

## SVO CONVERSION OPTIONS & CONSEQUENCES

Due to feedback from readers of this document, the Pro/Con of each is brought forward to under each diagram

PLEASE! ADVISE **ME** OF ANY ERRORS OR CHANGES YOU FEEL ARE NEEDED TO THIS DOCUMENT. That way I can either answer your questions to have you agree with the document or amend the document to better reflect reality. ;-)

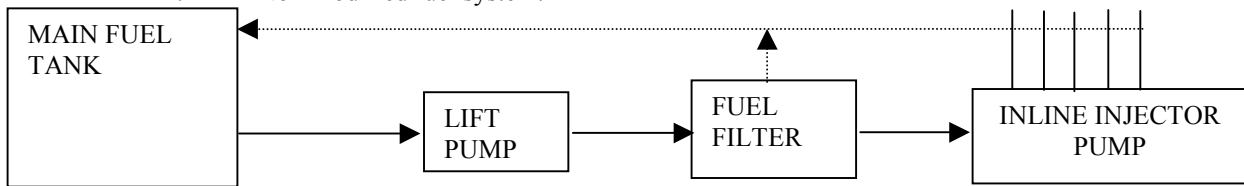
Tony Clark [tony.clark@arach.net.au](mailto:tony.clark@arach.net.au)

### Fuel System options for 2 tank SVO systems.

Note: all of these options rely on having a heated Auxiliary tank and heated fuel arriving at any filter or pump, and any fuel filter being able to be heated if using solidified oil, or low temperature overnight.

A. In-line injector pump Fuel System, normally uses lift pump (litres/ minute)

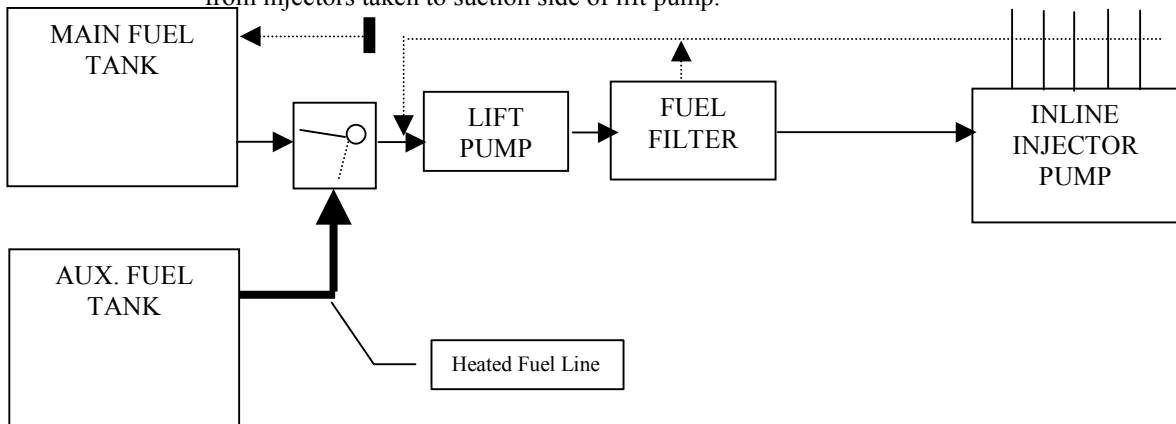
1. Non-modified fuel system.



Ref#	Advantages	Disadvantages
A 1	Fuel availability + ability to use biodiesel + Tank contents filtered + Air tolerance + no modifications to fuel system	

