THE THERMAL GROUP

MARCH 2019

CONVERTING FORESTRY AND AGRICULTURAL WASTE INTO, LOW-COST, LOW-EMISSION, DISPATCHABLE BIO- ENERGY

The Hermal Group are investing in the development of a BIO-ENERGY plant capable of generating electricity with the combustion of BIO-FUEL created from forestry and agricultural Bio-Mass waste. The BIO-ENERGY facility offers the potential to create near zero, or in many cases negative net greenhouse gas emissions in a superior dispatchable way that can take advantage of network demands and periods of high value power.

Waste products of the forestry industry, including sawdust, residues and chipper fines are often considered a cost to business requiring disposal. Many timber sawmills produce between 50% - 60% as waste, which the Hermal Group BIO-ENERGY plant will utilise as a Bio- Mass to feed a boiler and steam turbine capable of generating electricity.

Agricultural waste from various feedstocks including plant and fibre growing production systems, (e.g. hemp production), are also an ideal Solar Energy resourced Renewable Bio- Mass for BIO-ENERGY production.
Pre-feasibility results support current analysis to develop a business case for the implementation of BIO-ENERGY. Where implemented, it will significantly reduce current energy costs, provide a reliable, cost effective and secure source of sustainable and renewable energy, and improve the environmental credentials of a facility within the forestry and agricultural sectors.
The production of BIO-FUEL for use in a BIO-ENERGY plant offers an exciting opportunity to add value to the forestry and agricultural sectors and contribute to climate-change mitigation as well as providing reliable and dispatchable electricity both in Australia and around the world.

PROJECT OVERVIEW

Based in Victoria, Australia, the Hermal Group is engaged in a range of timber and forestry production sites, including a $190 million timber mill in Burnie, Tasmania. As an allied industry to our forestry businesses, we are heavily investing in the development of a BIO- ENERGY plant capable of generating electricity from the Bio-Mass waste of forestry industries. Not only will these energy plants reduce forestry operational electricity costs to nil, they will also add significant capacity to inject superior, dispatchable, baseload renewable energy into the network at times of high network demand and periods of high value power.

Significant quantities of heat are also available for the drying of timber and wood products, as well as for the other co-located food and industrial heart energy requirements.

BIO-ENERGY is an effective, efficient, low to zero or even negative emission renewable energy source offering enormous economic and environmental potential.

Our current analysis, which examined the production and application of BIO-FUEL within the forestry sector, found a range of opportunities from the displacement of electricity from the electricity grid to participating in the National Energy Market through the sale of electricity generated by a BIO-ENERGY plant.

Considering the Bio-Mass waste available across a range of real world applications, opportunities for BIO-ENERGY plants ranging from 1 MW to 33 MW were found. Projects which utilise wood waste from timber processing facilities and commercial plantations result in BIO-ENERGY plants on the smaller side of the range where projects which can combine Bio-Mass wastes result in larger projects.

This is a unique opportunity for plantation, forestry and production facilities in the timber industry to utilise and profit from their wood waste on-site compared with being left with a burden to remove the waste. The economic benefits would enable self-sufficient energy production, reducing load on the broader energy grid as well as improving the facilities own green credentials.

The BIO-FUEL can be manufactured on site where Bio-Mass waste is produced, alternatively, Bio-Mass waste can be collected and transported to a central location.
The results of the current analysis provide valuable insights into the potential for generating electricity from Bio-Mass for trading within the National Energy Market.

The Hermal Group - Bio Energy

PROJECT OVERVIEW

A limitation of the findings presented relate to the energy prices used as they have been derived from historical energy spot prices without accounting for changes in future spot prices. Further research is required to account for the addition of renewable energy generation to meet Australia's emissions reduction targets, demand side management, uptake in energy storage technologies, retirement of aging generation fleet or other market forces.

In collaboration with Monash University, the Hermal Group is currently undertaking a series of research and development projects relating to the properties of the BIO-FUEL and its use in and the configuration of a BIO-ENERGY plant. The results of this research will further refine the current results to provide insights to industry participants.

Building upon the findings of this research, the Hermal Group is working together with the timber industry to develop a business case for the implementation of BIO-ENERGY plants in scalable pant sizes to meet the waste needs of any forestry or sawmill facility.

