

Tips and Suggestions from Ecomodder.com for Better Aerodynamic Efficiency



Roof Racks (deletion)

A lot of vehicles (SUVs, crossovers, wagons and minivans particularly) come with roof

racks that are rarely if ever used by their owners.

The aerodynamic penalty of roof racks at highway speeds can be significant: they increase both frontal area AND Cd. Removal is usually easy (aftermarket) to moderately difficult (OEM). Removed racks can be reinstalled when needed.

A compromise for OEM racks with difficult to remove side rails/mounts is to remove just the crossbars. Usually this is a simple job.

mechanical skill required:



Impact on fuel consumption :



Cost of mod :



Mud flaps (deletion)

Aesthetics vs. aerodynamics... A [cleaner](#) vehicle vs. cleaner airflow... You decide!

Ironically, mud flaps can be useful when they're used as mounting points for aerodynamic mods such as boat tails behind the [tires](#), or fender skirt attachment points.

mechanical skill required:



Impact on fuel consumption :



Cost of mod :



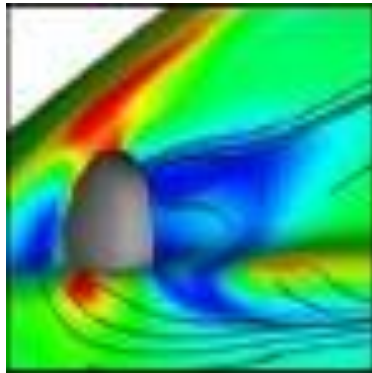
Raised wing type rear spoilers (deletion)

Sure, the dealer or that go-fast kid on the corner might've convinced you that spoilers are good for downforce, but in reality, most are merely a [cosmetic](#) addition - one that is more likely to add drag than it is to do anything meaningful for handling.

Take it off and your car will not only look [stock](#), but it'll have better aerodynamics.

It isn't always obvious whether a particular spoiler style is an aero help or hindrance.

mechanical skill required:		Impact on fuel consumption:		Cost of mod:	
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Side mirror/s (delete)

Side mirrors are absent from most high efficiency concept vehicles for a reason: they increase both frontal area *and* Cd.

Many jurisdictions do not require a passenger side mirror, so that is most often the one deleted.

Some will replace the outside mirrors with smaller mirrors, or more aerodynamically shaped mirrors from similar models.

Others replace the outside mirror with convex, in-car mirrors or extra width rear view mirrors. Cameras and LCD screens are a favourite of the [concept car](#) circuit, though a somewhat

costly option.

mechanical skill required:		Impact on fuel consumption:		Cost of mod:	
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Radio antenna (relocation/deletion)

Radio antennas aren't the biggest things in the world, but they do stick out in the way, and you definitely won't find traditional "whip" style antennas on high-efficiency concept & production cars.

You can either remove it or relocate it to a more aerodynamically friendly location.

mechanical skill required:		Impact on fuel consumption:		Cost of mod:	
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Shave badges, door handles, rain gutters, etc.

Yes, this falls into the "splitting hairs" category.

Shaving your [door handles](#) and smoothing out all the lines on your car isn't likely to boost your fuel economy a whole ton. However, if you're really motivated to create at the lowest drag form possible, this is what you'll need to do.

mechanical skill required:



Impact on fuel consumption :



Cost of mod :



Windshield wiper (deletion)

The effect of front wipers on airflow varies from vehicle to vehicle. Some people use RainX and remove their wipers completely, which is a bit risky and not advisable. Others, however, simply remove the blades and store them in their car. When rain threatens, you can easily throw the blades back on. If you're worried about airflow over the wipers, this is probably your best option.

Another hair-splitting option is to replace your blades with a lower profile style.

mechanical skill required:



Impact on fuel consumption :



Cost of mod :



Aerodynamic mods - fabrication ...



Smooth wheel covers

Moon caps or moon eyes, as they are often known, cut down on aero drag, and can even look pretty cool. The amount of drag reduction varies between different vehicle and wheel styles.

They can be made DIY style with things like [pizza](#) pans, or bought at various online retailers.

Some modders will also use clear tape over OEM hubcaps or wheels, though this is obviously less permanent.

mechanical skill required:



Impact on fuel consumption :



Cost of mod :





Upgrade headlights from "bucket" or pop-up style to aero assemblies

Some older headlight assemblies (particularly those with the sealed beam bulbs), have a bucket-style scoop design. Often these can be swapped out for different style headlights, or modified to cut down on aero drag.

