E-Bike Benefits

- It's fun
- Low maintenance
- Relax – enjoy the ride
- Keep up with the leader
- No driver's license required
- Hills are less of a challenge
- Great option for those with disabilities
- Save money - A lot less expensive than a car
- Ride and keep up with your zealous, fit friends
- Get to work or school refreshed - Get home happy
- Eco-friendly - Go for 35 miles on a charge or more
- Get a workout - You can turn off or turn down the assist
- Health – e-bikes are ridden more often than standard bikes
- Keep the family together - everyone can ride, no matter fitness

Why Ride an e-Bike?

Most people who own an electric bike use it for their daily commute to work or for errands. They really depend on them to move around! Riding a regular bike already has many benefits that a car or other alternative transportation does not offer, like saving time and money on gas, maintenance, parking, tickets, and insurance. Biking by itself helps you take care of the environment and your community, be healthy and fit, and enjoy more of what a city can offer you or enjoy the beautiful landscapes if riding off-road.

So, why an electric bike? While riding a regular bike is great, if you use it as your main transportation to work or move around, you start having some challenges and getting slightly uncomfortable. Who likes to get all sweaty on the way to work? No one, unless you can take a shower at work and have the time! Who likes to get to work and back home faster? Everyone! An electric bicycle helps you go further, ride smoothly, and have FUN simultaneously! What about steep hills? An electric bike helps you climb them with ease. What about a bum knee? An electric bike can keep you cycling. You still need to charge your e-bike's battery pack, but you will get an average range of 20-25 miles [or more]

depending on the rider's weight and type of terrain. The good news is riding an electric bike costs only pennies per charge, and you'll save lots of money compared to other ways of transportation.

E-Bike Laws

Arizona Adopts E-Bike Law

(Disclaimer: This is not a legal opinion or legal advice.)

E-Bikes Are Bicycles: Governor Doug Ducey signed into law e-bike legislation, HB 2266, which defines an e-bike as a bicycle. This allows all jurisdictions within the State to follow a standard classification system for e-bikes, like those in eight other States. Local laws do differ. Federal lands, like BLM and National Forests, usually follow State law and have unofficially considered Class 1 e-bikes not in the "motorized" category. State, County, and City parks and lands may adopt rules specific to their location, so always read the restrictions on signage. (E-Bikes are trail approved: Maricopa County Parks).

Either way, there is no ambiguity under the Arizona Revised Statute Title 28, (Chapter Three, Article 11), Section 28-819. E-Bikes are not motor vehicles. Most government agencies and authorities will gradually modify their rules to conform, but are free to exclude e-bikes, especially where safety is a concern. Arizona law:

A. An operator of an electric bicycle is granted all the rights and privileges and is subject to all of the duties of a person riding a bicycle. Except as otherwise provided in this section, an electric bicycle is subject to the same provisions of this title as a bicycle.
B. An electric bicycle is not subject to the provisions of this title relating to certificates of title, registration, vehicle license tax, driver licenses or vehicle insurance.
C. Beginning January 1, 2019, manufacturers and distributors of electric bicycles shall apply a label that is permanently affixed, in a prominent location, to each electric bicycle. The label shall contain the classification number, top assisted speed and motor wattage of the electric bicycle and shall be printed in at least nine-point type.
D. A class 1 electric bicycle or a class 2 electric bicycle may be used on bicycle and multiuse paths. A local authority or agency of this state having jurisdiction over a bicycle or multiuse path may prohibit the operation of a class 1 electric bicycle or class 2 electric bicycle on the path.
E. A class 3 electric bicycle may not be operated on a bicycle or multiuse path unless it is within or adjacent to a highway or roadway or unless the local authority or agency of this state having jurisdiction over the path allows the operation.

Minimum Requirements For Safe Riding

Includes e-bikes, regular bikes, scooters, and trikes

- No matter what or how you ride, you are responsible for your safety or your child's safety. Wear a helmet. Check your bike for proper fit and operation before you go out to ride.
- Under 18 must wear a helmet by law.
- Install a speedometer so you know how fast you are going. AZ bicycle speed limit is 20mph.
- Wear goggles or appropriate glasses to protect your eyes.
- Install a mirror. Looking behind you without the aid of a mirror makes you pull in the direction you are looking or become unbalanced.
- Install a bicycle headlight and taillight. Use the light day and night to alert others of your presence and to light your path.
- Wear appropriate, close-fitted clothing, gloves, and shoes.
- Follow all the rules of the road. Follow the same rules that apply to cars.
- Sidewalks are pedestrian walkways
- Class 1, Class 2, and Class 3 e-bikes are considered bicycles in the State of Arizona. (Consult your local authority for regulations governing your particular area.)
- Follow safe handling of e-bike batteries.

Get The Most Miles Per Charge From Your E-Bike

- Pedal more - especially up hills.
- Keep the tires inflated to the maximum rating.
- Keep the battery cool or shaded when not moving.
- Start with a full charge. Efficiency is better on a full charge.
- The motor draws the most power when first starting. Take it easy. Roll on the throttle slowly and pedal in a lower gear to help the bike get going.
- Back off the power when cruising. The slower you go, the farther you go. Wind resistance has a huge impact.

