Double Mileage Guaranteed!

Part 1: Why and How Double Mileage is Possible (Version 140310)

Please forgive the crudity of this document and supporting videos.
I'm on a year long sabbatical working on a Brown's Gas project and currently 2500 miles from my 'fuel saving' reference materials and other resources.

I'm making this document / videos **now** because I'm currently in a discussion with mechanics who want to understand why and how double mileage is possible.

So I'm using the limited resources I have available to me here and now to **reveal the key details** any mechanic would need to know to understand **that double fuel mileage is possible, practical** *and has been achieved thousands of times over the last century*.

Enjoy reading and **please do comment**. I'm always ready to learn from my mistakes and I'm open to suggestions for improvement.

You can email me at
http://www.eagle-research.com/cms/contact

I apologize in advance that the 'links' in this document are not directly clickable. The document instead takes you to its associated 'online Resources' where there is a page of the 'clickable' links. *This allows us to change links (and add corrections) so that you always get the latest information*.

To access the clickable links you need to log into your Eagle-Research account (see Eagle-Research.com webpage page sidebar) and go to here:
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I'll be upgrading this document over time; so do check here to see if you have the latest version.
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READ THIS FIRST

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2. This eBook is a direct electronic representation of the physical book, therefore, it is not optimized for viewing on a computer screen. You'll need to scroll up and down to read the columns. We kept it this way to allow reference, to exact locations in all versions, when answering questions or addressing corrections.

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Introduction

Unfortunately, before I can tell you how to double your fuel mileage by increasing combustion efficiency, *I first need to prove why it's possible*.

We will not be talking about hypermiling, drivetrain configurations, engine modifications or any of the dozens of ways to increase mileage by lowering wind and/or rolling resistance.

All those efficiency upgrades are complementary to increasing combustion efficiency. *It's a good idea to do them* but they are detailed elsewhere.

This presentation will concentrate on the primary area of ***inefficiency***, which falls under the category of '*Thermal Efficiency*'.

I'll present easy to understand fuel system changes that can bring significant mpg gains, while reducing pollution and increasing engine life.

Existing technology throws most of gasoline's potential energy away as heat without powering your engine. You may be pleasantly surprised when you learn how easily Thermal Efficiency can be dramatically increased.

I'll be walking you, step by step, through the information that we (mechanics) are taught, showing you where the inconsistencies are, so you can KNOW that doubling fuel mileage is only the beginning of the potential gains to be had.

You'll learn that while our education system did teach you some truths *and certainly enough to repair existing technology*, it did not teach you the WHOLE truth you need to increase the efficiency of internal combustion.

I won't harp on it here, so just be aware that I'm exposing a conspiracy so grand that it boggled my mind. f I didn't have actual proof and decades of experience, I simply would not have believed it and I'm certain that you would feel the same way.

I've arranged this information so that you can prove FOR YOURSELF that:
1. You (I and all mechanics for the last century) are taught SOME truth but not the WHOLE truth.

2. That the Vested Interest is USING us (mechanics) to unwittingly help them propagate a century+ long conspiracy.

3. Double Mileage can be achieved by any mechanic, in any garage.

The KEY to double mileage is simply knowledge.
The infrastructure and resources to do it have existed for a century.
Mechanics *already have the tools and skills to achieve high mileage once they know HOW*.
4. This is Part 1: Why and How Double Mileage is Possible!

In future Parts I'll explain some *practical* Thermal Efficiency (mileage) increasing techniques so you can Do-It-Yourself (DIY).

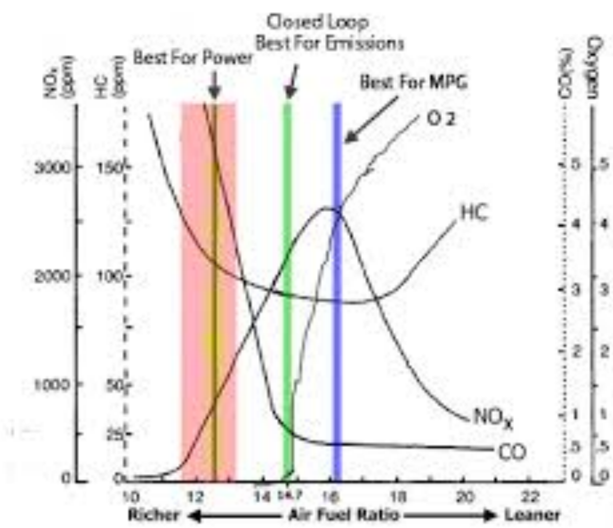
Many innovators are currently trying to apply vapor fuel techniques, but without understanding the issues involved they don't achieve the gains they should; and/or they don't have a practical (drivable) system.

5. Once you've achieved double mileage for yourself, you'll see how easy it'll be to make money upgrading customer vehicles.

Stoichiometric AFR

This is where the Vested Interest Myth-Direction starts…

Please have patience as I mention things you already KNOW first, because that's how I set the stage to point out the things you may NOT know.



We (mechanics) are taught:

1. That 14.7:1 is the stoichiometric air:fuel ratio for gasoline (each fuel will have it's own stoichiometric ratio).

The reasoning being that, at this ratio, there is an exact balance of molecular constituents to make a complete and balanced combustion.

2. That 12.6:1 is the optimum air:fuel ratio (AFR) for power and

3. That 15.4:1 is the optimum AFR for best fuel economy.

4. That (unless the engine is specifically engineered) mixtures leaner than 17:1 will not properly combust in an internal combustion engine.

5. That even 'slightly' leaner mixtures WILL cause high exhaust temperatures and incomplete combustion. We are taught that as we lean from 14.7:1, that the exhaust gets hotter, the exhaust constituents show less CO2, more HC, CO, and NOx.

The 'problem' is that all the above seems perfectly true in theory and, as we (mechanics) work with fuel everyday, we find it to be '*true in practice*'.

These AFR 'facts' are not only what all mechanics (including myself) are taught, it's also what all our testing equipment and experience tells us is true!

*But what if I can show you how to achieve **double fuel mileage** on virtually any vehicle without having exhaust temperatures rise (no engine damage whatsoever) and emit practically zero pollution (HC, CO and NOx)?*
Would you be interested in knowing how to do that?

The first thing to understand is that the *stoichiometric AFR chart* is not really relevant for INTERNAL combustion, as you will soon learn…

Note that I'm making a distinction between:
1. '**Stoichiometric AFR**', where the Air:Fuel mixture is defined to be 14.7:1.
2. '**Mass AFR**', where all the Air:Fuel mass that goes into an engine is measured to calculate Thermal Efficiency.
3. '**Actual AFR**', where we only count the fuel that could actually be converted into power (*you'll understand more about this as we proceed*).

To get the 'Actual AFR' we can't depend on our usual diagnostic equipment that is calibrated to assume 14.7:1 AFR. *Let's go gather some actual RAW data and do the math manually…*

Modern technology has made it possible to calculate *actual AFR* for most vehicles that have an OBDII port.

You can buy an 'OBD II reader' like the Scan Gauge http://www.scangauge.com/

A Scan Gauge will tell you simultaneously the: RPM, GPH, MAP and IAT.

Make sure your Scan Gauge MPH matches your vehicle speedometer at 60 MPH (if it doesn't, you can calibrate the Scan Gauge (also check with GPS).

You also need to set your engine displacement and run a few tanks of fuel through your vehicle, so you can calibrate your Scan Gauge, so its estimated fuel usage and your actual fuel usage match.

Then set the Scan Gauge for RPM, GPH, MAP, IAT and go for a drive on a flat road with no wind. Once you are holding a steady speed (I choose 60 mph using the vehicle's speedometer), simultaneously record the RPM, GPH, MAP and IAT.

See this video of me using the Scan Gauge to find real world *RAW data* using my wife's 2008 Aveo 5, which has electronic fuel injection. Engine E-TEC II, 1.6 L (97.638 cu in) DOHC I4 – with 5 speed manual transmission.
http://www.youtube.com/watch?v=qcpm5k_OSJk

Finally, go to your local weather station (I could access mine online) and get your local weather report (you need this to calculate Volumetric Efficiency). You'll need local temperature, pressure (hPa or mb) and air humidity %. My current local weather is here: http://pentictonweather.co.nf/

Current Conditions

Updated: **9:33 on 2/18/14**

Currently: 1.9°	 mostlycloudy	High: 2.2° (9:07) / Low: 0.3° (6:34)

Wind:	0 km/hr from the SSW
Wind Gust:	0 km/hr
Today's High Wind:	0 km/hr (0:00)
Humidity:	66%
Barometric Pressure:	1009.5 mb (Falling)
Pressure Rate:	-0.89 mb/hr
Dew Point:	-3.7°
Wind Chill:	1.9°
Today's Low Wind Chill:	0.3° (6:34)
Comfort Level:	Cool
Temperature Change Rate:	0.09°/hr

I traveled on a flat road with calm wind on the morning of February 18, 2014. I used a Scan Gauge (previously calibrated).

The Aveo 5 recorded at 60 MPH on a flat road, alongside a large lake:

8.9 MAP (intake manifold absolute pressure in psi) = 613.63 hPa
39°F IAT (intake air temperature) = 3.89°C
1.76 GPH (gallons/hour)
2630 RPM

The weather station tells me: there's no wind, 1.9°C, 1009 mb (barometric pressure), and 66 % humidity

Volumetric Efficiency Calculation:

Before calculating your *actual AFR*, you will need to know your engine's Volumetric Efficiency at the testing conditions. *This will allow us to calculate the air mass for the AFR*.

