



What is bioenergy?

A prepared information pack
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Biomass & Bioenergy



What is Biomass

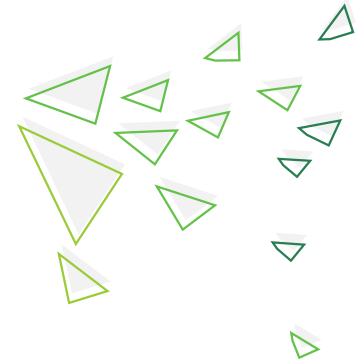
Any organic matter (biological material) available on a renewable basis.

Includes feedstock derived from animals or plants, such as wood and agricultural crops, and organic waste from municipal and industrial sources.



What is Bioenergy

Energy generated from the conversion of solid, liquid and gaseous products derived from biomass.



What sort of energy is bioenergy



Electricity

Gained from the combustion of biomass, biogas, or syngas. Combustion also usually generates heat.



Heat

A common by-product of combustion of biomass. Can be used on-site, in communal heating grids or converted to refrigeration.

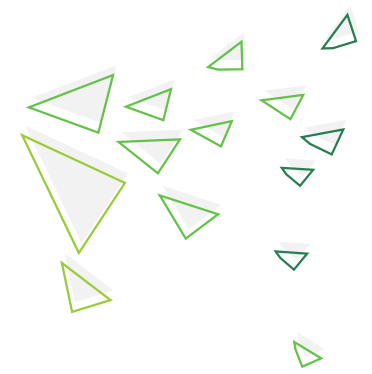
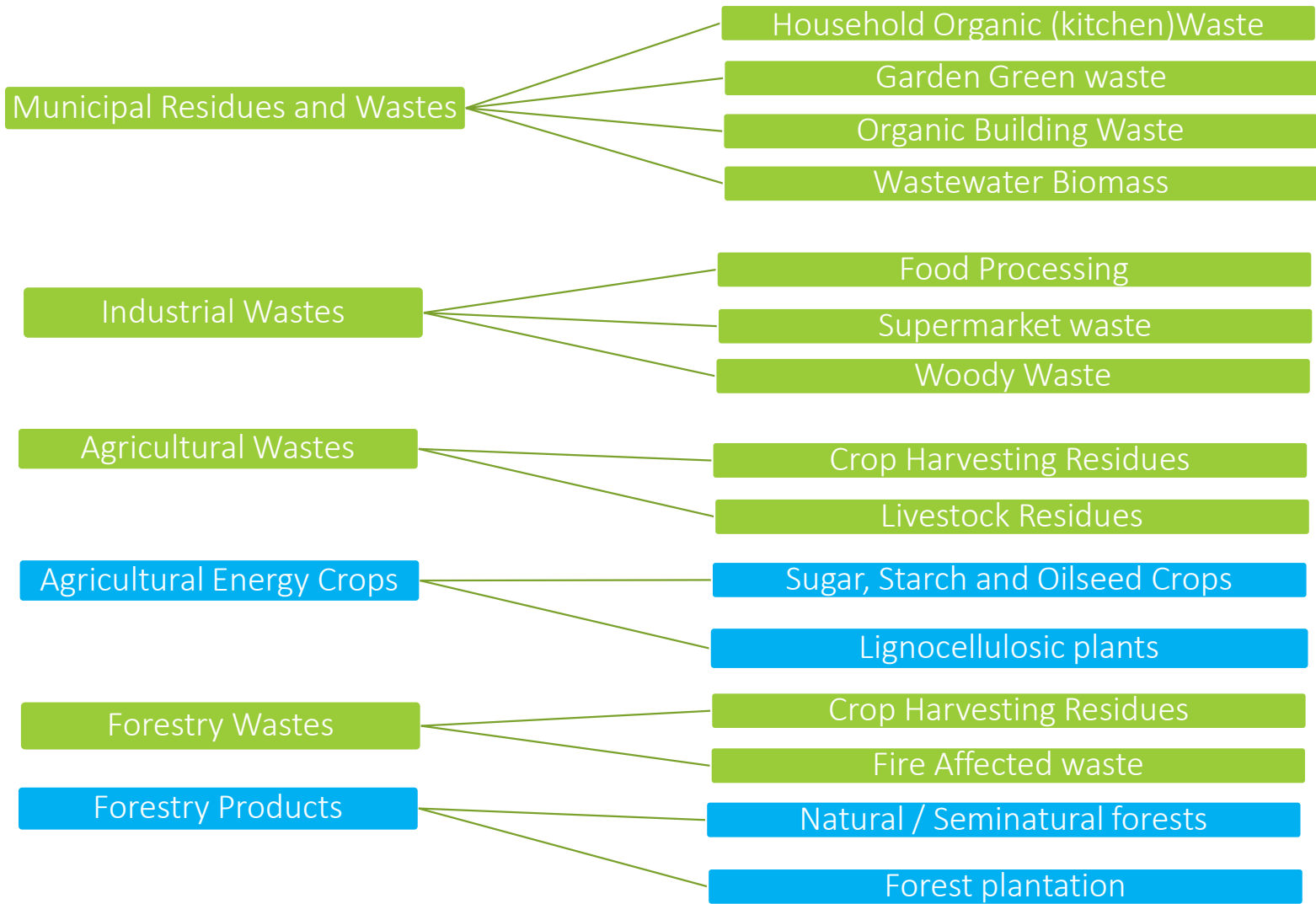