Frequently Asked Questions About E-Bikes and E-MTBs

How are electric bikes classified?

There are myriad ways to classify a bicycle with an electric motor. Most classification strategies use the following attributes:

- The motor stops assisting the rider at 20 MPH (or 28 MPH for S-Pedelec)
- The motor is activated when you pedal and/or operate a throttle
- The motor has limited power, usually 750 watts or one Horsepower (not a lot of power)
- The bike must be able to be propelled by pedaling alone
- The bike is not registered with the DMV, needs no license plate, and requires no driver's license or insurance
- Age limit on faster bikes - helmet required under 18

Where can I ride my electric bike (especially my mountain e-bike) - Arizona electric e-bike laws?

(Disclaimer: This is not a legal opinion.)

Governor Doug Ducey signed into law e-bike legislation, HB 2266, which defines an e-bike as a bicycle. This allows all jurisdictions within the State to follow a standard classification system for e-bikes, like those in eight other states. Local laws do differ. Federal lands, like BLM and National Forests, usually follow State law. State, County, and City parks and lands may adopt rules specific to their location.

Some complain that e-bikes are cheating, that they damage the path because of weight, or that they open the door to motorcycles. Of course, anyone who has ridden a pedal-assisted e-bike knows that none of this is true. After all, should a lightweight carbon hard-tail MTB be banned for cheating? Some contend that a "motor-is-a-motor" has no right on a bike path. However, this is completely contradicted by the national trend to permit Class 1 and Class 2 e-bikes on bike paths. It also recognizes that people with disabilities, through pedal assistance, should benefit from access to the many public-funded bike paths in the USA. No, it’s not cheating. E-bikes open a huge opportunity for everyone to enjoy the benefits of a bicycle.

Clearly, all paths on Federal Lands that are marked for ATV use (fire roads) are open to e-bikes (and there are thousands of miles of these in Arizona, such as in the Tonto National Forest). Generally, most bike paths are unrestricted for mountain bikes, such as on Federal lands (National Forest, National Park, BLM, etc.), but may restrict use by e-bikes, although

Class 1 e-bikes are not necessarily considered "motorized." It's still a little confusing, but the Department of Interior has considered exempting e-bikes as motorized vehicles. Any path where motorized travel is allowed, an e-bike can also use the path. Bike paths along highways are usually not an issue either (albeit ambiguous). However, if you ride in a public Park, they can make their regulations, especially if you behave recklessly. The best way for us all to safeguard our rights to access bike paths with e-bikes is to ride responsibly, be courteous, and not flaunt your pedal assist. Ask or refer to the signage to validate e-bike use if you are in a park. If a sign says, "no motorized vehicles," it's best to choose another path or get clarification. Class 1 and Class 2 e-bikes are considered pedal-assisted bicycles, not motor vehicles.

Classifications for E-Bikes

(Disclaimer: This is not a legal opinion.)

Every municipality is different in its regulations. City, County, State, and Federal lands are all governed differently. To be safe, find out local regulations. In general, when in doubt, while operating any bicycle – pedal, gas, e-bike, or moped – follow these simple guidelines:

- **Bicycle or E-Bike:**
    - Always wear a helmet (under 18 must wear a helmet)
    - Obey all traffic laws, including posted speed limits
    - Do not use pedestrian walkways or sidewalks unless specifically allowed
    - Limit your speed to 20mph - AZ State law for any bicycle
    - Use a front and rear light and have reflectors
    - At night, all bicycles require a headlight and rear reflector, at a minimum
    - Use a speedometer on the bike
    - Be exceptionally cautious when approaching or traveling through an intersection
    - The bike should be limited to under 1Hp or 750 watts
    - Do not modify the motor to achieve higher speeds
    - No driver’s license, insurance, license plate, or registration is required to operate an e-bike or bicycle

    - All e-bikes must have an official sticker that details Class Type, max speed, and max wattage

- **Class 1 E-bike:** is a pedal-assisted e-bike, without a throttle, whereby the motor stops helping propel the e-bike before reaching 20mph
- **Class 2 E-bike:** is the same as Class 1 but includes a throttle option
    - Class 1 and Class 2 e-bikes are considered bicycles and allowed anywhere a pedal bike is allowed, but subject to local regulation
- **Class 3 E-bike:** is the same as Class 2, often called an S-Pedelec, where the pedal assist helps up to 28mph (throttle is limited to 20mph if equipped).
    - Class 3 bicycles are not allowed on bike paths
    - Under 16 may not operate a Class 3 e-bike
- **Electric Kick Scooter:** a standing scooter with a helper motor may be operated using a throttle. It is treated and regulated like an e-bike.
- **Scooter:** is basically a small motorcycle, usually with an automatic transmission, typically between 50cc and 150cc.
- **Moped:** 1.5Hp (1,500w) max, 49cc max, 25mph max. Need insurance, any class of driver's license, moped registration (but no title), and proof of ownership. Must stay off bicycle paths/lanes and cannot operate on public roadways (but can use the shoulder or travel adjacent to the road). Usually, mopeds are equipped with pedals and safety items: mirror, lights, brake light, turn signal, horn, & speedometer. The ARS is a bit confusing on mopeds, such as the absence of a specific pedal requirement. In any case, ride sensibly and safely and obey all traffic laws. Wear a good DOT-rated helmet.
- **Gas bikes**: 48cc max, 1hp max, 20mph max. It's a bicycle with a helper motor.
- **OHV:** primarily driven or made for operation off-road. Must have a title, registration, driver's license, and an OHV decal. Under 49cc needs no OHV decal.
- **Motor-driven cycle:** a motorcycle. Title, MC license endorsement, registration, insurance, and all safety devices are required.

