

**DRIVER
ENERGY
CONSERVATION
TRAINING**

NEBRASKA ENERGY OFFICE

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Planning Techniques

Planning your travel. Sounds like a good idea . . . but it sounds as if it involves a lot of time.

Why bother? Because if you're like most drivers, you'll make about 1,400 trips this year traveling, consuming 800 gallons of gas and your automobile expenses will represent about 15% of your household's total expenses. So you see, the cost of private automobile transportation is no small item for most people!

Planning for more efficient travel goes a long way toward saving gas and time and money. And planning your travel doesn't require a great deal of time or effort. It just requires making more informed decisions about traveling.

The Short Trip

Most of us don't think anything at all about hopping in the car to go to the grocery store—wherever. But "short spins" are expensive, and can really add up over a year's time. Whenever you drive the distance of one, or even 5 miles, you are taking a short "trip." (Trips are not just something you take when going on vacation!)

Every day, the most frequently made vehicle trip is only 1 mile long. Trips of 5 miles or less make up 15% of all miles driven every year. But these 15% of all miles driven yearly consume 30% of all gasoline used by automobiles.

So, short trips make up the most expensive part of driving, and they often carry the cold start fuel penalty.

The Cold Start and MPG

But why are short trips so

expensive and so fuel inefficient? Well, on a short trip, when you're operating from a cold start, your vehicle won't be driven enough to reach its most efficient operating temperatures.

A vehicle operating from a cold start, say on a 4 mile trip, will probably achieve only 20% of the fuel economy possible after all parts of the vehicle are warm. That means if your car is capable of 20 mpg, you may only get 4 mpg under a cold start/short trip situation.

But, if you plan, combine several short trips into one longer one, your cold start penalties would be less. Your initial fuel inefficiency could be offset by the average mpg achieved by using your vehicle for one longer trip, where your car can reach its maximum potential for fuel efficiency.

Cold starts impose a heavy fuel penalty on your mpg for several reasons.

- **Tire Resistance**—When your tires are cold, they resist motion. It's only after you've driven your vehicle for a while that this particular resistance from your tires decrease. That's because your tires have gotten round again, heated up, and the air pressure has increased.
- **Engine Resistance**—Engine lubricants are designed to reduce resistance. They perform best, smoothing out engine resistance, only after they have warmed up. Then, they flow more easily because they are less thick. A richer fuel mixture is also required of a cold engine to overcome the poor air-fuel mixing.

- **Vehicle Resistance**—All the

parts of your vehicle resist motion at first. So all your vehicle parts must be lubricated properly. Proper lubrication occurs only after resistance is lower, and resistance is lower only after your vehicle has been driven about 15 miles.

So, at all times, it's wise to *reduce* the number of your cold starts. But the solution to the problems of short trips and cold starts isn't simply to make your short trips longer—or to idle longer—but rather, to *plan* your travel more efficiently to meet your needs.

Vehicle Idling

The relationship between vehicle idling and fuel economy is misunderstood by most drivers. A 30-second warmup, followed by operating at slow to moderate speeds, is what's best for fuel economy.

Few of us ever think of the fact that when a vehicle is idling and not moving, it's getting its worst fuel economy, zero mpg. And when you're idling the engine after deceleration, letting momentum carry you along, then you're operating at your *highest* possible mpg.

Idling Penalties

Excessive idling imposes a fuel economy penalty for both warm and cold vehicles. We've all seen vehicles idling in loading zones, in shopping mall parking lots, while parked at homes, even while waiting in gas lines! But time spent idling, waiting for someone, or in loading the vehicle, just increases fuel use. And that's like burning money.

Now this doesn't mean that you should turn off the engine every

time you stop your vehicle. It also takes gas to start the engine again! But a good rule-of-thumb to follow is this: "If the engine is warm and you expect to idle 30 seconds or more, it's more efficient to turn the engine off and re-start it when everything is ready to go."

An engine uses from 0.4 to 1.0 gallons of fuel per hour while idling. But idling can save gas if it means keeping your foot off the gas pedal when you're approaching curves or turns, or when stops at intersections will be necessary. Then it's more fuel efficient to decelerate early on, by smoothly lifting the throttle to idle speed and letting your vehicle coast, allowing its momentum to generate the speed you need to drive safely.

Combine Trips

Planning travel can pay off in savings of gas, time, and money.

A good way to start your planning is to take a hard look at the number and purpose and mileage of all the trips you take. Because the more you can combine, the more you can save.

Combining five or six short trips into one or two trips is much easier and more fuel efficient than it is to go back and forth from home several times, starting and stopping, only to have to go out and do it all again an hour later!

Of course, you must balance combining your trips to save fuel, grouping them around your appointments and daily schedule.

Why Combine Trips?

Not all vehicle starts can be warm starts—but when you combine your trips, you'll reduce two big gas-eaters: cold starts and operating a cold vehicle.

Short single purpose trips impose a fuel penalty because the car's parts never get a chance to really warm up and typical short trips are made up of fuel wasting stops, starts and low speeds. On a longer trip made up by combining short

trips you save gas because the car's parts:

- have time to warm up
- stay well lubricated for 15-20 minutes after individual stops
- stay warmed up for 3 to 4 hours after stopping

And if the trip is well planned you will actually drive substantially fewer miles.

How to Combine Trips

How do you combine trips? Getting a fix on common, everyday trips is a good place to start. Then figure out which trips can be combined easily. Usually some routine trips can be combined and your less common, infrequent trips can be added into the routine, too!

These trips should be clustered by three factors: time, location, and course.

- *Time*—Trips that need to be made in the same time period, e.g., A.M., should be examined and "plotted" or routed to see if they can be worked into a combined trip or trips.
- *Location*—Trips to the same general area or direction should form a combined trip or trips.
- *Course*—For combined trips, the course—route and order of stops—should be examined to make sure you've planned it as efficiently as possible.

Your Payoff

The average household takes 5-6 trips a day for family business, social, and other reasons. By combining a trip or two, you won't find it difficult to get more out of a tank of gasoline. And when you do, you can expect these things to happen:

- *Time spent*—You'll spend less time behind the wheel.
- *Trips eliminated*—You'll find that some trips won't be necessary to take at all.
- *Miles traveled*—You'll drive fewer miles to meet your travel needs.
- *Dollars spent*—Everything you need to do will get done—but at a lower fuel cost.

