What is a Bug-Out Vehicle & How do I Select One?

Or as I prefer to call it a SHTF Vehicle?

This is the vehicle used to get you to a safe place to sit out the crisis at hand and usually has some pre-packed 'supplies' in it. Where you live and what you are preparing for, are important factors in determining what *kind* of vehicle you need.

Needless to say a SHTF Vehicle is a very personal choice. However there are a few '*rules of thumb*' to help you in choosing the correct type of vehicle for your specific needs.

First we have to keep in mind that ANY vehicle, under ANY circumstance is likely to be the second most expensive item we purchase in our lifetimes. Most of us do not have the funds to have one vehicle for everyday use and one for SHTF use, so this means that the vehicle must be *multi-functional*. It must be able to meet our needs in our everyday life, as well as during the crisis and through the aftermath of the crisis.

Finding the perfect match between driving ability, fuel consumption, price and our needs, pre and post SHTF, ***requires an honest evaluation of our motoring skills and needs*.**

Because of this we **need to identify exactly what we Need** and what we **Would Like** in this vehicle for both here and now, and SHTF. Where vehicles are concerned, *most* of these Needs and Wants fall into two categories - ***Functionality and Ascetics*.**

> ***Functionality*** is the mechanics of the vehicle: Mileage and fuel type, ease of repair, parts availability, historical frequency of repair occurrence, adaptability to various and or difficult terrain and weather conditions (BOTH the vehicle and us the driver) and the like.
>
> ***Ascetics*** are the looks and feel of the vehicle, how you want to present yourself to the outside world when you drive and your comfort (beyond the necessities) while driving or riding in the vehicle. These are *mostly* the electronics of the vehicle: Music systems, auto door locks

and windows, electronic seat adjustments, seat warmers, GPS/OnStar systems, WiFi charging station, electric ignition and the like. Other ascetics are solely for looks like: the leather, dash embellishments, chrome, interior carpeting and such.



Side bar: Over the years I have *avoided* ascetic electrical gadgets in the vehicles I have purchased. I stuck mostly to the radio in the vehicle. I only got electric door locks when there was a manual override. (Have you ever tried to open a vehicle door while under water? It's the pitts!!) I dislike electric windows because should your vehicle go into a ditch, when the electronics get wet they tend to fail to work. Although it's hard enough to crank the window down when underwater, I'll take that over having to find a tool to break and pry the window out of the way – which is no easy task! As for other ascetics; I've been in a Caddy that had the electric seat adjustments fail and the driver's seat got stuck set for a 6' 4" male, while I am a 5' 1" female. Then just this past spring my friend's brand new 2013 Motor Trend magazine rated top of its class SUV, had the electric seat warmer get stuck in the ON position (and we had a super hot spring). Because the vehicle was a foreign job, it took 5 business days just to get the part to fix it!!!! Seven times out of 10 when my vehicle needed repairs it was due to an electronic component – fuel injection, electric sensor for 4-wheel drive, electric door locks (thank goodness for the manual override), wiper speed control and the like.

A big help in determining your needs and wants is a simple worksheet. (See example below)

Functionality		**Ascetics**	
Needs	Wants	Needs	Wants

Tip: This worksheet will be handy in recording your research findings and or taking with you when you shop the dealerships or go to see used vehicles being sold by an individual. With ANY used vehicle (dealership or private) check out CarFax (free or for a fee it is more than worth your hard earned dollars) and have a reliable independent mechanic look it over *before* you commit to the purchase.

As always, due to all the marketing and advertizing hype, **we need to research the vehicle from *other than* the manufacturer or sponsor of the manufacturer** sources. This means we need reports from *independent* studies and labs that are *not influenced* by any funding from a manufacturer or sponsor.

A crash test by the Insurance Institute for Highway Safety shows the damage to a compact Ford Focus struck by a Ford Explorer SUV

On top of this we have to remember that some of these independent sources will undoubtedly be geared to some ***vehicle niche***. Like luxury, consumer trends or fads or other more important things such as; safety, resale value, repair rates, availability of common parts and ease of DIY maintenance and repair and so on.

For example:

The Insurance Institute for Highway Safety, Consumer Reports and JD Powers offer independent ratings on various vehicles without a lot of influence (if any) from any sponsor or manufacturer.

Basically you can get the 'just the facts' from these sources, as they deal predominately with just one (such as IIHS) to several aspects of the vehicle from safety ratings, repair and ease of repair instances, resale value, reliability, bang for the buck and consumer satisfaction. These entities generate their reports *without* outside sponsors and do so at least annually.

> **Note:** Consumer Reports reviews the historical repairs needed and the average amount of time and cost needed for those repairs. Foreign vehicles consistently take 2+ extra days to repair, mainly because there are limited parts here in the states, and cost more due to import fees.

Other 'independent' entities like *Motor Trend or Car and Driver* rely heavily on outside sponsors for their reports, annual or not. They also tend to look predominately on sales and skimp on functionality; ie: you get a lot of 'fad' and 'social status' trends. You won't often see things like ease or frequency of repair, the number of lemons or 'bang for the buck' analysis and when you do, it is usually as a side note or after thought.

Then there are the various entities that research other specific aspects: *Niche vehicles* like *Peterson's 4x4 and Off Road, Four Wheeler, CRAWL and 4 x 4*, who only cover the vehicles in that particular class of vehicles. Others entities may only cover trucks, ATV's or hot rods and the like.

And then there is *Kelly Blue Book*, which in 1918, in the early days of the automobile industry, created an innovative salesmanship tool by publishing and placing values on used and even new cars, known as Blue Book® values. (In 1926, in Los Angeles, Les Kelley decided to expand the list of automobile values he had been producing since 1918 and published the first Blue Book of Motor Car Values. By 1962 the Kelleys were completely out of the car business and devoting full time to the Blue Book , with Buster as Publisher and Bob (shown here) as Assistant Publisher.) Although this started out as a sales tool, today it is a valued tool in determining the value of vehicle – new and especially used.

You name the niche and there is most likely an entity out there that studies and reports on it (some sponsored and some not).

Now most of us are not vehicle experts, the bulk of our knowledge probably comes from the media and manufacturer or friends. Hence, many of us have some misconceptions as to just what certain types of vehicles can and can't do. So let's discuss some ***terms and definitions on the various types of vehicles*** out there that most of us would probably consider as a Bug Out Vehicle and their pro's and con's. ***Then go back and review*** your functionality/ascetics-needs and wants - ***before*** starting on your independent research.

Note: The technical aspects of the following were received from an OEM engineer, several auto mechanics and off road enthusiasts that are friends of mine, spiced with some basic online research. Please excuse the technical jargon here and there, as I could not read some of my 'simple English' notes when it came time to write this article.

Torque	Torque is the twisting force produced by a car's engine. Torque is multiplied and split up between wheels by various gears in the transmission and differentials, which send torque from the driveshaft or transmission to the drive wheels. Applying torque to the wheels is what moves your car from point A to point B; granted, there's a force — a.k.a friction.
Friction	Friction prevents your tires from simply slipping along the road. That last bit is important, because it illustrates the relationship between friction, traction and torque. Friction is required for traction, and traction is required to harness torque. The most powerful engine in the world won't move you an inch if your tires lack traction.
Wheel Slip	Wheel slip results when the torque applied to a tire exceeds its available traction (often, at red-light drag races).
Traction Control	Traction control is one innovation that has helped limit tire slip in modern vehicles — even the two-wheel-drive variety. This technology leverages the same sensors used by anti-lock braking systems to measure wheel speed and determine whether any wheel under power has lost traction. Remember, if the amount of torque sent to a

	wheel exceeds the friction it has with the road, it'll slip. By braking select wheels when slipping is detected, these systems can limit the amount of torque sent to a wheel and reduce wheel slip in the process. In certain cases, reducing engine power to slipping wheels is also required to get things under control. Traction control systems are unquestionably beneficial, but it's important to remember that they only work to prevent wheels from spinning and can't actually increase traction. That's where 4WD and AWD come in.
Differential	A differential is a device, usually, but not necessarily, employing gears, which is connected to the outside world by three shafts, chains, or similar, through which it transmits torque and rotation. *"The gears or other components make the three shafts rotate in such a way that a=pb+qc, where a, b, and c are the angular velocities of the three shafts, and p and q are constants."* Which basically means that in automobiles and other wheeled vehicles, a differential is the usual way to allow the driving roadwheels to rotate at different speeds. This is necessary when the vehicle turns, making the wheel that is travelling around the outside of the turning curve roll farther and faster than the other. Except in some special-purpose differentials, there are no other limitations on the rotational speeds of the shafts, apart from the usual mechanical/engineering limits. Any of the shafts can be used to input rotation, and the other(s) to output it. When a vehicle is in motion, its wheels rotate at different speeds when making turns. This is because the inside wheels travel a shorter distance during a turn than the outside wheels. The front wheels and back wheels likewise travel at different distances and speeds in turns. This simple fact of physics poses a problem for wheels under power from the engine, since the left and right wheels are linked together by an axle so that the car's engine and transmission can turn both together. A differential is a type of gearbox found on front and rear axles that deals with this issue by supplying power to a set of wheels while still allowing them to rotate at different speeds. (An Excellent Explanation of Differentials Video http://www.youtube.com/watch?feature=player_embedded&v=ErNgz_7KhJQ#t=0s) *Limited-slip or automatic locking* differentials are usually sufficient in very light off-roading situations, but *they are not a substitute for a manual locking system*. With a manual locking system, you can lock-up your differential at the base of a steep grade or right before you slog through mud or sand – or at any other time of your choice for that matter. While most manual locking systems are marketed to hardcore off-roaders, they can effectively pull a 4x2 through 4x4-sized conditions about 95 percent of the time. If you're worried about that remaining five percent of time, then you really do need a seriously modified 4x4.
Transfer Case	A Transfer Case splits the power between the front and rear axles. Specifically, it locks the front driveshaft to the rear driveshaft, forcing equal amounts of torque from the engine to both axles, causing the front and rear axle of a car to rotate at the same speed. This provides greater traction to drivers, since it ensures power will continue to flow to the wheels on an axle with traction should wheels on the other axle slip.
Ground Clearance	Ground clearance (also called Ride Height) can be defined as the space or distance from the lowest point of your vehicle to the level surface below it. The tires are not considered for this definition as they are designated to be in contact with the ground. The ground clearance is not something that you have to go and measure or calculate as the manufacturers usually give the distance in millimetres or inches in the overall list of dimensions. **The lowest part of the vehicle is usually the differential**, but can be some other part of the undercarriage of your vehicle and the specifications given are for an *empty vehicle* so the ground clearance would be slightly lower when fuel, passengers and