The vast majority of e-bikes sold at Archer's Bikes are Class 1. More information can be found at People For Bikes or at Trailforks for places to ride.

What Arizona has to say (ARS **28-101**):

24. "Electric bicycle" means a bicycle or tricycle that is equipped with fully operable pedals and an electric motor of less than seven hundred fifty watts and that meets the requirements of one of the following classes:
(a) "Class 1 electric bicycle" means a bicycle or tricycle that is equipped with an electric motor that provides assistance only when the rider is pedaling and that ceases to provide assistance when the bicycle or tricycle reaches the speed of twenty miles per hour.
(b) "Class 2 electric bicycle" means a bicycle or tricycle that is equipped with an electric motor that may be used exclusively to propel the bicycle or tricycle and that is not capable of providing assistance when the bicycle or tricycle reaches the speed of twenty miles per hour.
(c) "Class 3 electric bicycle" means a bicycle or tricycle that is equipped with an electric motor that provides assistance only when the rider is pedaling and that ceases to provide assistance when the bicycle or tricycle reaches the speed of twenty-eight miles per hour.

Learn About Your New Bike

We recommend taking time to get to know your new bike and accessories. Practice riding in a safe open area, with e-bike power off, until you feel confident riding in more difficult terrain. Practice builds confidence and competence over time. Wear a helmet. Take your time.

What are the fundamental options when looking for an electric bike?
Electric bikes come in myriad shapes and sizes: folding, mountain, sporty, hauling, comfort cruiser, tricycle, recumbent, conversion kits, etc. Prices range from a low of $500 (kit) to $6,000 or more. Conversion kits are the least expensive way to modify your current bike, especially if you are handy. Used electric bikes are available but sell out fast. Folding bikes take up less space. Where and how you will use your electric bicycle will depend on your choice. There is a style that will fit anyone's needs.

How much does an e-bike cost?

A good e-bike starts at $1,500. Some bikes are available online for less but are hard to compare because of poor reliability and high repair costs. You may find a major brand on sale, but not usually less than $1,000. Using a base price of $1,500, 5-year expected life, 1,000 charge cycles, 30 miles per charge, and $0.15 to charge it back up, you would anticipate the bike to last 30,000 miles (115 miles per week). Add in the cost of maintenance and wear items (drive train, tires, tune-ups, etc.), at $50 for every 500 miles, your total cost of ownership is $1,500 (purchase), $3,000 (maintenance), $150 (charge up), TOTAL $4,650. That's less than $18/week or $0.16/mile. That's cheap transportation. Even the battery, which costs around $500-$800, usually the first item to need replacing, adds

little to the cost of ownership in the long run. If the residual value of the bike is $375 and you sell it or trade it in, you still maintain a very attractive total cost over time.

How do you make the bike go?

An electric bicycle may come with optional pedal assistance. Some electric bicycles come with an optional throttle to control the electric assistance. Some models come with only one option, some with both, while it may be an add-on option for others. The pedal assist feature allows the motor to add power to the rider's effort on every pedal stroke. The pedal assist power may be adjusted to increase or decrease the rider's effort through a small control interface. With a throttle (twist or thumb), there is a lever operated by hand and provides a variable input from the rider to increase or decrease the motor assistance. With pedal assist, pedaling is easier, making going uphill or level as easy as going downhill. Since the power is adjustable, the amount of effort used with each pedal stroke can be made normal to get full aerobic exercise benefits, easy to make up for any physical impairment, or just to make the ride a relaxing event. When you have a throttle option, the rider can choose not to pedal, let the motor do all the work, or give adjustable help, depending on the rider's preference, with or without pedaling.

How powerful are the motors?

Motors come in various sizes, commonly from 250 watts to 1,200 watts or more. However, that is still at most two horsepower (1,500w). Most government agencies limit power to 1Hp (750w) to be considered a pedal-assisted bicycle. Larger motors, measured on wattage, provide more assistance to climb hills or to get up to speed. This is analogous to the size of the engine in your car. Smaller motors use less energy, are less costly, and will have a longer range for every watt-hour pulled from the battery. Larger motors are heavier, will not go as far per watt-hour used, but provide much greater push in all situations. Lighter riders may want to look at smaller motors, while larger riders may want the added benefit of increased power. However, a caution note when comparing wattage: not all motors are created equal. 250w only tells you how much power the motor consumes, not how much power is transferred into forward motion. For example, center drive motors are more efficient and, thus, are typically lower in wattage. Conversely, a big (and heavy) 1,000w, direct drive hub motor sounds huge but is very sluggish at slower speeds. Also, larger-wattage motors need bigger (and heavier) batteries. Bottom line: you must ride the bike yourself and decide after the test ride.

What battery do I need?