Route Selection

The routes and the areas you drive in must be taken into account when you're planning for travel. Because the route you select *can* make a difference. Proper route selection can mean that you use less gas and avoid the traffic hassle without increasing your travel time.

Route selection applies to *all* of your trips whether a single trip, or a trip made by combining several destinations. Generally, when you're selecting routes, you should:

- *Minimize stops*—Select routes where you can keep going without interruption.
- *Maintain efficient speed*—Select routes that enable you to reach and operate in a fuel-efficient speed range.

In heavy traffic, in the city, and in some neighborhood areas, it's difficult to keep or even reach an efficient speed. Stop and go driving is all you can expect from areas with stop lights, traffic tie-ups, and the like. Even if it means extending your route slightly, it's better to do so if you can avoid these areas and stick to smooth and steady driving in the fuel-efficient speed range.

Carry Proper Loads

The load you'll have to carry is a factor in your trip planning, too. Cargo and passenger weight have a big effect on fuel economy. Weight causes mpg to drop. In fact, every 100 pounds of weight can penalize fuel efficiency approximately 3-6%.

Right Vehicle for the Load

Just as it's important to carry only proper loads, it's also important to use the right vehicle for that load. A station wagon wasn't built to carry one person fuel efficiently, just as a compact wasn't designed to carry six people.

The proper load does not necessarily mean the most weight, it is the useful weight you carry on a trip. And loads

should be carried inside the car as opposed to outside the car if you have a choice. Dead weight (e.g., snow tires in the trunk) penalizes your fuel economy every mile you transport it.

So, when you're planning a trip, plan for economy, too. Select the appropriate vehicle, eliminate extra weight, and carry necessary loads inside the car.

Travel Alternatives

Some trips just aren't necessary. But you have to take a moment to figure out just which ones you can cut out. Your effort will really pay off in time and money if you avoid an unnecessary trip.

Hopping in the car isn't always the best way to get what you need. Just consider some of these alternatives:

- **Use a more efficient mode**—Ride sharing, mass transit, vanpools, carpools, and Amtrak with their high load factors can reduce personal costs and save time.
- **Use an efficient alternative**—When the opportunity presents itself walk, bicycle, moped or motorcycle. These can be especially efficient for short single purpose trips.
- **Use the phone**—Many personal and work objectives can be met with a phone call. A call may prevent a time- and fuel-consuming trip. And who couldn't use a little extra time?
- **Call ahead**—Check to see if the people you want to see are available and/or that stores have what you want. A call ahead can save time, money, and the frustration of shopping for something you can't find.

- **Use deliveries**—If there's no real hurry, why rush around or worry about picking up and/or delivering something yourself. Try the mail or delivery services!

- **Try the mail**—More and more people are shopping with catalogs or doing business by mail. This is just another way that you can save a trip, and the time you'd have to spend in the store. Often you can place your catalog order by phone.

While all these alternatives to driving your car may not always work for you, give them all a chance, you're bound to find one that'll save you time, money, and gas.

Sharing Rides

You'll find ridesharing offers a number of benefits—financial, time and relaxation as well as others.

Ridesharing cuts into the number of times and miles you travel, your time behind the wheel, driving stress, and your total transportation costs.

Not only can you share rides to work (the traditional application of ridesharing), but it's easy to share rides while you're doing family business, or if you're heading out to social events. You'll save on fuel costs, on parking fees, vehicle maintenance costs, tolls, and the like.

In fact, you can save about *half* of what it costs you to drive to work every day (except for your fixed costs) by sharing that expense with only one other person. Considering that trans-

portation costs amount to about 15% of all family expenditures, this is no small amount.

Ridesharing Can Be Flexible

But statistics indicate that few people think of sharing rides. In fact, studies show that *more than 73%* of workers drive *alone*. Well, you may enjoy riding to work alone at times, but ridesharing *can* be flexible. You don't have to rideshare every day. You can still save substantially by sharing rides just two or three times a week.

Ridesharing is Fuel Efficient

Commuters who join a carpool or a vanpool increase vehicle load. So *they* get the best return on their transportation investment.

Look at it this way—if your vehicle gets 20 mpg and carries 6 passengers you're getting 120 passenger miles per gallon. But if your 20-mpg vehicle can only carry two people, that means you're only getting 40 passenger miles per gallon.

Ridesharing Has Other Benefits

The effects of ridesharing can be felt in other, less apparent ways. As fewer vehicles use existing roadways, look for:

- A reduction in congestion as well as in air and noise pollution,
- A reduction in the time it takes to drive from one point to another, particularly in heavily-populated areas.

Ridesharing can be a terrific solution to everyday travel for many people. Could you be one of those people?

Driving Skills



If you're like most drivers, you drive over 11,000 miles each year, and use almost 800 gallons of gasoline. But no matter how many miles you drive in a year, wouldn't you like to travel the same amount of miles, only using fewer gallons of gas? Well, you can, if you use fuel-saving driving techniques.

Just because of what they do behind the wheel, some drivers top the fuel economy estimates for their vehicle type. Why, in a recent Fuel-Economy-Challenge rally sponsored by the U.S. Department of Energy, 80% of the participants achieved a *higher* mpg than the fuel economy estimate for their vehicle!

Thirty-Second Warmup

After you start up, all you need to do is to idle for 30 seconds before you get going. That's right—only 30 seconds.

Just sitting there idling, burning gas but going nowhere, makes little sense. For, while a cold engine won't get the mpgs it normally gets when it's warm, you'll be getting much more than the zero mpgs you get sitting there idling away.

Oh, *your heater and engine will get hotter* with longer idle time, but the *rest* of your vehicle's parts can only warm up while you're underway. And to really save on fuel, your engine transmission, tires, and all the moving parts have to be warmed up. And that's easy enough.

After your good 30-second start-up idle, all you need to do is *drive at speeds of 25-35 mph for the first few blocks or so to warm the rest of the car.*

Normal Temperature

There is no simple way to tell when your car's transmission fluid is flowing with the least amount of resistance. But a good indication that your vehicle is warm is your engine's temperature. When the temperature indicator reaches normal, hits 120°, or when the light goes off, you can assume that your car's parts are warm enough to drive at normal driving speeds.

Only when it's very cold will you have to drive a longer distance than usual for your vehicle to warm up. But all else remains the same—30 second idle and go—slow—until your car's temperature indicator reaches its normal range.