	cargo is added. Ground clearance is a critical factor in several important characteristics of a vehicle. For all vehicles, especially cars, variations in clearance represent a trade-off between handling and practicality. *A higher ground clearance means that the center of mass of the car is higher*, which makes for less precise and more dangerous handling characteristics (most notably, the chance of rollover is higher). However, it also means that the car is more capable of being driven on roads that are not level, without the road scraping against and likely damaging the chassis and underbody. Higher ride heights will typically adversely affect aerodynamic properties. This is why sports cars typically have very low clearances, while off-road vehicles and SUVs have higher ones. Two well-known extremes of each are the Ferrari F40 and the Hummer. **High Ground Clearance** Higher ground clearance is used on vehicles with good off road abilities. *A higher ground clearance equals more practicality.* SUVs, pick-ups and minivans are designed with a high ground clearance with few exceptions. The high clearance allows these vehicles to have more practically such as transporting more cargo and travelling on rough roads or off road with a reduced possibility of the vehicle sticking or the undercarriage being damaged by the rough surfaces. *One drawback is the higher ground clearance equals a higher center of gravity.* Some off road vehicles and aftermarket off road kits compensate for this by 'weighting' the undercarriage and thusly lessening the chance of roll-over. **Low Ground Clearance** *Vehicles with a lower ground clearance will benefit from an increase in handling as their center of gravity will be significantly lower than average.* A lower ground clearance equals better handling and performance. the lower stance will assist in aerodynamics as less air will pass under the vehicle during driving but these vehicles will not be practicable. Sometimes a compromise between a high and low ride height is needed and this balance is adopted by some of the most 'executive' sedans and other cars. To further improve on the compromise some vehicle's **ride height** can be adjusted via air suspension either automatically or via controls inside the vehicle while you're driving, to cater to the road conditions. ***Ride height, however is NOT ground clearance!*** *Again ground clearance is the measurement from the ground surface to the lowest point on the undercarriage of the vehicle* (usually the differential). There are some aftermarket kits that actually raise and lower the chassis and is achieved by altering the height of the suspension to raise or lower the overall height of the vehicle. Imagine you're driving your high end vehicle through rough roads with ease because your ground clearance is above the normal settings and in a few minutes later you can be driving the same vehicle along an open smooth road with increased handling and aerodynamics because your ground clearance is now lower than the normal settings. These are usually very expensive add-ons.
n X n	The first digit refers to the number of wheels. The second digit refers to the number of *driven* wheels.
4x4 (four by four)	A vehicle with four wheels that's powered by four wheels (4WD) In general, 4-wheel drive refers to a vehicle's drive train system that can send power to all four wheels, but the four wheels are not necessarily under power all at the same time.
4x2 (four by two)	A vehicle with four wheels that's powered by two wheels (2WD)

Ok now that we have the basic terms under our belt, let's get on to some of the terms that affect the broader aspect of the functionality of the vehicle.

Vehicle Layout & Functionality

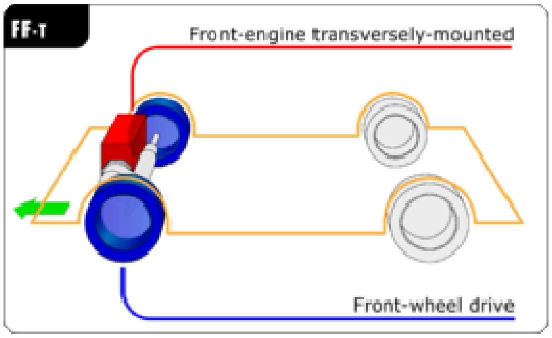
In automotive design, the *automobile layout* describes where on the vehicle, the engine and drive wheels are found. Many different combinations of engine location and driven wheels are found in practice and the location of each is dependent on the *primary application for which the vehicle will be used*. Factors influencing the design choice include cost, complexity, reliability, packaging (location and size of the passenger compartment and trunk), weight distribution and the vehicle's intended handling characteristics.

Two-wheel drive (2WD) describes vehicles with a drivetrain that allows two wheels to receive power from the engine simultaneously. The term 4x2 is also used, to denote four total wheels with two being driven. *For four-wheeled vehicles* (and by extension, vehicles with six, eight, or more wheels, but NOT 4WD) this term is used to describe vehicles that are able to *power at most two wheels*, referred to as either *front* or *rear-wheel drive*. Most road vehicles use a 2WD layout due to its light weight and simplicity. Traction on the road is usually sufficient that the driving force can be reliably transmitted through only two wheels.

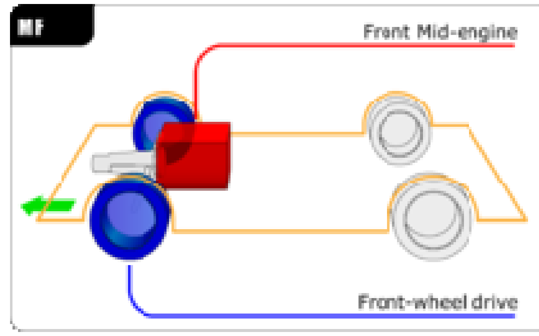
> **Note:** For vehicles that have part-time four-wheel drive (4WD), the term refers to the mode when 4WD is *deactivated* and power is applied to only two wheels.
>
> The differential found on basic two-wheel-drive vehicles is known as an "*open differential*", and it distributes power across both wheels following "*a path of least resistance*".
>
> This design is highly effective on typical surfaces like dry pavement, but it can result in real problems on poorer road conditions.
>
> For example, if one wheel on an axle hits a patch of ice while the other remains on dry pavement, an open differential will direct all available power down the path of least resistance, which in this scenario is the wheel with the least amount of traction. The additional torque applied to this wheel results in wheel slippage. Getting moving in these cases involves a sore back until both wheels on the axle gain traction again.

Two-wheel drive vehicles can either be 'pulled' by the front axle or 'pushed' by the back axle:

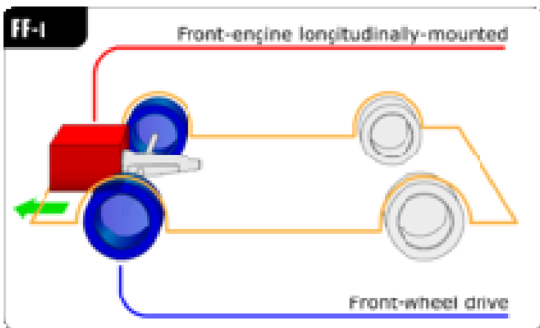
> *Front-wheel drive* (FWD) (alternatively, Forward-wheel drive) is a form of engine/transmission layout used in motor vehicles, where the engine drives the front wheels only. Most modern front-wheel-drive vehicles feature a transverse engine, rather than the conventional longitudinal engine arrangement generally found in rear-wheel-drive and four-wheel-drive vehicles. On FR cars, the long driveshaft adds to drivetrain elasticity.



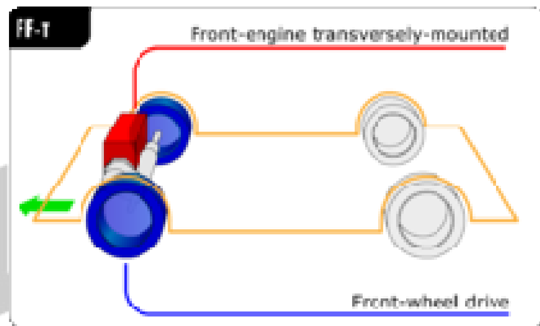
Basic FWD FF layout



FWD Front-wheel-drive MF layout with engine behind the transmission in the 1930s



FWD 1960-1975 Front-wheel-drive FF layout as used by Audi and Subaru



FWD 1975-1990 Front-wheel-drive FF layout is today the most common in mass market passenger cars

Advantages

- Interior space: Since the powertrain is a single unit contained in the engine compartment of the vehicle, there is no need to devote interior space for a driveshaft tunnel or rear differential, increasing the volume available for passengers and cargo.
    - Instead, the tunnel may be used to route the exhaust system pipes.
- Weight: Fewer components usually means lower weight.
- Improved fuel efficiency due to less weight.
- Cost: Fewer material components and less installation complexity overall. However, the considerable MSRP differential between a FF and FR car cannot be attributed to layout alone. The difference is more probably explained by production volumes as most rear-wheel cars are usually in the sports/performance/luxury categories (which tend to be more upscale and/or have more powerful engines), while the FF configuration is typically in mass-produced mainstream cars. Few modern "family" cars have rear-wheel drive as of 2009, so a direct cost comparison is not necessarily possible. A contrast could be somewhat drawn between the Audi A4 FrontTrak (which has an FF layout and front-wheel drive) and a rear-wheel-drive BMW 3-Series (which is FR), both which are in the compact executive car classification.
- Improved drivetrain efficiency: the direct connection between engine and transaxle reduce the mass and mechanical inertia of the drivetrain compared to a rear-wheel-drive vehicle with a similar engine and transmission, allowing greater fuel economy.
- Assembly efficiency: the powertrain can often be assembled and installed as a unit, which allows more efficient production.
- Placing the mass of the drivetrain over the driven wheels moves the centre of gravity farther forward than a comparable rear-wheel-drive layout, improving traction and directional stability on wet, snowy, or icy surfaces.
- Predictable handling characteristics: front-wheel-drive cars, with a front weight bias, tend to understeer at the limit, which (according to SAAB engineer Gunnar Larsson) is easier since it makes instinct correct in avoiding terminal oversteer, and less prone to result in fishtailing or a spin. A skilled driver can control the movement of the car even while skidding by steering, throttling and pulling the hand brake (given that the hand brake operates the rear wheels as in most cases, with some Citroen and Saab models being notable exceptions).