Volumetric efficiency is the measurement of how much air mass actually gets into your engine's cylinders compared to the theoretical air mass the engine could displace.
Any engine has a set volume (displacement) that can be calculated. Most engines will not generally get the full air mass available because restrictions, *like the throttle plate*, lower the intake manifold absolute pressure (and thus mass) of the air being sucked into the engine.

The below calculation will help you find your actual Volumetric Efficiency.

Convert the Scan Gauge readings to the same scales as the local weather measurements, so you can calculate the Volumetric Efficiency ratio.
I've included some conversion calculator links to assist you.

Convert MAP psi to hPa with pressure conversion calculator
http://www.sensorsone.co.uk/pressure-units-conversion.html
Convert °F to °C
http://www.wbuf.noaa.gov/tempfc.htm
Calculate ambient air density using temperature (°C), barometric pressure (hPa or mb) and humidity %.
http://www.brisbanehotairballooning.com.au/faqs/education/116-calculate-air-density.html

Intake manifold = 3.89°C, 613.63 hPa, 66% humidity = 0.7691 kg/m3
Local ambient = 1.9°C, 1009 hPa, 66% humidity = 1.2758 kg/m3
0.7691 / 1.2758 = **0.60 = 60% Volumetric Efficiency**

Convert kg/m3 to lb/ft3
http://www.engineeringtoolbox.com/density-converter-d_1038.html
1.2758 kg = 0.0796 lb/ft3 weight / density of local ambient air.

The actual AFR calculation:

$$AFR = \frac{m_{air}}{m_{fuel}}$$

1. We multiply 97.638 ci * 0.60 (volumetric efficiency) to get the actual air volume sucked in per engine displacement = 58.58 (cubic inches).
2. We divide 2630 rpm by 2 to get the actual intake displacements per minute = 1315.
3. We multiply 58.58 (actual air per displacement) * 1315 (intake displacements per minute) = 77032.7 (cubic inches of air per minute).
4. We multiply 77032.7 * 60 (minutes) = 4621962 cubic inches of air per hour.
5. We divide 4621962 by 12 by 12 by 12 to get 2674.75 cubic feet of air per hour.
6. We multiply 2674.75 * 0.0796 (local ambient density of ft3 of air) = **212.91** lbs of air per hour.
7. We multiply 1.76 (GPH) * 6.073 (weight of US gallon of gasoline) = **10.69** lbs of fuel per hour.
8. Finally, we divide 212.91 by 10.69 to get **19.92:1 actual AFR**.

Yes, I know that fuel mixtures vary all the time from 'rich' to 'lean' and lean is leaner than 14.7:1, but check the AFR charts... They'll tell you that gasoline will NOT combust properly at 20:1 unless ‘lean burn' technology is used.

I assure you the 2008 Aveo 5 doesn't have any kind of 'lean burn' technology installed; it *is 100% stock at the time of this test*.

I've heard of AFRs of 60:1 with ‘extreme lean burn’ technology (see Wikipedia) but doesn't that just further make my point that it is well known that gasoline *can be burned ‘oxygen rich’ and still produce power*?

My point is, that vehicles are ALREADY burning leaner mixtures that ‘officially’ admitted! And that you can prove it for yourself!

This ‘incomplete’ understanding of stoichiometric AFR compared to actual real world AFRs is the first example of a truth that mechanics are not taught. Our testing equipment is calibrated to ‘assume’ stoichiometric AFR, so we aren’t surprised to see the copious fuel consumption. **Because of our training, we (mechanics) ‘assume’ that much fuel is NEEDED!**

Unused fuel didn't power the vehicle!

This 20:1 AFR includes ALL the fuel put into the engine, *including the fuel that didn't burn and came out in the exhaust…*

While this 'wasted' fuel is included when calculating 'mass AFR' to determine Thermal Efficiency, we are trying to calculate the 'actual AFR' that powered the engine, so *isn't it fair to subtract the fuel (HC and CO) that was ejected from the engine unburned*?

In an 'excellent combustion' vehicle's exhaust, this unburned fuel makes up quasi 6% of the input fuel... (ref: Ice_handout2.doc page 15)
0.5% HC, fraction input energy exit in exhaust = 0.0417
0.5% CO, fraction input energy exit in exhaust = 0.019 = 0.0607 or about 6%

1. We multiply 1.6544 (1.76 GPH - 6% exhaust weight removed) * 6.073 (weight of US gallon of gasoline) = 10.05 lbs of fuel per hour.
2. Finally, we divide 212.91 by 10.05 to get **21.19:1** actual AFR.

So if I had near perfect combustion, my ACTUAL AFR would be **21.19:1**!

This is with the engine under load, driving normally at 60 mph!

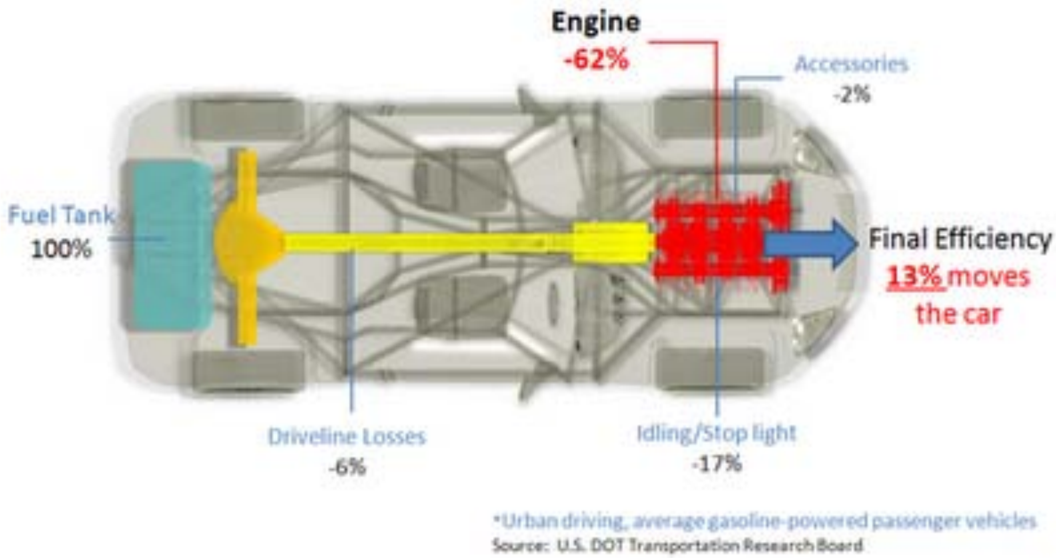
No one thinks to teach mechanics to subtract the 'unburned' fuel from the *total fuel mass to calculate actual AFR*.
While this revelation isn't earth shattering, it is another of the inconsistencies between what we mechanics are taught and **actual fact**.

Note: In most vehicles the unburned fuel can be (usually is) much greater than 6% and this 6% is post-catalytic converter, so this engine's unburned fuel % is inaccurate because some of the fuel exhausted from the engine burned in the catalytic converter (making the combustion seem more efficient that it actually was).

If you subtract ALL the unburned fuel (pre-catalytic converter), *you'll find the **actual AFR** go ever more '**lean**'*.

WHEN the fuel combustion is vital!

Fuel mixtures could be MUCH leaner, even without ‘conventional’ lean burn technology.



Engineers KNOW every place energy is lost, and the largest area of loss is the 62% heat that is NOT turned into mechanical energy. This heat is dissipated into the engine oil, coolant and exhaust.

Just because the fuel burned in the engine, or on it’s way out of the engine, (or in the exhaust system), *doesn’t mean the fuel actually (efficiently) powered the engine*.

This is another example of truth that is taught, but not the complete truth.

THIS is the place where **Thermal Efficiency can be significantly increased**; *if you know the complete truth*.

Thermal Efficiency is the ratio of converting potential heat energy (exothermic energy of fuel combustion) into mechanical (kinetic) energy.

A 62% inefficiency (heat lost) is the same as claiming that only 38% of the potential heat energy was converted to mechanical energy.