Moving Out From a Stop

Many drivers believe that fuel economy means accelerating slowly. But that's just not the case! There are several ways to control and adjust your vehicle's speed to get the most out of every gallon, and starting slowly and going slow isn't one of them. Fast isn't either.

Accelerating too gently—or too hard—wastes gas. As a car begins to move, inertia, surface rolling resistance, and wind resistance must be overcome.

This requires a great deal of fuel—as much as three times the amount needed to maintain a cruising speed. Further, lower gear ranges used in acceleration and low speeds use the most fuel. So, when getting underway, the most fuel efficient thing you can do is to accelerate briskly and steadily (without flooring it).

When you move away from a

stop, briskly and steadily, you'll minimize your acceleration time before reaching operating speed. This, then, reduces your time driving in the lower, less fuel efficient gears.

Brisk and steady acceleration also makes for more efficient shifting as you move into the higher, more fuel efficient gears. As all engines have an efficient speed range which isn't super fast—or super slow either—brisk and steady acceleration is the way to get into your engine's efficient speed range—as quickly as possible.

So, accelerate briskly and steadily up to the speed range where your engine operates most efficiently. Your car is in higher, more efficient gears and your car's momentum can work for you—and your fuel economy.

Moving Out . . . and Up

Moving out from a stop requires one acceleration technique, while moving up a hill requires another. The greater the degree of slope your vehicle has to climb, the more power you'll need to maintain speed. By accelerating just before you begin to climb a hill, you'll get better speed for less gas than if you accelerated against the resistance of the grade. Then, by easing off on the accelerator near the top and allowing your car's momentum to carry it over the crest, you can save more gas.

Maintaining a Fuel-Efficient Speed

All vehicles have a speed range in which they can achieve their best fuel economy. This fuel-efficient speed range varies somewhat from vehicle to vehi-

cle, but most are more efficient at speeds between 35 and 45 miles per hour. At speeds above or below this range, your vehicle will get less than its possible maximum miles per gallon.

Say your vehicle gets 22 miles per gallon in its fuel-efficient speed range of 35-45 mph. Well, you can expect to only get about 20 mpg at a speed of 30 or 50. And your fuel economy is penalized drastically at speeds below 30 and over 50 mph. If you're getting 22 mpg in the fuel-efficient speed range, then at 10 mph, you'll only get 14-15 mpg. And zipping along at 70 could mean using as much as a *third* more fuel than you would use at 45 mph.

Smooth and Steady Driving

Changing directions or speed any more than you have to wastes time *and* gas. The slightest pressure on the brake, or the gas pedal, or the steering wheel, costs you even when you're not aware of it! Speed fluctuations generally mean that a driver accelerates unnecessarily, or has an unsteady foot on the gas, or is indecisive, or, is all of the above! Pumping the gas pedal is especially wasteful, whether you are starting your vehicle, just getting underway, are going up a hill, or are trying to maintain your driving speed. So, smooth and steady does it!

Anticipating Traffic Conditions

Anticipation and fuel efficient response to anticipated traffic conditions have the potential to save more gas than any other driving behavior, particularly in city driving and rush hour.

Anticipating requires an alert driver—a driver who looks well ahead. To be able to operate smoothly and to maintain a fuel-efficient speed means that you *must* be able to anticipate changes in traffic conditions, and in the actions of other drivers. And if you're going to

flow smoothly through traffic, you've got to anticipate changes in conditions far enough in advance to allow yourself time to move through traffic without breaking your pace.

12 Seconds Ahead

How far is far enough in advance to look in order to anticipate and adjust to changing traffic conditions? Well, when you're looking about 12 seconds ahead, unnecessary braking and acceleration and small but wasteful changes in speed and steering can easily be avoided. And looking *12 seconds* ahead reduces aggravation because you won't be trapped behind slower moving vehicles, or forced into making last-second lane changes either.

Just how far ahead is 12 seconds?

In the city, looking about 12 seconds ahead means that you can anticipate changes in conditions for about a full block. And on the highway, looking 12 seconds ahead means checking out, and responding to, changes in conditions up to a fourth of a mile away.

Look to the Rear

Anticipation also requires observing traffic conditions to the side and rear. While this side and rear view of the driving scene may not seem to be as important as what's in front—you need that information so that you can change lanes more easily when there are slow-downs ahead.

Observing the *total* traffic picture will help you anticipate changes and handle a variety of driving situations, comfortably, safely and fuel efficiently.

Going With the Flow

Going with the flow of traffic saves both time and fuel.

When you get in tune with the other traffic and then stay in tune with it, you'll be able to move effortlessly along through it.

And as long as you move at the pace dictated by traffic conditions, your chances of being boxed in by others cars are minimized.

Your ability to control your traffic situation depends on staying out of the pack. Smooth and steady driving is difficult when vehicles bunch up because you have to keep adjusting to the changes and mistakes of the other drivers.

And because you're flowing through traffic, timing your arrivals at stop signs and red lights, your need to brake or to accelerate unnecessarily will be reduced. That way you'll get more miles to the gallon by not making any movements that break up your car's momentum.

Space to Move In

Anyone who wants to drive fuel efficiently will benefit by keeping a buffer of space *all* around their vehicle.

Buffering is Fuel Efficient

Without a buffer of space around your car, it's hard to go with the flow of other traffic, to anticipate changes in traffic conditions, and to react to them. And, when you follow too closely or drive right next to other vehicles, you can't drive smoothly and steadily. You are forced to respond to changes or mistakes made by others. And that's not fuel efficient driving.

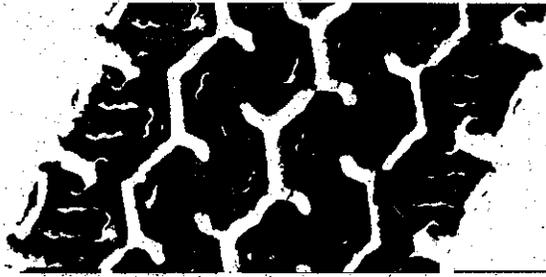
Buffering Payoff

Creating a buffer zone of about two seconds in front (on all sides if possible) pays off in four ways:

- Less tense driving;
- More room to maneuver;
- More of a bargain for safety;
- More time to react to conditions around you;

and you'll conserve your vehicle's momentum, by using the gas you've already invested most efficiently.

