

# **Simple Veggie Diesel Conversions In Nova Scotia**

Some Examples of how to Convert your  
Diesel Engine to Run on Vegetable Oil

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and  
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Third Edition

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**If you can't find a simple solution to a complex question...  
you're asking the wrong question.**

You can run diesel engines on vegetable, or "veggie"oil by:

1. Using Biodiesel - Biodiesel is made of animal or plant fats that have the glycerine (glycerin, glycerol, glyceride) removed. Glycerine makes up about 20% of a vegetable oil molecule, and makes the oil sticky and thick... especially in cold weather. Biodiesel works beautifully in all diesel engines, and except in severely cold weather, can replace petro-diesel outright without having to modify fuel lines or tanks.

2. Mixing straight vegetable oil (SVO) or waste vegetable oil (WVO) with kerosene, diesel or biodiesel. In warmer weather, experience has shown that mixtures of 25 - 50% SVO or WVO in kerosene, diesel or biodiesel works well without having to modify the engine. Starting gets harder as the weather cools... to the point of not working at all in winter. Fuel filters can clog more with impurities in oil (water, cooking crumbs, etc... from WVO). Mixtures with vegetable oils may be used in the winter with a heated fuel tank.

3. Straight Vegetable Oil (SVO) or Waste Vegetable Oil (WVO). May be used in diesel engines when the following steps are taken:

1. A separate veggie oil tank is used;
2. Veggie oil is heated by a heat exchanger (using hot engine coolant) and/or an electric element in the tank;
3. Filtering of veggie oil is done manually and/or through separate in-vehicle system (either recommended in WVO system);
4. Engine is started on diesel or biodiesel until veggie oil is warmed to about 80°C (175° F), then supply and (if used) return fuel lines are 'switched' (either manually or electrically) to allow veggie oil to flow freely in system;
5. Fuel supply and return lines are switched back to diesel or biodiesel to flush system of veggie oil before engine is turned off.

## Details of the parts for a Veggie Oil system:

### 1. The Fuel Tank

We'll talk about installing small fuel tanks (12-23 litres) for veggie oil storage in this workshop. The main diesel tank *may* be converted to have a heat exchanger in it to make it the main veggie oil tank. With this setup a separate diesel tank for starting and stopping the engine would still have to be installed. This system is ideal for people who drive long trips, as you would not have to stop every few hours and fill the tank. In our climate, we heat our homes for approximately 7-8 months of the year. Veggie oil could use extra heating in this time, too. Most trips people make in their cars are less than 20 minutes in duration, so in our climate it makes sense to use a smaller tank that can be heated up quickly, allowing the veggie oil to be used more often.

Veggie oils are not explosive, and installing a tank to hold it is not dangerous. Having vegetable oil in a small fuel tank in the trunk or the engine compartment should be as much a fire hazard as moving a container of cooking oil from the store.

The veggie oil tank may be a stock marine fuel type, a water tank, or may be a custom aluminum or polyethylene tank. Arrangements must be made for a supply line, the two ends of a heat exchanger loop (through a small radiator or coil of flexible copper or plastic pipe within the tank). The tank should be strapped or bolted down to avoid spillage or damage to the piping, and to keep a potentially mobile tank and oil from injuring passengers in a car accident.

Since the fuel pump on most diesels is on or near the engine, the fuel supply lines operate under a vacuum for most of their length. The oil is sucked to the engine instead of being pushed by an in-tank pump, as in most gasoline powered vehicles. If the system has been allowed to run dry the fuel pump *should* be able to suck oil to the engine. If not, the supply lines will need to be primed (filled) by either pumping or sucking veggie oil up to the fuel switching valve. An outboard motor-type marine tank usually has a priming pump built right into the fuel line and, as long as the oil is warm and free flowing this pump works well for priming the supply line (you'll have to change the pipe setup at the top of such a tank, but the bulb may still be used). A very simple tank setup under the hood may be primed by unplugging the supply line at the switching valve, sucking oil to the end of the supply line, then plugging the pipe back in. A spring clamp can keep the unused line closed.

