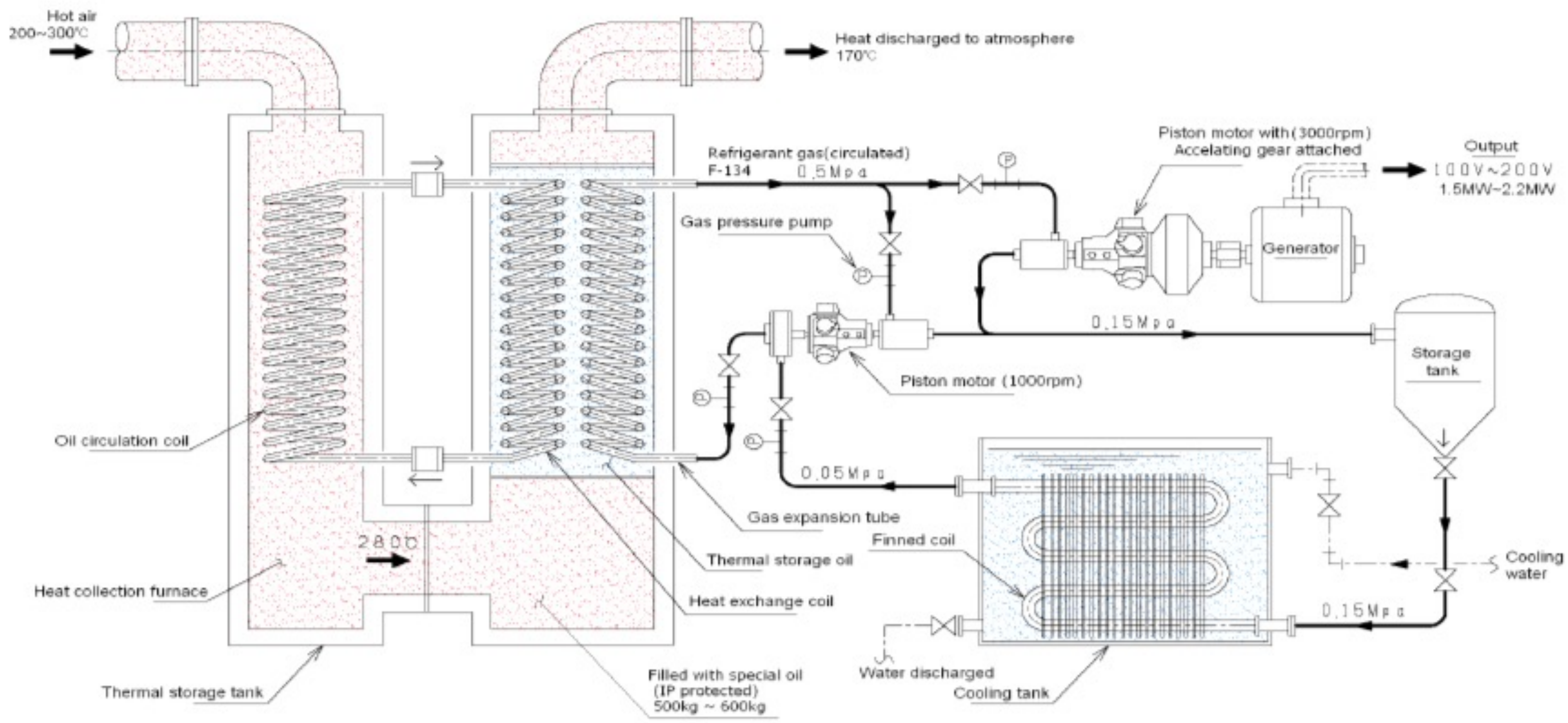
	Composition of Waste Materials	NZ – National Level	Manawatu
	SWAP - Classification		
1	Paper	10.0%	13%
2	Plastics	11.2%	20%
3	Organics	25.0%	38%
4	Ferrous Metals	4.3%	3%
5	Non-ferrous Metals	0.7%	3%
6	Glass	4.2%	4%
7	Textiles	4.7%	7%
8	Nappies & Sanitary	5.3%	7%
9	Rubble	10.7%	3%
10	Timber	14.9%	1%
11	Rubber	2.3%	1%
12	Potentially Hazardous	7.1%	1%
	Total (Tons/year) – Class 1 Landfills	3,220,888	45,000
	Clean Divert (1,2,7,10,11) for SRF	43%	42%
	Divert for Bioplant (1,2,3,7,8,10,11)	73%	86%