Vehicle Selection



Vehicle Selection

Choosing which vehicle to buy is the most important fuel economy decision that you can make—and it's a decision that affects you, as long as you own your car.

The decision is not always easy, either, because vehicle fuel efficiency varies widely—even among vehicles of the same type. Take compacts for example. One currently on the market gets 20 mpg while another of the same style gets 27 mpg.

If you buy the compact that gets 27 mpg, and if you use the 800 gallons of gas a year that most drivers do, then you'll be able to drive 5,600 more miles on that gas than if you had bought the 20 mpg compact.

That's particularly important when you know that, for the next several years:

- Vehicles will continue to need petroleum based fuels to run;
- These fuels will continue to rise in price.

And expecting a technological miracle to solve these problems at some point in the near future is not realistic.

So, unless you have unlimited funds and believe gas will always be readily available, fuel economy must be at the top of your list when selecting a vehicle.

Determining Transportation Needs

Many factors affect your vehicle purchase decision. These include vehicle:

- Style
- Make
- Comfort

- Dependability
- Performance
- Safety
- Economy

as well as others. But if you want to make as wise a vehicle purchase decision as possible, you'll have to ask and answer a few basic questions.

- What are you going to use the vehicle for every day?
- Do the occasional special purpose uses justify the car-life expense?

Once you establish your major use for the vehicle, you shouldn't let occasional or infrequent vehicle needs influence your purchase decision. It just doesn't make sense to pay exorbitant amounts in purchase price, operating costs, or maintenance costs, just to have a particular vehicle available for a "sometimes" use.

And your purchase decision should account for alternatives. The fact that public transportation or that two vehicles will be available should be taken into consideration, too.

The Fuel Economy Framework

With fuel economy considerations providing the framework upon which your vehicle selection will be based, you'll have to look at:

- *Miles driven*—The total miles you drive really influences gas purchase and vehicle operating costs. Usually, a new vehicle runs between 15,000 and 17,000 miles the first year, and the way you can reduce its operating cost is to buy a high-mileage vehicle.
- *Type of trip*—Will your vehicle be used a lot for short trips for family business? Then mpg will

be a major factor. A fuel-efficient vehicle, even under the cold start/short trip handicap will probably get better mpg than a fuel-inefficient vehicle that's fully warm.

- *Number of vehicles*—What transportation needs are met by your current vehicle or vehicles? If you own two vehicles, do they meet different needs? Is one of them more fuel efficient?
- *Common load*—How many people and how much cargo will be carried in the vehicle—every day?

Taking a moment or two to answer these kinds of questions will give you the specifications you need for vehicle shopping. Then apply them when you're looking at vehicle design, weight, engine size and type, fuel efficiency, and option efficiency. Stick by the facts and don't let yourself be persuaded to stray from them because something else is available or it seems like you're getting a good deal!

Once you've found a vehicle that seems suitable, and compared it against your needs, restudy those needs before buying. That way you'll probably be less tempted to buy a car on impulse. Why buy a car that is bigger than you need, more expensive than you can afford, and goes faster than you can drive?

When you approach your vehicle purchase in a "fuel economy state of mind," you're more likely to come out of it with something that's fuel efficient!

Determining Size

Once you've outlined your transportation needs, you'll

have to decide which vehicle size meets them best, or the class of vehicle that meets your everyday needs fuel efficiently. Vehicle class for passenger vehicles is determined by interior size; the class for trucks by gross vehicle weight. And, the classes of vehicles include: two-seater, mini-compact, sub-compact, compact, mid-size, large, small station wagon, mid-size station wagon, large station wagon, small pickup truck, standard pickup truck, van, and special purpose truck.

Then, when you've established what size vehicle you need, review the mpg estimates and comparative information available in the *Gas Mileage Guide*.

Mileage Guide

The most important source of fuel economy information for vehicle purchasing is the *Gas Mileage Guide*. You'll find it to be an essential tool when making fuel economy purchase decisions, and it's available, free by law, at new car dealerships. Key comparative mpg information from the "Guide" for individual cars is also displayed by law on every new car.

How the Guide Helps

Using the *Guide* can help you narrow down the number of vehicles that will meet your needs. And using it can save you time, energy, and gas by eliminating trips to look at vehicles that won't fill your requirements.

What to Expect from the Estimates

Mileage Guide estimates assume that the vehicles are broken in, and are driven in warm, dry weather on level roads. These assumptions (test conditions) are made so that all the tests for all the vehicles are done fairly under exactly the same conditions which are reasonably representative of average driving. Because these assumptions are common to all the vehicles listed in the *Guide*, the relative values for mpg are the most reliable

basis for you to use when comparing vehicles within and between classes. But, you may not get the mileage estimated for any particular vehicle. Any number of factors, including your driving habits, the road conditions you face, the type of trips you make, and vehicle condition, influence your mpg.

MPG Variations

A broad range of vehicles are manufactured to meet a variety of market considerations. So you should study the *Guide* to select vehicles with the highest mpg that meets your other important purchase considerations.

Variations in mpg are considerable. These mpg variations illustrate differences in all vehicle classes based on information in a recent *Guide*.

- *Compact*—130% difference in mpg between vehicles in highest and lowest mpg.
- *Mid-Size*—136% difference in mpg between vehicles with highest and lowest mpg.
- *Large-Size*—100% difference in mpg between vehicles with highest and lowest mpg.
- *Compact vs. Mid-Size*—163% difference in mpg between vehicles with highest and lowest mpg.
- *Mid-size vs. Large-size*—116% difference in mpg between vehicles with highest and lowest mpg.

If a mid-size is indispensable for your travel needs, then select a mid-size from among the most fuel-efficient mid-size vehicles. The *Guide* lists them all—along with their estimated mpg ratings—and, again, there are substantial variations. Some mid-size cars have a mileage estimate of 11 mpg while one of the most efficient gets 26 mpg. What that means to you is that, if both mid-size cars use 800 gallons of gas in a year's time, the mid-size that gets 26 mpg would be able to go 12,000 miles farther than the other mid-size on the same amount of gas!

Specifications for Fuel Economy

When choosing and equipping a vehicle for the greatest possible fuel economy without benefit of the *Guide*, other vehicle specifications, as well as available mpg estimates, must be considered. The major ones include:

- Vehicle weight
- Load
- Aerodynamic design
- Engine size and type
- Vehicle transmission
- Vehicle axle
- Tire selection
- Power options

Vehicle Weight

Vehicle size is secondary to vehicle weight for fuel economy. The more a vehicle weighs, the harder your engine must work to overcome resistance. And when a vehicle is being accelerated, your fuel economy penalty for weight is greatest.