Make sure that there is a small breather hole in the veggie oil tank cap or the tank itself. Without it, the fuel pump might collapse fuel lines or even the tank in its effort to get fuel from the tank to the engine.

## 2. Heating the Veggie Oil - switching valves and the heat exchangers

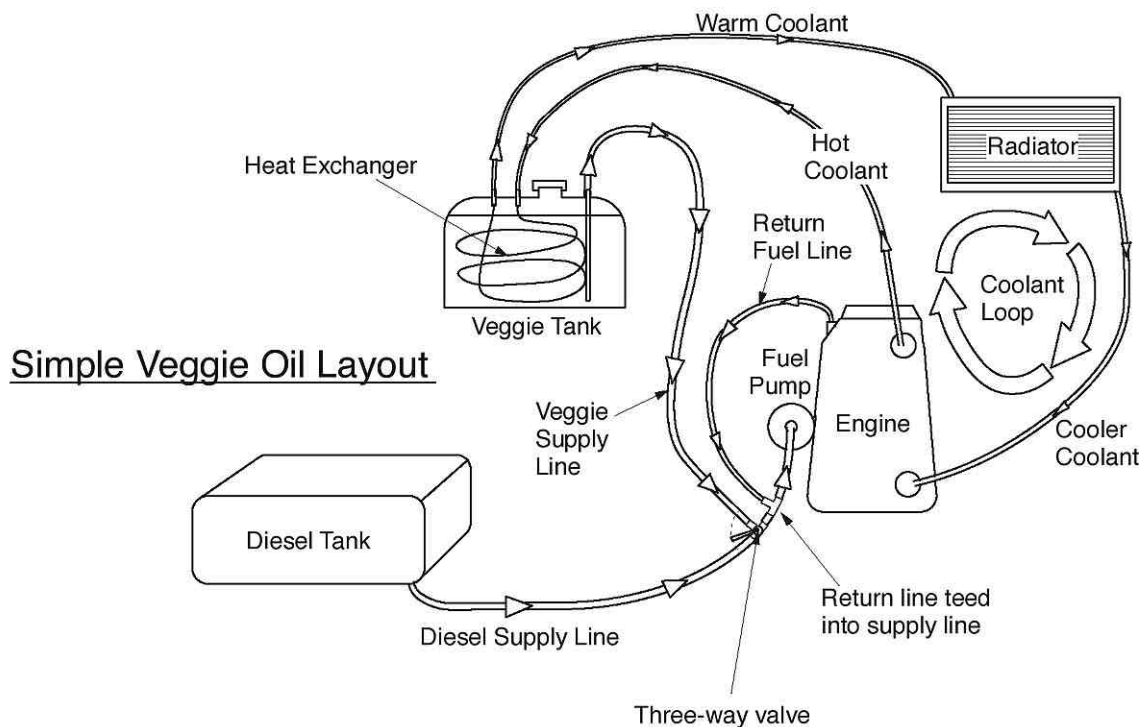
Veggie oil may be heated in the tank, on the way to the engine, and in the return line (if used). A simple under-the-hood setup usually only needs a heat exchanger in the tank and maybe a few wraps of the fuel supply line around a handy coolant pipe to allow things to work well. In any heated setup two things are needed:

1. A way to switch from diesel to veggie oil (with switching valves or by moving lines), and
2. A heat exchanger

### Switching Valves

In order to use a two tank system, a way to switch the fuel supply from diesel to veggie oil - and back must be provided. These switches are either manually operated in-line ball valves (two or three-way), electric 6-port solinoid valves (with a toggle switch on the dash), or simplest of all, by simply unplugging one tank's supply line from the engine supply line, and plugging in the other supply line.

Here is an example of the basic veggie diesel layout. The drawing has been simplified for clarity.