Batteries come in different voltages (usually 24, 36, or 48 volts - sometimes even more) and different sizes, usually from 6 amp-hour to 20 amp-hour. Lead-acid batteries are great for

golf carts; they cost less but weigh a lot, have a short life span, and require frequent maintenance. All modern bicycle batteries are made from Lithium. They are more compact, weigh less, and are very reliable. The life of lithium batteries is anywhere from 1,000 to 2,000 charge cycles and around three to six years, depending on how much they are used. The usable power of a lead acid battery drops dramatically as the power is depleted, making the last 30% of little use. Lithium-ion batteries allow the battery to be useful down to 10%. Battery energy (think: the size of the gas tank) is rated in Watt-Hours (or Amp-Hours). Higher numbers equal more power. Modern batteries do not need to be continuously charged or stored while connected to an electrical source. Batteries should be stored at room temperature (ideally) but only charged after they get low (do not leave any battery unattended on a charger). Commonly, the battery is attached to the rear rack or along the frame down-tube, leading from the handlebars to the pedals. Depending on how much you pedal and the size of the battery, your range will be anywhere from 15 to 40 miles or more. Higher voltage batteries must match the motor voltage limit but store and transfer energy more efficiently. Higher amp-hour batteries have a longer range because they store more energy and weigh more. For example, a 24-volt, 6-amp-hour battery will provide the least power and shortest range (144 watt-hours, commonly found on older e-trikes). Alternately, newer bike configurations are 52 volts with 20-amp-hour batteries (1,040 watt-hours). If the rider desires only a moderate range and less motor assistance, the smaller battery will be lighter, and the overall cost of the bicycle will be lower. Sporty models (lighter-faster) cost more, have more power, and will go farther, but may weigh less than an economy model, adding to the fun factor. Some bikes are made for hauling and have larger motors and heavier batteries, but they go at a very conservative pace. Many older e-bikes and scooters use lead-acid batteries. Lead-acid batteries have a lifetime of less than a quarter of a lithium-ion battery and stop providing power due to voltage drop long before a lithium-ion battery loses power.

Volts

There is a balance between battery voltage and battery efficiency. Given current battery and motor technology, 24 volts is OK for a front wheel, and a 250-watt hub motor has a low expectation of power. 36 volts works best for mid-drive because the motors work more efficiently, and the distance of the battery from the motor is short. 48 volts is best for rear hub drive systems, improving electrical power transfer and low-speed torque. However, because battery cells are connected in series to achieve higher voltages, 48-volt (and higher) systems degrade faster than 36-volt systems (given equal Watt-Hour ratings). Higher voltage systems transfer energy more efficiently to the motor than lower voltage systems. But remember, just because a system has higher voltage does not mean it is necessarily better (although it usually is). Power delivery efficiency and motor efficiency

impact distance and torque. As a result, most center-drive motor systems use 36-volt batteries, not 48-volt.

Amp-Hours

Battery power is measured by its ability to hold electrical energy for future use. Bigger cells last longer and can provide greater amounts of energy under heavy loads. Amp-Hour is a unit of measurement showing how much current can be delivered over some time. For example, a 10AH battery can deliver one ampere of electricity for ten hours before it is depleted. However, it also has a current limit. Most 10AH batteries cannot deliver more than 20 amperes at any given moment. Greater Amp-Hour ratings yield longer distances on a ride and more maximum power for climbing hills. Sometimes, you will see the capacity listed in Watt-Hours. This is the same result. Dividing Watt-Hours by the battery voltage gives you the Amp-Hour rating. A 36V 700WH battery has an Amp-Hour rating of about 20AH. Look for at least 10AH on a given battery for the best results. Lower ratings are okay, but you will not get as far.

Watts

Wattage (horsepower) measures how much power the e-bike motor uses, but not necessarily how much power it puts into the ground. 250 watts is the smallest practical motor power, while most bikes top out at 750 watts, which is very powerful. In almost all jurisdictions, government regulations limit maximum power to 750 watts (one horsepower) on e-bikes. Electric scooters, mopeds, pedicabs, OHVs, and motorcycles can exceed the 1 HP limitation. Hub motors need a higher power to work with heavier loads or climbing hills, but center drive motors work very well at 250 watts. Center drive is more efficient and can leverage different gear selections. The most common bikes have 250-watt center drives and 500-watt hub motors. Also noteworthy is that just because a motor is rated at 500 watts, a motor that is 1,000 watts will not necessarily be twice as powerful.

Torque

How hard the motor can turn the wheel over a given distance is torque. Knowing the torque of a motor is useful when comparing different motors by the same manufacturer. However, there is no standard for torque measurement, so comparing motors among different manufacturers is questionable. Think of torque as the ability of the motor to spin the wheel. If it's a center drive, then downshifting will provide more torque at the ground - you can climb a hill more easily. That's why center drives are best for mountain bikes. Hub drives are significantly disadvantaged when starting out because the torque is engineered to be maximized at cruising speeds, not from a dead start. Increasing starting torque on a hub motor is a trade-off for top speed: more torque at startup equals a lower top speed.

How do I charge and care for e-bike batteries?