Some [car models](#) came with both bucket and aero style assemblies, so swapping is a plug 'n' play affair. One EcoModder member even removed his significantly less aero pop-up style sealed beams with a lower profile flush fitting assembly from another vehicle.

mechanical skill required:	 easy ninja	Impact on fuel consumption:	 small large	Cost of mod:	 free ouch!
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Swap/fabricate a more aerodynamic front bumper cover

Some different trim levels of the same vehicle model have more aerodynamic bumper styles than others. If your car has the possibility of swapping between multiple different bumper styles, consider the one that is more aerodynamic.

Another option is fabrication/modification of your existing bumper.

mechanical skill required:	 easy ninja	Impact on fuel consumption:	 small large	Cost of mod:	 free ouch!
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Lexan/plastic covers over "bucket" style headlights

As mentioned in one of the previous tips, many cars come with unaerodynamic headlight assemblies. If no swap is easily available, clear covers can be made. These covers clean up the aero while leaving light from the headlights unfiltered.

mechanical skill required:	 easy ninja	Impact on fuel consumption:	 small large	Cost of mod:	 free ouch!
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Grill block (partial/full)

Grill blocks have two purposes. The first is it cut down on aerodynamic drag by limiting the amount of air that enters the engine bay. The second is to allow the engine/transaxle (fwd vehicles) to warm up more quickly and retain more heat in the colder months by reducing excessive airflow through the engine compartment in colder months.

Grill blocks come in many forms, though most often they are made to be flush with the outside of the bumper for greatest benefit. Simply inserting a piece of cardboard in front of the radiator does not provide the same aerodynamic benefit.

While grill openings are usually oversized for "worst case" applications (towing a trailer through Death Valley with the A/C on), obviously care must be taken to monitor coolant temperature. If your cooling fan runs more after installing a block, you've gone too far. So, pay attention to your temp gauge and making your grill block easy to remove.

mechanical skill required:	 <i>easy</i> <i>ninja</i>	Impact on fuel consumption:	 <i>small</i> <i>large</i>	Cost of modification:	 <i>free</i> <i>ouch!</i>
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Tire spats, or fully contoured deflectors

Properly designed tire spats or contoured deflectors direct flow around tires in such a way that drag is reduced without increasing outward flow enough to increase wake.

mechanical skill required:	 <i>easy</i> <i>ninja</i>	Impact on fuel consumption:	 <i>small</i> <i>large</i>	Cost of modification:	 <i>free</i> <i>ouch!</i>
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Boat-tailing behind tires

Just as entire vehicle rear ends can benefit from boat tailing, so can individual wheels/tires.

The 2nd generation Toyota Prius has tapered bodywork (in the bumper cover) behind its rear tires that serve this purpose.

mechanical skill required:



Impact on fuel consumption:



Cost of mod:



Belly pan / under tray

The underside of your car is one of its most aerodynamically dirty areas. Most vehicles will benefit by fitting a smooth undertray - something manufacturers are doing more and more where they want to squeeze the most efficiency from any particular model (eg. Jetta diesel vs. gas; Camry hybrid vs. non-hybrid).

Sheet aluminum or corrugated plastic will do the trick. Just make sure that you don't put any flammable

materials near hot exhaust pipes.

mechanical skill required:



Impact on fuel consumption:



Cost of mod:



Rear wheel skirts

Wheel arches & wheels can be a significant area of turbulence depending on the OEM design. Covering the back wheels to smooth airflow at the rear of the vehicle can make a measurable difference in fuel consumption.

This mod is seen on production cars like the 1st generation Honda Insight, GM EV1, and many other efficient concept cars. It's often one of the first attempted by ecomodders because it is rather easy to do.

mechanical skill required:



Impact on fuel consumption:



Cost of mod:



Front wheel skirts

Front wheel skirts have many of the same benefits as rear wheel skirts, but are a lot harder to make because the front wheels have to steer!

Front skirts have appeared on a few high MPG concept cars, and a few EcoModder members have tackled the project, but this mod is not for the faint of heart.

mechanical skill required:



Impact on fuel consumption:



Cost of mod:



Soften / radius aft edge of front wheel arches

Radiusing the aft edge of wheel well arches allows air exiting the wheel well to more easily stay attached to/reattach to the side of the body.

While modifying the metalwork itself would be difficult, the mod could also be accomplished by adding & shaping material on the inside of the arch.

Examples of this design approach can be seen on the first generation Honda Insight, GM EV1 and Corvette, VW 1L concept, and Solectria Sunrise prototype EV (pictured).

mechanical skill required:



Impact on fuel consumption:



Cost of mod:



Front wheel arch gap fillers

This mod could be considered a partial wheel/fender skirt, which in combination with a smooth wheel cover may provide some of the benefits of a full skirt.

