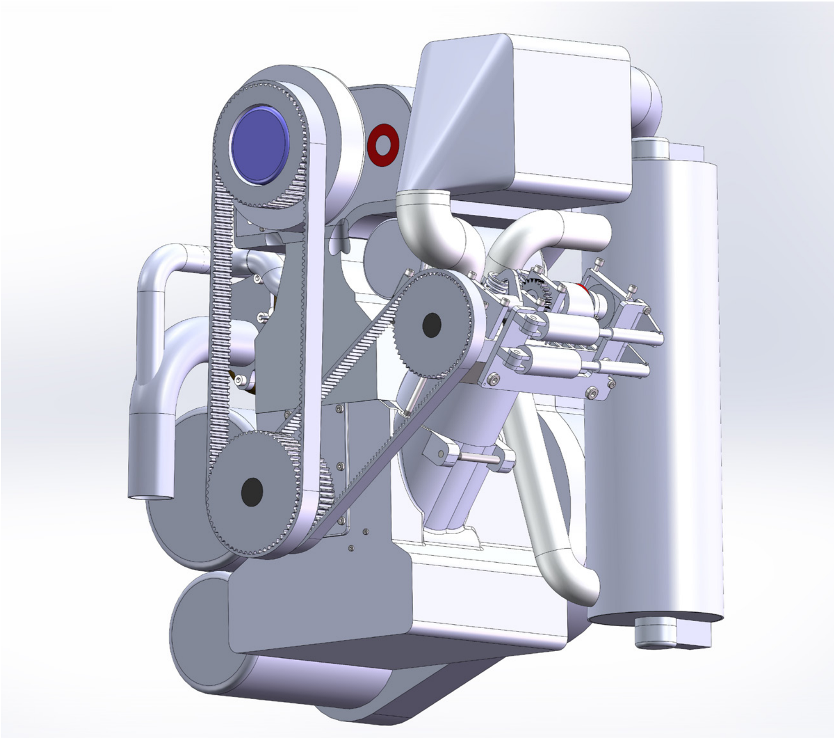
Aumet
The Z* -motor company

CO2 and NOx solver

Zero CO2 by using “green”methanol as fuel, BTE 60%
H2 from pyrolysis of methane and CO from organic materials