- It is easier to correct trailing-throttle or trailing-brake oversteer.
- The wheelbase can be extended without building a longer driveshaft (as with rear-wheel-driven cars).

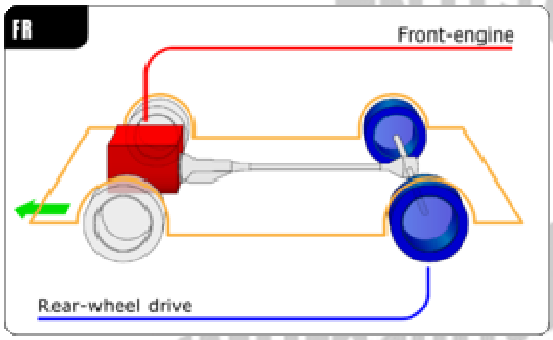
Disadvantages

- Front-engine front-wheel-drive layouts are "nose heavy" with more weight distribution forward, which makes them prone to understeer, especially in high horsepower applications. Enthusiast driver aids, such as active front differential, active steering, and ultra-quick electrically-adjustable shocks, can negate the understeer problem and allow the car to perform as well as a front-engine rear-wheel-drive car. These trick differentials, which are found on the Acura TL SH-AWD and Audi S4 3.0 TFSI quattro, and Audi RS5 4.2 FSI quattro, are heavy, complex, and expensive. While these aids do tame front end plow, cars fitted with these systems are still at a disadvantage when track tested.
- Torque steer is the tendency for some front-wheel-drive cars to pull to the left or right under hard acceleration. It is a result of the offset between the point about which the wheel steers (it is aligned with the points where the wheel is connected to the steering mechanisms) and the centroid of its contact patch. The tractive force acts through the centroid of the contact patch, and the offset of the steering point means that a turning moment about the axis of steering is generated. In an ideal situation, the left and right wheels would generate equal and opposite moments, canceling each other out; however, in reality, this is less likely to happen. Torque steer can be addressed by using a longitudinal layout, equal length drive shafts, half shafts, a multilink suspension or centre-point steering geometry.
- In a vehicle, the weight shifts back during acceleration, giving more traction to the rear wheels. This is one of the main reasons nearly all racing cars are rear-wheel drive. However, since front-wheel-drive cars have the weight of the engine over the driving wheels, the problem only applies in extreme conditions such as attempting to accelerate up a wet hill or attempting to beat another RWD car off the line.
- In some towing situations, front-wheel-drive cars can be at a traction disadvantage since there will be less weight on the driving wheels. Because of this, the weight that the vehicle is rated to safely tow is likely to be less than that of a rear-wheel-drive or four-wheel-drive vehicle of the same size and power.
- Traction can be reduced while attempting to climb a slope in slippery conditions such as snow- or ice-covered roadways.
- Due to geometry and packaging constraints, the CV joints (constant-velocity joints) attached to the wheel hub have a tendency to wear out much earlier than the universal joints typically used in their rear-wheel-drive counterparts (although rear-wheel-drive vehicles with independent rear suspension also employ CV joints and half-shafts). The significantly shorter drive axles on a front-wheel-drive car causes the joint to flex through a much wider degree of motion, compounded by additional stress and angles of steering, while the CV joints of a rear-wheel-drive car regularly see angles and wear of less than half that of front-wheel-drive vehicles.
- Turning circle — FF layouts almost always use a Transverse engine ("east-west") installation, which limits the amount by which the front wheels can turn, thus increasing the turning circle of a front-wheel-drive car compared to a rear-wheel-drive one with the same wheelbase. A notable example is the original Mini. It is widely misconceived that this limitation is due to a limit on the angle at which a CV joint can be operated, but this is easily disproved by considering the turning circle of car models that use a longitudinal FF or F4 layout from Audi and (prior to 1992) Saab.
- The FF transverse engine layout (also known as "east-west") restricts the size of the engine that can be placed in modern engine compartments, so it is rarely adopted by powerful luxury and sports cars. FF configurations can usually only accommodate Inline-4 and V6 engines, while longer engines such as Inline-6 and 90° big-bore V8 wi ll rarely fit, though there are exceptions. One way around this problem is using a staggered engine.
- It makes heavier use of the front tires (i.e., accelerating, braking, and turning), causing more wear in the front than in a rear-wheel-drive layout.

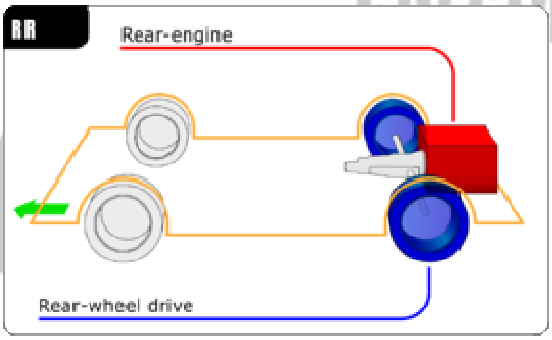
- Under extreme braking (like for instance in a panic stop), the already front heavy layout further reduces traction to the rear wheels. This results in disproportionate gripping forces focused at the front while the rear does not have enough weight to effectively use its brakes. Because the rear tyres' capabilities in braking are not very high, a significant number of cheaper front drive vehicles use drum brakes in the rear even today.
- The steering 'feel' is more numbed than a RWD car. This is due to the extra weight of drive shafts and CV join components that increase unsprung weight. Combined with torque steer, determining how much lateral traction is actually available is more difficult if not impossible especially during high performance driving.

Rear-wheel drive (RWD) typically places the engine in the front of the vehicle and the driven wheels are located at the rear, a configuration known as front-engine, rear-wheel drive layout (FR layout). The front mid-engine, rear mid-engine and rear engine layouts are also used. This was the traditional automobile layout for most vehicles up until the 1970s and 1980s.

Nearly all motorcycles and bicycles use rear-wheel drive as well, either by driveshaft, chain, or belt, since the front wheel is turned for steering, and it would be very difficult and cumbersome to "bend" the drive mechanism around the turn of the front wheel. A relatively rare exception is with the *'moving bottom bracket' type of recumbent bicycle*, where the entire drivetrain, including pedals and chain, pivot with the steering front wheel.



RWD FR layout



RWD RR layout

Advantages

- Even weight distribution — The layout of a rear-wheel-drive car is much closer to an even fore-and-aft weight distribution than a front-wheel-drive car, as more of the engine can lie between the front and rear wheels (in the case of a mid engine layout, the entire engine), and the transmission is moved much farther back.
- Weight transfer during acceleration — During heavy acceleration, weight is placed on the rear, or driving wheels, which improves traction.
- No torque steer (unless it's an all-wheel steer with an offset differential).
- Steering radius — As no complicated drive shaft joints are required at the front wheels, it is possible to turn them further than would be possible using front-wheel drive, resulting in a smaller steering radius for a given wheelbase.
- Better handling at the hands of an expert — the more even weight distribution and weight transfer improve the handling of the car. The front and rear tires are placed under more even loads, which allows for more grip while cornering.
- Better braking — the more even weight distribution helps prevent lockup from the rear wheels becoming unloaded under heavy braking.
- Towing — Rear-wheel drive puts the wheels which are pulling the load closer to the point where a trailer articulates, helping steering, especially for large loads.
- Serviceability — Drivetrain components on a rear-wheel-drive vehicle are modular and do not involve packing as many parts into as small a space as does front-wheel drive, thus requiring less disassembly or specialized tools in order to service the vehicle.

- Robustness — due to geometry and packaging constraints, the universal joints attached to the wheel hub have a tendency to wear out much later than the CV joints typically used in front-wheel-drive counterparts. The significantly shorter drive axles on a front-wheel-drive car causes the joint to flex through a much wider degree of motion, compounded by additional stress and angles of steering, while the CV joints of a rear-wheel-drive car regularly see angles and wear of less than half that of front-wheel-drive vehicles.[citation needed]
- Can accommodate more powerful engines as a result of the longitudinal orientation of the drivetrain, such as the Inline-6, 90° big-bore V8, V1 0 and V12 making the FR a common configuration for luxury and sports cars. These engines are usually too long to fit in a FF transverse engine ("east-west") layout; the FF configuration can typically accommodate at the maximum an Inline-4 or V6.
- Road grip feedback — front wheels are not affected by engine and gearbox, thus allowing for better feeling of tire grip on road surface.

Disadvantages

- Under heavy acceleration (as in racing), oversteer and fishtailing may occur as the rear wheels break free and spin. The corrective action is to let off the throttle (this is what traction control automatically does for RWD vehicles).
- On snow, ice and sand, rear-wheel drive loses its traction advantage to front- or all-wheel-drive vehicles, which have greater weight on the driven wheels. This issue is particularly noticeable on pickup trucks, as the weight of the engine and cab will significantly shift the weight from the rear to the front wheels. Rear-wheel-drive cars with rear engine or mid engine configuration do not suffer from this, although fishtailing remains an issue. To correct this situation, owners of RWD vehicles can load sandbags in the back of the vehicle (either in the bed, or boot) in order to increase the weight over the rear axle, however speeds should be restricted to correctly predicted available grip of the road.
- Some rear engine cars (e.g., Porsche 911) can suffer from reduced steering ability under heavy acceleration, because the engine is outside the wheelbase and at the opposite end of the car from the wheels doing the steering although the engine weight over the rear wheels provides outstanding traction and grip during acceleration.
- Decreased interior space — Though individual designs vary greatly, rear-wheel-drive vehicles may have: Less front leg room as the transmission tunnel takes up a space between the driver and front passenger, less leg room for centre rear passengers (due to the tunnel needed for the drive shaft), and sometimes less boot space (since there is also more hardware that must be placed underneath the trunk). Rear engine designs (such as the Porsche 911 and Volkswagen Beetle) do not inherently take away interior space.
- Increased weight — The components of a rear-wheel-drive vehicle's power train are less complex, but they are larger. The driveshaft adds weight. There is extra sheet metal to form the transmission tunnel. There is a rear axle or rear half-shafts, which are typically longer than those in a front-wheel-drive car. A rear-wheel-drive car will weigh slightly more than a comparable front-wheel-drive car (but less than four-wheel drive).
- Rear biased weight distribution when loaded — A rear-wheel-drive car's centre of gravity is shifted rearward when heavily loaded with passengers or cargo, which may cause unpredictable handling behavior at the hands of an inexperienced driver. It needs to be noted that rear engine cars are by their very nature, rear weight biased.
- Higher initial purchase price — Modern rear-wheel-drive vehicles are typically more expensive to purchase than comparable front-wheel-drive vehicles. Part of this can be explained by the added cost of materials and increased labor put in to assembly of FR layouts, as the powertrain is not one compact unit. However, the difference is more probably explained by production volumes as most rear-wheel cars are usually in the sports/performance/luxury categories (which tend to be more upscale and/or have more powerful engines), while the FF configuration is typically in mass-produced mainstream cars.
- The possibility of a slight loss in the mechanical efficiency of the drivetrain (approximately 17% coastdown losses between engine flywheel and road wheels compared to 15% for front-wheel drive —

