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CONVERTING HUNTLY POWER PLANT TO BIOMASS - IMPACTS ON FORESTS AND CLIMATE

June 2022

Introduction

Genesis Energy has started trialling burning black wood pellets in Huntly Power Station, New Zealand’s largest power plant and the only one still burning coal. The company is looking at converting the remaining two coal-burning units at the power station to wood pellets.



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How much wood is required for converting the Huntly coal units to biomass?

If both boilers were fully converted to wood pellets and ran at maximum capacity (i.e. full load, 8,000 hours a year), then they would require pellets made from 3.16 million tonnes of wood, based on the weight of green, i.e. freshly cut pinewood.¹ In reality, the two power plant units would likely burn less wood: they may continue to burn gas alongside wood. Recently, coal has only been burned 78% of the time, which would come to less than 7,000 hours a year.²

And, furthermore, Genesis Energy suggested in a 2022 presentation that they anticipate operating Huntly power station at much reduced capacity, to meet peak electricity demand only, by 2030, with more electricity to be generated by wind and solar power.³

All that is certain is that replacing a significant proportion of the fossil fuels burned in the plant today with wood pellets would require millions of tonnes of wood to be burned.

What would the impacts on climate and forests be?

Per unit of energy, burning wood releases similar amounts of CO₂ into the atmosphere as burning coal. In the EU and other regions where the use of wood for energy has expanded in recent years, logging and wood removals have intensified, contributing to forest degradation and declines in wildlife dependent on forests.⁴ In 2021, 500 Scientists signed an Open Letter to world leaders warning:

"The result of this additional wood harvest is a large initial increase in carbon emissions, creating a 'carbon debt', which increases over time as more trees are harvested for continuing bioenergy use. Regrowing trees and displacement of fossil fuels may eventually pay off this carbon debt, but regrowth takes time the world does not have to solve climate change. As numerous studies have shown, this burning of wood will increase warming for decades

*to centuries. That is true even when the wood replaces coal, oil or natural gas."*⁵

Sustainability of forest management makes no difference to those climate impacts.

A peer-reviewed study published in 2018⁶ showed that even burning genuine forestry residues for energy is not compatible with the goal of the Paris Agreement, which is to keep warming to 1.5 or well within 2 degrees.

As for residues from wood products industries, it is important to remember that a plant like Huntly Power Station would require pellets made from clean virgin wood with a low bark content, which rules out a lot of such residues. The remaining, technically suitable, sawmill residues, especially sawmill off-cuts are also suitable go make panel board or paper and paper products. Burning this wood instead of using it for wood products contradicts the principles of a circular economy. And burning



wood that would currently be used to make such wood products, whether in New Zealand or importing countries, will inevitably cause displacement, i.e. cause

panelboard or pulp and paper companies to have to use more virgin wood, thus contributing to increased logging elsewhere.

What are black pellets and why does Genesis Energy want to burn those, rather than conventional 'white' wood pellet?



Although several coal power plants worldwide have been converted to burn conventional wood pellets, there are three drawbacks for operators of such plants:

1. Compared to coal, wood pellets are much bulkier, resulting in higher transport costs.
2. Conventional wood pellets have very different chemical and therefore combustion properties than coal. Co-firing a small proportion of biomass with coal is fairly straightforward, but burning mostly or exclusively wood in a conventional coal plant requires expensive upgrades to boiler equipment.
3. Even with upgraded boilers, the only type of biomass which can be burned in a converted coal power

station⁷ is wood pellets made from clean virgin wood from slow-growing trees, with a low bark content.⁸ Burning post-consumption waste wood, eucalyptus wood, or biomass from short-rotation coppicing would damage the boilers.

To overcome those limitations, there have been long-standing efforts to develop black pellets, which are more energy dense and have combustion properties much more similar to those of coal. Three different technologies for producing such pellets are being developed: steam-exploded black pellets, torrefied black pellets, and pellets produced via hydrothermal carbonisation.