Lead-acid batteries require relatively continuous charging during breaks of more than a month (trickle charge). They do best when connected to a high-quality trickle charger with limited current and are kept in a climate-controlled area (32-70 degrees). They last longer if you recharge them before they get to about 50% discharge. Deep cycling does deplete the battery life more quickly. Expect most lead-acid batteries to last about 300 cycles or two years before degrading. Chargers can break; batteries can leak toxic fumes and gasses or may cause a fire. Never leave any battery, even lead-acid, unattended for long periods while connected to a charger.

It is always a best practice to plug the charger into the battery first, then plug it into the wall. Unplug the charger from the wall when disconnecting, then unplug the battery. This procedure helps minimize voltage surge when charging.

The newer Lithium-ion type battery does not need to be continuously charged. They can be safely stored in a climate-controlled environment for 6 months or more with no detrimental effect (32-68 degrees). They do best if stored in a safe place from causing an accidental fire and put at about 50% charge before storing. These newer batteries get 1,000 or more cycles and can last as long as five years before substantially degrading. As they degrade, you get less range. You can, however, charge your battery back to 100% before every ride. If the battery was at 50%, this would count as 1/2 of a charging cycle (you get 2,000 1/2 cycles). Never leave any type of battery, even lithium-ion, unattended for long periods while connected to a charger.

Unplug your charger when unattended and after the battery has fully charged.

All batteries should be kept out of extended sun and temperature extremes. Many will show an error when allowed to exceed 104 degrees. They also work poorly when cold (below 35 degrees) or hot (over 100 degrees). Don't leave your battery out in the hot Arizona sun (like on a car carrier - even while moving).

Always recycle old batteries properly, as they could cause an accidental fire or contaminate the environment.

Battery Safety

Leaving the battery on the charger might be dangerous should the circuitry malfunction in the battery or the charger. Furthermore, it's best not to leave any charging battery unattended to be safe. It is an electrical appliance, and the safest way to handle it is never to leave it unattended, especially overnight, and limit the charging time to four hours. If it is not charged in four hours, give it a break to cool off. The charger and the battery may get

warm, but never too hot to touch. Read more detailed information on our Lithium-Ion Battery Safety FAQ page.

If your battery shows signs of swelling, hot spots, or damaged electrical terminals, stop using it. Recycle it properly, referring to the manufacturer's guidelines. A good reference is Call2Recycle.org. Many manufacturers charge for the recycling service at the time of purchase. That means you may have already paid for recycling at Call2Recycle.



Maximize Battery Lifespan

E-bike batteries have come a long way. They are lighter and more powerful than even a few years ago. However, they are still quite expensive. Following just a few basic tips can dramatically extend battery lifespan.

Keeping the charge between 20% and 80% when not used will help the battery last longer. This can even extend to charging it all the way up just before you use it. Also, you don't need to discharge modern Li-Ion batteries down to zero to keep them healthy. However, most people charge it all the way up after every ride. This is most convenient so that the battery is ready to go when you are. Ultimately, charging after every ride may shorten its life, but the difference is not really worth the inconvenience of not having the bike ready to ride when you are. But, if you don't plan to ride for a while, a few weeks or months, store the battery at around 50% charge. Check it periodically to keep it between 20% and 80% charged.

Store the battery at room temperature. Don't leave it in the garage where temperatures may go below freezing or above 100 degrees.

Don't leave the battery on the charger after it has fully charged. Most of the newer chargers from name-brand manufacturers have an automatic charge limit that does not come back on until the battery drops measurably in voltage. In other words, it will not hurt the battery if you accidentally leave it on the charger. However, leaving it on the charger will cause the battery to get recharged periodically, constantly leaving it in a full-charge state (reducing lifespan), and it uses up your charge cycles.

Don't let the battery sit in the sun. This can overheat it and cause damage. Definitely ride in the sun or heat. That's okay. You're moving, and this helps keep the battery cool. In cold weather riding, the battery will not work as well because the cold slows the chemical reaction in the battery cells, so you cannot expect as much range, but you can still go for a ride. Keep the battery in the vehicle when traveling and out of the elements. Only charge the battery when it has reached room temperature. Too cold or too hot charging can hurt the battery. Avoid charging the battery with a fast charger when possible. Fast charging does shorten the battery lifespan.

Most modern batteries, such as Shimano, Yamaha, Samsung, Panasonic, Bosh, and Specialized, are the best that can be found today. You can expect 500 to 800 full charging cycles before the battery shows significant signs of age. Some customers report 1,500 or more cycles before losing steam. You can count a quarter charge as a quarter cycle as well. This means you can get 3,200 quarter cycles.

Where does the motor attach?

Motors may be attached or configured in many ways: clamped on the back and with a friction wheel to push the tire, a motor attached to the side of the bike with a chain driving the wheel, integrated into the wheel hub (front or back), or as part of the pedal crank – mounted in the center of the bike frame. The most common configuration is the motor integrated into the wheel hub. The motor is what provides the assistance. It can be attached to the tire, the hub, the chain, or the pedals. The bicycle looks like a normal bike with the most common hub motor, except for a larger wheel hub. This leaves a lot of space for a bike rack and the battery. It also protects the motor from damage and moving parts away from the rider. Mounting the motor on the rear hub gives added traction and some complexity if you need to change the tire. With the hub motor in the front, there is less complexity but less traction overall. Tire-mounted motors are generally easy to install but unreliable (usually found as kits). Center drive motors mount at the pedals, provide a good balance, and give easy access to changing flat tires. They are newer and more complex but

are gaining in popularity. Older styles include having the motor hang on the side and driven by a chain, but they have lost popularity because they are damaged easily, have low wattage, and require frequent maintenance.