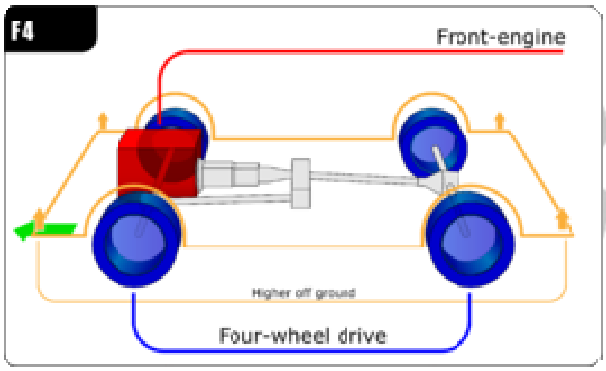
however these losses are highly dependent on the individual transmission). Cars with rear engine or mid engine configuration and a transverse engine layout do not suffer from this.

- The long driveshaft (on front engine cars) adds to drivetrain elasticity. The driveshaft must also be extended for cars with a stretched wheelbase (e.g. limousines, minivans).

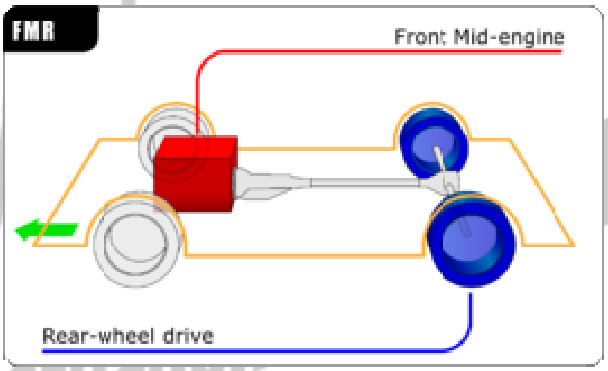
Four-wheel drive (4WD), All-wheel drive (AWD), or 4×4 ("four by four") is a four-wheeled vehicle with a drivetrain that allows all four wheels to receive torque from the engine simultaneously.

While many people associate the term 4WD with off-road vehicles and sport utility vehicles (SUV), it is important to note that 4WD is ***not*** synonymous with *true* off road functionality.

The key aspect of powering all four wheels is that it provides better control than normal road cars (2WD) on many surfaces and is an important part in the sport of rallying.



4WD Front-engine, rear-wheel drive derived "F4" layout



4WD FMR layout, standard in most Front-engine / Rear-wheel-drive cars pre-World War II, where the engine was located behind the front axle.

In abbreviations such as 4×4, the first figure is normally the total wheels (more precisely, axle ends, which may have multiple wheels) and the second, the number that are powered. 4×2 means a four-wheel vehicle that transmits engine power to only two axle-ends: the front two in front-wheel drive or the rear two in rear-wheel drive.

By this system, a six wheeled military transport truck would be a 6×6, while the typical American semi-truck tractor unit having two drive axles and a single unpowered steering axle would be a 6×4.

Note: *in North America, Australia and New Zealand the term "four-wheel drive" usually refers only to drivetrains which are primarily two-wheel drive with a part-time four-wheel-drive capability, as typically found in pickup trucks and other off-road vehicles, while the term "all-wheel drive" is used to refer to full time four-wheel-drive systems found in performance cars and smaller car-based SUVs. I am using the term four-wheel drive to refer to both.*

There are several different types of 4WD systems. The two most common include **full-time 4WD** and **part-time 4WD**.

Selection lever

- **Full-Time 4WD** (or permanent 4WD) means the vehicle is constantly providing power to all four wheels, usually with power being shifted between the front and rear axles as needed. This provides maximum traction in both dry and slippery driving conditions and requires no action from the driver to activate it. Full-time 4WD offers maximum traction under all conditions, and does not require additional input from the driver (to turn on or off). Due to the nature of a full-time 4WD system, you'll find the vehicle does not have the overall on-road mobility of a part time 4X4 package.

  In this case 4WD systems 'full-time' means some portion of the engine's power is spread across each of the wheels, *all of the time*. These systems are becoming increasingly popular in SUVs and unlike the Part-Time 4WD systems mentioned above, they eliminate the risk of drive train binding thanks to a *center differential*, which allows each of the vehicle's axles to receive at least some amount of power at all times and still rotate at different speeds during a turn.

  While Full-Time 4WD systems are convenient (since all of the wheels are always under some degree of power without any action from the driver), they still have faults. Fuel economy naturally takes a hit, and there is inherent wear on the drive train. Just like a high roller in Vegas buying drinks for any female in a 30 yard radius, Full-time 4WD continues to shower each of the wheels with some portion of power, even those without a snowball's chance in hell of gaining traction.

  Some *center differentials* boast a *locking feature* to partially overcome this problem, which splits engine power equally between the front and rear axles (not the wheels, as with a locking differential on Part Time 4WD vehicles mentioned above). A full-time 4WD car with a locked *center differential* thus behaves in many ways like a Part-Time 4WD vehicle in 4WD.

  > A Torsen limited slip center differential does an even better job of putting power where it's most needed in Full-Time 4WD vehicles. It features a unique gearset that locks if it senses a torque imbalance between a vehicle's two axles and then transfers power to the axle with traction.
  >
  > The particular ratio of power that a Torsen can shift between the front and rear axles varies. In the case of Toyota's vehicles, it can direct up to 53% of available engine power to the front axle if the rear starts spinning. If it's the front wheels that are spinning on the other hand, up to 71% of all engine power can shift to the rear axle to get you and backseat full of sugared-up kids out of a jam.

  Important: Full-time 4WD does NOT provide as much mobility off-road as part-time 4WD does, because the system is designed such that it allows a set of wheels (front or rear) to spin if they don't have traction.

Pros and Cons of FULL-TIME FOUR-WHEEL DRIVE

PROS	CONS
Gives drivers added traction and improved handling in all driving situations, without the risk of drive train binding.	It's less fuel efficient and puts more wear on a vehicle's drive train.
It's always on and doesn't require any action from the driver.	Often requires advanced drivetrain equipment that can increase initial vehicle cost relative to more basic 4WD systems.
Systems equipped with Torsen center diffs are the ultimate solution for putting engine power where it's needed most, lowering the risk of getting stuck even further.	They're generally more prone to damage compared to simpler, more rugged Part-Time 4WD systems.

	Inspires drivers to believe they can drive anywhere.

Just to add more confusion to this mess of drive and differential types there is also something called the '**Full-Time 4WD Multi-Mode**'.

Full-Time 4WD Multi-Mode systems can operate in full-time 4WD mode, just like other Full-Time 4WD systems. Drivers have the added bonus, though, of switching to 2WD when additional traction isn't necessary. This system is generally harder to find and is usually only used on higher-end SUVs.

Pros and Cons of Full-Time 4WD Multi-Mode

PROS	**CONS**
Gives drivers added traction and improved handling in all driving situations if desired, but it can be turned off should fuel economy and drivetrain wear be a concern.	Often requires advanced drivetrain equipment that can increase cost relative to more basic 4WD systems. They're generally more prone to damage compared to simpler Part-Time 4WD systems and more expensive compared to regular Full-Time 4WD systems. Available on only a limited number of typically lower-powered vehicles. Inspires drives to believe they can drive anywhere.

- **Part-Time 4WD** means the vehicle has a means to select between 4WD and 2WD. It could be a lever or a switch. With this setup, you shift between 4WD and 2WD on the go. A vehicle with part-time 4WD provides superior traction on slippery surfaces because the front and rear sets of wheels are (obviously) locked together.

  Though the name might seem counterintuitive, Part-Time 4WD is a feature found primarily on SUVs and Trucks designed to handle demanding off-road environments (yet not actual full time off road use).

  Unlike Full-Time 4WD or some all-wheel-drive solutions, these systems allow drivers to normally operate the vehicle in 2WD during everyday driving scenarios (which is more fuel efficient and puts less wear and tear on the vehicle), or switch into either a 4WD high or a 4WD low gear for particularly bad traction scenarios via a selector switch.

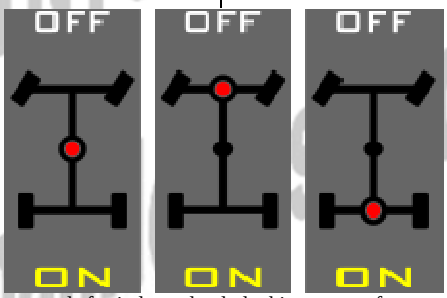
  The presence of a 4WD low gear, combined with a more basic design and implementation, generally makes Part-Time 4WD a superior option to 4WD and AWD alternatives when really veering off the beaten path — granted ***all of this is dependent on a driver who knows what they're doing*.**

  4WD mode works in the simplest terms thanks to a dedicated *transfer case*, that provides greater traction to drivers, since it ensures power will continue to flow to the wheels on an axle with traction should wheels on the other axle slip. By the same token, though, *switching back to 2WD on normal road conditions is critical to prevent potential damage from a condition known as Drive Train Binding* — when a vehicle's axles cannot rotate at different speeds to accommodate the different distances wheels travel during events like turning.