As a general rule, fuel economy is reduced from 1 to 5 miles per gallon for every 500 pounds gained in vehicle weight. And both city and highway miles per gallon decrease as weight increases, although the penalty is especially large in city driving.

Within vehicle classes, there is a wide variety in vehicle weight. Differences of over 1,000 pounds can exist within the same class from the same manufacturer.

Load

That "small is beautiful" is not an inflexible fuel economy maxim. Small cars ordinarily do use less gasoline, ease into smaller parking spaces, and their registration fees, based on weight, may be lower. However, you would do best to choose the most fuel-efficient vehicle that will meet your determined load requirement.

A small station wagon that carries six commuters may have to work so hard that your fuel economy is sacrificed. And if that's the load your vehicle will need to carry often, then a mid-

size station wagon may be your best bet both for good fuel economy (because it can handle the load better), and for comfort, too.

Aerodynamic Design

When considering fuel economy, design is not only a matter of aesthetic preference but is also a factor in air resistance. The smaller the frontal area of a car, the better gas mileage it will get; when air resistance is lowered, fuel economy increases. Tests have shown that for a vehicle traveling at 70 mph, a 10% increase in frontal area will cause a fuel efficiency loss of almost 1 mile per gallon.

When considering the design of an automobile, you must also take into account your travel habits. If most of your driving will be at moderate (45 mph or lower) speeds, the effect of frontal design on gas mileage will be minimal. However, if most of your driving will be at highway speeds, frontal design could be a factor.

Engine Size and Type

Conventional engines are most fuel efficient when operating at a high percentage of full power. Selecting the smallest engine that meets your needs and matching it to your model choice is the best idea. A small engine in a small car is usually most economical, but it's not as economical if loaded down with heavy power options. A large engine in a small car is not a wise choice because you'll use more gas than necessary. So figure on comparing the fuel efficiency ratings of your model choice, and options, with engine size to get the combination that gives you the best mpg. Usually, it's a four-cylinder engine for a small car, a six-cylinder for a large one, and an eight-cylinder for a car that has to carry heavy loads nearly every day.

Diesel or Turbo-Charged Engines

Diesel or turbo-charged engines are other energy-saving alternatives.

While conventional engines rely

on the ignition spark to ignite the fuel/air mixture in the cylinder, diesel fuel is ignited by compression-induced heat. A vehicle powered by diesel fuel is capable of getting 25% or more miles per gallon than an identical gasoline-powered vehicle, depending, of course, upon driving conditions, driver habits, and so on.

Not only does a turbo-charge allow a smaller engine to have the power of a larger engine on demand, but it allows more efficient normal driving with efficient extra power available. In turbo-charged engine operation, extra warm air is pumped into the cylinder, allowing a leaner mixture to be burned efficiently in the combustion chamber.

Vehicle Transmission

It used to be a fairly firm rule that a manual transmission was more fuel-efficient than an automatic. The newer automatic transmissions are lighter, and improvements such as torque converters and lower gear ratios make them more fuel efficient than they used to be.

Lock-up torque converter automatics can be responsible for about a 2-to-6% improvement in fuel economy over conventional automatics.

Other design factors of the newer automatic transmissions are significant, too. On vehicles with automatic transmissions, the level and type of emission controls may be less restrictive than those on standards, and, too, the rear axle ratio may be lower for an automatic. You'll find this to be a real plus. With a lower axle ratio, the engine has to turn the drive shaft fewer times for each rotation of the wheels, and so needs less gas to power the vehicle.

However, at cruise conditions they often consume more for equal performance.

Standard Transmissions

With all other factors being equal, a conventional automatic transmission, when compared to

a standard, can use substantially more fuel. But, an unskilled driver of a manual transmission may consume a greater amount of fuel by stalling the engine, running in the wrong gear, or revving the engine while shifting. So, if you drive mostly in the city, you're not a smooth shifter, and you're not willing to learn to become one through practice, it might be more fuel-efficient to go with an automatic.

Vehicle Axle

The rear axle ratio is defined as the number of times the drive shaft must rotate to turn the wheels one time. A low rear axle ratio is normally more efficient than a high ratio because the engine must power the drive shaft fewer times to turn the wheels once. This allows the engine to turn more slowly at a given speed, thereby reducing engine wear and saving gas.

Don't forget to compare axle ratios when selecting vehicles. Tests have shown that when the rear axle ratio was only 10% lower, vehicle fuel economy improves 2 to 4%. So, the lower the axle ratio—the better the mileage. And, the lower the axle ratio—the less wear on the engines.

Tire Selection

When you buy radial tires you are probably making your most important fuel economy purchase decision—aside from your selection of the basic vehicle itself. Radial tires can provide a substantial 3 to 7% improvement in your mpg over conventional bias ply tires in highway conditions. This factors out to about 2- to 3-cents per gallon.

Radials are built to minimize rolling resistance. And, while they may cost more than other tires, they tend to last twice as long and help improve vehicle handling. And, if you get twice the life out of your radials, that means that you can eliminate a trip to buy tires, too!

Power Options

Power options will increase your

vehicle's power requirements in two ways: By using power themselves, and by adding weight. Power accessories—windows, seats, roofs, door locks—are energy-consuming items which can be eliminated. Power seats and windows are heavy, so it takes extra gas to use them and to carry them around.

If you own a small car, power options will penalize your gas mileage even more than on a larger car, because the added weight is an added strain. Most power options are not needed on a small car. Power steering is usually considered a non-essential item.

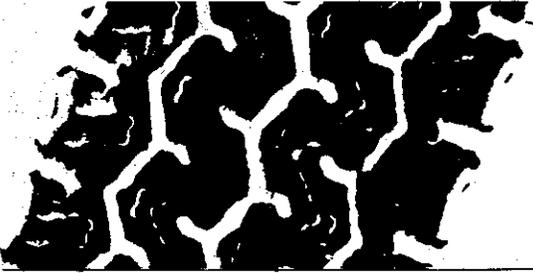
If you want "something extra" choose luxuries like super sound equipment or plush leather seats that add to your enjoyment without subtracting from your mpg!

