How to Electrify Plastic

At-a-glance

- An important aspect of the global crisis of plastic waste is the sheer waste of energy it represents. Making plastic requires several times more energy than steel.
- An effective response to this crisis will include recycling far more and making new plastic from plants instead of fossil fuels. Electricity can power both solutions.
- Plastic recycling is already carried out in electric furnaces and consumes less than 5% of the energy required to make virgin plastic.

The Case for Electrifying Industry

Electrifying industry with renewable energy is an unmissable opportunity for Australian manufacturing.

Electricity is a remarkably versatile form of energy that can power any industrial heat process, from cooking a can of beans to melting 100 tonnes of iron.

From industrial heat pumps, electromagnetic heating, electrical furnaces and renewable hydrogen, there is no shortage of proven technologies to help industry make the switch to renewable electricity, and unlock huge cost savings and operational efficiencies in the process.

Making the switch would eliminate 6 to 8% of Australia's national greenhouse gas emissions.

Plastic and climate change

Over 90% of plastics are made by refining oil or natural gas. For example we require 2.2 tonnes of oil to make High Density Polyethylene (HDPE), used to make some plastic piping. Plastic production consumes about 5% of the world's annual oil output, about as much as the aviation sector.[1]

Making plastic is energy-intensive and produces more emissions per tonne of production than steel (see table below).

We are also increasingly aware of the problems of single-use and discarded plastic. About 95% of plastic packaging is used briefly, thrown away and not recycled.[2] Most of this plastic sits in landfills – a tremendous waste of resources. A third of plastic does not even make it to landfill, and every year millions of tonnes escape into rivers and oceans.[3] By 2050 there could be more plastic than fish in the sea.[4] If the plastic biodegrades or burns, fossil carbon enters the atmosphere, just as if we had burned the oil or gas from which it was made.

Despite these problems plastic has some benefits, and its excellent strength-to-weight ratio means it can even be a lower carbon option than alternatives. For example, a 1-litre plastic drink bottle has lower embodied energy and emissions than one made of glass or aluminium.[5] We will continue to depend on plastic for its usefulness and versatility, but we need to make fundamental changes to the way we produce it and treat it.

A sustainable, electric-powered future for plastic

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A sustainable, zero carbon future for plastic will rely on four strategies[6]:

i. *Reducing consumption.* There is growing awareness of our wasteful use of plastic, especially single use plastics. A cross-party Australian Senate inquiry has recommended that all single-use plastics, such as coffee cups with plastic linings, be banned by 2023.[7]

ii. *Reusing*. Some plastic products, such as HDPE pipes, are durable and can be reused. The Ellen MacArthur Foundation estimates this applies to **20%** of plastic.

iii. *Recycling*. Most plastics can be recycled, though in 2017 Australia recycled only 12% of plastic.[8] We should aim to increase this to **55%**. This would require not only an effective recycling regime, but changes to the way some plastics are made to facilitate recycling.

iv. *Bio-based plastics.* The remaining demand for virgin plastic **(25%)** can be met with bio-based plastics which can be carbon negative. Most plastics can be made from natural polymers occurring in plants such as potatoes, tree bark and sugar cane.[9] Some bio-based plastics are already cost competitive with current fossil-based plastics.[10] For example, bio-ethylene and bio-propylene are already produced commercially from wood in Brazil and Europe.[11] Renewable plastics can also be manufactured from renewable hydrogen and waste sources of carbon dioxide.

This combination of strategies can eliminate the need for virgin fossil fuel-based plastics and the emissions associated with their manufacture. This approach is finding increasing favour with major corporations such as IKEA planning to use only recycled or bio-based plastics,[12] and chemicals companies like Dow, Dupont and BASF are investing heavily in bio-based plastics.[13]

Biobased plastics - most plastics can be made from natural polymers occurring in plants such as potatoes, and can be carbon negative.