What type of motor is best?

Most commonly available motors are either direct drive or geared drive. Both direct drive and geared motors use electric power from the battery to turn the wheels. Direct drive motors have no gears or brushes, reducing wear and complexity. Geared drives tend to be smaller and provide greater power (torque) when starting off or at lower speeds but are more complex and have a greater number of wear points. Both types come at various levels of quality and performance. Direct drive motors have fewer moving parts, may last longer, are quieter, and weigh a little more, but they have better efficiency at average speeds. Geared drive motors deliver power from the start better, weigh a little less, and provide more consistent power delivery at all speeds. Opinions about which is better are somewhat subjective, leaving riders to decide what functions suit them best. A more sophisticated motor is a stepped motor like the Shimano E8000. Stepper motors are DC motors that move in discrete steps. They have multiple coils that are organized in groups called "phases." The motor will rotate one step at a time by energizing each phase in sequence. With a computer-controlled stepping, you can achieve very precise speed control. For this reason, stepper motors are the motor of choice for center drive systems as they can more precisely apply torque, yielding a smooth and natural feel to the motor. Most all center-mounted drive systems are geared. Mounting the motor at the pedals allows the motor to use the bicycle's gears, improving efficiency and power transfer at different speeds.

Rear Wheel (hub) drive e-bikes

Rear wheel (hub) e-bikes offer a good economical solution, as they are the simplest method of adding a motor to a bike, providing pedal assist and/or throttle to an e-bike. The design is less complicated and easier to manufacture as well, so rear wheel/hub drive e-bikes can be priced more competitively. It also puts all of the extra weight on the wheel for best traction. Compared with mid-drive e-bikes, rear wheel (hub) motors are much more common, making up 90% of the e-bike market. The biggest downside of the rear drive is it is challenging to change a flat tire. The wheel is heavy, and the axle is usually bulky and keyed. Also, the bike can become unbalanced if the hub is heavy or the battery is mounted on the back.

Front Wheel (hub) drive e-bikes

Like a rear wheel, front-wheel (hub) e-bikes offer a more economical solution, especially if you are doing a conversion or a trike. The design is also less complicated and easier to manufacture, so front-wheel-drive e-bikes can be priced more competitively. Front drive is a disadvantage for traction, though, because the tire has little weight compared to the rear drive. A big advantage of the front-drive is it is much easier to change a flat than a rear-drive.

Mid-Drive e-bikes

Mid-drive offers the highest efficiency and performance for e-bikes. They are more expensive than hub-drive e-bikes but offer superior performance, especially in hilly terrain. Mid-drives incorporate the bicycle's transmission as the gears for the motor, allowing the electric motor to operate in the optimum RPM range. Because they are more efficient, the battery can last longer (which can also make the bike lighter since a smaller battery can be used.) Mid-drive e-bikes also handle better than their rear wheel/hub drive cousins, because the weight of the motor is balanced in the middle of the bike. Mid-drive has some downsides: they can be noisier than hub drive models and are more complicated to service. Despite these downsides, they are usually the best choice for riding in hilly terrain or off-road. Mid-drive motor setups make changing a flat very straightforward, as it is just like any bike.

What about the brakes?

Brakes can be rim-style or disk. Disk brakes come in mechanical and hydraulic. Rim or V-brakes work by squeezing the wheel's rim and have been used for years. Disk brakes are newer but have been perfected to the point where they are better than rim brakes. Disk brakes work by squeezing a small disk attached to the wheel. Mechanical disk brakes work using a wire that is pulled at the brake handle to apply pressure to the disk. Hydraulic brakes are similar, except they use a fluid, usually brake fluid or mineral oil, to transfer the pressure to the disk. Disk brakes stop better than rim type and work better when wet. Hydraulic brakes are more reliable and stop better with greater feel and road feedback. Disk brakes are preferred on an electric bike because of the increased weight of the bike, applying better stopping power. Nearly all of the newer electric bikes come with disk brakes because they have become almost as inexpensive to install as rim brakes. Mechanical disk brakes are less expensive and work well, but they require more maintenance and attention. Many bikes will cut off the motor when the brake is activated.

How does the bike "know" how much power to apply?

Speed sensors limit maximum power assist for most bikes at 20mph (S-pedelec 28mph). Cadence sensors tell the motor controller how fast you are pedaling. Torque sensors tell

the controller how hard you are pedaling. speed, cadence, and torque sensors may all be used to help the motor controller modulate the power provided to the motor. A speed sensor helps the rider stay within the federal regulations and guidelines, limiting power-assisted bicycles usually to 20mph (State and Local laws may vary - AZ is 20mph). Cadence and the more advanced torque sensors help the controller make the motor feel natural and efficient. If the bike only has a throttle, it is unlikely to have cadence or torque sensors, as they would be superfluous.