Important: Vehicles with part-time 4WD systems should NOT be driven on dry, smooth road surfaces when in 4WD mode, or you will soon be spending a lot of money on repairs.

Pros and Cons of PART-TIME 4WD:

PROS	CONS
Gives traction when needed, while switching to 2WD improves fuel economy and reduces wear on the drivetrain in normal conditions.	Doesn't provide extra traction and handling improvements in everyday driving situations.
Since it's generally less complicated and of an older design from an engineering standpoint compared to other systems, it's easier to build and therefore less expensive, lowering initial purchase cost. Its simplicity also tends to make it more rugged.	A driver has to actively turn on 4WD to take advantage of it and remember to turn it off after.
In extremely difficult terrain, drivers can engage an extra-low 4WD gear for improved torque.	Creates the potential for uneven tire wear.
LSDs, A-LSDs and locking differentials act as the ultimate trump card in poor conditions by better directing engine power from "wheels that slip, to wheels that grip".	Inspires drivers to foolishly believe they can drive anywhere.



Some vehicles have controls for independently locking center, front, and rear differentials

There are also certain **automatic 4WD systems** offered that allow the vehicle to operate in 2WD until the system senses a need for 4WD, or *all-wheel drive (AWD)*. The system automatically routes the power delivery to all four wheels, varying the amount of power provided to the respective axles as necessary. Most often, a sensor is triggered by a slipping wheel, which, in turn, engages the 4WD.

There are several other innovations, beyond simply sending power to all four wheels, that enhance many Part-Time 4WD vehicle traction abilities by solving the woes of *open differentials*.

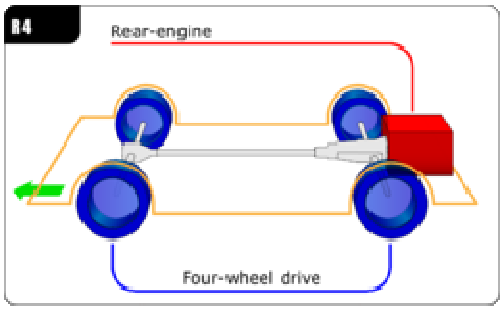
A limited slip differential or LSD (not that kind, you Deadhead) is one such solution that automatically directs some available power to the path of more resistance (a.k.a the wheel that's not slipping) to provide grip on poor roads, and it works in the background without any input from the driver. But it doesn't prevent wheel slippage entirely.

So-called automatic limited slip differentials (A-LSD), also known as electronic limited slip differentials (e-LSDs), are activated by drivers via a button or switch and provide the same traction benefits as a typical LSD using a different methodology with a few notable enhancements. Instead of relying on clutches to evenly distribute drive wheel power, these systems rely on the automatic intervention of the braking system to transfer power between the wheels. But unlike basic traction control, A-LSDs also do not require a reduction in engine power to work and can shift power back and forth from the left and right wheels as each wheel's level of traction varies.

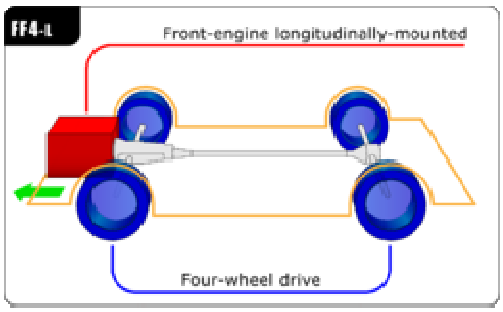
Locking differentials kick things up a notch further by allowing users to *manually* activate a locking mechanism inside the differential. A *locked differential* forces each wheel on an axle (vs. just the axle as is the case in basic Part-Time 4WD) to rotate at the same speed, no matter their tractional differences, which gives a wheel that may have more traction a better chance of freeing the driver from a slippery situation.

Keep in mind that some of *these systems are NOT designed for serious off-roading* (usually in vehicles where the front axle does the principle amount of work). On the other hand, applications—such as those found under some pickup trucks where the rear axle does the principle amount of work in 2WD—are more than off-road capable.

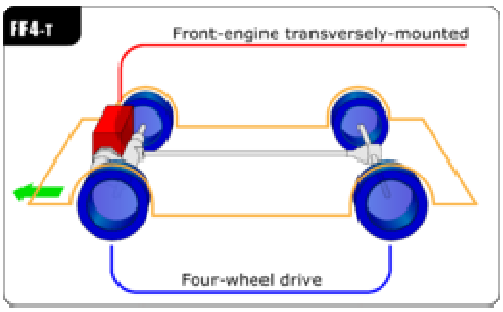
Important: *Automatic 4WD* vehicles are NOT recommended for serious off-road driving because all four wheels are powered at all times, which is not wise under certain off-road conditions.



R4 layout. Rear-engine / All-wheel-drive system (AWD)



FF4 layout. Front-engine longitudinally-mounted / All-wheel drive (AWD)



FF4 layout. Front-engine transversely-mounted / All-wheel drive (AWD)

Most 4WD layouts are front-engine and are derivatives of earlier front-engine, two-wheel-drive designs. They fall into two major categories:

Front-engine, rear-wheel drive derived 4WD systems, standard in most sport utility vehicles and in passenger cars, (usually referred to “front engine, rear-wheel drive/four-wheel drive”), forerunners of today's models include the Jensen FF, AMC Eagle and Mercedes-Benz W124 with the 4Matic system and Suzuki Grand Vitara with/without 4 mode transfer case.

Transverse and longitudinal engine 4WD systems derived almost exclusively from front-engine, front-drive layouts, fitted to luxury, sporting and heavy duty segments, for example the transverse-engine Mitsubishi 3000GT VR-4 and Toyota RAV4 and the longitudinal-engine Audi Quattro and most of the Subaru line.

Center transfer case sending power from the transmission to two output shafts: to the rear axle (visible on the right) as well as to the front axle (on the left side)

Unusual 4WD layouts

- From 1989 onwards, some models of Porsche 911 feature a rear-engine 4WD layout, which is akin to a longitudinal front-engine 4WD layout installed backwards with the engine at the rear of the car
- From 2007 onwards, the Nissan GT-R features a front-engine 4WD longitudinal layout, but with the gearbox at the rear of the vehicle. This provides a more ideal weight balance, and improves directional stability at very high speeds by increasing the vehicle's moment of inertia around the vertical axis. This layout necessitates a second prop-shaft to carry power to the front wheels.
- Some types of farm tractors and construction site machinery use a 4WD layout where the wheels on each side are coupled together, rather than the wheels on each axle, allowing these vehicles to pivot about their centre point. Such vehicles are controlled in a fashion similar to a military tank.
- The Citroën Sahara had a 4WD system using complete Citroën 2CV drivetrains at both ends of the car, such that the engine at the front powered the front wheels and the engine at the back powered the rear wheels.
- A 'through the road' hybrid vehicle uses a conventional piston engine to power two wheels, with electric motor/generators on the other two wheels, giving a form of part-time 4WD.
- The 2005 Jeep Hurricane concept had an all-wheel drive layout that featured two V8 engines powering a single driveshaft, with a gearbox mounted in the centre of the vehicle. The gears connected to two additional driveshafts, one on each side of the vehicle, that delivered power to the wheels via driveshaft joints. This was designed in order to accommodate the vehicle's unique steering system.

Advantages

In terms of handling, traction and performance, 4WD systems generally have most of the advantages of both front-wheel drive and rear-wheel drive. Some unique benefits are:

- Traction is nearly doubled compared to a two-wheel-drive layout. Given sufficient power, this results in unparalleled acceleration and driveability on surfaces with less than ideal grip, and superior engine

braking on loose surfaces. The development of 4WD systems for high performance cars was stimulated primarily by rallying.

- Handling characteristics in normal conditions can be configured to emulate FWD or RWD, or some mixture, even to switch between these behaviours according to circumstance. However, at the limit of grip, a well balanced 4WD configuration will not degenerate into either understeer or oversteer, but instead break traction of all 4 wheels at the same time into a four-wheel drift. Combined with modern electronic driving aids, this flexibility allows production car engineers a wide range of freedom in selecting handling characteristics that will allow a 4WD car to be driven more safely at higher speeds by inexpert motorists than 2WD designs.
- Disadvantages
- 4WD systems require more machinery and complex transmission components, and so increase the manufacturing cost of the vehicle and complexity of maintenance procedures and repairs compared to 2WD designs
- 4WD systems increase power-train mass, rotational inertia and power transmission losses, resulting in a reduction in performance in ideal dry conditions and increased fuel consumption compared to 2WD designs
- The handbrake cannot be used to induce over-steer for maneuvering purposes, as the drivetrain couples the front and rear axles together. To overcome this limitation, some custom prepared stage rally cars have a special mechanism added to the transmission to disconnect the rear drive if the handbrake is applied while the car is moving.

When is 4WD Helpful?

The gearing options found in 4WD vehicles help a vehicle tackle many of the unique situations encountered while driving off-road. Following are a variety of conditions in which you would want to use 4WD to avoid sliding or spinning:

Here is a synopsis of where and when to engage the 4WD system:

High-Range 4WD (4H)**:** 4-High allows you to drive full speed, if necessary (keeping in mind the caveat mentioned earlier regarding driving on dry pavement). The high-range ratios in 4WD mode are the same gear ratios as the vehicle has in 2WD mode.

When to use 4-High: Additional traction when the terrain isn't steep; snow; ice; muddy roads or when operating where there is no road; rocky, gravel roads; when stuck in sand or snow; under extremely slippery conditions.

- for traction when the area isn't steep
- when stuck in sand
- extremely slippery conditions
- snow
- ice
- rocky, gravel roads
- gullies
- extremely muddy areas
- ridges

Low-Range 4WD: 4-Low alters the gearing in your vehicle. It is designed so you can creep along at slow speeds (which also reduces the potential for damage to your vehicle). It reduces the strain on your vehicle, just remember to stay below 25 mph in low range, even if the manufacturer states to stay below 45 mph. While it does not provide more traction, it does provide 2-3 times

more torque at about 1/2 or 1/3 of the speeds in high range. Low range gear ratios are approximately half that of high range. Keep in mind that 4-Low does *not provide more traction*.