Let’s examine the actual situation…

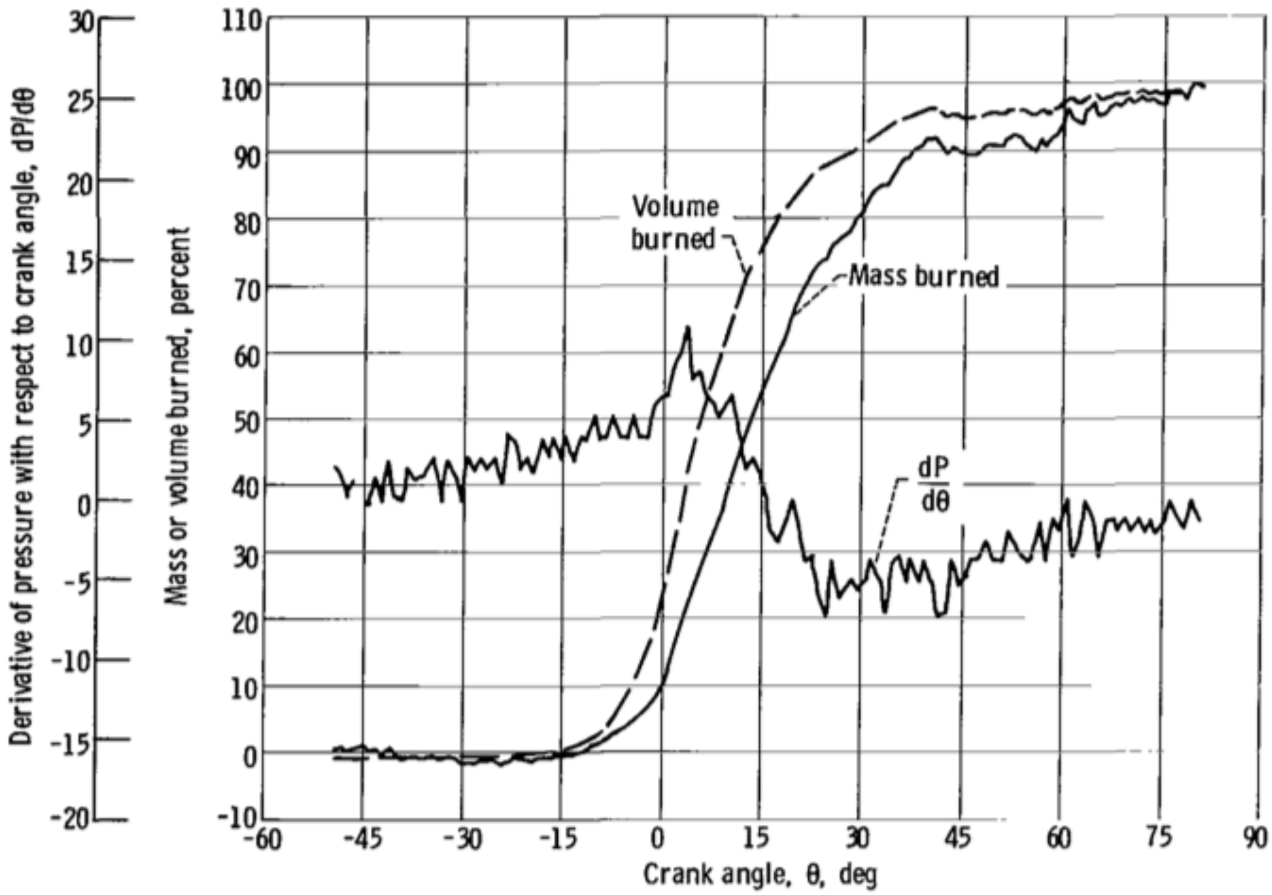


Figure 4. - Computer output showing percentages of mass and volume burned and derivative of pressure with respect to crank angle for gasoline-air combustion at equivalence ratio of 0.82.

1. Any fuel that burns before top dead center (BTDC) creates ‘negative’ energy. Fuel burned during this time provides pressure that fights the upward movement of the piston on the compression stroke. This is generally assumed to be 5% to 10% of the fuel.

You do recover some of that energy because the pressure is still there to push the piston down once it goes past TDC.

Ignition is BTDC because it takes time for the combustion process to start. *If you have a faster burning fuel, you should retard the ignition toward TDC.*

2. It is known that the most thermally efficient combustion happens between 10° and 20° after top dead center (ATDC). This is the time that pressure (caused by heat) is most efficiently converted to mechanical energy. This is usually considered to be about 50% of the fuel mass.

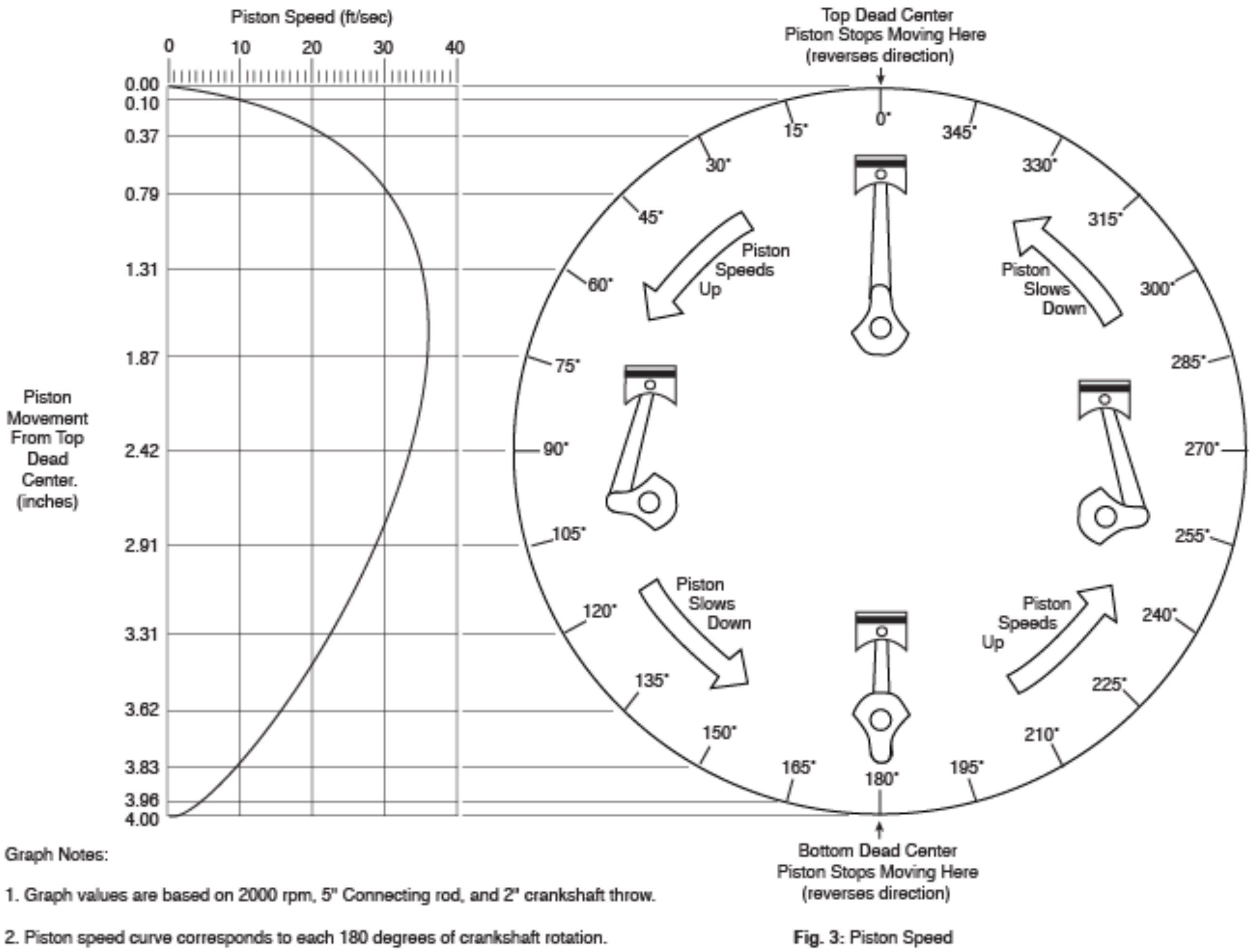


Fig. 3: Piston Speed

3. Fuel that burns 20° ATDC is mostly wasted because:
a. The piston is now accelerating away from TDC, lowering thermal efficiency http://www.camotruck.net/rollins/piston.html

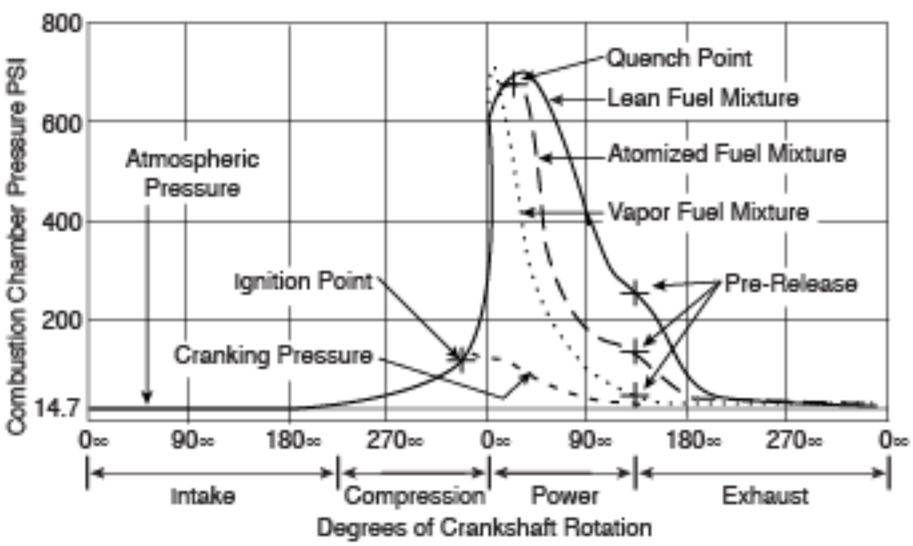


Fig. 8a: Combustion Chamber Pressures

b. The increasing cylinder volume is lowering actual pressures (pushing on the piston) and
c. The combustion is being quenched (by 'excess fuel' vaporizing to make a 'rich' mixture) to prevent high temperatures flowing out the exhaust.

The 'post 20° combustion' is about 45% of the fuel mass.