How fast can I go?

Any bicycle, electric or otherwise, can go quite fast. None of the electric bikes have a governor or speed-limiting device other than to stop applying power (helping) after a preset limit (usually 20mph or 28mph). Obviously, pedaling or going downhill, you can go over 28mph. Electric-assisted bicycles, foot-powered elect/gas scooters, and gas-powered bicycles all fall into a general bucket of law enforcement. They are not automobiles, motorcycles, mopeds, or ATVs. Mostly, they are unregistered, unlicensed, and not titled or plated; they need not be insured and require no operating license. The laws in Arizona are not precisely clear, leaving enforcement and interpretation up to local law enforcement. Federal laws generally restrict speed to 20mph and less than 750W at the motor (under 49cc for gas). To be as safe as possible regarding the law, keep your speed under 20mph, stay out of traffic, use bike lanes as appropriate, yield to pedestrians, obey all traffic laws, wear a helmet, and be courteous. In Arizona, Law enforcement may interpret your riding how they see fit, considering public safety first.

How far can I go?

The bigger the battery, the farther you can go. A lighter rider on a lighter bike will go farther. Small-profile, high-pressure tires go faster and easier. Several factors affect range: temperature (warmer is better), wind, hills, tires and pressure, how much you pedal, battery age, motor design, battery type, etc. A 24v 10Ah battery supplies 240 watt-hours of energy. A 48v 10Ah battery supplies twice the energy at 480W-hours. A 36v 20Ah battery holds twice the energy of a 36v 10Ah battery. Under moderate load, assisted with pedaling, most bikes will go 20 miles before needing a charge. Some models will go 40+ miles between charges. Under a hard load, the bike might only go 5-10 miles before running out. Of course, you can always pedal home. Lithium-ion batteries will last three or more months without being charged and sitting on the shelf. That said, always follow the manufacturer's storage, charging, and disposal recommendations. Major factors affecting distance on a charge: Wind, human effort, battery capacity (in watt-hours), voltage (higher voltages are more efficient), weight (both the bike and rider), hills (even with regenerative systems, you never get much back), tire pressure (keep those tires filled), maintenance (a rubbing brake

can rob a lot of power), motor RPM (every motor has a sweet spot - usually slow, hard pedaling is a power waster), battery age, and charge (the first half of the battery charge is livelier than the last half).

What is the controller?

The controller is the brain. It interfaces the motor to the battery through user input (throttle or pedal assist). The controller is the central electronic unit that controls when battery power is applied to the motor. It does this by interfacing with most if not all, the electric bicycle-specific components, including the battery, throttle, sensors, motor, brake override, and display. The controller regulates everything for smooth, dependable operation.

What about insurance?

Your homeowner or renter insurance may allow you to add your bike to the policy. However, it may be a better idea to purchase a separate policy from an insurer that explicitly covers e-bikes. EBR has a good article on insurance that may help. Either way, ensure you are protected with a good lock and be very careful where you store your bike.

What about regenerative braking?

As you pedal up a hill, you create potential energy that can be recaptured on the descent. Equally, if you are going 20mph, coming to a stop can generate power. The motor or braking system can capture this potential and kinetic energy to charge the battery. On a Prius electric car weighing two tons, this can translate into a significant amount of energy. On a bicycle, it is negligible. With most electric bikes, the notion of recapturing lost energy is small because most of the kinetic energy used to accelerate or climb a hill is lost in wind resistance, tire flex, heat loss, and other factors. Potential energy, by virtue of the ride down the hill, is relatively small (you don't weigh that much). In other words, there is nothing to gain through regeneration. Comparing two bikes, one with regenerative braking and the other without, both will travel about the same total distance on a given charge. Ultimately, it is hard to justify the added cost of regenerative braking on an e-bike.

How can I transport my e-bike?

E-bikes are heavier than non-electric bikes because of their motors and batteries. As a result, you might need help putting it into your trunk like a regular bike. When putting your electric bike in your car isn’t an option, we recommend using a car rack. They’re easy to install, easy to secure your e-bike to, and leave space inside your car. But not all car racks are made for the weight of an electric bike. Some e-bikes weigh over 60 pounds, and many car racks just can't handle that weight. Most trunk racks are incompatible as they typically

have a per-bike weight limit of 35 pounds. Even most hanging-style racks are not an option because most are rated for 40 pounds per bike. Tray-style hitch car racks are the best option (the only option, really). We recommend this style because you don't have to lift your e-bike high up off the ground and maneuver it onto a hanging-style rack. Each of the bike's wheels is secured to a tray that holds the bike. Also, there are several ratings for electric bikes. But, even with tray hitch racks, you'll have to check the capacity. Some racks have a 60-pound-per-bike capacity, but you must also be aware of the total weight capacity. Even though a rack may have a 60-pound per bike weight capacity, the entire rack may only have a 100-pound total capacity (meaning it might only hold one e-bike). We carry Kuat bike racks that are rated for the weight of an e-bike.

What about an e-bike versus a gas bike?