Single fuel RCCI combustion with high voltage ignition control

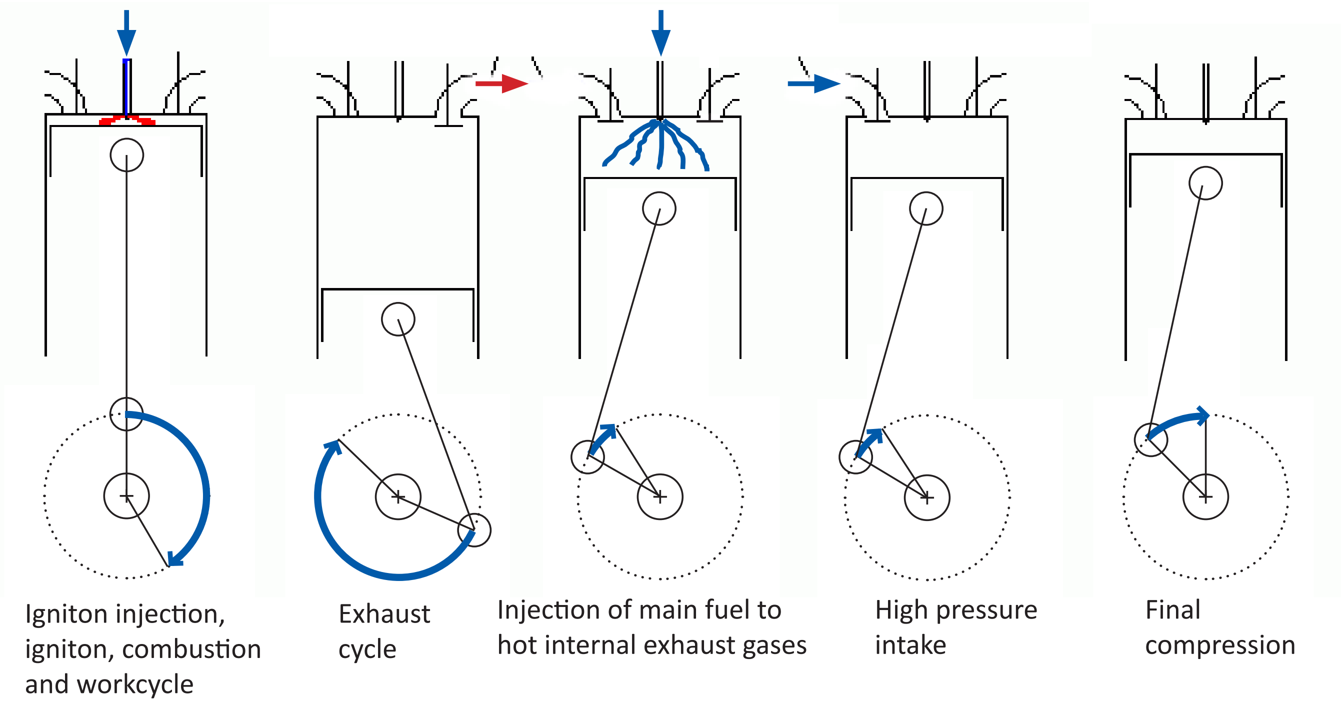
Todays demand of lower NOx and CO2 emissions is not easy to fulfil without extra costs in car engines. Electric car is one solution for this problem, but about 70% of electricity in the world is produced by burning fossil fuels with about 40% electric efficiency. The battery price and weight are making the growth of number of electric cars slower and it is expected that ICE shall still long time dominate the passage car market. Hybridization helps ICE cars to recuperate the braking energy, even very small batteries, 1-2 kWh are big enough for this purpose in passenger cars, but also other actions are needed to solve NOx and CO2 problems.

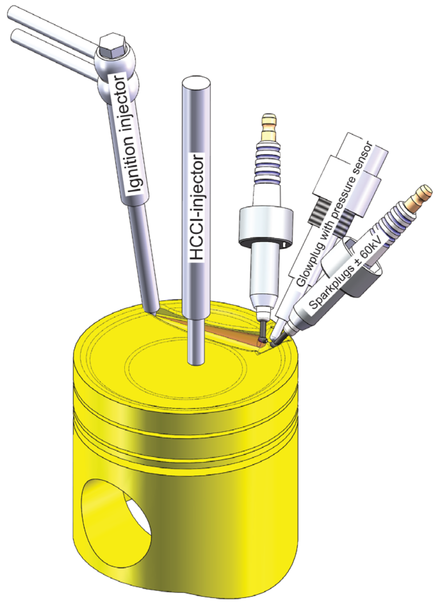
The split-cycle engine, where compression is partially or totally transferred outside of the work cylinder, is a new development in combustion engines. This offers new thermo dynamical possibilities to adjust the working cycle and the combustion. As there are methods to control the temperature at TDC, a HCCI-combustion is possible in the Z-engine at all loads.