Table: Energy and emissions related to production of 1 tonne of different types of plastic (prior to forming into products)

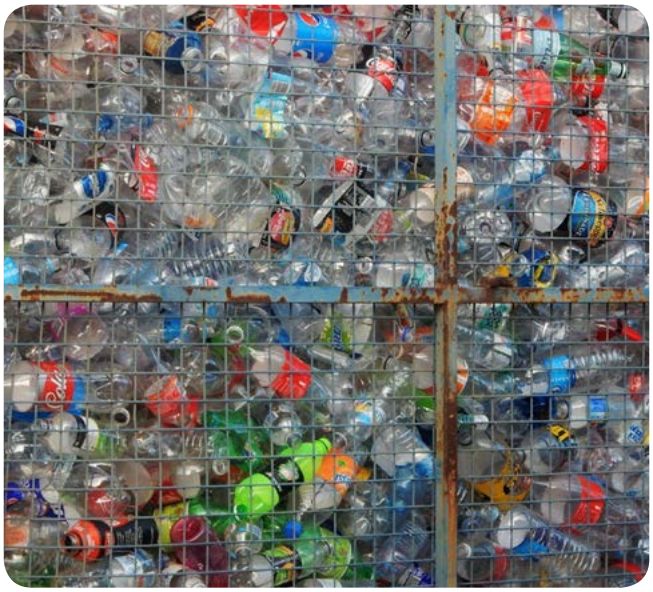
Plastic	Example applications	Energy (kWh)	Production emissions (T CO_2e)
Polypropylene (PP)	Ice cream containers, crisp packets, plant pots	23,056	2.0
Polyethylene terephthalate (PET)	Food and drink containers	22,972	3.0
High density polyethylene (HDPE)	Films, pallets, bins, hoses and pipes	21,111	1.9
Polyvinyl chloride (PVC)	Pipes, garden hoses, floor coverings.	16,444	1.9
Polystyrene (PS)	Yoghurt pots, plastic cutlery, take away containers.	25,000	3.4
Primary steel (for reference)		*5,489*	*1.8*

All-electric plastics industry

The sustainable strategy outlined above will facilitate the electrification of the plastics industry. The production of bio-based plastics has the potential to be fully electrified,[14] and plastics recycling is already an electrified process. Recyclers prefer electric furnaces for their higher temperature control and lack of combustion gases. This means that to electrify the plastics industry we don't need to electrify oil refining – we can dispense with it altogether.

By recycling plastic we also save a lot of energy. Cryogrind is one of Australia's largest plastics recyclers, producing PVC pellets, from industrial plastic waste. Cryogrind's process of shredding, blending and extruding pellets uses 273 kWh per tonne of pellets – just 2% of the energy of virgin PVC. Newtecpoly produces a recycled hard plastic that can replace virgin HDPE, also uses about 2% of the energy of the equivalent virgin product. See Case study: Newtechpoly - Polywaste Technology.

Bio-based plastics can even be carbon negative, as they store carbon dioxide captured by plants. New Zealand company *ecostore* produces a plastic bottle – *the Carbon Capture Pak* – made from sugarcane.[15] The plastic in these bottles is physically and chemically identical to conventional high-density polyethylene (HDPE). However, whereas conventional HDPE production releases nearly 2 tonnes of emissions, the sugarcane-based alternative is carbon negative. For every tonne of product, more than 2 tonnes of carbon dioxide are sequestered.[16]



Case study: Newtecpoly - Polywaste Technology

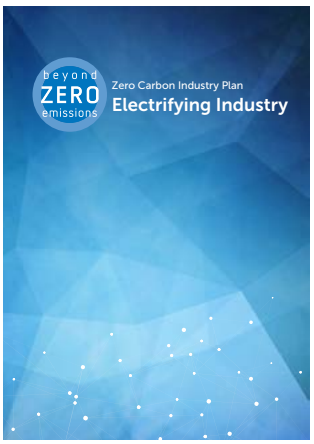
Newtecpoly is a Victorian manufacturer and plastics recycler. The company is a licensee of the PolyWaste technology – a low energy method of recycling plastic waste into products such as outdoor furniture, piping, pallets, posts and bottles.

PolyWaste's key innovation is the ability to recycle mixed waste plastics which otherwise go to landfill.[1] Most other plastic recycling processes are sensitive to contamination, and so require careful and costly separation of different plastic polymers. The PolyWaste technology also saves energy by melting the feed only once before producing plastic products.

Newtecpoly requires approximately 540 kWh per tonne of product (based upon a high proportion of polyethylene in the feed). In comparison, one tonne of virgin HDPE requires 21,306 kWh and 2.2 tonnes of crude oil.

1 *Mixture can include high density polyethylene (HDPE), low density polyethylene (LDPE), polypropylene (PP), nylons, polyesters and polyethylene terephthalate (PET).*

Find out more



Download the full Electrifying Industry report at

https://bze.org.au/research/manufacturing-industrial-processes/electrifying-industry/

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Endnotes

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