When to use 4-Low: On wet, slippery surfaces; in heavy, wet snow; climbing or descending steep hills; on very rough terrain (trails, off road); powering through mud; climbing rocks; driving through deep sand; fording water.

- on wet, slippery surfaces
- passing through sandy areas
- on rough trails
- through shallow water
- rock-climbing
- climbing steep hills
- through mud
- descending steep hills

Ok we have covered the general automotive terms, the various vehicle layouts, drivetrains, the pro's and con's of various types of n x n drives and when 4WD is helpful. Now is the time to review the various types of vehicles out there that are most likely to meet our today and SHTF needs, as well as a few wants and desires too.

A sport utility vehicle (SUV) is a vehicle similar to a station wagon or estate car, usually equipped with four-wheel drive for 'on- or off-road' ability. Some SUVs include the towing capacity of a pickup truck with the passenger-carrying space of a minivan or large sedan.

Premium-Compact SUVs

2013 LAND ROVER RANGE ROVER EVOQUE

2013 LAND ROVER LR2

2013 MERCEDES-BENZ GLK-CLASS

Since SUVs are considered light trucks in North America and often share the same platform with pick-up trucks, at one time, they were regulated less strictly than passenger cars under the two laws in the United States; the *Energy Policy and Conservation Act* for fuel economy, and the *Clean Air Act* for emissions. Starting in 2004, the United States Environmental Protection Agency (EPA) began to hold sport utility vehicles to the same tailpipe emissions standards as cars.

Midsize SUVs

2013 DODGE JOURNEY

2013 FORD EXPLORER

2013 JEEP GRAND CHEROKEE

2013 NISSAN PATHFINDER

2013 SUBARU TRIBECA

2013 TOYOTA 4RUNNER

Premium-Midsize SUVs

2013 LAND ROVER LR4

2013 MERCEDES-BENZ G-CLASS

2013 MERCEDES-BENZ M-CLASS

2013 VOLKSWAGEN TOUAREG

The term SUV is not used in all countries, and outside North America the terms "off-road vehicle", "four-wheel drive" or "four-by-four" (abbreviated to "4WD" or "4×4") or simply use of the brand name to describe the vehicle like "Jeep" or "Land Rover" are more common. In Europe the term SUV has a similar meaning, but being newer than in the US it only applies to the newer street oriented one, where-as "Jeep", "Land Rover" or 4x4 are used for the off-roader oriented ones.

Large SUVs

2013 CHEVROLET SUBURBAN

2013 DODGE DURANGO

2013 FORD EXPEDITION

2013 TOYOTA SEQUOIA

Premium-Large SUVs

2013 CADILLAC ESCALADE

2013 LAND ROVER RANGE ROVER

2012 LINCOLN NAVIGATOR

2013 MERCEDES-BENZ GL-CLASS

2012 TOYOTA LAND CRUISER

Not all SUVs have four-wheel drive capabilities, and not all four-wheel-drive passenger vehicles are SUVs. Although some SUVs have off-road capabilities, they often play only a secondary role and SUVs often *DO NOT* have the ability to switch among two-wheel and four-wheel-drive high gearing and four-wheel-drive low gearing. While automakers tout an SUV's off-road prowess with advertising and naming, the daily use of SUVs is largely on paved roads and they are built as such.

Popular in the late-1990s and early–mid-2000s, SUVs sales have since declined due to high oil prices and a declining economy. The traditional *truck-based* SUV is gradually being supplanted by the crossover SUV, which uses an *automobile platform* for lighter weight and better fuel efficiency, as a response to much of the criticism of sport utility vehicles. But by 2010, SUV sales around the world recovered, in spite of high gas prices.

Important: SUVs that are truck-based rather than automobile-based are better for off-road activities.

Compact Pickup Trucks

2012 SUZUKI EQUATOR

2013 TOYOTA TACOMA

Large Pickup Trucks

2013 CHEVROLET SILVERADO 1500

2013 FORD F-150

2013 RAM 1500

2012 TOYOTA TUNDRA

All-Wheel Drive (AWD): The most basic definition of an all-wheel-drive vehicle is one that can send some percentage of engine power to the non-primarily powered wheels when needed. (Today, this is an oversimplification for most new cars driving off of the lot, but we'll go with it for clarity's sake.) AWD systems were originally made popular by European sports cars in the '80s after drivers found their added road grip boosted handling. The most basic implementations are usually found on front-wheel-drive cars, though this is far from being always the case.

Today, AWD is available on all kinds of vehicles and offers many of the benefits provided by more traditional 4WD systems.

Important: 4-Wheel Drive and All-Wheel Drive are NOT interchangeable - they are two different animals.

Minivans

2013 TOYOTA SIENNA

Full-Size Vans

2012 CHEVROLET EXPRESS

2012 GMC SAVANA

Mechanically, AWD systems incorporate a front differential, center differential and the transfer case into one compact component, which makes it more suitable in smaller, lightweight vehicles with *lower levels of ground clearance*.

Despite the "All" terminology, cars with basic AWD still typically send the majority of power only to one axle.

For example, in the case of the Porsche 911, only 5% is typically pushed to the front axle while 95% is directed to the rear. In these cases, a series of sensors monitor wheel slip and automatically shift power to wheels where there is no slippage, without any action need from the clueless driver screaming Katie Perry at the top of their lungs.

Subaru XV

Some AWD systems (considered the best by non-SHTF people, but untrustworthy by out-in-the-boonies-with-no-help-around expedition organizers) leverage *software and wheel sensors* (those ever vulnerable electronics) to detect wheel slip as fast as possible. They then react by activating traction control to reduce or eliminate wheel slip while re-routing engine torque to the wheel with the best grip on the road. AWD with dynamic torque control found on cars like the Toyota RAV4 are a riff on this theme and utilize an electro-magnetic coupler (ECU). During normal driving, the RAV4 defaults to front-wheel-drive for improved fuel economy while still sending power to rear wheels during turns for improved cornering and driving performance (up to a maximum of 45% rear and 55% front torque distribution.)

Lock mode, on the other hand, essentially acts like Full-Time FWD on the RAV4 at speeds below 25 MPH by directing 50% of engine power to the rear wheels. Sport Mode provides smoother torque transfers between the front and rear wheels to improve steering by maximizing the traction of each wheel. Braking in a straight line is also enhanced in this mode by stopping torque to the rear wheels, allowing ABS and vehicle stability control to work unmolested.

IMPORTANT: AWD systems generally excel at "all-weather" driving, ***not*** "all-terrain" driving.

Pros and Cons of All-Wheel Drive (AWD)

PROS	CONS
Gives drivers added traction and improved handling in all driving situations if desired.	A lack of a transfer case means engine torque cannot be geared down to a very low range for rigorous off-roading.
It's always on and doesn't require any action from the driver.	Compared to other systems, it's less adept at pinpointing power to the wheels that grip v. the wheels that slip.
Available on a wide range of vehicles beyond trucks and SUVs.	

Note: For a chart sorted by vehicle class, thatlists all the 2013 models that offer AWD or 4WD see: *'AWD and 4WD Explained'* @ http://www.consumerguide.com/research-tools/expert-advice/awd-4wd-explained/

An off-road vehicle is considered to be any type of vehicle which is capable of driving on and off paved or gravel surfaces. It is generally characterized by having large tires with deep, open treads, a flexible suspension, or even caterpillar tracks. These come in truck, SUV and even car (sedan/station wagon) formats.

Some specialty off-road vehicles are now their own class called **ATVs or All Terrain Vehicles.** Other vehicles that do not travel public streets or highways are generally termed off-highway vehicles, including tractors, forklifts, cranes, backhoes, bulldozers, and golf carts.

There are tons of *aftermarket kits* available to turn a truck or SUV into a serious off-road vehicle, like; *armor* the vehicle by protecting the undercarriage, interior *roll bars*, carburetor and exhaust *snorkels*, front, side and rear *brush guards*, heavy duty engine *heating and cooling systems*, dual *batteries*, extra large and armored *gas tanks*, built-in *water tanks*, *short wave radio* systems and the like.

Приезд экспедиции на могильник.

Off-road vehicles were first made for the military, modern explorers and archeologists and the like. These people had to travel where there are no roads, no roadside services, no GPS and no service repair stations in order to do their job. Especially in the case of explorers, they had to carry everything in with them and (hopefully) haul out much more. Their vehicles were indeed 4WD and much more, plus they were usually special ordered.

You can still order 'expedition' 4WD vehicles from manufacturers like Toyota, International and Range Rover, to name a few. If you do they won't be like what you see people driving around on the highways and byways of your country. Nope, these are heavy duty vehicles with much thicker electrical insulation, high road clearance (above 18"), two-way radios, thick and flat/squared windows, weighted chassis and all of the other typical off-road add-ons, but on steroids! No electric seat adjustments, windows or doors, no seat warmers, no fancy cup holders, no carpeting and the most common luxury you are likely to find are saddle leather seats, which can take a beating and keep on ticking (not your butter soft fashion leather).

Off-road vehicles have an enthusiastic following because of their many uses and versatility. Several types of motorsports involve racing off-road vehicles. The three largest "4-wheel vehicle" off-road types of competitions

are Rally, Desert Racing, and Rockcrawling. The three largest types of All Terrain Vehicle (ATV) / Motorcycle competitions are Motocross, Enduro, and also Desert Racing like Dakar Rallye and Baja 1000. The most common use of these vehicles is for sight-seeing in areas distant from pavement. The use of higher clearance and higher traction vehicles enables access on trails and forest roads that have rough and low traction surfaces.

Off-road driving has its own set of mandatory skills that the driver must master. Just having a 4WD or special ordered 'expedition' off-road vehicle will not provide the safety, security, stability or functionality by itself – **the driver must *know* how to drive where no one has driven before**. If the driver is unknowledgeable, the vehicle can be damaged and leave the driver stranded, out there somewhere or at worst - someone could be injured or killed.

As one off-roading friend of mine stated repeatedly ***"4WD is not equal to Off-The-Road, not in mechanics, add-ons or driving methodology."*** This is an important distinction for someone who is looking for a bug-out or SHTF vehicle that will have to perform, 'out there', where no one has gone before and yet they themselves have never driven 'out there' before in their lives.