Transport Fuel

Ethanol, a liquid produced from fermenting carbohydrates rich biomass. Biodiesel, a diesel equivalent fuel made from vegetable oil / animal fats



Where does the biomass come from?



Waste biomass

Non-waste biomass

Traditional Bioenergy

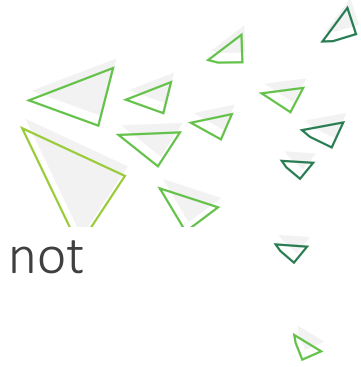
Consist of wood, charcoal, agricultural residues and animal dung sometimes converted with basic techniques, for heating and cooking in the domestic setting.

These traditional techniques are often not sustainable and are a cause of deforestation. Combustion inside (in absence of chimney) is a causing of lung damage.

An increase in this type of Bioenergy is not what this project is trying to achieve.



What is not bioenergy for a circular economy

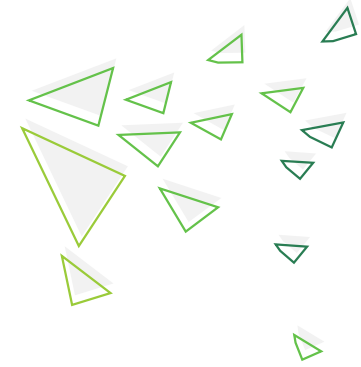


- Traditional combustion of biomass. This may be bioenergy but its increase is not desirable due to air pollution and efficiency concerns.
- Combustion of coal (which may have been biomass originally) is not bioenergy as it is from a fossil source.
- Combustion / gasification /pyrolysis of municipal (rubbish bin) wastes fits into an 'Energy from waste' process but is mostly not from renewable sources.
 - Organics should be separated
 - Plastics and should be recycled
- Landfill gas is good practice for existing landfills, but landfilling of organics needs to stop. Organics need to become part of a more circular economy. As this happens the returns for landfill gas will become less.



Six established Bioenergy Processes

- Anaerobic Digestion
- Advanced Combustion
- Pyrolysis
- Gasification
- Transesterification
- Fermentation



There are other ways of producing energy from biomass, however these six technologies have proven to be technologically viable. They are deployed widely, in diverse locations globally, and have shown that they can be used on a commercial scale. This does not however mean that they are financially viable for all locations, feedstock types, equipment vendors or geopolitical situations.

Projects involving other technologies, will involve greater financial risk, higher technical barriers and are likely to be more time consuming.



Anaerobic Digestion



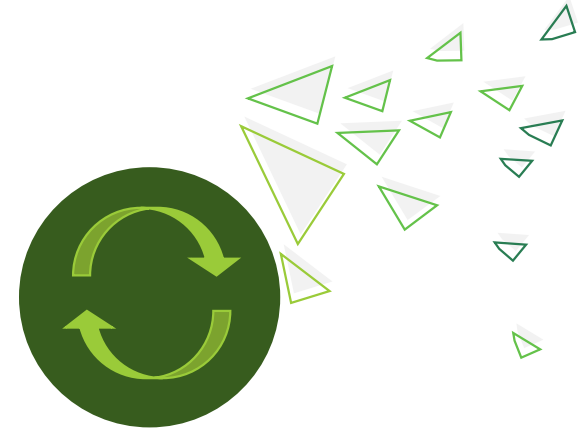
Anaerobic Digestion is a natural process in which microbes (bacteria and archaea) convert organic material to biogas (methane and carbon dioxide) in the absence of oxygen.