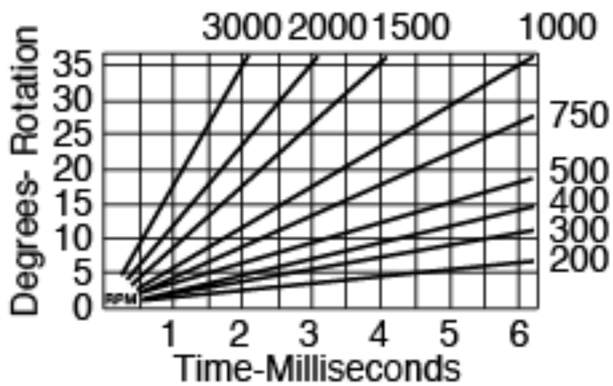


Fig. 4: Relation of time and degree of crankshaft rotation for various rpm.

Depending on RPM, the thermally efficient combustion 'window', where the combustion heat energy can be efficiently converted into mechanical energy, is only about 7 milliseconds.

The ideal situation would be to have a fuel that will completely combust in those 7 milliseconds, so you can have ignition retarded as close to TDC as possible (to minimize negative energy) and then have the combustion complete by 20° ATDC, allowing the gasses to 'cool' by expansion as the piston flies downward.

ONLY fuel that is already in a vapor state when the spark plug fires can completely combust that fast.

So, if we could completely burn the fuel at exactly the right time and ONLY the right time, **we could reduce fuel consumption by at least 50%** without affecting power or performance and the exhaust emissions would drop to near nothing.

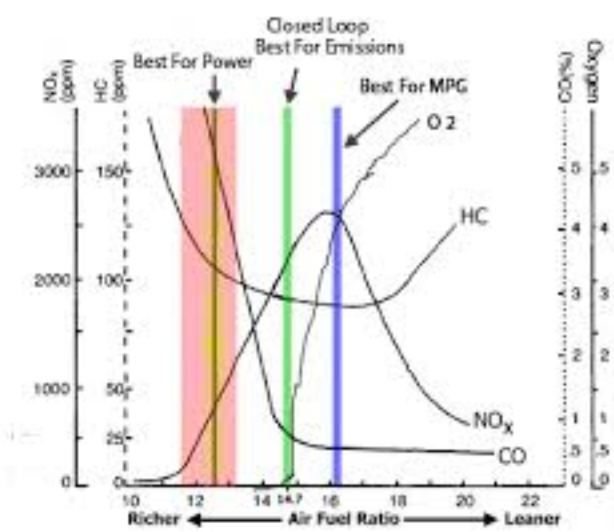
This is another example of information that was not deemed important enough to teach to us (mechanics)… ***Or maybe it was too important?***

Note: What do you think happens to the AFR when the fuel consumption is cut by at least 50%... While maintaining full power / performance and decreasing both exhaust temperature and all pollutants?

If fuel was being burned ‘efficiently’ in the 2008 Aveo 5, the (total mass) AFR would be over 40:1 and we’d be achieving 70+ mpg.

Total mass AFR should pretty much match *actual AFR* because there’d be NO fuel coming out the exhaust and all (or most of) the fuel will have combusted at exactly the right time to maximize Thermal Efficiency.

Ambient vs. Pressurized Combustion



The main reason that external combustion AFR technology (as per stoichiometric AFR chart) isn’t directly applicable to internal combustion engines, is that internal combustion engines COMPRESS the mixture, which among other factors, move all the AF molecules closer together, allowing leaner mixtures to be efficiently burned.

We (mechanics) are **NOT** taught that we can completely burn gasoline in extreme ‘lean’ mixtures, IF the gasoline enters the engine only in pre-vaporized form, pre-mixed with the air, and the AF mixture is COMPRESSED! *True, a ‘lean vapor’ AFR is NOT a stoichiometric mixture* ***but it doesn’t NEED to be***! 14.7:1 is a mixture that is only insisted upon *by the Vested Interest* (that wants to burn as much fuel as possible) and *by the unfortunate people who don’t know the whole truth*.

The truth is that it is perfectly OK if there is excess oxygen, as long as the fuel is completely burned at the correct time to convert the heat energy to mechanical energy.
~ *This is a KEY piece of knowledge for achieving high mileage*.

Do you think the automobile engineers know these facts?

Actually… They generally don’t (*or publically say they don’t*)…

Those who learn the true efficiency advantages of vapor fuel are suppressed. *Sometimes, however, they go rouge* and 'accidentally' release proof that they DO understand these facts.

For example; starting about 1939, Shell engineers started an annual competition between themselves, to see who could achieve the highest MPG. They would work on their own project in their spare time in their own garages. Shell then held a mileage marathon each year at their company picnic.

The 1973 winner achieved 376.59 MPG with a modified 1959 Opel P1 at an average speed of 30 mph. *This happened during the 'Oil Crisis…'*

The engineer cut away all the weight he could (it still weighed 2500 lbs) and gave it a chain drive. He used a standard 4 cylinder IC engine (that was part of the competition rules) and he VAPORIZED the fuel to achieve the high mileage. Video of the 1959 Opel
https://www.youtube.com/watch?v=II1_Vg8dP64

Actually, my experience with vapor tells me that he did more than pre-vaporize the fuel to achieve that mileage; he must have been cracking it as I describe in my book 'Extreme Mileage, 101'.

Note that the name of the scientist that accomplished this ‘very public’ display is withheld and no other Shell scientist was allowed to duplicate his system in subsequent mileage marathons.

Here’s a portion of a 1958 video called “The Story of Gasoline” http://www.youtube.com/watch?v=Ltu8I61eLcc
Showing that vaporized fuel is better for the engine and explaining why.

The whole “The Story of Gasoline” video (see it on YouTube) also shows how gasoline is ‘now’ composed of many different liquids, supposedly so that each ‘portion’ will burn at the correct time.

In fact, using ‘heavy ends’ that won’t vaporize until there is sufficient heat, is just a scheme to ‘consume’ more fuel; the heat energy of fuel portions that don’t burn at the correct time (for efficient energy conversion) is just wasted.

Now I’ll tell you one of my experiences with liquid vs. vapor fuel.

One day, as I experimented with the HYCO 2A (cold fuel vapor) technology, two of the fuel and vacuum hoses were accidentally connected up backwards.

This caused liquid gasoline to be sucked from the HyCO 2A container directly into the intake manifold, bypassing the carburetor.

The 350 ci engine in the 1974 GMC ¾ ton pickup started ‘OK’, it idled a little rough and smoked a bit but I was in a hurry to get to town, so I drove away.

I quickly noticed that my fuel gauge was dropping like a rock. I had about 30 miles to town and I was using about 5 gallons to the mile. I could see I wasn’t going to make it, not even to the nearest fuel station. I pulled over, found the problem, connected the hoses up correctly and the mileage went back to the 18 mpg that we normally achieved on this truck, using the Carburetor Enhancer and the HyCO 2A.

My point is that it *doesn’t matter how much liquid fuel you put into the engine*! Until it is vaporized, **liquid fuel might as well be water** as far as the engine is concerned.

Speed of Fuel Vaporization

We (mechanics) are taught that only vapor fuel burns.
So the first thing we need to do, before we can burn the fuel, **is vaporize it**.