Some Basic Four Wheeling Tips

1. Most systems can be shifted into 4-Low as the vehicle is moving forward very slowly at 1-2 mph with the transmission in neutral. Alternatively, you can stop the vehicle completely and engage 4-Low. Wait for the drive system lamp to stop flashing before shifting the transmission into gear.
2. To shift back from 4-Low to 4-High, slow to 1-2 mph with the transmission in Neutral. Wait for the drive system lamp to stop flashing before shifting the transmission into gear.
3. Always engage 4-Low before you need it, and if you're in doubt about the conditions, slow down and select 4-Low.
4. Never operate 4WD on hard dry surfaces.
5. the vehicle has an "Auto" setting, it will prove ideal for use when road surfaces vary (for example, wet or dry, snowy or dry, etc.). Typically, driving in this mode results in slightly lower fuel economy than the 2WD mode.
6. Even with 4WD, slow and steady is much more important than fast and aggressive.
7. When in 4WD, the front wheels will feel as if they are "pushing" or "skidding" in a tight turn. Don't worry! This is normal.
8. Treat loose or wet surfaces as if they are ice. That means you should do everything (brake, accelerate, turn) slowly and gently. This approach keeps the tires from spinning on acceleration and it also keeps them from locking up on deceleration.
9. If you have driven through deep water or mud or deep wet snow, apply your brakes several times at low speed to dry them out. Keep in mind that water, mud and deep snow will affect brake operation.

Remember to check your vehicle owner's manual for more information along with vehicle-specific dos and don'ts. As your off-roading skills improve you could be surprised to discover that your four-wheel drive likely has capabilities you never dreamed possible.

Dangerous Misconceptions:

The best SUV from an active safety point of view *appears* to be an AWD vehicle that does not require driver selection to drive all four wheels. This is because twice the level of traction is always available to get out of that difficult situation when a split second can make the difference between life and death.

In a quote from the Popular Mechanic's article by Mac Demere titled "*The Myth of the All-Powerful All-Wheel Drive*", dated March 11, 2013 (http://www.popularmechanics.com/cars/news/industry/the-myth-of-the-all-powerful-all-wheel-drive-15202862) **Buyer Beware** –

> ***"It sounds like having power to all wheels would help drivers negotiate corners and slippery surfaces. But don't believe the hype about all-wheel drive and handling****. ... "Sure-footed all-wheel-drive handling." That's the kind of lingo you're likely to hear in car ads and marketing material, and it has prompted me to shout at televisions, print ads, and the occasional car-company rep:* ***All-wheel drive doesn't help handling!*** *… It's disingenuous to say or infer that AWD enhances cornering prowess, or that it'll help a driver avoid a fallen tree or dodge Bambi.* ***When it comes to handling, all-wheel drive is overrated*** *(not to mention heavy and gas-sucking), especially in foul weather. …* ***"All the best*** *[AWD systems and electronic-stability control]* ***will still get beat by a good set of snow tires and excellent driver capabilities,"*** *Hannemann says.*

Safety Misconception: While 4WD and AWD can help the vehicle "go in the snow," they do little to improve cornering grip and virtually nothing to improve braking. Oftentimes, drivers believe that because they can accelerate in snow just as quickly as on dry roads, they can turn and brake just as well also. This is not true, and can lead to overconfidence and accidents. Despite what ads may imply, you have to drive a 4WD or AWD vehicle in snow just as you would any other. You just won't get stuck as easily.

Another misconception, this one due to mis-information: It says "4WD" on the tailgate, and there it is again on the list of standard equipment. But is it really four-wheel-drive - or just all-wheel-drive pretending to be something more than it really is?

Increasingly, it's the latter, most notably when it comes to the ever-growing ranks of so-called "crossover" vehicles and compact SUVs. Examples of this category of vehicle include models like the Ford Escape and Hyundai Tucson and "crossovers" like the Volvo XC90 and Honda Element. These popular vehicles combine the appearance and stance (including higher ride height) of an SUV but handle and drive more like cars, because they are typically built around passenger vehicle platforms. They usually come with front-wheel-drive standard and some sort of all-wheel-drive system available as an extra-cost option.

AWD is not the same thing as 4WD - and it's arguably false advertising to lead people to believe otherwise. Each system works differently and offers different levels of capability.

4WD versus All Wheel Drive (AWD)

Four-wheel-drive used to be synonymous with off-roading in the minds of most consumers. Like many buzz-worthy specs originally developed for enthusiasts and professionals, though, some variant of the general principle was soon rushed into vehicles of all stripes by manufacturers. There's no denying that a new generation of sure-footed cars with better handling in tricky conditions has benefited drivers everywhere.

Four wheel drive refers to vehicles that have a transfer case (some of which include a differential that may or may not be lockable) between the front and rear axles, meaning that the front and rear drive shafts will not rotate at different speeds. This provides maximum torque transfer to the

axle with the most traction, but can cause binding in high traction, tight turning situations. They are also either full-time or part-time 4WD selectable.

All wheel drive refers to a drive train system that includes a differential between the front and rear drive shafts. This is usually coupled with some sort of anti-slip technology that will allow all wheels to spin at different speeds, but still maintain the ability to transfer torque from one wheel in case of loss of traction at that wheel. All wheels are engaged to the drive full-time.

4WD versus Individual Wheel Drive (IWD)

The term individual-wheel drive is coined to identify those electric vehicles whereby each wheel is driven by its own individual electric motor. This system essentially has inherent characteristics that would be generally attributed to four-wheel drive systems like the distribution of the available power to the wheels. However, the term IWD can refer to a vehicle with any number of wheels

What is the difference between an All-Wheel Drive (AWD) car and a Four-Wheel Drive (4WD) car?

Both cars drive all four wheels so in one sense there is no difference except that AWD has become an accepted description for a car that drives all of the wheels, all of the time. 4WD is generally accepted as a car or more typically a larger SUV (Sports Utility Vehicle) that uses a driver selectable system that mechanically engages the drive to all four wheels.

4WD is normally used on large SUV Four-Wheel Drive (4x4) vehicles designed to use the extra traction of 4WD in off road situations. These vehicles are predominately truck based platforms with large wheels and off road ties that combined with a manually selected and a locked 4WD driveline enables the vehicle to venture off-road and negotiate very difficult terrain.

A locked 4WD driveline means that there is direct mechanical link between front and rear axles with no mechanism to allow any difference in the number rotations of the front and rear axles. This means that when the 4x4 vehicle turns a corner because the radius of turn is different for front and rear axles, the tires on the axle with the smaller radius of turn must be able to slip on a loose slippery ground surface. If the ground surface is not slippery and the tires do not slip, then the driveline (axles and propeller shaft etc) will twist and stress will be induced. This is known as ‘wind up’ and ultimately if the twist cannot dissipate the vehicle will no longer be able to move as it becomes ‘locked up’. This will generally only happen at lower speeds on ground surfaces with no slip. At higher speeds or on slippery road surfaces, the tire is able to slip and the ‘wind up’ is released. This means that when 4WD vehicles are driven on normal road surfaces, 4x4 must be deselected and the vehicle driven in two wheel drive.

As stated previously, an AWD vehicle drives *all* of the wheels *all* of the time, so the system must include a mechanism that is generally a limited slip differential or an electronically controlled clutch to allow a rotational difference between front and rear axles.

Crossover small or medium SUV All-Wheel Drive cars such as Subaru Forester that are designed for normal road use with occasional dirt or mild off road use generally use permanently engaged AWD systems. This has the active safety advantage of always having twice the grip of a driver selectable 4WD system. This means that in the unexpected situation where the corner is more slippery than expected or when immediate traction is required to move safely into merging traffic, All-Wheel Drive is already engaged and the required level of traction is available to safely negotiate the situation.

Remember **to be a true All-Wheel Drive vehicle the system must be one that does not require any driver intervention to select drive to all four wheels.** Any system that normally runs in 2WD and only engages Four-Wheel drive when loss of traction occurs or requires driver selection is not a true AWD system because it is not driving all of the wheels, all of the time. With these systems, by the time 4X4 is engaged, traction is lost and a potentially dangerous situation has occurred.

As you can see despite the clear differences in design and capability between 4WD and AWD, several automakers brazenly conflate the two as a way of bulking-up the perceived capability of their light-duty, car-based "crossovers" and compact SUVs - all to make them appear less like the passenger vehicles they're related to. Unfortunately way too many of us consumers continue to believe the hype and purchase a vehicle that will ultimately fail us if put to the test. **As Preppers, we cannot fall prey to this. We must be informed and cautious, especially with manufacturer/dealership marketing and sales antics.**

On top of that, other manufacturers offer **misleading 'options' like *body lifts*** (you know those things that make different ends of the vehicle raise and lower and are commonly seen on 'Low-Rider' vehicles). These are only lowering and raising the body of the vehicle, not the important base or chassis, which contains your differential and other important mechanical components. Your only added 'clearance' with this option or add-on is visual or rider ride height or visual clearance, NOT actual road clearance or functionality.

Another misleading option is tire inflation/deflation. This can give you added traction on certain types of terrain. Just remember you, the driver, needs to know when under or over inflation of your tiers will get out of a sticky spot. However oversized tires, yet alone over or under inflated tires, in

and of themselves, will NOT provide you any other functional attribute that may be needed in true off the road travel.

The size of the tires may give you a little added road clearance, however you have now dangerously upset the center of balance on the vehicle and run the risk of roll-overs on the slightest grade difference.

Don't be fooled. Don't expect a *car-based* SUV or crossover vehicle with a car-based AWD or 4WD system to be able to do things a true 4WD *truck-based* equipped vehicle will be able to do. Nor will ANY option or functionality make up for the *drivers own knowledge and abilities* in various road, no road or weather conditions.

Case in point: When I lived by the Jersey Shore I had a VW Squareback. I often out drove other drivers with Jeeps and such, in my 2WD VW Squareback, all because I not only knew how to drive on sand, I also had much practice at it. These other drivers made the mistake of thinking that having 4WD meant they could drive off the road with no problem. They lacked the knowledge and experience to do so and got stuck because of it.

