



pedal-powered machines



what are they?

Pedal-powered machines can either be driven directly by the turning pedals, or by electricity generated by the turning pedals. The former is very simple, relying on belts, friction wheels and / or gears rather than motors, batteries or inverters – although they're used for machines that involve motion, like grinders, blenders or sewing machines (and of course, bicycles!), rather than non-moving or digital kit like lights, laptops or TVs. Pedal-powered generators have been around since at least the early 1900s, when they were used during WWI to power field radio equipment. You can use a regular bicycle with a generator on a modified training stand (used by cyclists for indoor exercise during the winter). The stand is adapted by replacing the resistance unit (the bit that makes you feel like you're cycling on the road) with a plate on which a generator is fixed. When pedalling you spin your bike wheel, which spins a roller, and in turn spins a series of magnets in a motor that creates an electromagnetic charge. It's like a large dynamo (in other words, a motor in reverse: instead of electrical energy producing mechanical power, it's mechanical power producing the electrical energy). The generator will produce direct current (DC) – the type of electricity produced by renewable electricity systems or stored in batteries (the other type of current is AC, or alternating current – i.e. mains electricity).

But a DC current is 'spiky' – depending on how hard you pedal, you create different voltages (resulting in very jerky electricity) – anything between 0-60 Volts. Most DC appliances (typically used in caravans or boats) need a smooth 12V, so the voltage needs to be regulated. A regulator can be included in a DC system, and can be set from 0-30V depending on what you're trying to power. So let's say the voltage is set via the regulator to 12V. You can plug in a 12V appliance, pedal away and power it in real time with no battery storage. Or, you could connect an inverter that would allow you to power standard 240V household appliances. Pedal-powered generators can also be used to charge batteries, so that the energy can be stored for later.

However, you can do more work by not generating electricity at all. For example, you couldn't pedal hard enough to generate enough electricity to power a 600W blender in real time. But you could work the blender directly via a roller on the wheel, connected to the drive shaft with the blender blade on. There are washing machines run directly from pedal power, and even Scalextric tracks.

what are the benefits?

- Good exercise – but even better, you don't waste your energy. On a stationary exercise bike all the energy produced is simply wasted as heat. Replace the resistance unit with a generator or a mechanically-driven machine and you can do useful work as you're cycling ...
- ... which saves money, obviously ...
- ... and it also saves all the carbon emissions and pollution associated with the electricity generation that you've avoided
- Educational, and can be used by teachers and campaigners to explain electrical and mechanical, as well as environmental topics
- Raises awareness, and helps people question their electricity usage, and the wattage of their appliances; especially good at highlighting the benefits of low-energy lights and appliances, when you have to work to produce that energy
- Very useful in remote situations, or for emergency backup, as it doesn't rely on the sun or the wind – just on you and a bike
- Easily transportable and storable
- Good for public participation, especially when several bikes are connected together, as you might have seen at festivals
- Festivals! One bicycle can easily power 1000 LED lights, creating an impressive display, or an amp / mike for a singer with a guitar entertaining 50 people. And obviously, the more bikes connected, the bigger light display or sound system can be powered
- Driving machines mechanically is more environmentally-friendly, as there's no need to manufacture batteries, motors or inverters



Turning a generator via a friction roller.



what can I do?

You can't power an entire house via pedal-power. A fit cyclist may generate an average of 70W for an hour, and 160W in short bursts. Let's say around 100 Watt-hours from an hour's cycling. A unit of electricity is a kilowatt-hour (kWh), so you'd be generating one-tenth of a unit of electricity with an hour's cycling – the value of which would be less than 2p. But you can power small items as you're using them, and bigger things if there are several cyclists working together; or you can re-charge things like laptops, mobile phones or batteries, whilst exercising. Even a relatively unfit person can generate 50W consistently for an hour or so (and the more you do it, the fitter you'll get). So if you have a 50W TV you could power that directly, and watch it while you're cycling. You can check the wattage of your appliances by looking for a sticker on the bottom or back of them.

You can power all sorts of things. For an average person, powering a radio or laptop is easy. One person could charge 15 mobiles at the same time. You can run a small stereo, 3 or 4 low-energy light bulbs or a small LED projector with one bicycle. You can power all these things directly, or charge a battery. A 12V leisure battery (used in caravans) is good, and a deep-cycle battery is best of all as it can be discharged more often and more deeply. You can connect an inverter to the battery if you want to power 240V appliances.

Because of the small amounts generated, you might decide to power equipment directly, rather than generate electricity to do the work. Search online for 'pedal power plans' to find plans for food blenders, woodwork tools, pumps, drills, potters' wheels or wool carders, as well as for generators.



Pedal-powered generator stand onto which you fix your bike to generate electricity.



Pedal-powered washing machine.

You can buy a pedal-powered generator, or make one if you're a DIYer who knows something about electrics. There are several options to suit all:

- Make the entire generator yourself from recycled parts, if you know how
- Buy a generator and a stand
- Buy a generator and fix it to a stand you've already got for exercising
- Put together a DIY DC or AC (mains) kit to use with your generator
- Buy a resistance unit to go with your generator, which contains both the DC and AC kit – then you can just plug anything you like into it and away you go

Remember:

- You'll get better results (i.e. more power) with a road bike with smooth tyres rather than a mountain bike or a bike with chunky tyres
- Several bikes can be connected together to power larger appliances or systems – but then you'll have to get friends and family involved
- You can use a pedal-powered generator in combination with other renewables, e.g. solar

resources

- see lowimpact.org/pedal-power for more info, courses, products, links and books, including:
- Tamara Dean, *the Human Powered Home*
- James McCullagh, *Pedal Power*
- bit.ly/3vHHUpp – David Butcher: lots of free info
- bit.ly/2TJVHhU – Instructables: how to make a bike-powered food blender
- mayapedal.org – NGO developing pedal power for rural areas in Latin America

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