Biogas can be burnt to produce electricity, heat or steam.



A wide range of feedstocks can be used. Most commonly these are moist substances like sewage sludges, food waste, animal manures and industrial wastes.

A range of reactor styles and sizes can be used to suit the type and volume of feedstock.



Anaerobic Digestion can have a range of benefits other than bioenergy production.

They reduce biomass volume, decrease chemical use and the digested biomass is called 'digestate' and can be cycled back to farms as a fertilizer.

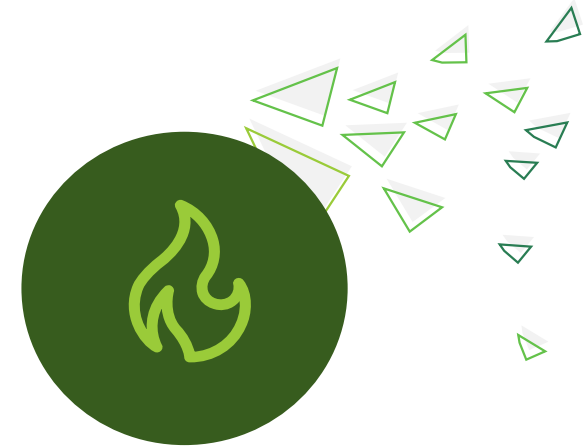
Advanced Combustion



Highly controlled combustion processes operate in the presence of oxygen at a high temperature 800-1000°C. Thus they efficiently convert solid / woody biomass into steam which can then produce electricity and heat.



A wide range of solid feedstocks can be used. Most commonly these include agricultural residues, forestry wastes, the organic fraction of domestic wastes, digestate from anaerobic digestion or specially made biomass pellets.



Combustion massively reduces the volume of most wastes – leaving only ash. This reduces landfill volumes.

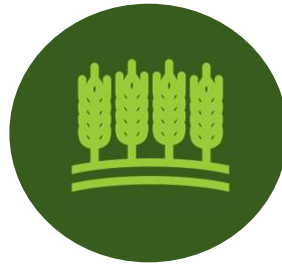
Biomass combustion technologies can help reduce reliance on fossil fuels.

Pyrolysis



Pyrolysis is the heating of generally dry biomass in the absence of oxygen.

This process causes the biomass to decompose into a range of byproducts which are varied according to the temperature used and the source of the feedstock. Including Biochar, Wood Vinegar and Bio-oils.



A wide range of solid feedstocks can be used. Most commonly these include agricultural residues, forestry wastes, specially grown crops. Some crops can produce specific and valuable products when pyrolysed



Biochar is a byproduct which has a proven role in helping build soil carbon and can have a range of higher value uses.

Wood Vinegar (condensate) has agricultural application.

Bio-oils can be further processed to Bio-diesel

Gasification



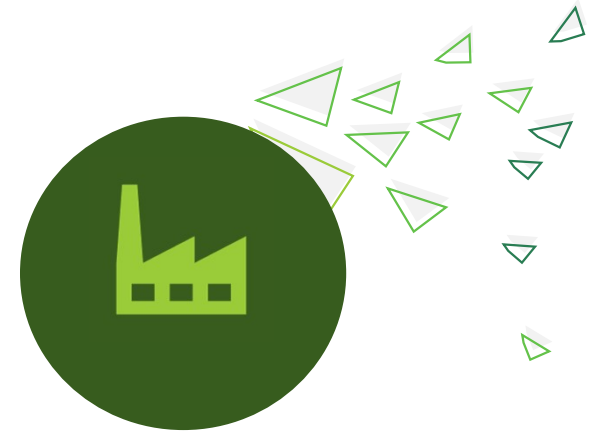
Gasification is a highly controlled processes which operates at temperatures in excess of 700°C in the presence of controlled amounts of oxygen and or steam.

The process produces gas called Syngas (H₂ and CO) and Biochar (a solid product).



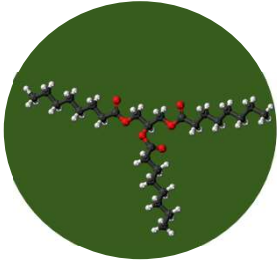
In the gasification process, the input biomass is not a fuel, but a feedstock for a high temperature chemical conversion to syngas and biochar.

Syngas may be burned directly in gas engines, or used to produce methanol or purified to hydrogen.



Gasification is more efficient than combustion at converting biomass to energy. The low oxygen conditions also mean that it is superior to combustion for the control of emissions such as SO_x, NO_x and dioxins.