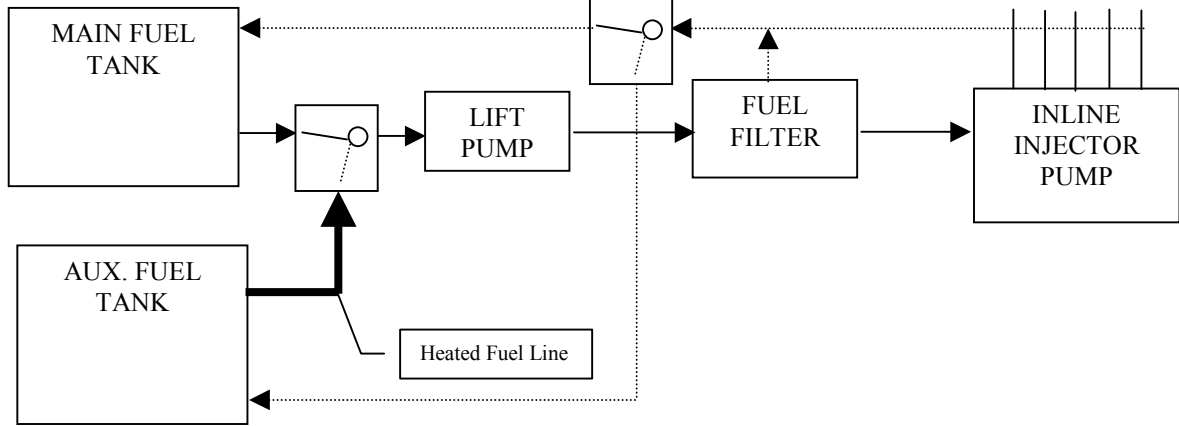
SVO Conversions:

2. One 3 port solenoid valve, return line to main tank closed. Filter return & spill line from injectors taken to suction side of lift pump.



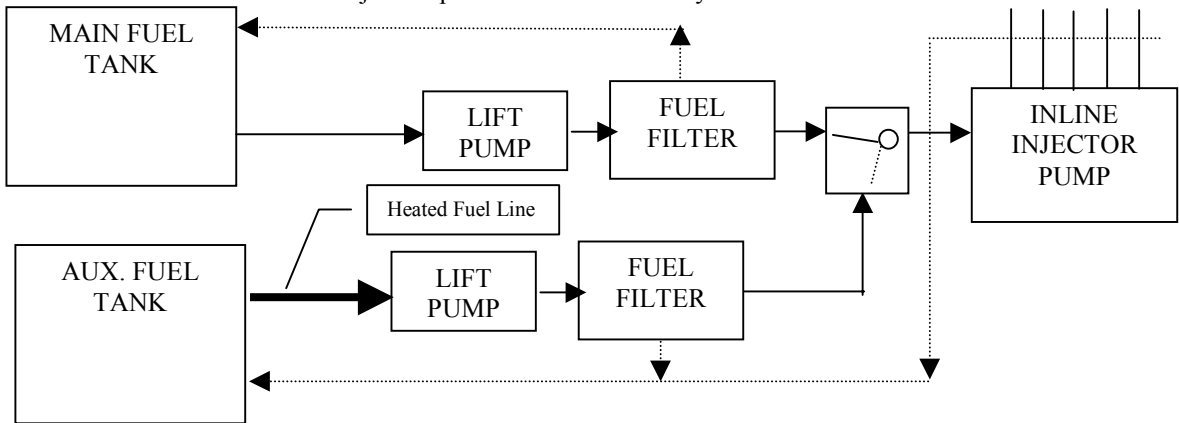
Ref#	Advantages	Disadvantages
A 2	Cheap conversion (1 x 3way valve)+ no Aux Tank fuel into main tank	Air intolerance + possibility of shutdown with cold oil in injector pump + Tank contents not continuously filtered + loading of lift pump + Filter clogging affects both fuels

3. 2 – 3 port (or 1 - 6 port) solenoid valves. Filter return & spill line to each tank.