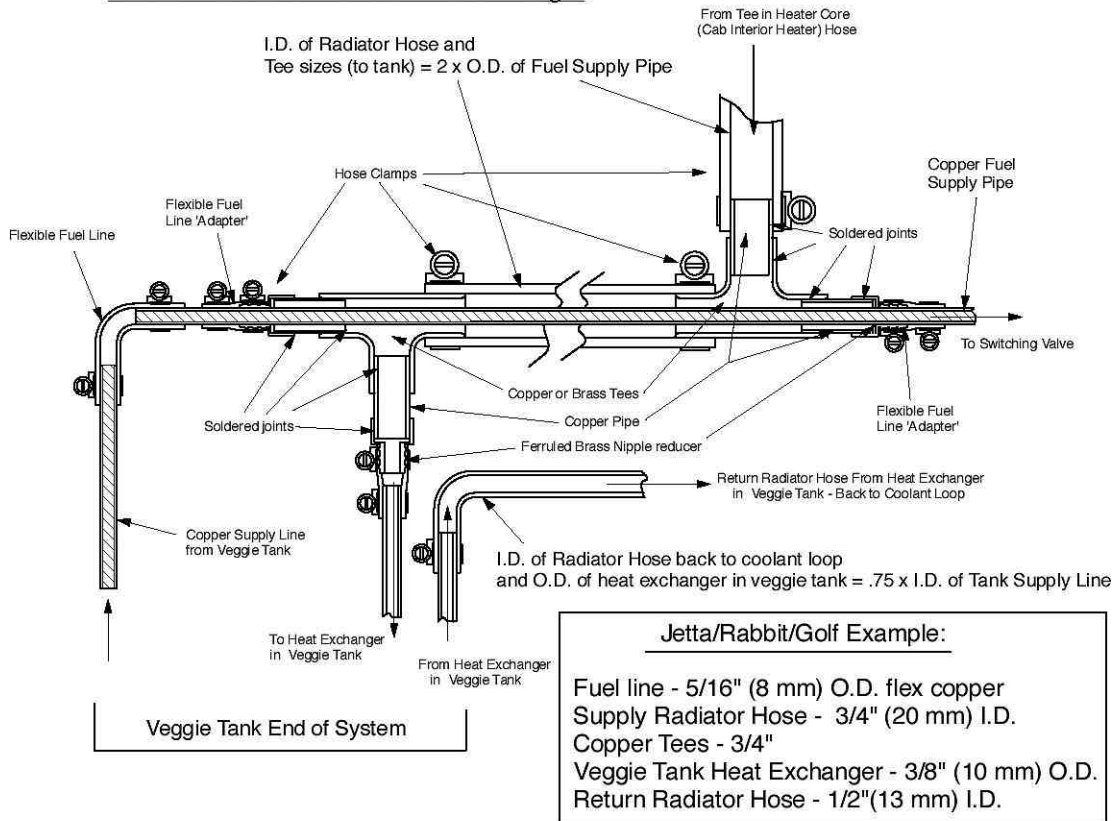
Instead of having the fuel return line go all the way back to either fuel tank, it may be rerouted to a tee fitting in the engine supply line so that excess fuel oil will be available to the fuel pump right near the pump. The engine's demand for fuel is always more than it can supply to the return line, so there is no worry about an overflow or backup somewhere. The tee eliminates the need for a return line to the tank. However, one reason to have a return line routed to a fuel tank is to help heat it up, as the returning fuel is hot. Another is to avoid having air bubbles in the return line (from fuel line air leaks somewhere) introduced into the supply line again. This can cause a large air bubble in the system and make starting very difficult. Having proper return lines running to fuel tanks allows for any bubbles to vent within the tank.

### Heat Exchanger

A heat exchanger can be a small radiator, coil of flexible copper pipe, or a coil of flexible fuel line placed within the fuel tank and flushed with hot engine coolant. This heats up the veggie oil to make it viscous (runny) enough to flow freely in the fuel pump and injectors. In a 23 litre veggie tank, for example, a heat exchanger coil of 5 or 6 loops (loops sized to almost the circumference of the tank) of 8 - 10mm (5/16" - 3/8") flexible copper piping should be enough to heat up the tank within five minutes of starting the engine, in the middle of the winter.