Transesterification



Transesterification is the conversion of triglycerides to glycerin and biodiesel, using an alcohol. This is normally done in alkaline conditions using some heat.



A wide range of oil based feedstocks can be used. This includes waste cooking oil, animal fats, or vegetable oils. Oil based crops can be grown specifically for production of biodiesel as can algal mass.



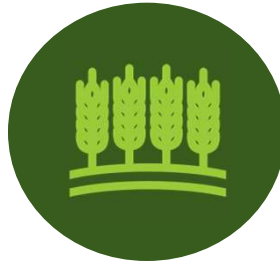
After transesterification the crude biodiesel and glycerin need to be further refined to remove the methanol and purify the product



Fermentation



Fermentation is a biological process (involving yeasts) which produces ethanol from plant sugars, starches and cellulose.



A wide range of plant material (corn grain, sugar cane) can be used as feedstock for fermentation. Commonly plant material will have to undergo some sort of processing prior to fermentation to make these molecules available to yeast.

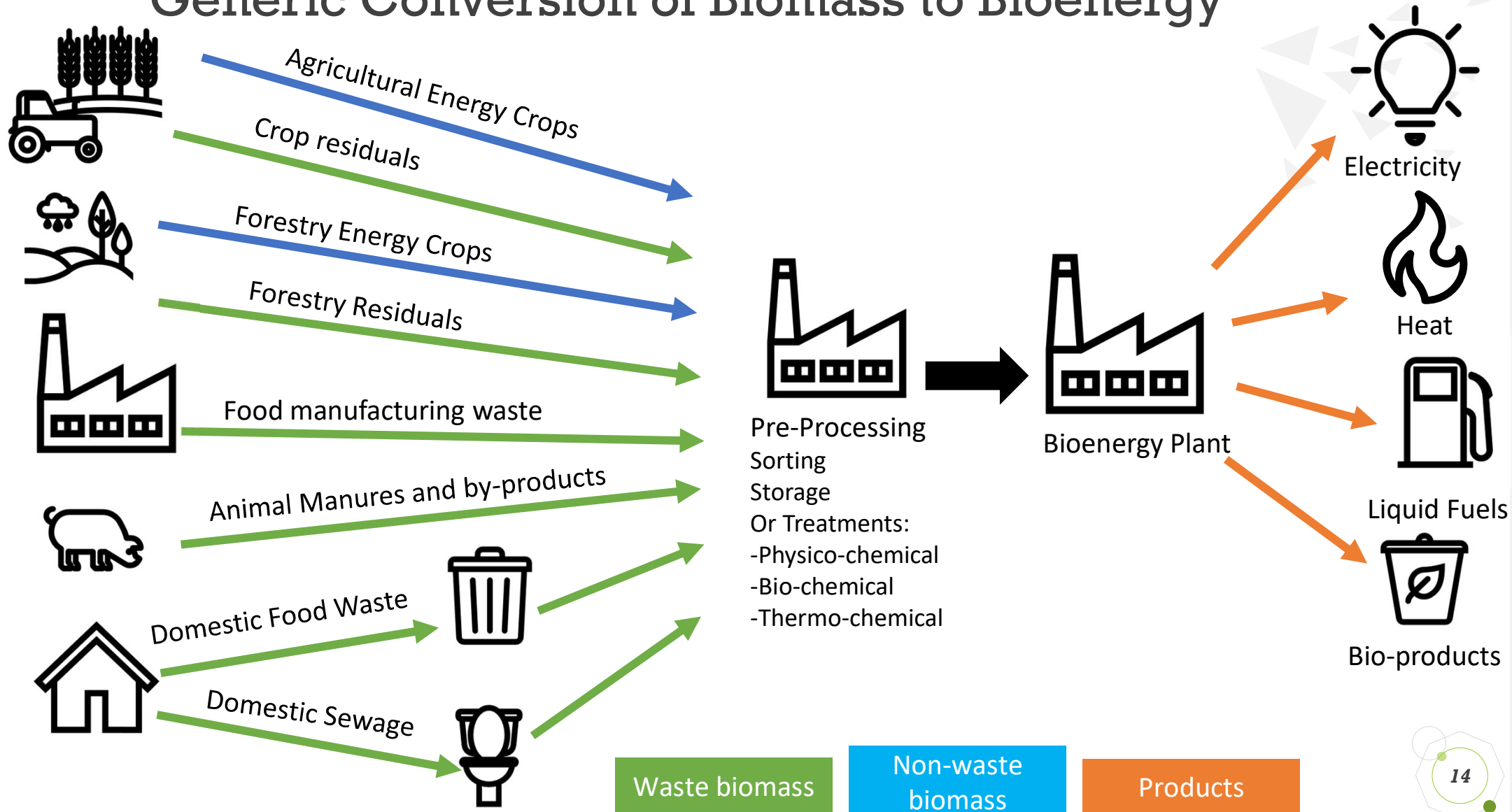


Ethanol is an ideal biofuel as it can be added to petrol and used in most current machinery without modification.