Ref#	Advantages	Disadvantages
A 3	Air tolerance + Tank contents continuously filtered	Cross contamination of tank contents at changeover, contents of filter, injector pump and injector spill lines returns to opposite tank + Conversion cost (2 x 3way valves) + possibility of shutdown with cold oil in injector pump, loading of lift pump + Filter clogging affects both fuels

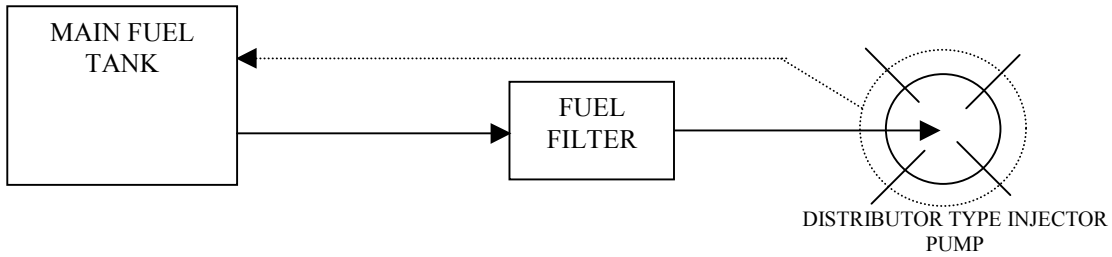
4. Single 3 port solenoid – return lines to each tank, separate lift pump and filter added for SVO. Injector spill line to Aux tank only



Ref#	Advantages	Disadvantages
A 4	Ease of bleeding after filter change + Air tolerance + Both Tank contents continuously filtered using separate filters	Conversion cost (1 x 3way valve, lift pump & SVO filter) + possibility of shutdown with cold oil in injector pump + possibility of overflow aux tank

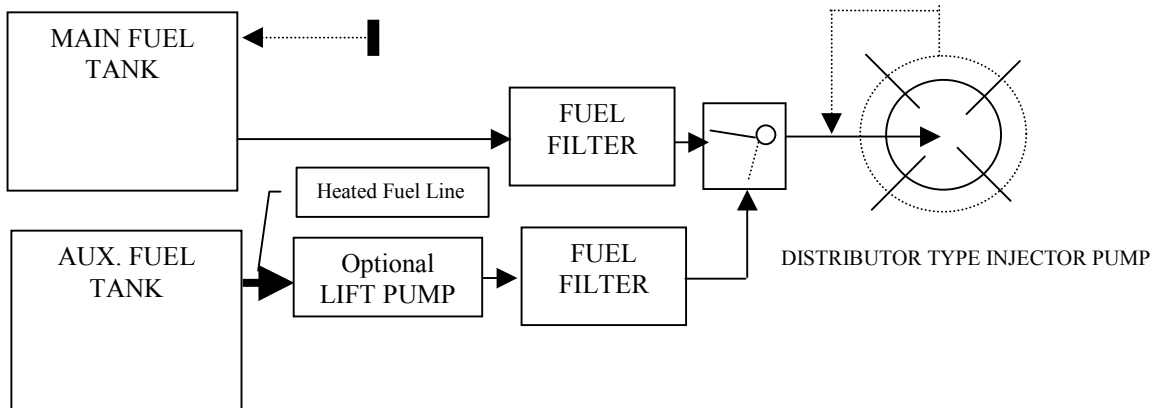
B. Rotary (distributor type) injector pump – normally not fitted with lift pump

1. Non-modified fuel system diagram



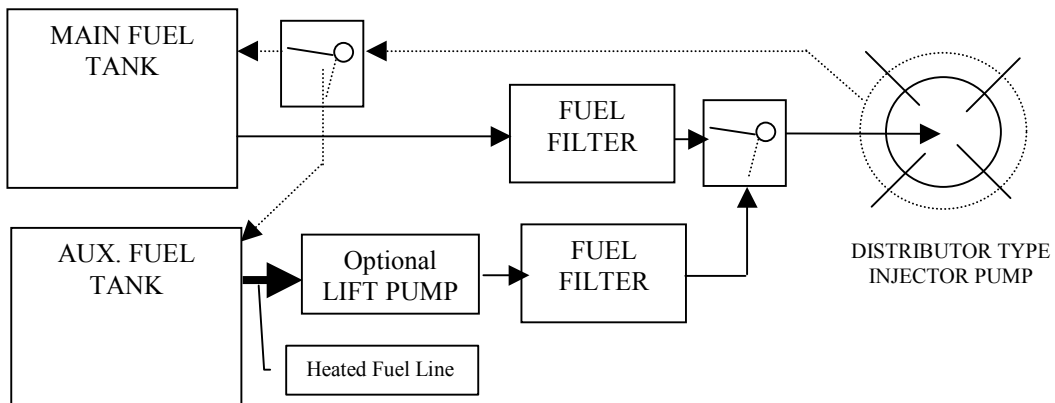
Ref#	Advantages	Disadvantages
B 1	Fuel availability + ability to use biodiesel	Unable to use SVO as fuel