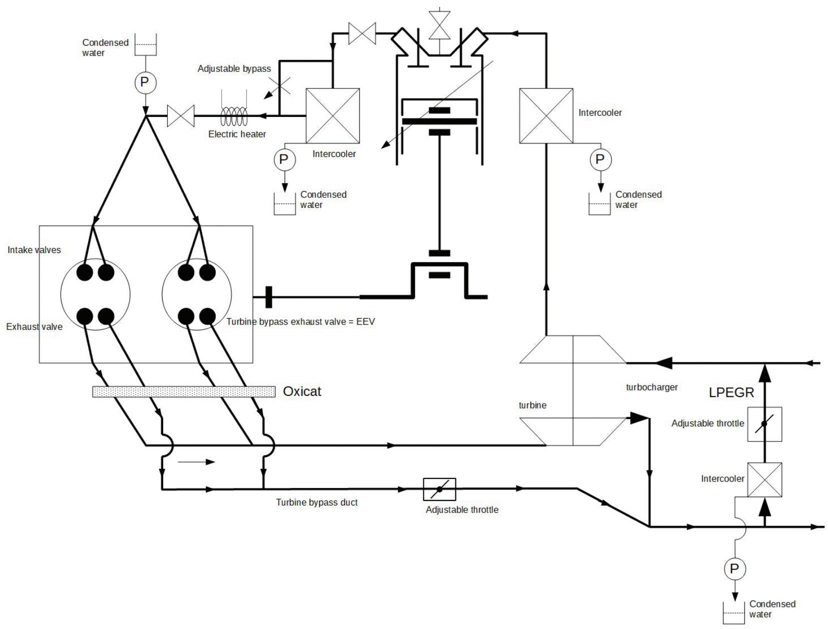
The new trend in car engines is HCCI-combustion, for example Mazda and Honda have published information about their HCCI projects. HCCI has lower heat losses and quicker combustion than normal combustion and therefore better efficiency and also lower emissions. Honda uses in their new HCCI-gasoline engine project homogenous fuel-air mixture, ignited with extra fuel injection to the sparkplug.

Aumets new technology split-cycle Z-engine works with spark controlled single fuel RCCI combustion. When controlling the ignition point with spark, the best efficiency can be achieved and it is possible to avoid too high pressure in the cylinder. The air-fuel mixture in Z-engine is lean,

Gas exchange of split-cycle Z-engine







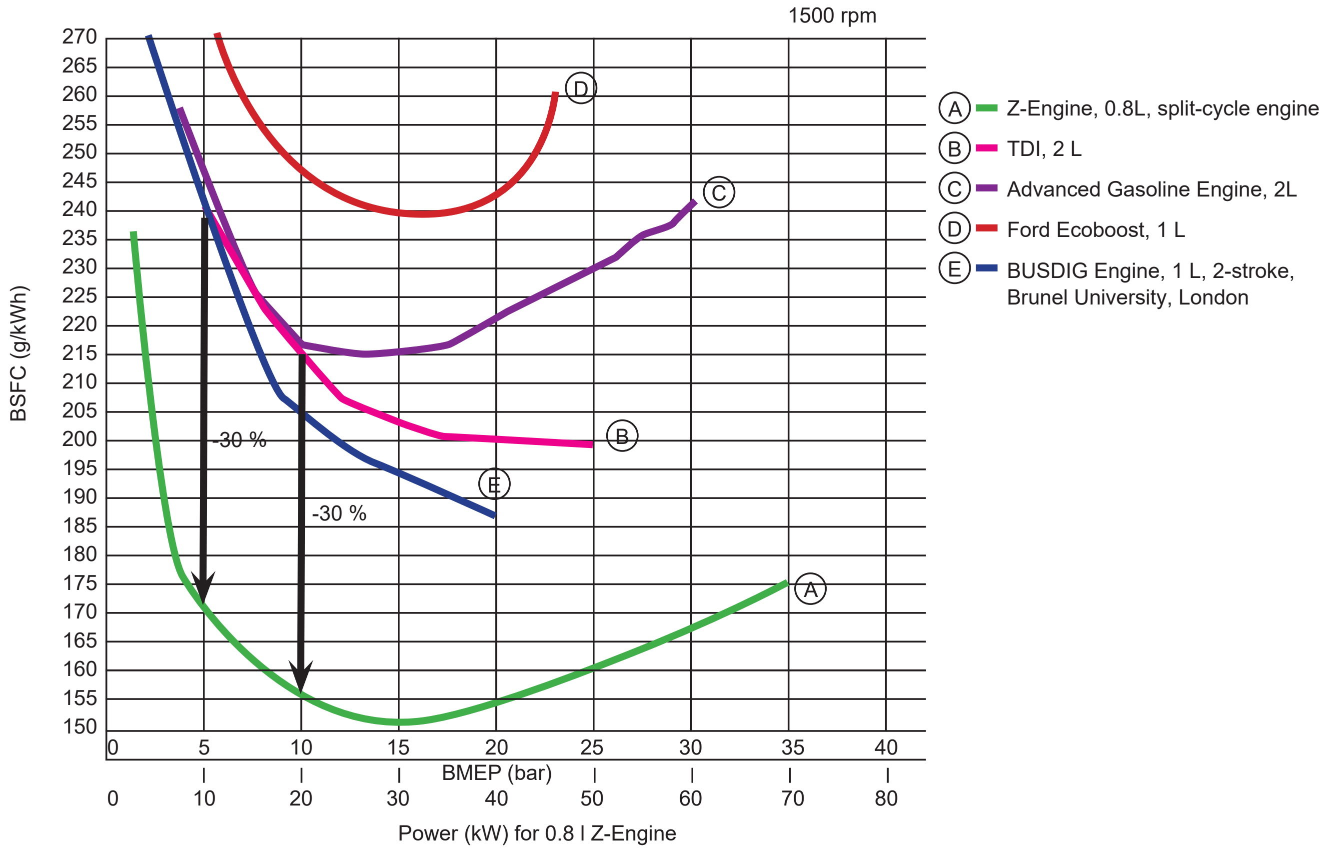
Fuel ignition close at TDC **Z-engine with adjustable turbochargers bypass and LPEGR**