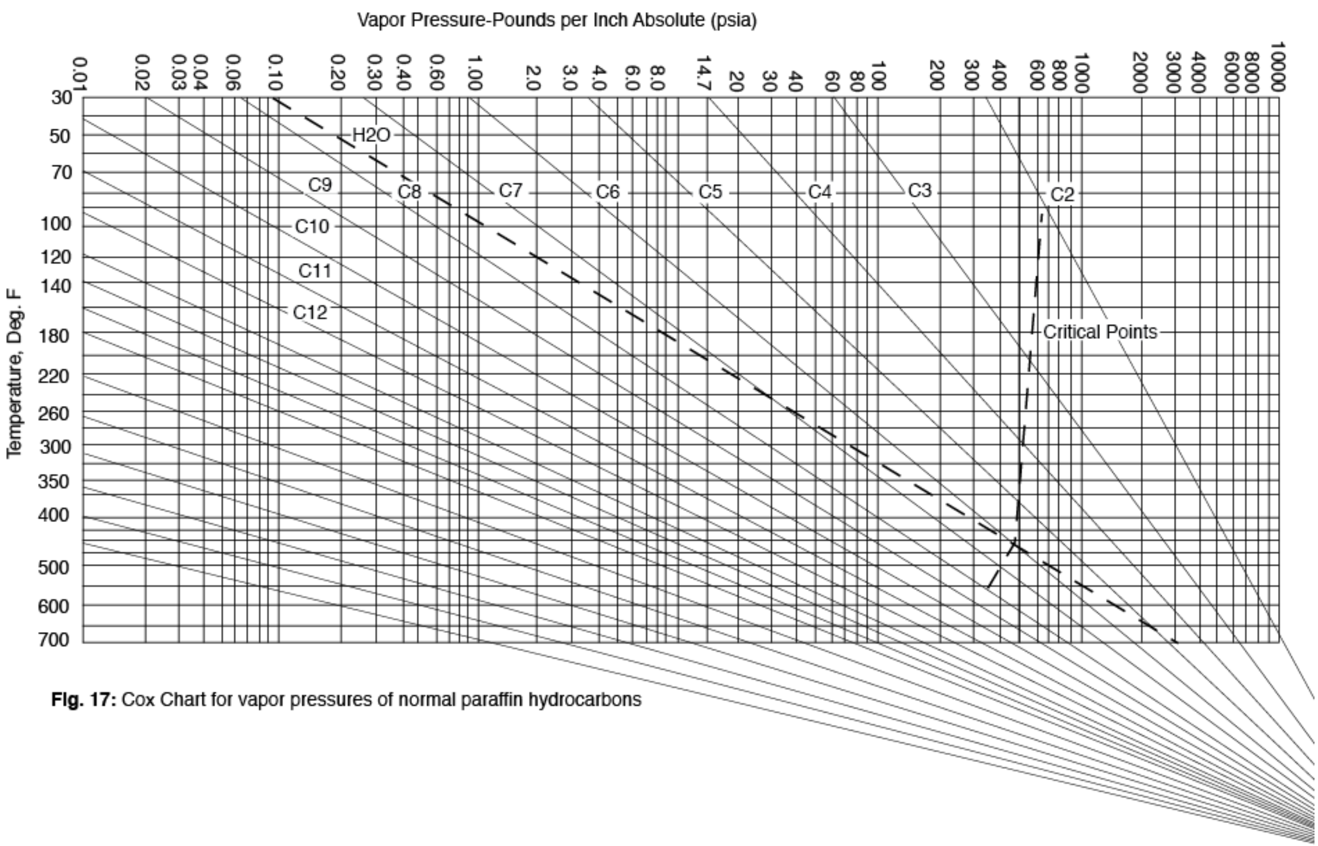


Fig. 17: Cox Chart for vapor pressures of normal paraffin hydrocarbons

This chart shows that vacuum promotes vaporization of the fuel 'light ends'. Most liquids will boil at lower temperatures when the absolute pressure is lowered. This assumes there is enough enthalpy (heat energy) to maintain the temperature as the liquid goes through the phase change to vapor. If there is not enough heat available the AF mixture will 'cool' as some fuel turn to vapor and the rest of the fuel will NOT evaporate!

We (mechanics) are taught that if we increase the 'surface area' of fuel exposed to air, then the fuel would evaporate faster.

This is why we are taught to make the fuel droplets as small as possible, to maximize surface area.

Here at Eagle-Research we call evaporation of fuel 'cold vaporization'.

Engines fueled by liquid gasoline NEED the intake manifold vacuum to help boil (vaporize) the fuel. This is why the 'vacuum gauge' was such a great (passive) fuel saver… *Because it helped drivers modify their driving habits to keep the intake manifold vacuum high*.

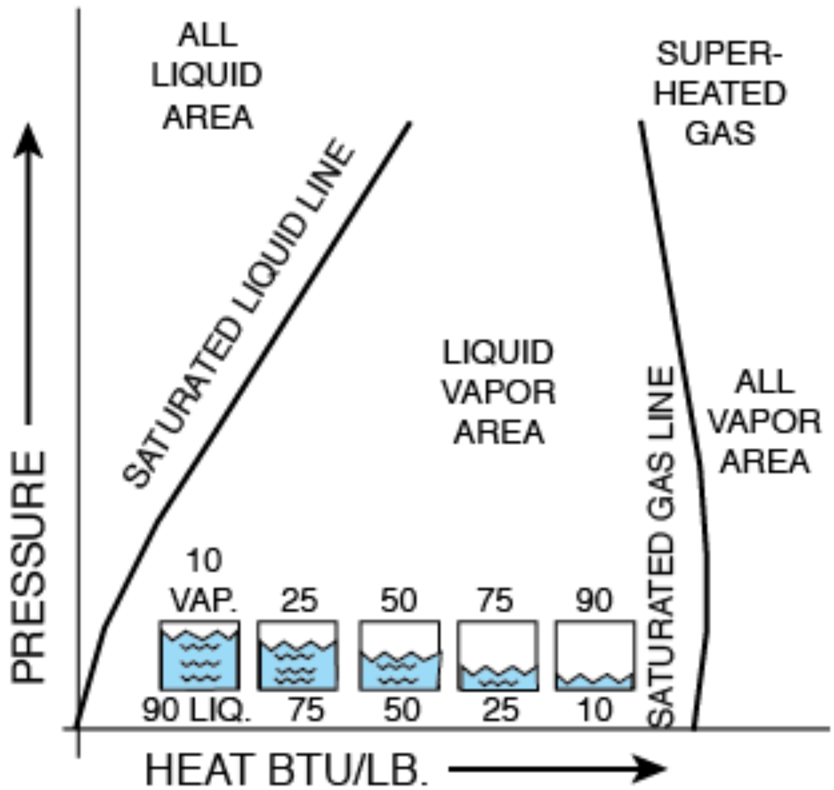


Fig. 9: Pressure-heat diagram. Note that as heat is subtracted, fuel becomes a liquid. As heat is added, fuel becomes a vapor.

Heating the fuel will help it vaporize even faster, by boiling it.

'Boiling' also allows a much greater percentage of the fuel to be vapor when the spark plug fires, thus less fuel 'mass' is needed to maintain the correct air:*vapor fuel* ratio.

'Boiling' fuel has several issues that need to be addressed to have a practical 'on road' fuel system. These issues are discussed in 'Extreme Mileage, 101'.

Here at Eagle-Research we call boiling fuel 'hot vaporization'.

Velocity of gasoline combustion is also vital!

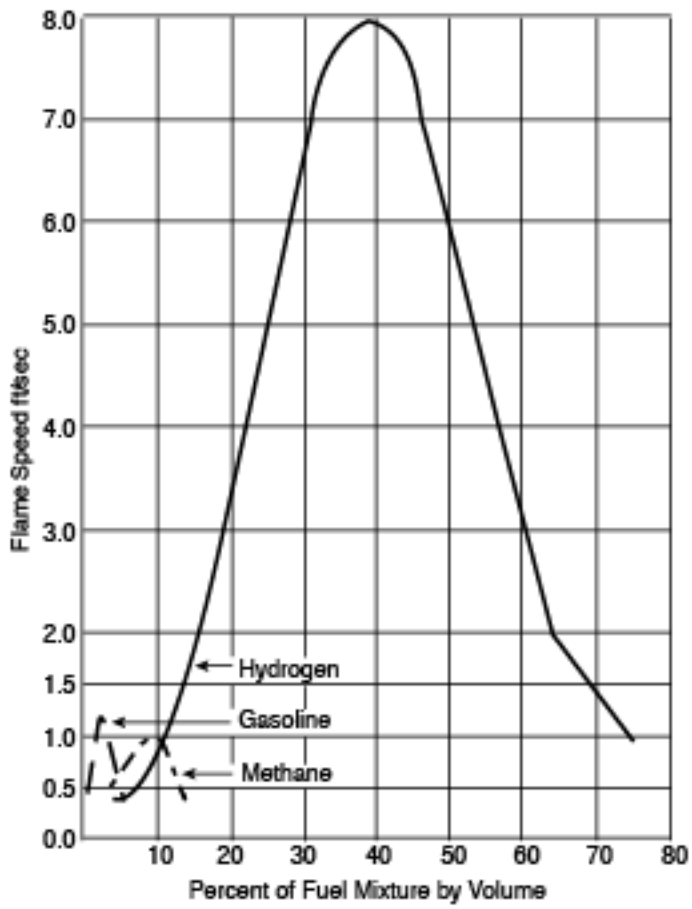


Fig.12: Flame Speed of Hydrogen

At optimum AFR and in ambient atmospheric conditions, hydrogen burns at about 8 ft/sec and gasoline burns at about 1.25 ft/sec.

We are taught that when fuel is 'burned' or 'combusted' that it has been 'oxidized'. The oxidized exhaust of gasoline (HC + O2) is CO2 and H2O.

We mechanics do learn that there are *several general speeds of oxidation*.

'Rusting' of iron is an example of very slow oxidation.
The next faster rate of oxidation is called 'burning',
Even faster rate of oxidation is called 'explosion'.
The fastest oxidation rate is called 'detonation'.

As a mechanic, I was NOT taught that fuel oxidizes much faster if combusted *in an enclosed container*. This came as quite a surprise to me…

This 'quirk' of combustion is vital to know, to increase Volumetric Efficiency.
http://www.youtube.com/watch?v=5zKkHMA8Urk

In open air hydrogen burns at about 8 ft/sec.
But in an enclosed area, the speed of combustion accelerates to explosion velocities of about 800 ft/sec…

Gasoline oxidizes at 'burn' speeds in open air… about 1.25 ft/sec.
But when ignited in an enclosed container, vapor gasoline oxidizes at explosion speeds of about 100 ft/sec.

ONLY the gasoline that is already vapor and pre-mixed with air can oxidize fast enough to efficiently power an internal combustion engine.

As shocking as the 'if the mixture was enclosed' combustion speed changing revelation was…
It was even more of a shock when I learned the REAL reason SPEED (velocity) of combustion is important.

Physicists know that Kinetic Energy = ½ Mass x Velocity Squared!
$KE = ½ M*V^2$

Increasing the combustion velocity by twice increases KE by 4 times!
Increasing velocity by 3 times increases KE by 9 times!

In converting potential energies, the mass of the fuel is much less important than the speed of combustion!

By enclosing and pressurizing the combustion, we can increase the speed of combustion more than 100 times.

Exploding gasoline FAST maximizes the conversion of heat energy to kinetic energy. Exploding gasoline at the right TIME, maximizes the conversion of kinetic energy to mechanical energy in an internal combustion engine.

Note: There is at least one engine designed to actually use the detonation principle to increase Thermal Efficiency. It is known as the Bourke Engine (Google it to see 'the most efficient engine ever built').

Speed of vapor fuel combustion does not mean the fuel will 'knock'

I included this section for people who think pure gasoline vapor would explode so fast that it'd destroy the engine with 'knock' detonations.