2. Simple SVO Conversion – no spill line to either tank, spill line “T ’d” to pump suction



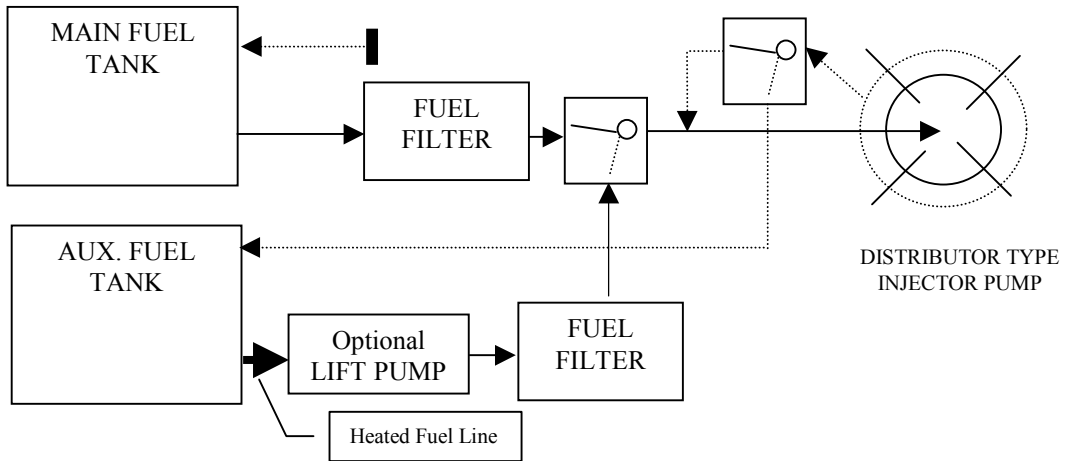
Ref#	Advantages	Disadvantages
B 2	Cheap conversion (1 x 3way valve)+ no Aux Tank fuel into main tank	Cost of Optional SVO Fuel Filter & Lift Pump + Air intolerance + possibility of shutdown with cold oil in injector pump + Tank contents not continuously filtered + loading of lift pump

3. Additional 3 port solenoid valve for spill lines to each tank.



Ref#	Advantages	Disadvantages
B 3	Air tolerance + Tank contents continuously filtered + easy bleeding after filter changes (pump available)	Cross contamination of tank contents at changeover, contents of filter, injector pump and injector spill lines returns to opposite tank + Conversion cost (2 x 3way valves + lift pump + SVO Fuel Filter) + possibility of shutdown with cold oil in injector pump.

