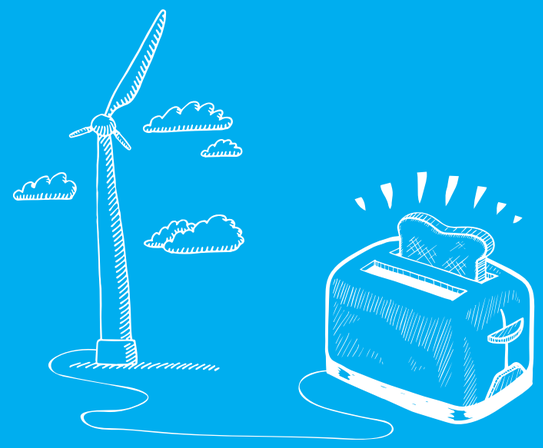


FROM A GUST OF WIND TO A SLICE OF TOAST

A turbine can transform the kinetic (moving) energy of wind into electric energy you can use in your house. It's like an appliance that powers your other appliances! However, even turbines have to obey the natural law; energy can't be destroyed or created, only changed.

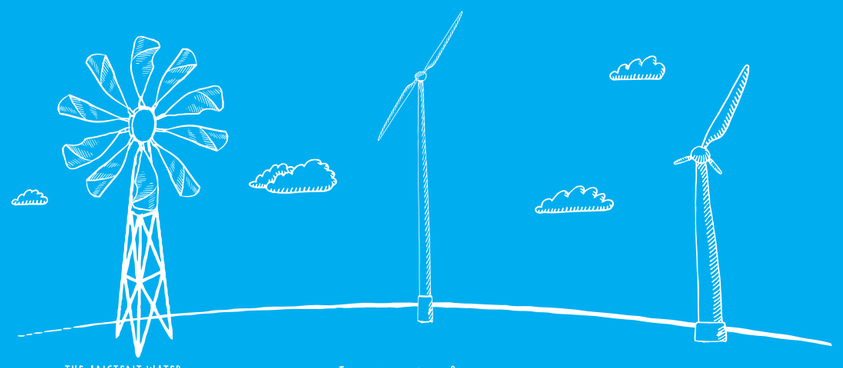
THE BEAUTIFUL EQUATION:

When making an energy transformation machine you have to make it out of stuff that doesn't take heaps of energy to make, and doesn't cost the earth. This magical machine must also transform the energy without losing it all in the process.

So, our clever clogs engineers at workSpace have done some physics optimization and created a machine that captures and changes as much energy from the wind as possible.

Kinetic (movement) energy = ½ x mass (weight) x speed ^{2}
Amount of Energy produced = power x time
Mechanical power = torque (turning force) x rotation speed
Electrical power = voltage x current

Turbines can't be greedy, and have to leave the wind enough energy to keep moving. Years ago a guy called Betz figured out the exact amount of energy you can take from the wind before the turbine head explodes. It has a fancy name - the 'coefficient of Performance' CP.



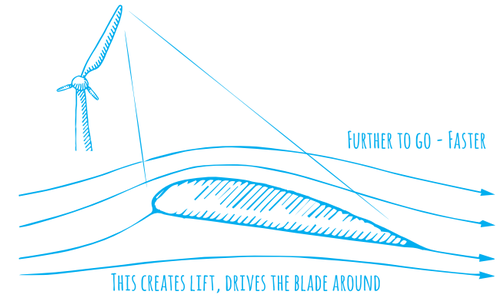
HOW DOES THIN AIR HAVE THE BEST PERFORMANCE OF ANY SMALL WIND TURBINE?

Lucky for you we're going to share which variables can be fiddled with when trying to achieve the magic 59% CP.

THE VARIABLES:

- The number of blades (but the more you have, the slower they turn)
- The speed of the blades (the faster they turn the more wear and tear on the turbine and the noisier they get)
- The width (chord) of the blades - (the wider the blade the more it slows the wind)
- The airfoil performance (this is the design of the blade – See cross section – creates torque that drives the blades around, this is what keeps an aeroplane in the air too)
- Airfoil performance is improved by air speed and increased blade width so it's a good idea to put your wind turbine somewhere windy.

You might think the faster the blades spin the more energy they produce, but there is a magic ratio here too..



TIP SPEED RATIO:

The 'tip speed ratio' is the speed of the blade tip / incoming wind speed. The tip is the thing that travels the fastest on the turbine, even faster than the wind.

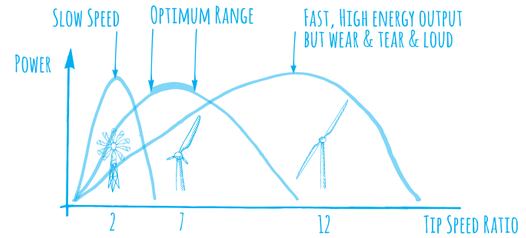
To keep our turbine rotor producing as close to the magic 59% as possible while keeping maximum torque (driver of the blades), you've got to choose an optimum tip speed ratio for your turbine. The designers of Thin Air have optimized it to a TSR of 7, which means the tip travels 7 times faster than the wind.

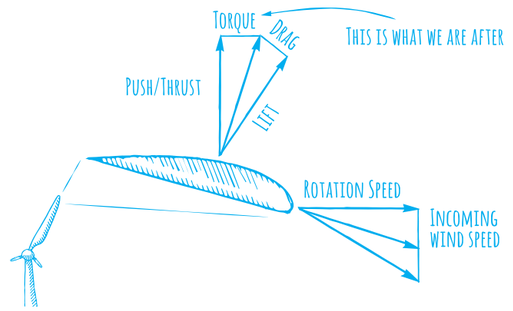
Now that we're cranking close to the optimum CP of 59% you might be wondering where the toast is at? To keep the turbine humming at optimum power production the rotor speed has to stay within range of the chosen tip speed ratio (7 for Thin Air). We can do this by taking just the right amount of energy out of the system without slowing the Tip Speed Ratio down.

mechanical power = Torque x rotation speed
electrical power = voltage x current

Together this all makes a bunch of high voltage direct current. But don't switch the toaster on yet. NZ uses AC, not DC for electricity, and we don't want you blowing up your toaster before you've had breakfast.

For the final transformation – an inverter takes our DC volts (between 120 and 500 VDC) and converts it to 230V AC that can then be used in your home (without any explosions).





thinair
BY POWERHOUSE WIND

www.powerhousewind.co.nz

workSpace
communication. product realisation. transformation