lambda 1,2-1,5, containing about 15% IEGR and 10% LPEGR. IEGR makes possible the main fuel rapid evaporation during the main fuel injection and it also makes the formation of active radicals possible, thus lowering the activation energy of the fuel. LPEGR contains water steam and when it condensates in the high pressure intercooler, the water can be injected to the intake ports of the Z-engine for controlling TDC temperature. The controlled turbo bypass channel helps to keep the IEGR pressure in cylinder at the end of exhaust cycle at about 2 bar. Thus the main fuel injection with outwards opening conical nozzle can form a homogenous mixture in the cylinder without wall wetting.

As TDC temperature in Z-engine is low, the main air-fuel mixture in the cylinder is lean and its Livengood-Wu integral can be kept between 0.4-0.6 so self ignition cant occur. The ignition injection with side injector forms a rich mixture around the high voltage spark electrodes and as this fuel is fully evaporated, it is easy to ignite accurately with high voltage sparks.

Brake Specific Fuel Consumption (g/kWh) vs Brake Mean Effective Pressure (bar)

(Compression ratio e = 30, Z-Engine)



The ignition of the mixture occurs in Z-engine always at lower temperature than negative temperature coefficient regime of the mixture and so knock is impossible. RCCI and HCCI combustions produce ultralow amount of NOx, especially when TDC temperature is low, as in Z-engine. Because the ignition fuel is fully evaporated before its ignition, it produces very little NOx. Particle emissions from HCCI combustion are very low and they are so called wet particles, combusting easily in oxicat.

The mass flow of the piston compressor in Z-engine is adjustable by using early intake valve closing method and so no throttling occurs. Z-engine has expansion ratio of 30:1 at all loads and therefore it has a high TDC compression pressure. The spark ignition at up to 150 bar pressure requires a high ignition voltage, in Z-engine this is solved by using + and – polarities against the earth in the middle electrodes of the modified sparkplugs. Thus commercial ignition components, for example ignition coils, can be used.

As a result of all before mentioned: part load BSFC=150g/kWh, NOx = 0.005 – 0.09 g/kWh, only oxicat needed, manufacturing costs 20% lower, weight 20% lower, no urea needed, normal car industry components, no changes in the supply chain.

“To be able to reduce the fuel consumption of the cars, HCCI combustion must be used and it is needed to make changes to the combustion engines and their thermodynamics.”

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