Another way to preheat the veggie oil is to run a section of the supply line from the tank inside the pipe of hot coolant as it flows toward the heat exchanger in the tank. This is a Line-in-Line, or Hose-in-Hose setup. Copper supply line may be run through radiator hose to get it good and hot. As a guide, try to have the radiator hose i.d. (inside diameter) about twice as large as the o.d. (outside diameter) of the supply pipe. For example, with 5/16" (8mm) o.d. copper supply pipe try to use 3/4" (20 mm) i.d. radiator hose for the coolant supply line to the tank heat exchanger. The return coolant line may be 1/2" (13 mm) i.d. if no other line is run inside it. See drawing below. Be careful not to let coolant and fuel oil mix as the engine doesn't like any water in the fuel... especially sweet coolant water. Make sure all pipe joints are excellent.

### A Possible Line-in-Line Heat Exchanger



### 3. Filtering Veggie Oil

If you suspect or know that there is water in a container of WVO, siphon it off with 1" clear polyethylene hose. (Cleanup tip: Siphon oily water into sawdust. It composts easily or can be burned in a woodstove. Sawdust or planer shavings are also great for cleaning out the sludge in the bottom of buckets of WVO, making the buckets recyclable, or totally useable for other fun projects.)

Filter the WVO through pantyhose or old shirts as demonstrated in the workshop. Filtering three times works best. Store oil in a cool, dark place.

Unless you are very fastidious, a diesel/veggie oil blend will eventually cause a clogged main diesel fuel filter. It just does... and it's lousy. This isn't a big deal in the summer or on a short trip as you're not likely to have any trouble getting to where you want to go. A clogged filter is bad if you're on a long trip in cold weather, and don't have a spare.

Some people run SVO without an inline filter, and rely on doing a good job of filtering before pouring the oil into the veggie tank. This works fine for quite a few people (including me, at times) but isn't a good setup. Damaged injectors and engine may result from clogging an injector with crud left in the veggie oil. Having two totally separate fuel systems is a great thing. If there is trouble in either... just switch to the other.

If you can get a used coolant-heated engine oil filter (like on a Jetta or Golf), you'll then be able to place an inexpensive spin-on 10 micron fuel filter in the veggie oil supply line. Bolt the heated base to a plate or bracket in an open space somewhere near the fuel pump (if it's to be located in the engine compartment). Run heater hoses to the filter base from a nearby coolant hose, making sure the new run of hose is still part of the coolant loop.

#### **4. Starting on Diesel - Switching to Veggie Oil**

That pretty much describes the sequence. Start on diesel, warm the engine up for a few minutes (about five in the coldest part of winter), then switch to veggie oil. If you have a way to switch the tanks from within the car, you'll be able to head on down the road during the warmup period and switch at your leisure. If you have the switching valve in the trunk or under the hood, you'll have to switch the harder way... manually with a trunk or hood opened.

#### **5. Stopping on Diesel - Switching back from Veggie Oil**

This is the reverse of #4 (above). You don't want to forget to do this in cold weather because unless you have access to a warm garage, it'll be a pain to get the thickened oil out of the not-working fuel pump and injectors.