Genesis Energy is trialling the use of steam-exploded black pellets and calls

for government support for developing black pellet production capacity in New Zealand.⁹ Steam-exploded pellets are made by placing biomass in a high-pressure vessel filled with steam at

temperatures of 180-240°C for several minutes and then rapidly reducing the pressure to cause explosive decompression, breaking up the fibre structure of the biomass.¹⁰

How realistic is Genesis Energy's proposal?

In short, it is highly unrealistic. In 2021, Biofuelwatch published a report based on desktop research of companies that have invested in commercialising black pellet production. Of the companies and company partnerships we identified, five have invested in steam exploded black pellets and 17 in torrefied wood products. Hydrothermal carbonisation investments remain confined to small-scale research and development. There is no evidence that any of the investments in steam exploded or torrefied pellets have led to commercial success, i.e. that anybody has succeeded in achieving continuous operation of a black pellet plant and has been capable of meeting. Only small quantities of black pellets have been delivered to energy companies and industrial customers for testing purposes. The only exception we found was a contract between the Norwegian pellet company Arbaflame and Ontario Power Generation, who convert their Thunderbay Power Station to burning steam-exploded black pellets in 2015.¹¹ Once converted to black pellets, the plant operated only 2% of the time, far less than had been expected even for meeting

peak electricity demand only.¹² In July 2018, the operators announced the closure of the plant due to severe boiler corrosion. Clearly, Arbaflame's steam-exploded black pellets had not been suitable for burning in a pulverised coal plant (of a type similar to Huntly Power Station's coal units).¹³

Genesis Energy states that it is importing steam exploded pellets from the USA. Two companies have attempted to commercialise the production of such pellets in the USA: Zilkha Biomass (acquired by NextGen Black Pellets in 2016) built a 275,00 pellet plant of this type in Alabama, which was unsuccessful despite multi-million dollar upgrades.¹⁴ It has been shut down and bankruptcy proceedings were filed against the company in 2020.¹⁵ The other company, Active Energy Group (AEG) tried to build a 400,000 tonnes pellet plant in North Carolina, against strong opposition. Even before the plant was fully commissioned, the operators violated their air permit.¹⁶ AEG has since abandoned this venture.¹⁷

Genesis Energy's claims that black pellets "*would be a low cost, low risk option*"¹⁸ are clearly not borne out by experience around the world.

High cost to bill payers or to the government:

If Genesis Energy wanted to convert Huntly Power Station's coal units to

biomass, the only realistic option would be conventional white wood

pellets. This, as the company admits, requires substantial plant upgrades.

For example, the conversion of a 420 MW coal power station in England cost the operators £450 million (NZ\$828 million). This included the cost of wood pellet silos (required to store black or white wood pellets), boiler and emission control upgrades.¹⁹ Conversions of coal power plants to burning mainly or only biomass have been highly dependent on subsidies, including in the UK, Denmark and the Netherlands. In the UK, Drax Plc received £982.5 m (NZ\$1,914m) in

subsidies for its biomass electricity. For a single 649 MW unit, subsidies amounted to £329.1m (NZ\$642m)²⁰. Without those subsidies, Drax Plc would have made net losses, due to the high cost of wood pellet production and procurement. Production of black pellets (challenging the technologies are) is even more expensive than that of conventional pellets.²¹

The cost of such a biomass conversion would thus be high and would have to be borne by the government, by bill payers, or both.



Conclusion

Genesis Energy's proposal to convert the coal units at Huntly Power Station to black wood pellets are highly unlikely to succeed. A conversion to conventional white pellets is technically feasible but would come at a high cost, which would likely be borne by bill payers, by the government or by both. However, regardless of the type of wood pellets, such a conversion would undermine efforts to reduce greenhouse gas emissions fast

enough to have a chance of limiting warming to 1.5 or well within 2 degrees, which is the vital goal of the Paris Climate Agreement. It is thus incompatible with the aims of New Zealand's climate change commitment. Coal plants need to be shut down, not replaced with another high-carbon fuel, be it fossil gas or wood pellets. Energy investments and state support must focus on energy use reduction and clean, non-emissive renewable energy sources instead.