Vapor gasoline not only doesn't knock, it resists knock! The key is to keep the oxidation rate in the 'explosion' category and not have it accelerate into the 'detonation' category and/or we want to prevent ignition from any other source than the spark plug (to prevent colliding wave fronts).

I'll start with pure hydrogen combustion. Hydrogen IS undeniably a VAPOR fuel and combusts 7 times faster than gasoline vapor. So if hydrogen explosions don't knock, it should be understandable that the (much slower) gasoline explosions won't be an issue.

Hydrogen burns so fast that you could (and should) have the ignition retarded close to TDC or it will waste part of its energy as 'negative energy'.

Internal combustion engines run just fine on hydrogen (no pre-ignition or detonation).

When I made this video of my Vega running on Brown's Gas (hydrogen) I didn't know to retard the ignition or to eliminate the engine vacuum, so I was using much more hydrogen than I needed to (2000 L/hr of hydrogen to idle 140 ci engine at 450 rpm).
http://www.youtube.com/watch?v=JnXuhTaay_I

My experience is that engines powered by vapor fuel just purr, quieter and smoother than liquid fuel combustion.

Pre-vaporized gasoline has been called "fast burn technology" but, as you've seen, the combustion speed of vapor gasoline is nowhere near as fast as hydrogen. Since neither hydrogen nor gasoline vapors cause 'knock' of any kind, we can conclude that the speed of combustion isn't an issue.

Besides, as you go 'leaner' with vaporized fuel (see the Flame Speed chart), the combustion speed goes down!

Increase Thermal Efficiency by Eliminating the Throttle Plate

Another thing we (mechanics) are NOT taught is that the throttle plate is NOT needed if the fuel is pre-vaporized.

The ONLY reason the throttle plate exists is to create a vacuum to vaporize fuel. The throttle plate is NOT needed to restrict air to the engine, even though we (mechanics) are taught that it is used for that purpose. Gasoline engines run just fine with no 'vacuum inducing' throttle plate; just vary the pre-vaporized fuel to control rpm, like diesel engines do.

I'm sorry to say that I don't (currently) have access to my own examples of running gasoline engines without a throttle plate.
I'll have access to some working examples this summer (2014).

One example I've already had running and tested by manually operating the 'air diverter valve' (to vary the AFR) is my RV generator (a 1975 4 kW Onan that I bought off eBay and have partially installed in my 2003 RV).
http://www.eagle-research.com/erpdf/fs/HyCO2A/HyCO2AonOnan.pdf

I use a HyCO 2A system to generate the (cold) fuel vapors and I'll use a frequency (60 Hz) controlled valve to vary how much of the intake air flows through the HyCO 2A (thus simply and precisely controlling the actual air:VAPOR fuel ratio).

The air stream divides just after the air cleaner, one goes straight to the intake manifold, through the Hz feedback controlled shutoff valve; the other goes through the HyCO 2A container and to the intake manifold (no restriction other than the resistance of bubbling through the fuel in the HyCO 2A).

The air takes the path of least resistance, and would generally bypass the HyCO 2A because bubbling up through the fuel has resistance. As the Hz controlled valve is closed (increasing resistance to direct flow into the engine), the engine pulls an increasing portion of the air it needs through the HyCO 2A (this air is loaded with fuel vapors).

Thus, when the two air streams meet and mix in the intake manifold, an air:*vapor fuel* ratio is achieved (simple and straightforward).

In the meantime (until I can show you my own work) here are some YouTube examples that show a 'vacuum inducing' throttle plate isn't needed.

First see Roy McAlister explain that a throttle plate isn't needed when burning hydrogen (a vapor fuel).
Remember to retard ignition when burning vapor fuel.
See the engine run without a throttle plate, allowing the engine to have all the air it wants and just varying the fuel flow to control rpm and power.
http://www.youtube.com/watch?v=bSwSPvjk8NA
http://www.youtube.com/watch?v=DMLL4UfjSeA
http://www.youtube.com/watch?v=bnLdUZGrk70

As for vaporized gasoline, here is a YouTube video of Tyson Capel showing a 'cold vapor' (fuel evaporation) technique to power a lawnmower without a throttle plate.

He simply varies air and air:vapor flows to create the AFR that the engine actually needs. The air either goes through the 'vaporizer' to pick up fuel OR bypasses the vaporizer to provide the leaning air. There is no carburetor at all, thus no 'vacuum inducing' throttle plate.
http://www.youtube.com/watch?v=ZaLOelCv7Us

Note: Tyson is doing great and is coming along well but is making mistakes I made and solved decades ago.
For example, Tyson is making a miss-assumption about what he calls 'dry-vapor'. He doesn't understand that as the 'light ends' of the fuel are vaporized away he requires more heat and/or airflow through his vaporizer to get the progressively more 'heavy' remaining fuel to produce enough vapors to maintain the needed AFR.
My point is that even though you'll see lots of 'vapor fuel' experiments on YouTube, keep in mind that they may not yet know all they need to know to make the system practical.

It's sad that we have to keep 're-inventing the wheel' as Vested Interest keeps suppressing those of us that succeed.
*That's why **this information** needs to become widespread general knowledge, so we can finally have the fuel economy we should have had for a century!*

Maintaining an intake manifold vacuum takes a LOT of fuel; in most vehicles about the same fuel as needed to travel 25 mph. The ‘vacuum inducing’ throttle plate is one of the methods the Vested Interest uses to keep us burning more fuel than we actually need to (*thus helping ‘prove’ the 14.7:1 AFR lie*).

If the intake manifold vacuum is eliminated, both the Volumetric Efficiency and the Thermal Efficiency rise dramatically.

Natural Gas and Propane as ‘vapor fuels’

When skeptics that say vapor fuel doesn't work and use Natural Gas and/or Propane mileage loss (when used as a fuel in gasoline engines) as an example, they exhibit ignorance of engine design and combustion facts.

Natural Gas and Propane are not gasoline and require different conditions to optimize their combustion.

Those skeptics wouldn't put diesel into an engine designed for gasoline; or gasoline into an engine designed for diesel.

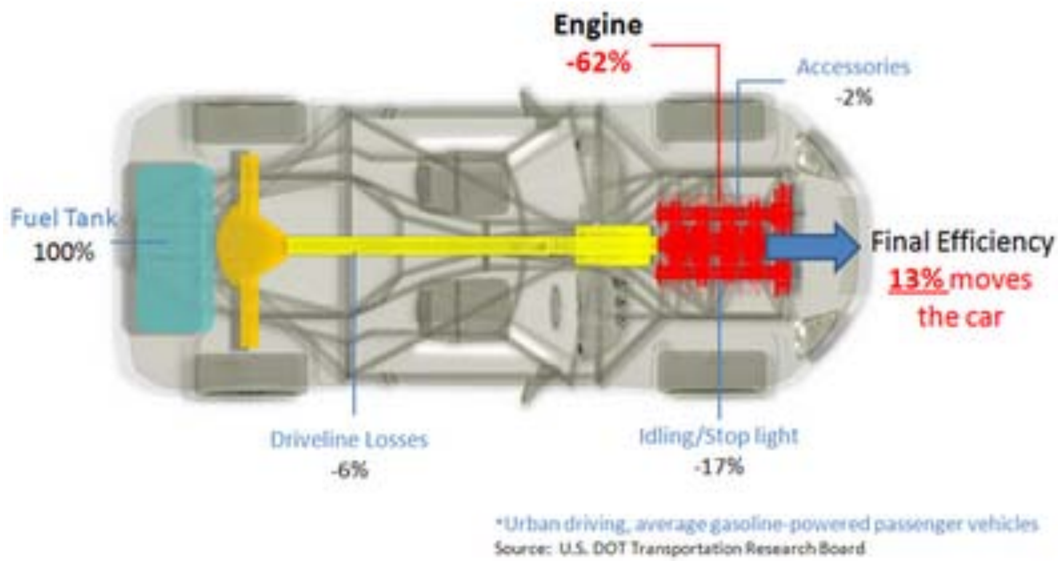
Natural Gas and Propane would get at least double mileage if the engines have higher compression, optimized valve timing, proper ignition timing and no throttle plate.

With Propane, make sure the fuel is actually vapor. A lot of Propane systems have inadequate pre-heat, so some of the fuel may not vaporize before the spark plug fires.