Manufacturers of high efficiency cars that do *not* use wheel skirts typically try to minimize the tire/wheel arch gap to assist airflow, in addition to using a wheel offset which has the outside wheel/tire surface close to the side plane of the vehicle. Examples are the 2nd generation Prius, GM Volt, Audi A2.

mechanical skill required:



Impact on fuel consumption:



Cost of mod:



Sealed panel gaps

All those little gaps may not seem like much, but they add up. That's why all the Bonneville race cars come sealed up like a coffin, and automakers are starting to pay attention to these areas on production cars.

There are many solutions here, including the use of clear tape, color matching silicone filler, or foam weatherstripping. Others will adjust body panels to minimize gaps.

mechanical skill required:



Impact on fuel consumption:



Cost of mod:





Partial Kammback

One of the biggest aerodynamic problems with the majority of bluff body vehicles (most hatchbacks, vans, wagons) is the amount of pressure drag / size of the trailing wake. In other words, the rear of the vehicle is where the big gains are to be made.

That said, a hatchback configuration isn't automatically an aerodynamic death sentence. Several of the most slippery production cars in recent years (1st gen Insight, 2nd gen Prius, Audi A2) have used "Kammback" shapes, where the roofline tapers downward, following a particular shape (a "chopped" teardrop). It's possible to retrofit this shape onto existing vehicles and gain a measurable improvement in fuel economy.

mechanical skill required:		Impact on fuel consumption:		Cost of mod:	
	<i>easy</i> <i>ninja</i>		<i>small</i> <i>large</i>		<i>free</i> <i>ouch!</i>



Full boat tail

Taking the partial Kammback to its logical conclusion, this mod dramatically reduces rear pressure drag and minimizes trailing wake.

Of all aero mods, a full boat tail will probably have the single largest effect on reducing fuel consumption, though it is obviously more difficult to construct (and will result in more heads turned than anything other mod!).

mechanical skill required:		Impact on fuel consumption:		Cost of mod:	
	<i>easy</i> <i>ninja</i>		<i>small</i> <i>large</i>		<i>free</i> <i>ouch!</i>



Frontal area reduction

This mod involves any radical modification that reduces frontal area (aside from simple removal of a mirror, roof racks, etc., or lowering). This may include chopped tops, or other reforming of the body.

mechanical skill required:



Impact on fuel consumption :



Cost of mod :



Decrease hood to windshield angle

Another radical modification requiring much fabrication. Decreasing the angle between the hood and windshield reduces the amount of pressure build-up at its base and can help maintain laminar flow at the windshield/roof transition.

mechanical skill required:



Impact on fuel consumption :



Cost of mod :



Front air dam

Extending a dam to the level of the lowest underbody component (possibly lower depending on the vehicle) diverts air away from (around) the most aerodynamically "dirty" area of most vehicles.

Adding air dams (particularly on trucks & SUV's) is a common tactic used by auto makers looking for quick aero-fixes to improve efficiency.

mechanical skill required:



Impact on fuel consumption :



Cost of mod :



Rear corner airflow trip feature

Airflow along the side of a vehicle tends to follow the curvature of the tail lights and bumper part way around to the rear of the car, which can cause more drag than a sharp corner "crease" that promotes clean separation at the trailing edge.

GM designers integrated such a crease at the rear of the Chevy Volt "production" concept, a feature that could be retrofitted onto existing vehicles.

mechanical skill required: 	Impact on fuel consumption: 	Cost of mod: 
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Ride height reduction

Lowering a vehicle is a common tactic employed by auto manufacturers to improve efficiency in production and concept vehicles. While not a guaranteed improvement (much depends on the initial vehicle design - particularly the underbody), reduced ride height has multiple

aerodynamic benefits, including:

- improved fineness ratio (length/height)
- slightly reduced frontal area (tires and possibly suspension components)
- reduced tire/wheel arch gaps

Lowering may also reduce body roll, and improve handling enough to permit comfortable/safe cornering at higher speeds, thus saving fuel.

mechanical skill required: 	Impact on fuel consumption: 	Cost of mod: 
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Pickup truck aeroshell/fastback bed cover

Pickup trucks have high coefficients of drag. Fortunately, they're also ideal platforms for adding this highly effective aerodynamic modification.

A number of EcoModders have undertaken this task, recording highway fuel economy improvements of between 13-20% compared to an uncovered bed.

They can be built in such a way as to retain the usability of the bed as well.

mechanical skill required: 	Impact on fuel consumption: 	Cost of mod: 
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Pickup truck tonneau cover (partial or full)

Not quite as effective as a full aeroshell, a tonneau cover can still provide a measurable fuel economy benefit vs. an open bed.

A tonneau is however much easier to install or fabricate. Perhaps somewhat counter-intuitive, a partial tonneau can be more effective at drag reduction than a full cover.

mechanical skill required:



Impact on fuel consumption :



Cost of modification :