PROJECT EXAMPLE
PINE SAWMILLING FACILITY

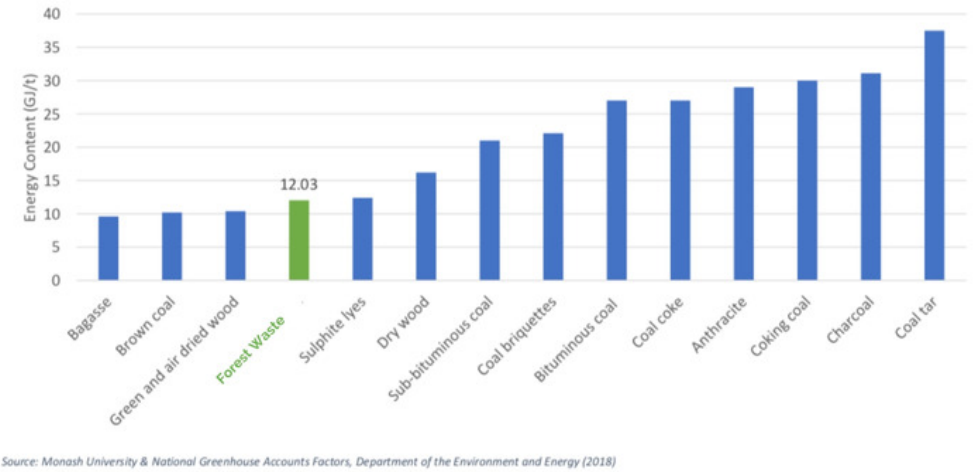
A Pine Sawmilling Facility with an electrical load of 16.9 GWh per annum.
With 46,000 tonnes of Radiata Pine sawdust, the sawmilling facility will produce the required quantity of BIO-FUEL to provide more than 100% of the electrical load of the facility. With 66,000 tonnes of Radiata Pine Sawdust, the BIO-ENERGY system will result in additional electricity of up to 8.2 GWh, which can be sold into the National Electricity Market (NEM).

PROJECT ANALYSIS

The current analysis investigates the opportunity to produce BIO-FUEL from solid wet Bio- Mass waste product to be retrofitted into a boiler - steam turbine system to generate electricity. Thus, substituting fossil fuels, converting solid wet Bio-Mass to fuel for biopower has several advantages, including ease of storage and longer temporal stability if alkali species are removed. BIO-FUEL also has a bulk density and energy density much greater than solid Bio-Mass.

The production of BIO-FUEL is conducted through the process of pyrolysis. Pyrolysis of Bio- Mass takes two forms, slow pyrolysis as traditionally applied for charcoal making, or fast pyrolysis (flash pyrolysis), which mainly produces a combustible liquid fuel which can substitute for diesel or act as a chemical feedstock.

The Hermal Group expects the primary source of fuel for the pyrolysis system to be a wood waste by-product from the harvesting operation within plantation forests, their chipping processes, as well as sawmilling and sustainable wood products manufacturing In this initial phase of commercialisation. This is expected to very quickly become applied to all other forms of Bio-Mass available.



Source: Monash University & National Greenhouse Accounts Factors, Department of the Environment and Energy (2018)

PROJECT ANALYSIS

As the BIO-ENERGY plant can be located on-site close to the sustainable sources of Bio-Mass, there is no longer a need for significant transport cost associated with the removal of the wood waste as well as reduced emissions from the transport of the waste.

The current analysis aims to gain a deeper understanding of the financial feasibility of the BIO-ENERGY plant through real-world applications as a retrofit to an existing site with a steam boiler.

To achieve this, a supplement and standalone scenario will be analysed using BIO-FUEL as a fuel input to a boiler – steam turbine system:

Supplement – The displacement of electricity from the NEM will be modelled to demonstrate how a BIO-ENERGY plant can be applied to manufacturing and industrial facilities to reduce their dependence on the electricity network. Historical annualised base case to be considered.

Standalone – Electricity generated from the combustion of BIO-FUEL will be modelled to provide dispatchable, peak-load, electricity supply into the NEM. Historical annualised base case to be considered.

In the end, the energy content of the transformation of waste products is critical to the viability of the project. Current findings of this research confirm that the BIO-FUEL provides 20% more energy than Brown Coal and is approximately half the energy of Thermal Coal.

The future lies with new industries manufacturing Bio-Chemicals from sustainable, renewable Bio-Mass.

THE BIO-FUEL EQUATION

1 x Tonne of wet Bio-Mass yields ~2MWt of Thermal Energy1
From this energy...

⅓ is required to sustain the System
⅓ can be converted into high-grade energy, such as electricity
⅓ can be converted into low-grade energy, for process heating

Operating conditions can modify this equation around project requirements.

BIO-MASS

There is currently significant amounts of Bio-Mass waste available fro various Forestry and Agricultural operations. Bio-Mass is grown by the photosynthesis of Carbon Dioxide ("Green House Gas:") and water together with Solar Energy, due to the action of the chlorophyll in plants, Thus, Bio-Mass has a negative carbon footprint.

THE HERMAL BIO-ENERGY PROCESS

The key factor is to locate the processing of the Bio-Mass very close to where the Bio-Mass resources are grown. This is essential to minimize costs of transport & handing (Logistics)

Bio-Mass consists of about 50% of water, by weight. This Sustainable, Renewable Process effectively & efficiently converts Bio-Mass into BIO-ENERGY & the Bio-Gas can be converted into a market competitive & environmentally attractive Bio-Chemical.