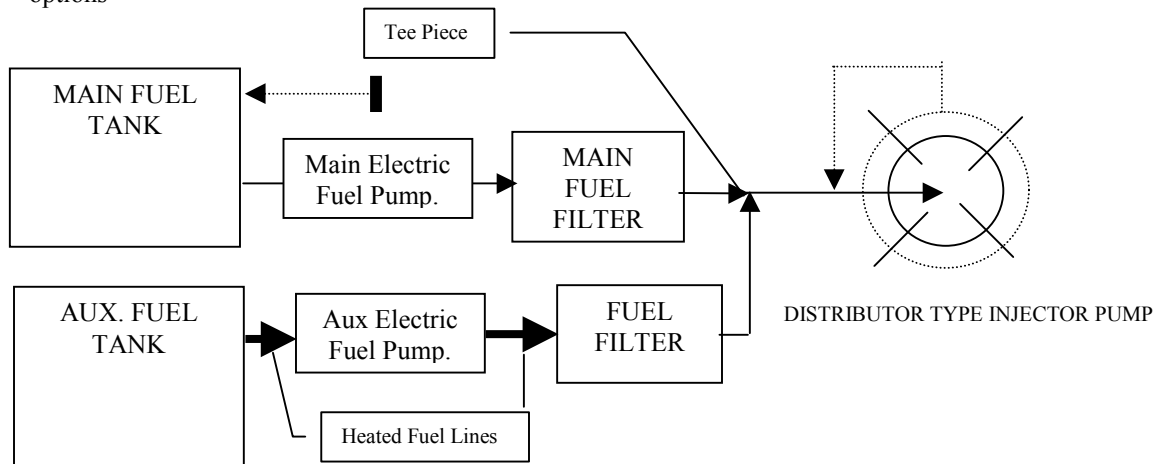
3a. Variation – Main Tank spill line routed to injector pump suction, Aux Tank spill line to Aux Tank



Ref#	Advantages	Disadvantages
B 3a	Air tolerance on Aux Tank + Aux Tank contents continuously filtered + easy bleeding after SVO filter changes (pump available) + No cross contamination of Main tank contents	Air intolerance on Main tank + Contamination of SVO tank with Main tank at C/O + Conversion cost (2 x 3way valves + lift pump + SVO Fuel Filter) + possibility of shutdown with cold oil in injector pump.

In-line injector pump

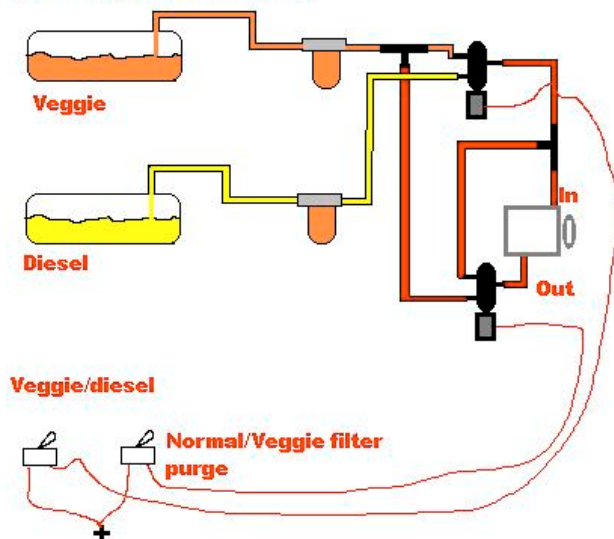
B 4. Dual electric fuel pumps, with integral non-return valves, used to provide main tank fuel, aux tank fuel or both fuels, mixed at injector pump fuel input. Return line may be looped, or switched as in options



Ref#	Advantages	Disadvantages
B 4	Readily available, cheap, salvaged fuel pumps used. Choice to blend both tank fuels. Could be used with return line options, B3 or B3a	Possibly need to pre-filter at pump suction line, to protect pumps from tank residues.

B5 Looped return line with purge/backflush.

**Looped dual fuel system with veggie filter purge (Coolant system not shown)**



Ref#	Advantages	Disadvantages
B 5	no Aux. Tank fuel into main tank, where solidified oil is used, purges filter so no oil solidifies, preventing veg-oil use	Air intolerance + Tank contents not continuously filtered. Manual control, of fuel select & purge lines. – Potential for dumping most of diesel tank into veg-oil tank

OTHER ISSUES:

## HEATING VEG-OIL

Vegetable oils and tallow comes in a variety of types, with many different melting points, from  $>20^{\circ}\text{C}$  for Tallow and Palm oil to  $<-10^{\circ}\text{C}$  for new Canola oil.