Waste Treatment - Pyrolysis



Pyrolysis Chamber

Power Generation – Waste Heat Harvesting



Emissions Control

Contaminant	Concentration Units	Canadian Council of Ministers of the Environment (CCME) Guidelines (1989)	BC Emissions Criteria for Municipal Solid Waste Incinerators (1991)	OLD ONTARIO MOE A-7 (February 2004)	OREGON OAR 340-230-310 Incinerator Regulations – Emissions Limits for New Facilities (April, 2010)	WASHINGTON WAC 173-434-310 Emissions Standards for Large Combusting and Incineration Units (2003)	NEW ONTARIO Guideline A-7 (October 2010)	US EPA 40 CFR Part 60 (May-10-06 Edition) Standards of Performance for Large Municipal Waste Combustors (New Facilities)	EU Directive 2000/76/EC of the European Parliament And Council on the incineration of waste	GGII Emissions Test results Airflow 292.0Sm2/hr Air ratio 5.7%
Total Particulate Matter (TPM)	Mg/Rm3 @ 11% O2	20 (1)	20	17	18	32	14	14.0	9.22(12)	6.75
Sulphur Dioxide (SO2)	Mg/Rm3 @ 11% O2	260 (2)	250	56	53(17)	92(22)	56	55.0(7)	45.82(12)	4.02
Hydrogen Chloride (HCl)	Mg/rm3 @ 11% O2	75 or 90% removal (1)	70	27	30(18)	52(22)	27	26.1(8)	9.22(12)	2.10
Nitrogen Oxides (NOx) (as NO2)	Mg/rm3 @ 11% O2	400(2)	350	207	270	N. Def	198	197.5(9)	183.22(12)	50.20
Carbon Monoxide (CO)	Mg/rm3 @ 11% O2	57 (114 for RDF Systems) (1)	55 (14)	N. Def.	N. Def.	N. Def.	40	41 to 200(10)	45.82(12)	10.12
Cadmium (Cd)	Ug/Rm3 @ 11% O2	100 (2)	100 (15)	14	14	N. Def.	7	7.0	N. Def.	0.03
Lead (Pb)	Ug/rm3 @ 11% O2	50(2)	50(15)	142	140	N. Def.	60	98.0	N. Def.	0.02
Mercury (hg)	Ug/rm3 @ 11% O2	20(3)	200(15)	20	25(19)	N. Def.	20	35.0	45.83(13)	Undetectable
Cd + Tl	Ug/rm3 @ 11% O2	N.def.	N.Def.	N.Def.	N.Def.	N.Def.	N.Def.	N.Def.	45.83(13)	1.60
Sum (Sb,As,Pb,Cr,Co,Cu,Mn,Ni,V)	Ug/rm3 @ 11% O2	N.Def.	N.Def.	N.Def.	N.Def.	N.Def.	N.Def.	N.Def.	458.13(13)	0.433
PCDD/F TEQ (Dioxins and Furans	Ug/rm3 @ 11% O2	0.08(4)	0.5(16)	0.08	25(20)	N.Def.	0.08	9.1(11)	0.92	0.042
Organic Matter (as Mathane)	Mg/Rm3	N.Def.	N.Def.	65.5	N.Def.	N.Def.	33	N.Def.	N.Def.	Undetectable
Opacity	%	5	5		10	5	5(2 hr avg) and 10 (6min avg)	10		0.50