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Biofuelwatch provides information, advocacy and campaigning in relation to the climate, environmental, human rights and public health impacts of large-scale industrial bioenergy.

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- 1 See Annex for calculation
- 2 <https://www.mbie.govt.nz/assets/2020-thermal-generation-stack-update-report.pdf>, Table 3-3
- 3 <https://media.genesisenergy.co.nz/genesis/investor/2022/Genesis%20Energy%20-%20Biofuels%20Insights.pdf>
- 4 See for example https://media.voog.com/0000/0037/1265/files/Biomass_report_ENG%20_2020.pdf about the impacts in Estonia and Latvia
- 5 <https://www.woodwellclimate.org/letter-regarding-use-of-forests-for-bioenergy/>
- 6 Not carbon neutral: Assessing the net emissions impact of residues burned for bioenergy, Mary S Booth, Environmental Research Letters, 21.2.2018, <https://iopscience.iop.org/article/10.1088/1748-9326/aaac88>
- 7 Note that this statement refers to pulverised fuel coal plants only. Most coal plants worldwide are pulverised fuel plants, including Huntly Power Station's units 1,2 and 4.
- 8 See findings of pre-conversion trials by Drax Plc in 2012: biofuelwatch.org.uk/docs/DECC%20FoI%20EIR%2013-0340%20Q1%20Documents%20Drax%20etc%209May%202013.pdf Note that this is consistent with the feedstock burned in other converted coal plants.
- 9 <https://www.newsroom.co.nz/genesis-imports-us-wood-pellets-to-fuel-huntly-renewable-energy-trial>
- 10 <https://pubs.acs.org/doi/10.1021/acs.energyfuels.0c04246>
- 11 <https://bioenergyinternational.com/worlds-first-advanced-biomass-power-plant-conversion-nears-completion/>
- 12 <https://www.tvonews.com/article/why-arent-northwestern-ontarios-state-of-the-art-energy-facilities-producing-any-energy>
- 13 <https://www.cbc.ca/news/canada/thunder-bay/thunder-bay-gs-close-1.4764057>
- 14 https://www.einnews.com/pr_news/541647940/schneider-industries-announces-sale-of-complete-zilkha-pellet-mill-for-the-biomass-industry
- 15 <https://casetext.com/case/in-re-zilkha-biomass-selma-llc-1>
- 16 <https://ncpolicywatch.com/2021/05/25/active-energys-controversial-wood-pellet-plant-in-lumberton-on-hold-indefinitely/>
- 17 <https://www.dogwoodalliance.org/2022/04/statement-wood-pellet-mill-stopped-in-lumberton-nc/>
- 18 <https://media.genesisenergy.co.nz/genesis/investor/2022/Genesis%20Energy%20-%20Biofuels%20Insights.pdf>
- 19 <https://www.modernpowersystems.com/features/featurelynemouths-silo-mentality-on-the-road-to-full-conversion-5836078/>
- 20 https://www.drax.com/wp-content/uploads/2022/03/Drax_AR2021_2022-03-07.final_.pdf, page 214, figure for "ROCs generated" divided by 2 because those subsidies are paid for two biomass units)
- 21 <https://biomassmagazine.com/articles/18143/futuremetrics-discusses-potential-of-advanced-undefinedblackundefined-pellets>

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Annex:

The figure of 3.16 million tonnes of green wood is based on the following assumptions:

Average green wood in New Zealand has a net calorific value of 6.9 GJ/tonne, which is equivalent to 1.91667 MWh/tonne.²¹ 8,000 hours a year is generally assumed to be the maximum number of hours a power plant would be operating, taking account of maintenance requirements.

According to a report by the Ministry of Business, Innovation & Employment, published in 2020, units 1,2 and 4 of Huntly Power Station have a heat rate of heat rate of 10,900 GJ/GWh, which makes them just 33% efficient.²¹

Therefore, 757 MW must be input to generate 250MW. This is equivalent to 21.802×10^{15} J input per year. The green wood contains 6.9×10^9 J/tonne and so 3,159,000 tonnes is required per year to operate the plant at maximum annual capacity.