BIO-MASS STORAGE AND DRYING

The Bio-Mass is collected at a key central location, processed & fed into a Dryer, powered by the Bio-Energy (low grade heat energy) produced by this System. The moisture content can be varied and is controlled to be optimum for the end use requirements of this Process.

Typically —-The Bio-Mass is dried from 100% moisture content to around 20% MC or 10% MC (according to requirements). This drying process yields clean water.

PYROLYSIS

There are three phases of products from this Process ——

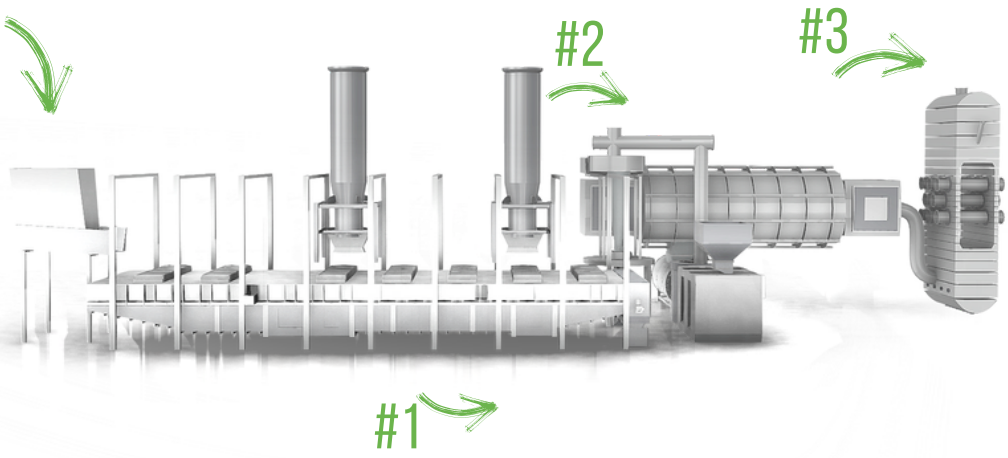
Solid = Bio-Char
Liquid = Condensibles from the Bio-Gas
Gas = Non condensibles as well as un-condensed Hydrocarbons

CONTAINER 1

BIOMASS DRYER

PYROLYSIS UNIT

SYNGAS COOL



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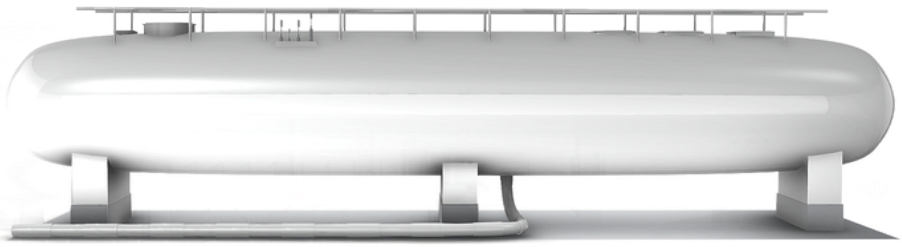

SYNGAS STORAGE UNIT

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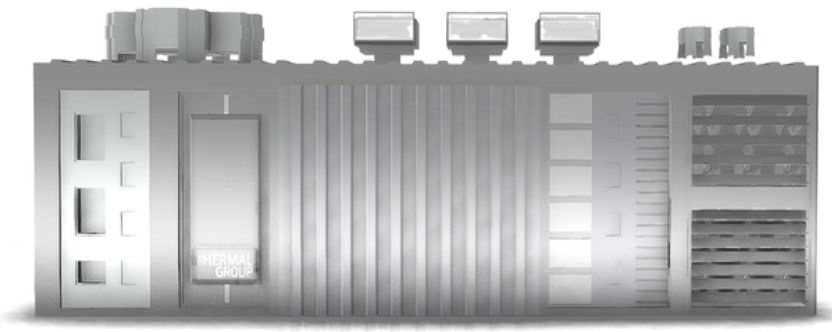

CONTAINER 2 - 1MW POWER GENERATOR

THE BIO-FUEL EQUATION

The Pyrolysis reaction conditions can be varied and controlled to produce the optimum yields & combinations of these products, depending upon the commercial requirements of the System. All Bio-Mass contains some small quantities of Inorganics (e.g. Potassium, Sodium, Silica, Calcium, Chlorine, etc.) —- These will cause problems if included in a BIO-FUEL for engines, as they will form ash during combustion & foul the cylinder heads, as well as corrode other components, therefore, the ash must be targeted early & directed away from the BIO- FUEL

Our "Kibria Cyclone Vortex Burner" can easily utilise such inorganics included in the fuel, Pyrolysis can also produce Hydrogen under certain reaction conditions. Whilst engines don't like Hydrogen, Bio-Chemicals do, and we have a lot of flexibility in operating our Pyrolysis

1 Variations to this equation are determined based on the source of Bio-Mass and Moisture content

Reactor to meet the highest & best Commercial Outcomes by providing the optimum mix of products.

ABOUT US

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