SKILL GUIDE · ENERGY & HEAT

Pedal Power: Bicycle Generators

The Energy & Heat chapter's Bicycle Generator item names this as a way to charge small batteries when solar input is low. This guide is the real detail behind that: honest output numbers, a real commercial option, the DIY design that actually works, and a viral claim about this exact technology that's worth knowing is false.

Realistic output, mechanical and electrical

A person's own sustained mechanical output varies a lot by fitness and duration: roughly 75W or less for casual pedaling with no real effort, about 100W sustained for an hour from an untrained adult, 150-200W from a fit recreational cyclist, and up to 250W from a trained athlete over extended periods.

> WARNING
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> **Electrical output is meaningfully lower than mechanical output**
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> Generator conversion losses mean 100W of pedaling might only yield 31-74W of actual electricity, depending on the system's efficiency. Any pedal-power plan built around the mechanical number rather than the electrical one will disappoint.

A real commercial option

The K-Tor Power Box (roughly $200) delivers 20-50W of continuous, smooth DC output at a pedaling cadence of about 90rpm, consistent with the real-world losses above rather than the higher mechanical figures. Its intended use is charging small and medium gadgets: phones, tablets, cameras, radios, walkie-talkies, flashlights. K-Tor's own guidance is refreshingly honest: nobody sustains an hour of pedaling, they recommend 10 minutes several times a day instead.

Building your own: what actually works

A DIY build has three real parts: a stand to hold the bike stationary, a generator to spin, and a way to get that generator's output safely into a battery. Mount the bike on a bicycle trainer stand (the kind sold for indoor winter training) rather than improvising a frame, it's built to hold a bike rigid under real pedaling force. A car

alternator, salvaged or bought used, is the generator most DIY builds actually use, since it's cheap, durable, and already built to charge a 12V battery.

If building a DIY pedal generator, drivetrain choice matters more than most builders expect. A direct chain-and-sprocket drive from the pedals to the generator runs up to 98% efficient. A friction drive (a roller pressed against the tire) runs only 80-90% efficient, wears the tire quickly, and its efficiency varies with tire pressure, making it inconsistent as well as lossy. Build a direct chain/sprocket drive if you're building one at all: connect a chain from the bike's own rear sprocket (with the bike in its lowest gear) to a second sprocket welded or clamped onto the alternator's shaft, sized so a comfortable 60-90rpm pedaling cadence spins the alternator up into its efficient range, typically 1,000-3,000+ rpm depending on the specific alternator.

An alternator's own internal voltage regulator and diode trio already rectify its output to a clean 13.5-14.5V DC suitable for charging a 12V battery, which is a real reason to use one instead of a bare DC motor. Still wire a blocking diode and a fuse in series between the alternator and the battery: without the diode, the battery can drain backward through the alternator's windings whenever you stop pedaling, and the fuse protects the wiring if something shorts.

Does adding a flywheel increase output?

No, and it's worth being precise about why not: a flywheel cannot create energy, only conservation of energy applies here, the same physics problem behind the debunked claim below. What a flywheel actually does is smooth pedaling's naturally uneven, pulsed torque (much harder on the downstroke than the upstroke) into steadier rotational speed. That steadiness keeps the generator running in its efficient RPM range instead of constantly moving in and out of it; a real documented example uses sprocket sizing to turn a 60-100rpm pedaling cadence into 2,000-5,000rpm at the alternator shaft, right in a small alternator's efficient band. Net effect: less of your effort is wasted as heat and vibration, not more electricity from the same effort than physics allows. It also reduces peak stress on your legs and the drivetrain.

The claim that gets oversold

A viral pitch for a bicycle-generator product claimed "pedal for one hour and you have electricity for 24 hours." The real, documented output: about 120Wh from an hour of pedaling, averaging out to roughly 5W over a full day, enough for some phone charging and a few small lights, not a house. The hour of pedaling that produces it also burns roughly 550 kcal, a real cost nobody selling these mentions. Treat any bicycle-generator claim that doesn't specify actual watt-hours with real skepticism.

Pedal power or a small solar panel

For the same 20-50W of charging capacity, a small solar panel costs less than a $200 purpose-built pedal generator and needs zero ongoing physical effort once installed. Pedal power's genuine advantage is working when solar can't: at night, during heavy overcast, or in deep winter when panel output drops, exactly the niche the manual's own equipment list already names.

Charging a thermal battery instead of an electrical one

Running pedal-generated electricity straight into a resistive heating element, rather than a battery, skips a real loss: converting electricity to heat through a resistor is close to 100% efficient, while charging a battery loses another 10-20% to round-trip inefficiency on top of the generator loss already at play. For heat specifically, resistor-to-thermal-mass is the more efficient path of the two. Skipping the generator and resistor entirely, using a direct mechanical friction heater instead, is more efficient still, since virtually all mechanical work against a resistive load becomes heat directly, though this means building a genuinely unusual DIY device rather than buying one.

WARNING

This is a trickle charge, not a fast one

Even at a generous 50W electrical output, an hour of pedaling delivers only 50Wh, enough to raise about 10kg of sand by roughly 20°F. This is a real, legitimate supplement to a thermal-mass system like a Jean Pain mound or a rocket mass heater's bench, not a fast or primary way to heat one.

Sources

- Sustained human mechanical power output by fitness level: Mapawatt; PedalPC
- K-Tor Power Box specifications and use guidance: K-Tor; Walden Labs
- Direct chain drive vs. friction drive efficiency: Low-Tech Magazine
- Flywheel smoothing and alternator RPM matching: Hackaday; Early Retirement Extreme Forum
- "Free Electric" bike claim, debunked with real output figures: Metabunk; Science for Sustainability
- Resistive heating efficiency and thermal-battery charging: Polar Night Energy, Sand Battery technical documentation
- DIY alternator-based bicycle generator build (trainer stand, sprocket ratio, diode trio, blocking diode): Appropedia; Practical Survivalist