Dollar-for-dollar, Gas bikes generally cost a lot less and are more powerful than an electric bike. They do require much more attention and maintenance. Without question, they are noisy, messy and smelly. Gas bicycles come with a small, often 2-stroke, motor (oil is premixed with the gas). Some may have a 4-stroke motor, often larger and heavier, but most bicycle frames cannot handle a lot of stress, so large motors are unusual. More power is just a motorcycle. Just like an e-bike, the gas motor is used to provide extra pedaling power to the bicycle. Electric bikes do cost more than gas bikes, but are clean and friendly to the environment, with far less maintenance. With either motor type, the rider may use the motor to assist in pedaling, reducing the effort used to move the bicycle. All electric bikes have the option of turning off the motor and even leaving the battery at home, making the bike a traditional pedal bike. Gas bikes are very cumbersome to operate without the engine running.

What does Wikipedia have to say?

"Motorized electric bicycles and tricycles meeting the definition under the applicable statute are not subject to title, licensing, insurance, or registration requirements, and may be used upon any roadway authorized for use by conventional bicycles, including use in bike lanes integrated with motor vehicle roadways. Unless specifically prohibited, electric bicycles may be operated on multi-use trails designated for hiking, biking, equestrian, or other non-motorized usage, and upon paths designated for the exclusive use of bicycles. No operator's license is required, but anyone operating a bicycle on Arizona roads must carry proof of identity. A "motorized electric bicycle or tricycle" is legally defined as a bicycle or tricycle that is equipped with a helper motor that may be self-propelled, which is operated at speeds of less than twenty-miles-per-hour. Electric bicycles operated at speeds of twenty miles an hour or more, but less than twenty-five miles per hour may be registered for legal use on the roadways as mopeds, and above twenty-five miles-per-hour

as a registered moped with an 'M' endorsement on the operator's driving license. However, mopeds in Arizona are prohibited from using bike lanes on motor vehicle roadways. The Arizona statute governing motorized electric bicycles does not prohibit local jurisdictions from adopting an ordinance that further regulates or prohibits the operation of motorized electric bicycles or tricycles." (Note: to be registered, a vehicle must comply with all the legal requirements, such as, lights and mirrors.)



IMBA Rules of the Trail

The following is an excerpt from the IMBA website (Rules of the Trail) and represents a very logical approach to mountain biking:

"[The] IMBA developed these "Rules of the Trail" to promote responsible and courteous conduct on shared-use trails. Keep in mind that conventions for yielding and passing may vary in different locations, or with traffic conditions.

Ride Open Trails:

Respect trail and road closures. Ask the appropriate land manager for clarification if you are uncertain about the status of a trail. Do not trespass on private land. Obtain permits or other authorization as required. Be aware that bicycles are not permitted in areas protected as state or federal Wilderness.

Leave No Trace:

Be sensitive to the dirt beneath you and the environment around you. Wet and muddy trails are more vulnerable to damage than dry ones. When the trail is soft, consider other riding options. This also means staying on existing trails and not creating new ones. Don't cut switchbacks. Don't ride around standing water which results in widening the trail. Be sure to pack out at least as much as you pack in. Consider improving the trail experience for those that follow by picking up and removing any litter.

Control Your Bicycle:

Inattention for even a moment could put yourself and others at risk. Obey all bicycle speed regulations and recommendations and ride within your limits. Social conflicts on trails often result when riders are going too fast.

Yield Appropriately:

Do your utmost to let your fellow trail users know you're coming — a friendly greeting or bell ring are good methods. Try to anticipate other trail users as you ride around corners. Mountain bikers should yield to other non-motorized trail users, unless the trail is clearly signed for bike-only travel. Bicyclists traveling downhill should yield to all users headed uphill, unless the trail is clearly signed for one-way or downhill-only traffic. In general, strive to make each pass a safe, controlled and courteous one.

Never Scare Animals:

Animals such as horses are easily startled by an unannounced approach, a sudden movement or a loud noise. Give animals enough room and time to adjust to you. When passing horses, dismount from your bike, walk around them on the downhill side of the trail, use special care and follow directions from the horseback riders (ask if uncertain). Running cattle and disturbing wildlife are serious offenses.

Plan Ahead:

Know your equipment, your ability and the area in which you are riding and prepare accordingly. Strive to be self-sufficient: keep your equipment in good repair and carry necessary supplies for changes in weather or other conditions. Always wear a helmet and appropriate safety gear."

e-Bike Trekking

The idea of taking long excursions on a bike can be daunting. However, commuting, short touring, or extended trips, all are within your reach with an e-bike. On low power, or level one assist, most trips of 35-45 miles are within the capabilities of the standard battery pack. Trekking or commuter e-bikes are made to be efficient at higher speeds, with low rolling resistance. That means you can go farther per charge than on a mountain e-bike or cruiser e-bike. Many trekkers take their charger on longer rides, stopping for a "charge" break along the way. Fortunately, trekking bikes are reasonably light weight, where the battery and motor adds only 15-20 extra pounds. You and your gear, plus water (1-pound per 16oz), usually weigh over 250 pounds. That means a 100-mile ride is achievable.

Trekking bikes are also a good choice for commuting. Ditch the car and go green. These bikes are very reliable and way cheaper than a car. They cruise fast too. Specs aside, all three bikes are very highly rated, come in several sizes and with different options. The best part is you can come to our shop and test ride them before you buy.

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