Air Conditioning

Some air conditioning units can add as much as 100 pounds of weight to a car. They also need power to drive the compressor and fan. And in city driving, this can cause a 1-3 mpg reduction in fuel economy.

Designers are creating more efficient air conditioning equipment all the time, so the penalties aren't what they were. It's how

you use the air conditioner that makes the difference. It doesn't have to run all the time. And it doesn't have to run full blast. In fact, it may be more efficient to use air conditioning at certain times. Driving on the highway with your windows open increase the amount of resistance your car has to fight. So the drag caused by open windows will cause a mpg loss. But when the windows are closed and the air conditioning is being used moderately, your penalty will probably be no greater than if the windows were open. So, selecting an air conditioner has a lot to do with your driving situation.



Regular vehicle maintenance not only helps you prevent breakdowns, but it is an important aspect of fuel economy and driver safety. So your one investment can pay off in a couple of ways!

How do vehicles maintained for fuel economy offer a margin of safety for normal and emergency driving situations?

Well, a well-tuned vehicle is less likely to fail the driver after a cold start when entering the traffic flow. And it's those same tires (that you made sure were inflated properly for good fuel economy), that help you hold your vehicle in turns, stop on wet pavement, and grip the road's surface when you have to maneuver quickly to avoid a collision.

If you want to benefit from fuel economy savings, you'll have to be willing to spend on some areas of maintenance. But, there are many areas of maintenance where you can save money—and without investing a penny to do so! Many maintenance tasks for fuel economy are simple to do, and can be done with little or no cost to you.

Tires and Fuel Economy

The rolling resistance of any tire is greatly increased if it's not inflated properly. And, as rolling resistance from under-inflation increases, a fuel economy penalty is paid. You can expect a fuel economy loss of 1% for every two pounds your tires are below their *recommended* pressure.

What Tire Studies Tell Us

Studies have shown that *many drivers fail to keep their vehicle tires inflated to the maximum recommended level*. And while

these studies have resulted in different findings, all make the same point: that vehicle owners should be more concerned about proper tire inflation.

Findings from studies and surveys indicate that:

- About 25% of the cars examined had at least one tire four pounds below the recommended level.
- About 80% of the vehicles checked had tires that were either over- or under-inflated by two or more pounds.

Determining the Right Pressure

Determining the recommended pressure for your tires is not difficult. The recommendation for tire inflation is expressed as a range of pounds for each tire. And that information appears on your tire's side wall, as well as in your owner's manual. But making sure your tires are inflated to the minimum level of the range isn't enough. Real fuel economy comes from maintaining their pressure at the highest level of the recommended range. So if your range is, say 24-28 pounds, keep your tires at 28 pounds!

Tire Checks

Check your tire pressure during your pre-drive and service routine. It won't take much time or effort, and it will really pay off.

- When approaching your vehicle, glance at the tires, looking for those that appear low.
- At least once a month, check your tires with a good tire gauge.
- Check troublesome tires (those that seem to lose air) more frequently.

And check your tires *before*

driving. Tire pressure increases with the heat produced from driving, which can give you a high reading.

Tire Tips

All drivers will want to keep these tips in mind:

- All vehicle tires should be properly inflated.
- Proper inflation for fuel economy means inflating tires to the upper level of the recommended range.
- Incorrect inflation also causes unnecessary tire wear, and affects vehicle handling.
- Tire wear and vehicle handling is also affected by *just one* low tire.
- Under-inflated tires impose a fuel economy penalty.

A Balanced Vehicle Diet

For the best price and fuel economy:

- Only buy the octane level gasoline your vehicle needs.
- Use the new high mpg motor oils.

Gas Selection

Some drivers feel that they can keep their vehicle running better by using high octane gas. But using a higher octane gas than you need *does not* improve a car's mpg, and may actually decrease it, nor does it make up for a lack of maintenance.

Octane levels are usually displayed on the pump and the correct level for your vehicle should be listed in your owner's manual. A practical guide, however, is to use an octane level just high enough to prevent engine knocking or pinging during normal driving conditions or engine "run-on" when you

turn the engine off. But using a higher octane gas, in no case substitutes for keeping your vehicle tuned.

If, after an engine has been properly tuned, your car continues to knock, it may need a higher octane fuel. This does not necessarily mean buying premium fuel, just a higher level octane than you normally use.

Oil Selection

Engine oil can also make a difference in your fuel economy.

An engine oil that is too thick will resist flow and increase friction among engine parts. And the more resistance your engine must overcome, the more gas you will have to use. So it's wise to use a multiple viscosity oil such as 10-40 or 10-50 oil which changes thickness to respond to temperature changes.

Newer synthetic oils, designed to improve mpg, are also available. While many factors influence a vehicle's mpg, reports indicate that these high mileage oils may improve mpg as much as 3 to 5%.

Maintenance Checks

You can prevent costly repairs by making some simple maintenance checks on your vehicle, which can help save you a little gas at the same time. They may cost you a few dollars now, but they can save you *many* dollars later. A quick glance at your owner's manual can show you which checks to make.

Anyone can check the fluid level in the battery or radiator. Checking and maintaining the oil level, brake and transmission fluids, and keeping the air filter clean are easy to do.

And while electrical wires and spark plugs may be more difficult to inspect, they shouldn't be ignored. So look for loose, worn or broken parts or other problems. And while you're at it, check for loose or frayed belts and look at their undersides for cracks. All hoses should be checked for leaks as well as for signs of general

deterioration. Finally, leaks can often be detected by checking the ground for stains where you regularly park your vehicle.

Tune-Up Requirements

A tune-up merely means everything is adjusted properly and that your engine adjustments are synchronized. If your vehicle is in tune and running well, then it will help you get your best mpg.

Certain tune-up requirements are *absolutely* critical to the fuel efficient operation of your vehicle. But unless you are mechanically knowledgeable, these adjustments are probably best left to a skilled mechanic.

Tune-Ups Pay Off

A simple tune-up can improve your vehicle's fuel efficiency anywhere from 4 to 12% in most cases. For a vehicle that has been badly neglected, a tune-up can improve mpg by at least that much!

Tune-Up Requirements

The suggested schedule of tune-ups for your vehicle is discussed in your owner's manual. Of course there will be times when your car won't need a complete tune-up. And if your car is running well and has no apparent problems, you should probably leave it alone (aside from routine care).

Tune-Up Cost

If you want to keep your maintenance costs as low as possible, only have apparent problems fixed. The conventional notion of a tune-up as a cure-all for everything is unrealistic—and can be expensive!