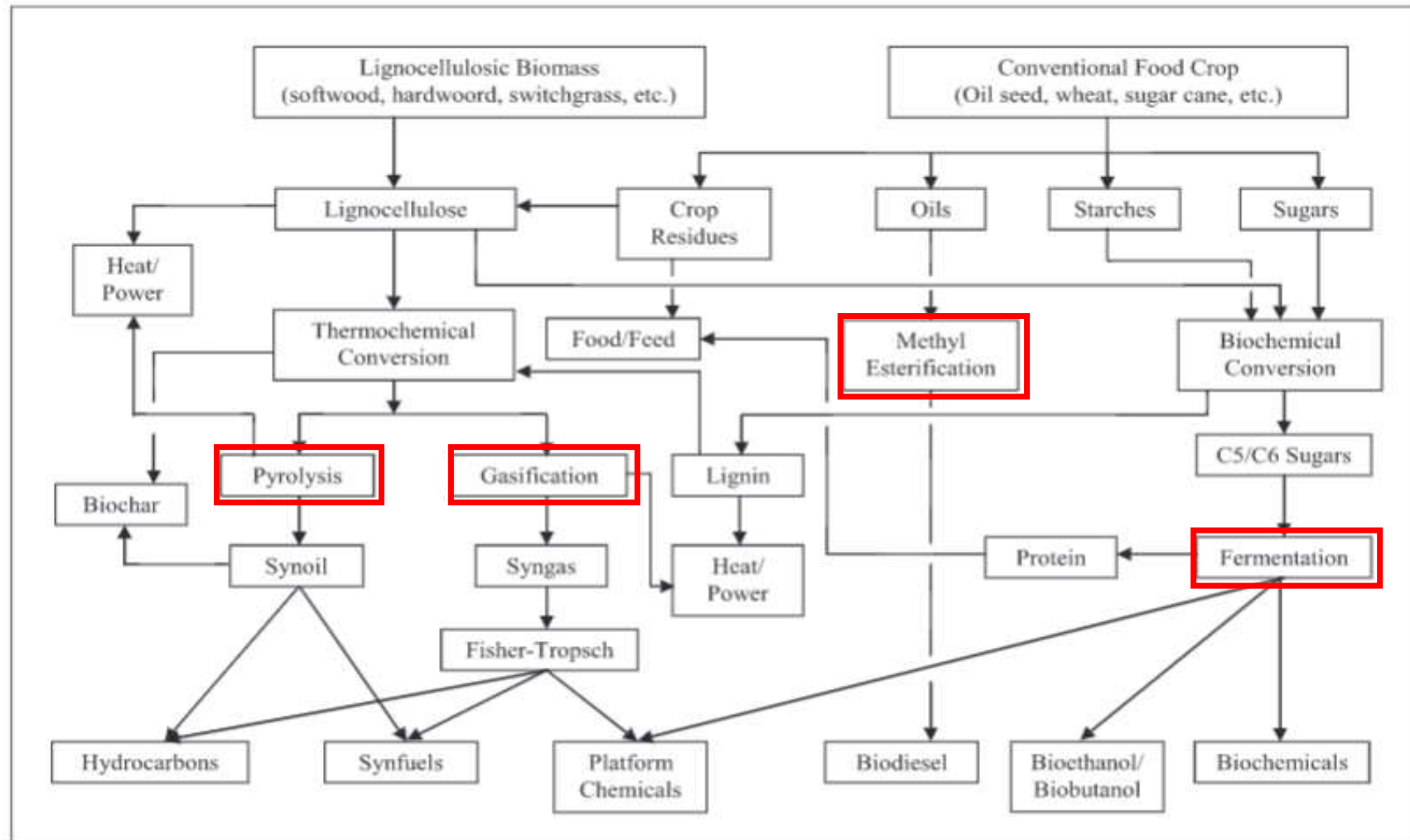
Newer biofuels try to use waste products or crops which can be grown on dryland without fertilizer.



Generic Conversion of Biomass to Bioenergy



Technologies that make biofuels / bioproducts



More Information?



Emily Scholes
www.enviromicrobio.com.au