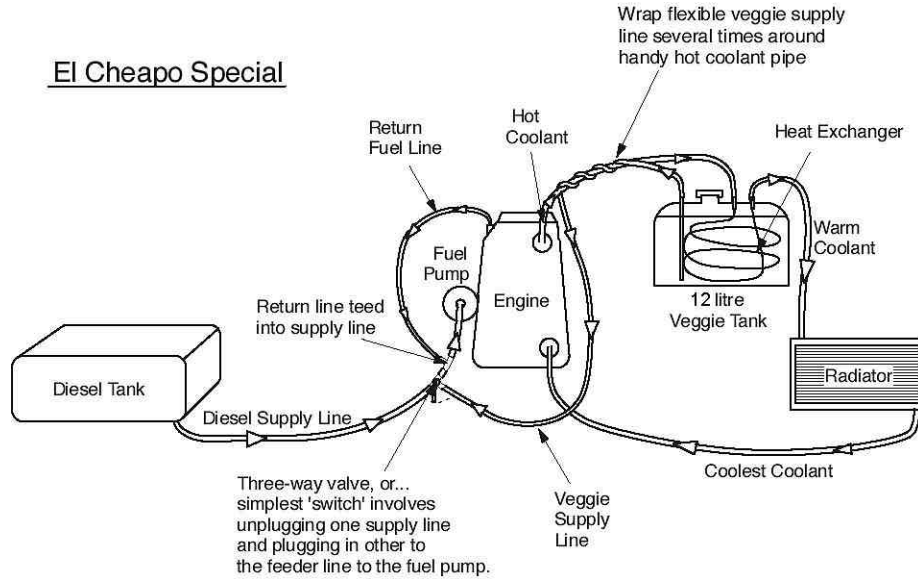
### **Three Veggie Oil Systems**

Here are three possible veggie oil setups. You can mix and match bits from each to customize a system that works for you.

#### **El Cheapo Special** - an under-the-hood quickie

This is a simple veggie setup for people with tight budgets and with room in the engine compartment for a 12 litre (or so) plastic veggie oil tank. The battery may be moved to the trunk to make room for the tank, but costs would increase with the purchase of battery wiring and terminals.