Real World Performance and Finding the Right System for You

Plenty of folks buy a 4x4 truck or SUV and never intend to take it off-road. In fact, plenty of those same folks never even think about actually using the vehicle's capabilities to its fullest. They simply want the peace of mind that comes with the fact they can switch from two-wheel drive (2WD) with either the tug of a lever or (even more common today) the turn of a switch. If you're in that group, have you ever wondered *what the controls for the 4WD system actually do*? And, equally important, *when and where you should use them*? If yes, you are not alone.

Understanding the science and engineering behind each of these vehicle systems is informative, but no amount of book smarts can replace a test drive to discern what system is right for you.

Recent studies have made it abundantly clear that competent drivers armed with even basic AWD can comfortably navigate less than ideal road conditions — and we didn't even follow a cardinal rule of using snow tires. AWD cars can manage the slushy terrain to the local Starbucks just as competently as the mighty Canyonero and save fuel in the process. In short, justifying the expense of Full-time or Part-time 4WD over more basic AWD options simply as a necessity for "surviving" your neighborhood makes much less sense than it used to.

There are obviously adventurous lifestyles and harsher environments where owning a more robust system is a reasonable investment, though. The 4WD solutions found on true SUVs (your Aztec doesn't count) are all capable of pushing drivers well beyond the paved safety of Main Street. But while their advanced drive train systems and various enhancements like Hill-start Assist Control (HAC), Downhill Assist control (DAC) and Crawl control are taking more of the hassle out of going off road, they should ***never*** override common driving sense. **Driver experience and competence is still the biggest single factor in avoiding disaster.** No option package, add-on kit or a decal on the bumper will ever change that fact.

According to Ben Bowers of GearControl.com; *"Some point out that when it comes to buying a car, it's hard to put a price on the single moment where a good traction system could save your bacon from a bad situation — and for the most part, we'd agree. You can't put a price on safety, but shelling out isn't a get-out-of-a-ditch-free card either.* ***Your first concerns should center around driving ability, size, fuel efficiency and creature comforts.*** *Only once the field is narrowed should you consider the various drive train options available and start the honest conversation of "Is it worthwhile?"* ***No matter what you wind up picking, our advice is to study up on good winter driving skills, focus on regular maintenance, and work on improving your decision making behind the wheel first.*** *After all, at the end of the day, it's the man behind the machine, not the other way around."*

Ok I know I went into a lot of detail on the different wheel drive vehicles out there. I have a good reason or two for doing so.

If you are like the average American your bug out vehicle is also your everyday vehicle. To avoid spending too much money or worse, ending up in a deadly situation with the wrong vehicle, we need to understand the differences between these vehicles and their various drivetrains and differentials.

Just having a 4WD vehicle will NOT provide you with all the functional capabilities you are thinking it will. Knowledge is Power and it pays big time here!

On top of this the experts have stressed, several times, that ***the functional abilities of the vehicle are second to the skills and competency of the driver***. For instance:

- An off-road driver will *not* straddle an obstacle, rather they will try to have the left or right wheels take the highest point of that obstacle. This avoids damaging anything important housed in the undercarriage of the vehicle.
- Studded tires do *not* equal stopping power, they merely provide extra friction or traction.
- Just because you can go fast does *not* mean you can turn on a dime or stop fast.

There are also some 'common sense' type attributes that we need to consider if this vehicle is going to perform as we wish it to – now and SHTF:

Metal

Fibreglass

- *Look for vehicles that are made of metal and not fiberglass.* Vehicles made of metal can keep going much longer than fiberglass vehicles and are easier to perform 'on the fly' repairs too (you can push out metal away from a tire, while damaged fiberglass will need to be removed).

- *Electronics are some of the most costly and most often cause of failure to any vehicle.* The more electronics control the vital aspects of the vehicle (fuel injection, drivetrain sensors, etc.), the more dependent this vehicle is on an expert mechanic and non-SHTF world.

- *The more electronics the more weight the vehicle must move around* – ie lower gas mileage (and less passenger and cargo capabilities too). So all those electronic gadgets means the less distance you can travel SHTF before having to fuel up again.

- *It will be harder to find parts, post SHTF, for foreign vehicles than it will be for US manufactured vehicles*. Don't be overly fooled by manufacturers likeToyota, that are now assembled here in the States. Assembled means just that – *assembled, not manufactured*. Although on the plus side, being assembled in the States also means that the more common replacement parts are indeed more readily available.

- *Beware of vehicles manufactured that utilize proprietary parts*, such as GM and Chevy. These require special tools when working on the vehicle, even for changing out a head/tail light bulb. Any specialty tools will be hard to find SHTF.

- *If the window glass* itself is curved, bowed or angled in any way it is not only more expensive to replace, the windows will also be harder to find in a SHTF world. (Same holds true for body parts)

- *Look for vehicles with gages and not 'idiot lights' for the RPMs, oil and gas.* Gages will keep you informed on these key aspects of your vehicle's health so you have time *before* anything happens to address them.


Mechanical Gages


Digital Gages

- Avoid digital speedometers and other indicators. Stick to the actual gage or mechanical display. Digital types of repairs will be very difficult in a SHTF environment.

- *Most options* (and digital gadgets) *add weight without SHTF functionality.* So even if the vehicle is good off the road, it could end up being too uncomfortable to use over the long haul or even break down in the SHTF world when you need it the most. Think about those butter soft, molded leather seats; the leather gets torn or splits and now the insides to the seat are exposed to the elements, they start to rust and squeak, etc., not to mention they are now extremely uncomfortable to sit on. *Remember SHTF your vehicle will most likely NOT be in a garage or other 'protected from the elements' structure*, especially if you are indeed traveling off the road. The sun and other elements will get to it and vehicles now days, especially luxury vehicles, are NOT built to withstand all that direct exposure. *Stick to heavy duty vinyl or saddle leather and save the butter soft fashionable stuff for your special order seat covers.*



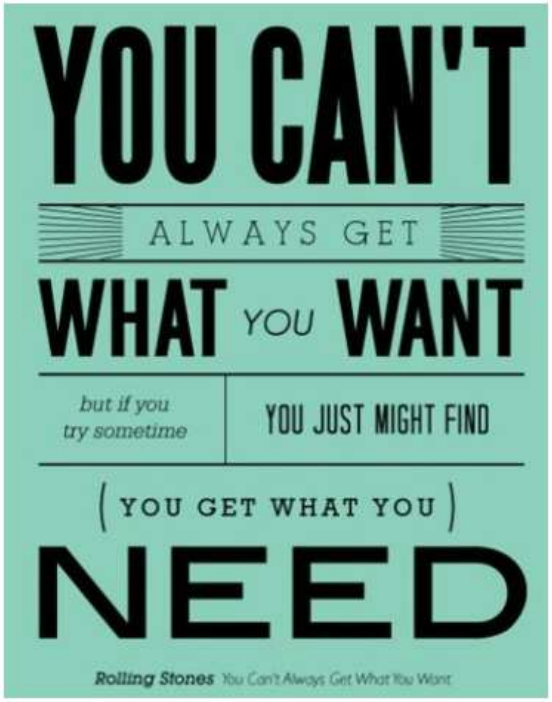
- Tracking: Just about every vehicle manufactured today has some kind of GPS or OnStar capability. If you are concerned about someone finding you or following you, these will guide them right to you - even if the function is NOT activated on your vehicle. *The only way to be sure this doesn't happen is to have the computer chip to this function physically removed from the vehicle.* Needless to say if you have a GPS map display in the dash of the vehicle, you are screwed (the cost of removing this computer component is expensive since in most vehicles today is it bundled with other electronics in the vehicle). Better to order a vehicle without one. (This applies to cell phones and especially these new iPhone/Smart Phones. If it has GPS and or wireless internet capabilities the battery must be removed to avoid tracking. Simply deactivating the service will not do the trick. Also make sure the camera function has disabled the Geo-Tagging option to the digital pictures. This is true with digital cameras as well.)

- *If you must have electronic door locks, windows and or seat adjustments, find a vehicle that also has the manual overrides to these things.* This is not only a good safety aspect, it is most definitely a good SHTF move. Like most electronics, these are difficult to repair and in too many cases are actually *replaced*, not repaired.

- *Know your vehicle.* Learn how to replace spark plugs and change the oil. You don't have to do this all the time in our non-SHTF world, it does however, pay to be able to do the basics – just in case. I would even keep a few spark plugs, extra oil and a fan belt or two, on hand in the trunk. After all we never know when a crisis will occur or where we will be when it does.

- *If you have never driven off the road, get some instruction on the methodologies of off-roading and practice once a year to keep sharp.* This could be a life saver.

- *If you feel this vehicle may be your temporary 'home away from home'*, as in bug-out car camping, and you are not a camper – it pays to take a weekend once a year to camp out for one night and acquaint yourself with camping and your camping equipment. Let's face it, *we can have all the equipment and gadgets in the world and if we don't know how to use them, they are useless.* Besides the experts agree that a SHTF environment is NOT the time to be reading directions and trying this stuff out for the first time!



- Above all be honest in your evaluation of your everyday and SHTF needs (not wants), for both your Preparedness Plan and your potential bug-out vehicle.

- Last but not least your SHTF vehicle must be able to traverse the road less traveled. You don't want to be stuck on the same byway as everyone else!

So before you purchase that add-on kit or vehicle as your bug-out vehicle (even if you are one of those people that can actually afford a vehicle just for SHTF scenarios);

- Review the various crises on your list
- Determine the likely travel conditions during and after this crisis
- List the *functional needs* this vehicle should have for now and those SHTF conditions, then the wants
- List the *ascetic needs* the vehicle should have for those SHTF conditions, then the wants
- Research the vehicles that qualify using sources that are not; just consumer trends, or funded by the manufacturer or sponsored by a manufacturer.
- If there is *any* possibility of having to drive off the road, get an off-roader to teach you the methodology of off road driving. Remember: *Practice makes perfect and repetition is the foundation to learning.* You want to be able to drive off the road in a SHTF environment *without* having to think about how to do it.

Then and only then make your vehicle choice.

Lots'O Luck & Keep on Preppin ;-}

TNT