All vegetable oils and Tallow are much more viscous than diesel or biodiesel. To make the veg-oil behave more like diesel, it is heated to  $\sim 80^{\circ}\text{C}$ . Engine coolant temperatures generally are in this temperature range and are regulated by the coolant thermostat and thermal/electrically controlled fan(s), so it makes sense to use this source of heat.

Although the exhaust is a source of heat, which could be used, it is an uncontrolled heat source, which may cause vaporisation of the veg-oil or other heat related problems.

Although I am currently using canola oil, I have a heating coil in my veg-oil tank. I have a copper fuel line, encased in a coolant line from the engine to the fuel tank, which carries the coolant for the tank heater. The coolant, return line, could carry the fuel return to tank line, but this was not done at installation and has remained in the "too hard" basket since then.

I plan to have a fuel filter heater fabricated, to ensure that even if I need to use solidified oils or fats, I will be able to heat all parts of the veg-oil system and avoid "cold spot" fuel line blockages.

## CONTAMINATION OF START TANK FUEL WITH VEG-OIL.

Where a return to tank system is used and the fuel supply and return lines are switched at the same time when switching from veg-oil to the start fuel (diesel or biodiesel), it is known that veg-oil in the injector pump and fuel lines which is not injected into the engine will return to the start fuel tank, contaminating the start fuel and potentially causing starting difficulty.

To overcome this, it is possible to use a timer to delay the return line solenoid changeover to the start tank. This timer may also be used to keep the injector pump run solenoid energised and thus keep the motor running until all veg-oil has been purged from the fuel system.

A "turbo Timer" kit from Jaycar was modified to give a 5 minute time delay. As this unit also provided voltage whilst the ignition terminal was energised, this lead was used to control the return line solenoid and, via isolating diodes, the injector pump run solenoid.

In practice:

I start the vehicle on biodiesel.

When the engine coolant temperature is up to "normal" I operate the veg-oil switch to ON. The fuel selection solenoid is operated to veg-oil. The modified Turbo Timer ignition lead is energised, and it's output is energised too, causing the return line solenoid to operate to the veg-oil tank.

If I need to stop for a short time, I operate a Timer Bypass button on my control panel, which allows the shutdown delay to be overridden. I simply restart on veg-oil and continue my journey.

At the end of the day, or if stopping for an amount of time which would cause the veg-oil in the injector pump to cool considerably, I change from veg-oil to biodiesel about 5 km from the end of the journey and, by the time I arrive, I simply turn off the ignition and if the time delay has been completed, the motor stops.

If I forgot to switch back, or if the time delay has not been completed, the motor continues to run, albeit with no engine ancillaries (instruments, cooling fan etc.) until the time is completed. The engine then stops, ready for the next cold start.

Should I then need to use the vehicle again and the engine is still warm enough, I just switch to veg-oil as soon as the engine starts.

The only problem occurs when I think that I need to go out again, so do not purge, then fail to use the vehicle again and purge the veg-oil at the end of that trip. My engine does not start well on cold veg-oil. I pour a kettle of boiling water over the injectors and then the engine starts, sometimes reluctantly, but I have always managed to start the engine on cold veg-oil using this method.

## FILTRATION OF VEGETABLE OILS:

### PRE FILTRATION.

It is vitally important that any fuel used in a diesel engine is filtered to at least 5 micron. Inexpensive “bag filters” are available in a variety of mesh sizes.

### VEHICLE FUEL SYSTEM FILTERS.

Fuel filters designed for heavy haulage and industrial engines are suitable for veg-oil. The elements are generally cheaper than automotive fuel filters and they tend to be capable of high flow rates with low pressure differential (large effective filter surface). I recommend filtering the veg-oil before the injector pump, in a separate filter for the veg-oil. Should this filter become clogged, you still are able to continue your journey on the start tank fuel.

I recommend replacing the original fuel filter with one of these filters if any problems develop with the original one (mine developed an air leak at its priming pump). In this case, I need to have only one type of fuel filter cartridge.