Source: GGI Korea

Air Dispersion Modelling for BPMNZ – HRC Technical Assessor's Report

Table 2: Assessment of non NESAQ Compounds

Parameter	Units	GLC	Averaging Period	Guideline	Source
HCl	µg/Sm³	0.113	1 hour	190	TCEQ
HCN	µg/Sm³	0.061	1 hour	20	TCEQ
Dioxins	fg/Sm³	0.0067[1]	Annual	0.03	TCEQ

Notes:

1. *Annual value derived by comparison with the PM_{10} annual modelling results*

Air Dispersion Modelling for BPMNZ -

- Assessment based on Guidelines for Discharge to Air – Industries, MfE
- Using NESAQ Standards & Guidelines for Ambient Air Quality and Cumulative Contribution to Manawatu's Background Air Quality

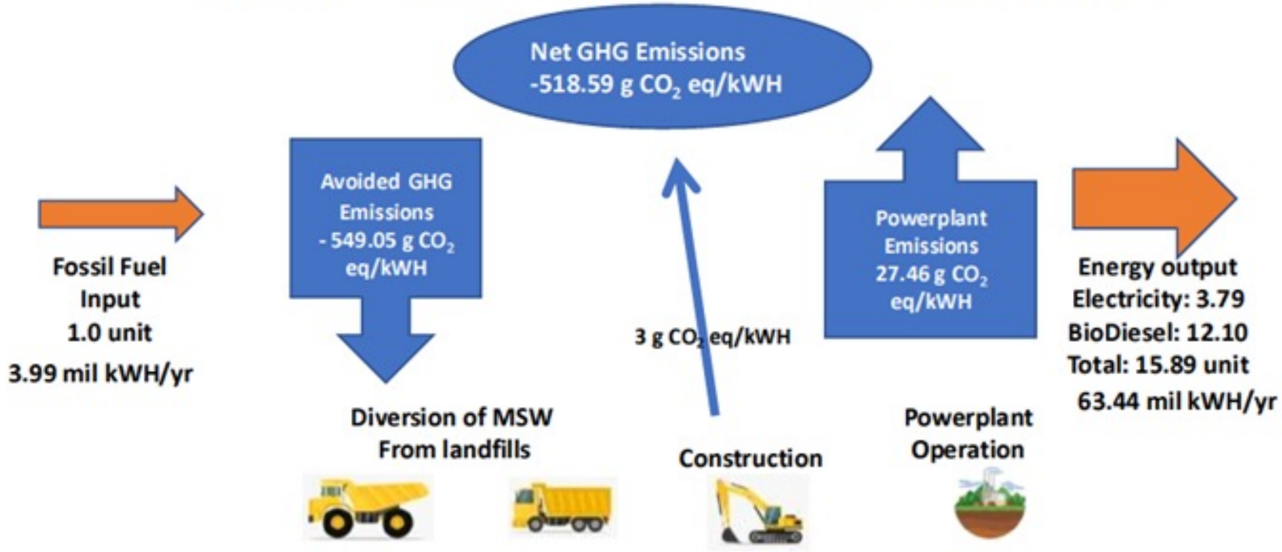
- Odour Emissions : *…." PDP considers that this approach represents best practice for odour control and should minimise the potential for fugitive odours from the process". …"* PDP considers that the level of conservatism is appropriate".
- Air Emissions : … "Overall PDP is comfortable that the combustion related emissions will not result in any exceedance of the NESAQ".

"There are other pollutants that the Applicant has modelled which are not compared to any standards or guidelines. Therefore, for completeness PDP has set these values out in Table 2, together with an appropriate standard to compare the predicted value against."

"Based on the data set out in Table 2, it is unlikely that there will be any effects associated with these emissions".

Life Cycle GWP and Energy Balance for BPMNZ

Feedstock – MSW and Tyres (80 tons/day @ 50% moisture)



Hybrid Pyrolysis Plant using MSW and Tyres

Bioplant

Plant Control Room

PyrolysisHankook Tyre

Safety Measures

- Predictive Emission Monitoring System
- Ion Scrubbers
- Carbon filters