Real World Thermal Efficiency Math

Our (mechanics) training ‘assumes’ the maximum Thermal Efficiency of gasoline internal combustion engines is somewhere between 25% - 35%. http://en.wikipedia.org/wiki/Thermal_efficiency

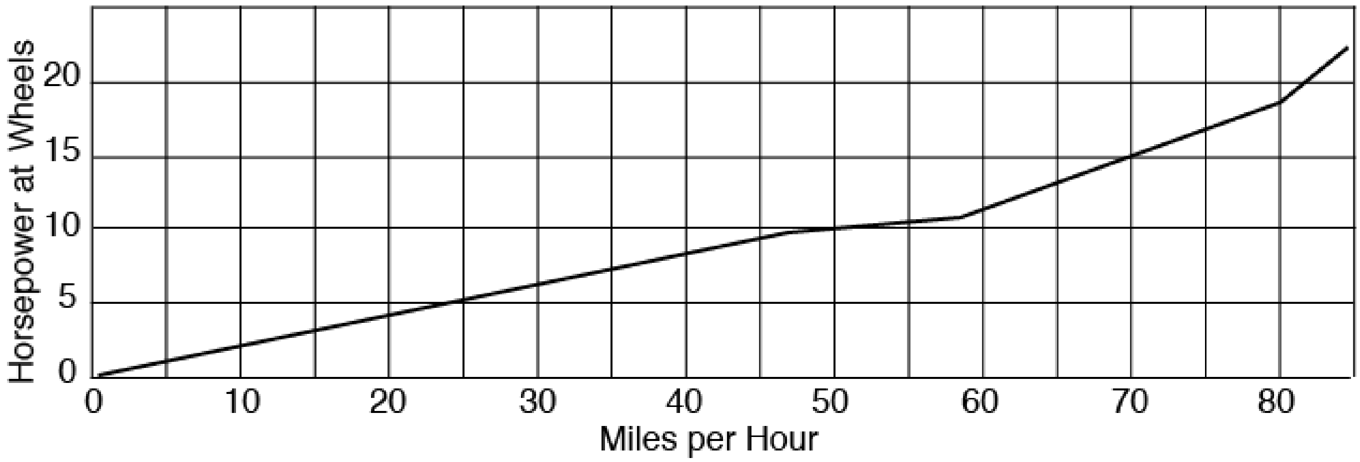
Thermal Efficiency is the ratio of the energy input to the useful (measured) power output (in this case, the potential heat energy in gasoline compared to the actual horsepower).



We are taught that the Thermal Efficiency is low due to energy lost as heat in the exhaust, heat in the radiator, heat in the oil and that after all those initial thermal efficiency losses, that energy is further lost in idling, overcoming various frictions and wind resistance.

We (mechanics) are taught that only about 13% of the original fuel’s potential energy actually propels the vehicle.

Let’s check this ‘fact’ by looking at some real world Thermal Efficiency examples with figures and conversion factors generally accepted in the engineering community.



Horsepower required to propel a 1,700 pound car with drag coefficient of .32

This chart shows that a 1700 lb car can maintain 50 MPH on about 10 hp.

1700 lb cars currently get about 50 mpg.
http://ecomodder.com/forum/tool-aero-rolling-resistance.php

46 mpg, 1700 lb Geo Metro
http://mste.illinois.edu/malcz/Regression/Linear_Model.html

50 mpg, 1700 lb Morris
http://www.lewrockwell.com/2012/07/eric-peters/35-5-mpg-is-no-big-deal/

10 hp x 1 hour at 50 MPH = 50 miles travel.
50 MPG at 50 MPH uses 1 US gallon for 50 miles in one hour.

1 US gallon of gasoline is 114,000 BTUs
114,000 BTU consumed in 1 hour to travel 50 miles.

10 hp = 25,444.33 BTU/h

So 25,444.33 BTU is theoretically required to maintain speed and yet we 'consumed' 114,000 BTUs to actually maintain that speed… 25,444.33 / 114,000 = 0.22. **Actual Thermal Efficiency is about 22%.**

So there still is LOTS of room for Thermal Efficiency improvement…

What happens to the Thermal Efficiency when 1700 lb vehicles get higher than 50 mpg?

135 mpg, 1700 lb Peugeot
http://www.thetruthaboutcars.com/2013/07/peugeot-working-on-1700-lb-hot-hatch-good-for-135-mpg/

10 hp x 1 hour at 50 MPH = 50 miles travel.
135 MPG at 50 MPH uses 0.37 US gallon for 50 miles in one hour.

1 US gallon of gasoline is 114,000 BTUs
0.37 x 114,000 = 42180 BTU consumed in 1 hour to travel 50 miles.

10 hp = 25,444.33 BTU/h

So 25,444.33 BTU is theoretically required to maintain speed and yet we 'consumed' 42180 BTUs to actually maintain that speed…
25,444.33 / 42,180 = 0.60. **Actual Thermal Efficiency is about 60%.**

Obviously, **the AFR is NOT 14.7:1**…
Oops ☺ maybe they thought no one would notice ☺ …

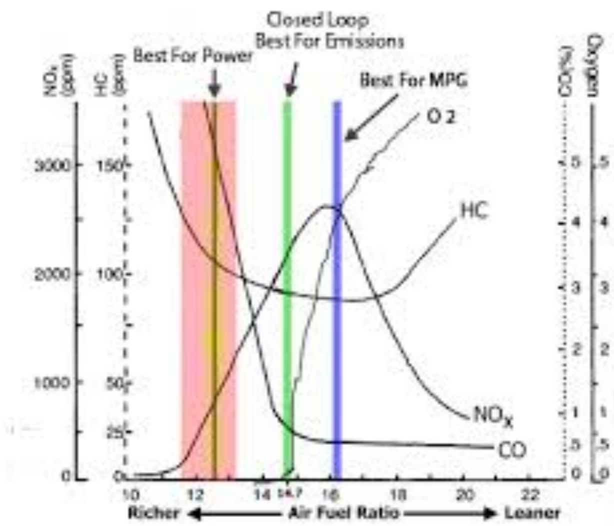
Remember that 62% initial thermal waste?
The key is to burn the fuel completely at the right time and only the right time to convert the heat energy to mechanical energy.

Vapor fuel technology is what raises the Thermal Efficiency to reasonable levels. There's no magic or 'extra energy' and it's **not even rocket science**.

It's just a matter of burning the fuel quickly, completely and at the exact right time to convert the resulting heat energy into mechanical energy.
Any mechanic can do it in their own garage.

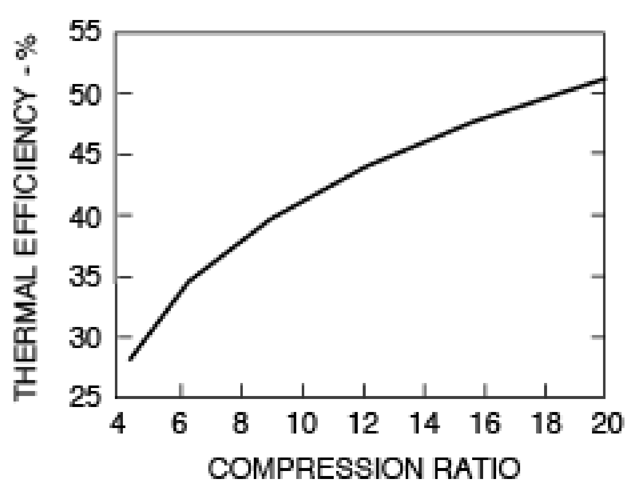
Done correctly, using only fuel that is already vapor when the spark plug fires, the engine *exhaust temperatures drop dramatically* because the flame is hot but short and more of the heat is actually converted into mechanical energy.

My conclusions are:



1. The 14.7:1 stoichiometric AFR chart is for theoretical understanding of balancing combustion equations:
a. 14.7:1 isn't the actual AFR vehicles commonly use.
b. Stoichiometric is only a way to say that you need 'at least' 15 parts air to completely combust 1 part fuel.
c. It is most relevant to open air (non-compressed) AF combustion.
d. It does not address the issues that make a high Thermal Efficiency.

2. Fuel is most efficiently combusted when it's 100% vapor when the spark plug fires (be sure to retard the ignition timing).



Thermal Efficiency
vs Compression Ratio (approx)

3. Compressing Air:Fuel mixtures allow 'leaner' mixtures to combust efficiently in 'excess air' (high AFR) conditions.

4. Eliminating liquid fuel results in more complete combustion and cooler exhaust temperatures. (More proof about that coming).

5. To dramatically increase Thermal Efficiency with combustion enhancement you need to merge efficient (fast and complete) fuel combustion with internal combustion engine requirements (pressure at right time). *This can be achieved with pre-vaporized fuel.*

6. Burning all the fuel is important, but it can be done in 'excess air' conditions and MORE important is to completely burn the fuel at exactly the right TIME.

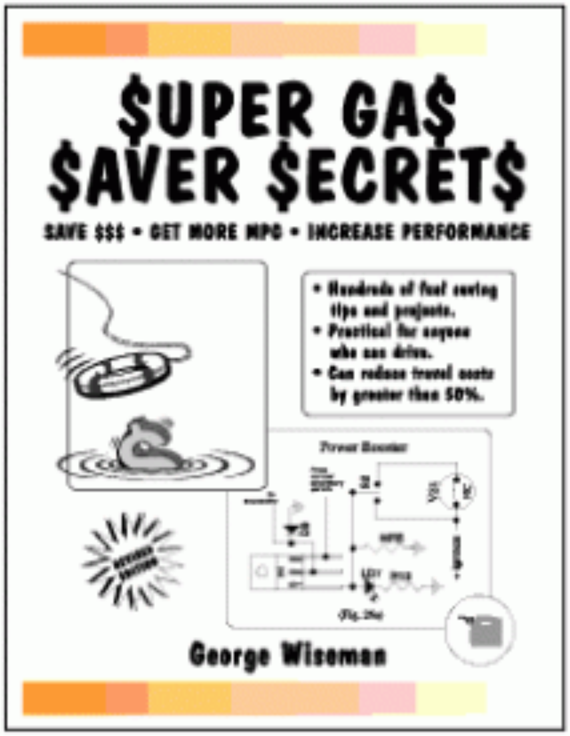
7. In the real world (not a mathematical theoretical simulation) the AFR is ALREADY 'off the charts' leaner than officially admitted.

Measure it yourself on your own vehicle, *using RAW data*. You can't trust equipment that was calibrated to 'assume' 14.7:1 AFR.