If you're unsure of the exact problem, it would be wiser to take your car to a diagnostic center. That way you'll avoid paying for unnecessary adjustments. Of course, there will be times when a complete tune-up will be necessary. But the diagnostic test will indicate that, also.

The following major tune-up items contribute to your fuel economy:

Adjust Idle

The faster your idle speed, the more gasoline your vehicle consumes. This is true not only when your car is standing, but whenever you release the gas pedal and allow your engine to idle.

To maximize your fuel economy, the idle on your car should be set just high enough for the engine to run smoothly, according to manufacturer's recommendations.

Adjust Air/Fuel Mixture

The air/fuel mixture affects the quality of a car's emissions as well as fuel economy. This air/fuel mixture should be adjusted to the manufacturer's specifications so that neither excess fuel (rich mixture) nor excess air (lean mixture) will be present in the combustion chambers. A mixture which is too rich will lower the fuel efficiency of the combustion while a mixture that is too lean could cause engine damage or complete combustion failure.

Adjust Timing

Your engine will operate most efficiently when peak combustion pressure is reached, just after your piston passes the top dead-center position (TDC). To achieve this, the fuel/air mixture must be ignited before TDC. If the spark arrives at a cylinder just 5° too late, your efficiency will be reduced enough that you can lose as much as 1 mile per gallon. To avoid this, the timing of the spark must be set according to the manufacturer's specifications.

Adjust Points

The contact points in the distributor control the strength and timing of the spark arriving at each cylinder. If your vehicle is troubled with inefficient firing, and/or a subsequent fuel economy loss, then your points might be worn or they're adjusted incorrectly.

The dwell angle of each ignition point (the angle of rotation the points are when closed) must be adjusted so that a spark of

adequate strength arrives at the cylinder. Many newer vehicles do not have points and don't usually require adjustment.

Clean and Adjust Plugs

A spark plug that is fouled, improperly gapped, or defective can cause a fuel economy loss that is not always detectable in normal driving. For this reason, it's to your advantage to keep gas mileage records. Careful records could reveal such a problem.

Plugs should be regularly inspected, cleaned, and the ground (side) electrode should be bent (gapping) to the setting recommended by the manufacturer.

Clean the PCV Valve

The PCV (positive crankcase ventilation) valve monitors the amount of crankcase fumes which flow into the intake manifold. The system circulates a current of clean air through the crankcase which helps remove combustion by-products while recirculating crankcase fumes for more complete combustion. If the PCV valve becomes clogged, it will unbalance the combustion mixture. And the result is poorer fuel economy and emissions. So, it is important for you to check (just shake and listen, it should rattle sharply) and periodically replace your PCV valve.

Testing for Efficiency

There are several signs and tests which can be an indication that your vehicle needs a tune-up. If your mpg has started to slip gradually, a tune-up could be the answer. But make sure this decrease is real. Don't just act on the mpg from one tank full of

gas! Variations in mpg can be expected with each tank because surface angles vary at each pump, and there are differences in how *full* is full. And—before you decide on a tune-up—check your tires. Low and/or uneven tire pressure in some vehicles can penalize your mpg as much as if your engine needed a tune-up. The following are some ways to test your car for proper operating conditions.

The Drive Test

Your engine should perform smoothly and be responsive in normal driving situations. If your vehicle is sluggish, *or* sputters *or* coughs, *or* hesitates when accelerated, *or* if your vehicle idles roughly, then it's probably tune-up time.

The Warm-Up Test

A tuned car should pull away—without stalling—after only a 30-second warmup. If your car doesn't pass this simple test, it probably needs some tune-up adjustments.

Diagnostic Test

In order to pinpoint specific problems, a vehicle may need to be taken to a diagnostic center. There, a series of tests can be performed on your vehicle so that unnecessary repairs may be avoided. By learning the problems *before* taking in your vehicle to be serviced, you can give the mechanic some real guidance.

Maintenance Schedule

Maintaining the proper tire pressure, buying the right octane gasoline, and using a high mileage oil help you get the best mileage from your car. And they're not really difficult things

to do, either! Planning maintenance according to the manufacturer's suggested schedule will help ensure good gas mileage and reliability over the life of your car.

Periodic Checks

It's wise to plan your long range maintenance as well as make periodic checks of your vehicle's condition. Periodic maintenance checks will help keep your vehicle in its most fuel efficient operating condition.

Frequency of Maintenance

The frequency of your maintenance depends on your driving habits, road conditions, and what kind of vehicle you own. A car driven on rough roads or under adverse weather conditions will require more maintenance than another car driven under more ideal conditions. Some cars, because of engine design, need more maintenance than others. You have to consider your car as an individual—and treat it that way.

Records Talk

Keeping vehicle maintenance and gas mileage records will help you judge your car's needs. And these same records will tell you just how much you are saving on gas, too.

Your Expectations

In the final analysis, many factors determine how much your car's maintenance will cost you. Included in those factors are your *own* expectations. If you want better safety, more gas mileage, more for your trade-in, and more life out of your car, you may have to tune and adjust it more frequently. Good care will definitely show in the long run.



Text provided by:
U. S. Department of Energy
Office of Conservation and Solar Energy

DECAT

Driver Energy Conservation Awareness Training

RESOURCE DIRECTORY

Program Administrator and Instructor

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Nebraska Energy Office
P.O. Box 95085
Lincoln, NE 68509
(402) 471-2867

Coordination of DECAT Program for the State Of Nebraska, Program Information, Literature, Audio-Visual Information, Certificates, 2 Training Vehicles

DECAT Coordination for Law Enforcement Officials

Lt. Robert J. Buchholz
Nebraska State Patrol
P.O. Box 94907
Lincoln, NE 68509
(402) 470-2404

Program Information, 1 Training Vehicle, Training Facilities

DECAT Coordination for Driver Education Instructors

A) Dr. Floyd Krubeck
Nebraska Safety Center
Kearney State College
Kearney, NE 68847
(308) 236-4256

College Credit, 1 Training Vehicle, Test Track, Training Facilities, Additional Contacts: Richard Ashman and Sherry Morrow

B) Larry Vice
Educational Service Unit #3
4224 So. 133rd
Omaha, NE 68137
(402) 330-2770

1 Training Vehicle, Training Facilities

An Operating DECAT Program

Kenneth Rittgarn
Lincoln Electric System
2620 Fairfield
Lincoln, NE 68521
(402) 473-3161

Provides DECAT Instruction for LES Employees, 5 Instructors, 3 Training Vehicles, Additional Contact: Mike Petersen (402) 473-3435. Feel free to approach for referrals and experience information.