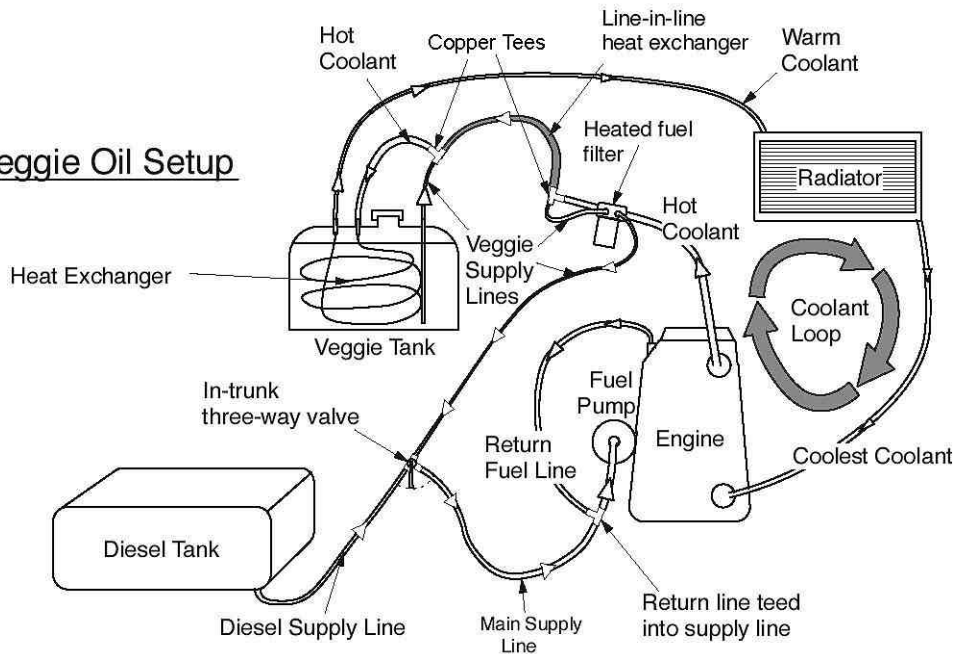
### El Cheapo Special



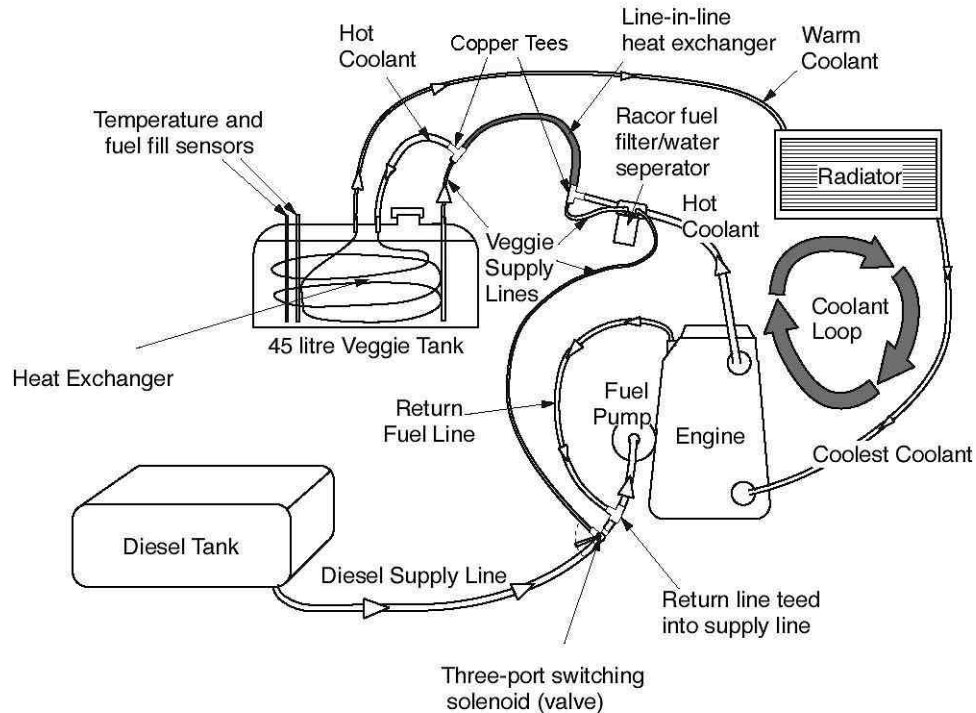
In a VW Jetta, Golf, or Rabbit, this fuel tank is known as a 'Windsor' (NS) tank in the Annapolis Royal area. That's how far a fill will take you. In practice this tank heats up quickly and may be switched over in just a couple of minutes of engine use.

**A Nice Veggie Setup** - Trunk-located 23 litre (Halifax) marine tank with priming bulb in fuel line, trunk-located switch valve, fuel filter in engine compartment, line-in-line heat exchanger.

### A Nice Veggie Oil Setup



**A Deluxe Veggie Setup** - Trunk-located 45 litre marine tank with priming bulb, dash-located toggle switch for electric switching valve in engine compartment, Racor ® fuel filter/water separator in engine compartment, line-in-line heat exchanger, electric fuel gauge and oil temperature gauge.



**A Deluxe Veggie Oil Setup**

## **Credit and Thanks**

The main inspiration for this work comes from the book, "**From the Fryer to the Fuel Tank: The Complete Guide to Using Vegetable Oil as an Alternative Fuel**", by Joshua Tickell, Kaia Tickell, Kaia Roman.

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Product Id: 1938

Thank you Joshua, Kaja, and Kaja!

## **A Warning:**

I cannot control what a car owner will do to their car, what the quality of the veggie oil is that they use, what the make of their car is, how it's set up, or who works on their car. Manufacturers of automobiles strongly recommend against changing how their vehicles are set up, and using waste veggie oil (not biodiesel) as a fuel source will surely void any engine warranties. (Some manufacturers do allow the use of clean canola oil, however) Though I personally haven't seen or heard of engines being harmed by converting them to run on veggie oil, car owners must understand that doing so must be viewed as an experiment... and some experiments don't get the hoped-for results. Converting your car to run on veggie oil may harm your engine.

**Happy driving!**

*Perry*