8. If vapor fuel technology were to be applied properly, ALL gasoline vehicles would be getting at LEAST double the mileage they are now.

In future videos /document, I'll be showing you practical ways to do that for yourself.

Reference books mentioned:



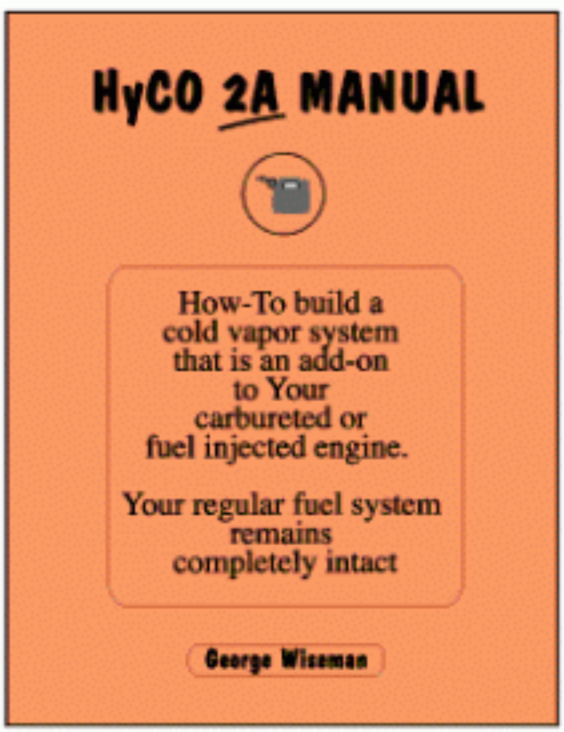
This book outlines dozens of methods of saving fuel that have been around for decades, but have not been made common knowledge.

For example, water injection was used in World War II to increase the performance of fighter aircraft. Water injection can be applied to modern carbureted and fuel injected vehicles.

A simple water injection system can be put together for less than $5.

Note: If you apply any combustion enhancement technology, remember to apply Combustion Enhancement Interface Technology (CEIT) like the Carburetor Enhancer, appropriate EFIE and/or MAP Enhancer too.

http://www.eagle-research.com/cms/node/218



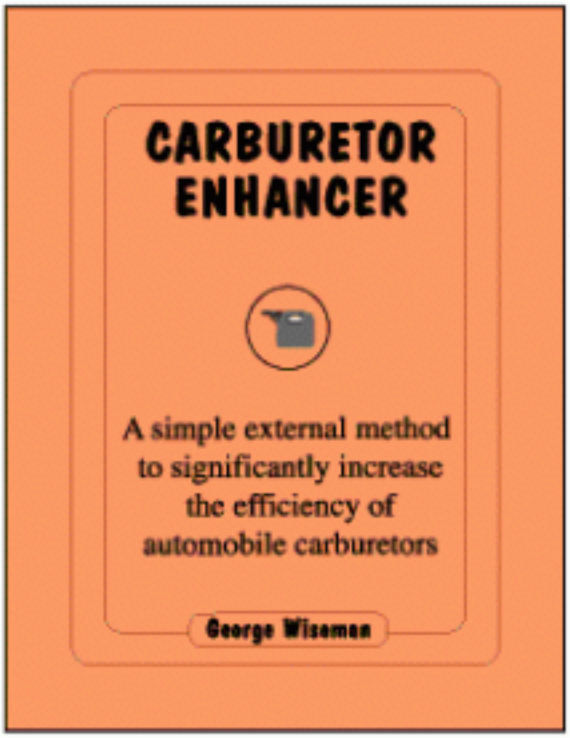
Originally designed for carbureted engines. We have included information to adapt the technology to **fuel injected** vehicles.

The manual tells you how to build and operate the HyCO 2A system from scratch. Gains of 50% in fuel mileage are common.

All the HyCO systems are named that way because they are using air to evaporate fuel. Thus the name HydroCarbon (petro-fuels) Oxygenator (evaporate with air).

The HyCO systems are simple and straightforward, designed to be fail-safe and to be built and installed by backyard mechanics.

http://www.eagle-research.com/cms/node/213



The Carburetor Enhancer Manual is full of practical information on how to save fuel. This book takes you, step-by-step, to a complete understanding of how to increase the efficiency of the vehicle you already have!

There is no power loss and vehicle emissions usually drop below California standards.

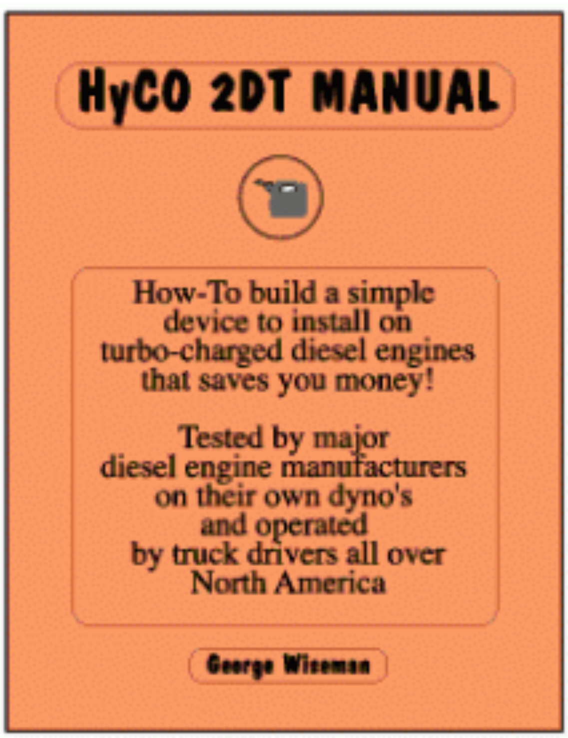
Based on our own results and those from testimonials; Gains of 25 percent are typical.

This information is practical, tested and easily used by anyone who drives a vehicle with a carburetor.

What's more; your cash out of pocket to follow the basic steps of the Carburetor Enhancer Manual, will usually cost you less than a tank of gas.

The Carburetor Enhancer is not a fuel saving device, it is a custom tuning technique that increases the efficiency of the carburetor you already have.

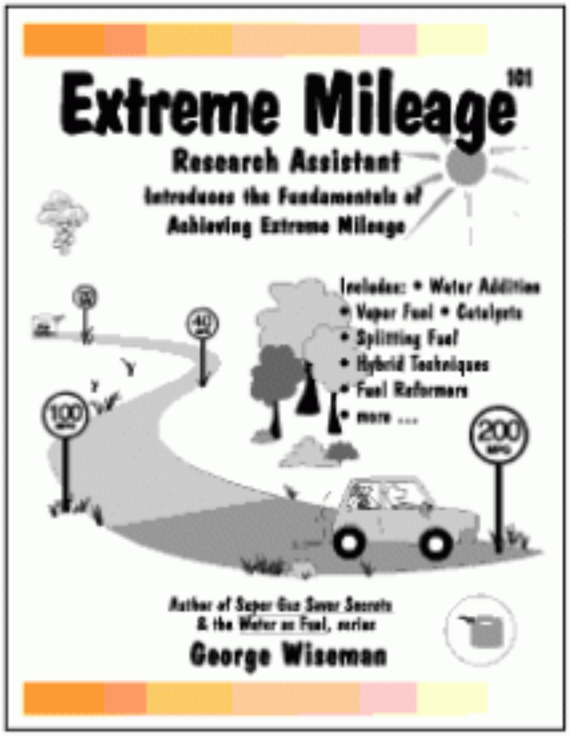
http://www.eagle-research.com/cms/node/211



Explains how to install a simple device on large turbocharged diesel engines, that increases power about 14%, **while reducing fuel consumption about 10%**. In a Jetta it increased economy 40%. Tested by major diesel engine manufacturers on their own dyno's and operated by truck drivers all over the World. The HyCO 2DT is a different device than the HyCO 2A system. It uses a different process and is designed specifically for turbo-diesels; although it will also work on turbo-gasoline.

This book was the mockup for an operator's manual and therefore not up to our usual standards for how-to instructions. We offer it because it is a shame to have this phenomenal technology simply sitting on our shelf, un-used, when truckers NEED to save fuel.

http://www.eagle-research.com/cms/node/217



This book is an introductory training course for high-mileage-seekers who are working to achieve *serious* gains with internal combustion engines.

We cover the mind-opening facts (yes, facts!) that clearly illustrate why, we could and should be getting greater than (>) 200 miles per gallon in … full-sized, four-door vehicles!

This book is based on hands-on research performed by myself since 1977.

Outlines my research for extreme mileage, wherein my brother and I achieved over 200 mpg in a 1973 GMC ½ ton pickup by using a thermal cracking system that not only vaporized the fuel, it cracked it into methane before combustion.

The only reason Eagle-Research isn't selling > 200 MPG kits is because the kits would (currently) retail in the $20,000 range; so there just isn't a market.

However, based on this knowledge, Eagle-Research has developed several **practical** (cost effective and DIY friendly) fuel saving technologies.

Here is the truth... That has been suppressed by the Vested Interest for over a century.
http://www.eagle-research.com/cms/node/223

You can join a community of fuel saving enthusiasts (but vapor fuel skeptics) at http://www.EcoModder.com

This has been Part 1: Why and How Double Mileage is Possible!

When I get time I'll be making these follow up documents and videos:

Part 2: Designing and Building Practical Vaporizers
Part 3: Adjusting and Driving
Part 4: FAQ
Part 5: Some Complementary Technologies