DECAT Program Development (under Contract with U.S. Department of Energy)

Boris Hubar
Reynolds Electrical & Engineering Co., Inc.
P.O. Box 14400
Las Vegas, NV 89114
(402) 986-0734

Technical Assistance, Program Resource & Information, Audio-Visual Material, Additional Contacts: Elton Brakhane, Val Smith and Jim Hansen

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U.S. Department of Energy
Washington, D.C. 20585
(202) 252-8003

Technical Assistance, Program Resource & Information, Audio-Visual Material, Additional Contact: George Chaconas (202) 252-2302

Equipment Suppliers

A) Floscan Instrument Company, Inc.
3016 N.E. Blakely St.
Seattle, WA 98105
(206) 524-6625

Model 660 Fuel Economy Meter (Specify: gallons to .001)

B) Marshalltown Instruments
Box 400
Marshalltown, IA 50158
(515) 752-9299

Vacuum Gauge (2" or 2½"; Model 22 KC)

C) Vilem B. Haan, Inc.
7531 Coldwater Canyon
North Hollywood, CA 91605
(800) 423-2334

Halda Tripmaster Odometer (Specify vehicle & type of connection)

This listing of equipment suppliers reflects contacts made in developing the Nebraska DECAT Program, and is by no means a complete list of suppliers of similar acceptable products. The Nebraska Energy Offices does not warrant or guarantee any products or systems as to quality, safety, durability, or performance, nor does it certify the accuracy or validity of the information provided regarding products or systems.

Other Ideas for:



from the Nebraska Energy Office

16-mm Films:

- Running On Empty
- Vanpooling
- Who Cares?
- Why Should I Care?

Slide Sets:

- A Better Way
- Routes To Fuel Economy

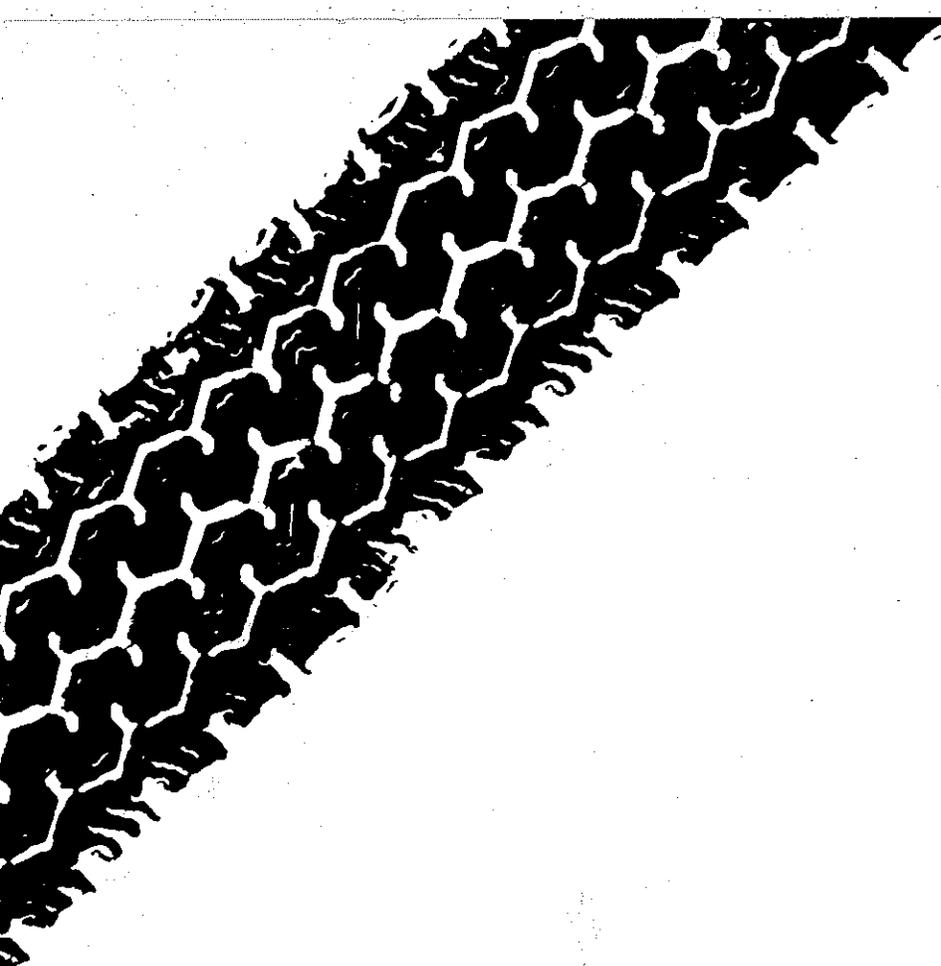
Publications:

- MPG Kit — More Miles Per Gallon
- "Import 2 Less"
- Transportation Portfolio
- Gas Mileage Guide
- How To Save Gasoline And Money
- Your Way To Better Fuel Economy
- Get The Most From Your Drive And Energy — CARPOOL
- Driving Alone May Cost You More Than You Think
- COMMUNITY RIDESHARING: A Leadership Role
- COMMUNITY RIDESHARING: An Easy Way To Save Energy And Gasoline
- Rideshare and Save: A Cost Comparison
- Energy Conservation In Transportation
- VANPOOL
- Vanpool Implementation Handbook
- How Ridesharing Can Help Your Company
- 55 Saves
- Driver Attitude
- Trucker's Guide To Fuel Savings
- Driver Energy Conservation Awareness Training
- A Proposed Standby Plan For Gasoline Rationing

- Grain Alcohol — Fuel From The Farm
- Nebraska Gasohol Directory Of Service Stations

Additional Information:

- Nebraska Department of Roads
Box 94759
Lincoln, NE 68509
—Derald S. Kohles
Planning Engineer
(402) 473-4519
- Federal Highway Administration
100 Centennial Mall North
Lincoln, NE 68508
—Milo Cress
Division Bridge Engineer
(402) 471-5524
- Fuel Availability Travel Information
Out-of-State: (800) 228-4307
In-State: (800) 742-7595
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