How Renault partnered with València University to develop new powertrain concepts targeting CO2 reduction – Q&A

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Francisco Payri, Frederic Ravet, Ricardo Novella

As automakers search for novel ways to improve fuel efficiency, technology partnering with universities remain popular. Matthew Beecham spoke to Pascal Tribotté and Frederic Ravet from Renault in France and Francisco Payri and Ricardo Novella from CMT Motores Térmicos at the Universitat Politècnica de València in Spain to learn how industry-academia collaboration can deliver some powerful results.

Francisco, as the head of CMT-Motores Térmicos, can you tell us a little about your university department?

Of course. Based in Valencia, we are an educational and research centre focussed on advancing combustion engine technology. We've been around for 35 years now. We have around 40 researchers, 45 research assistants and 65 students on site working on a huge range of projects. At any one time there are around 50 research projects progressing and we've done over 540 to date. We have particular expertise in combustion and the opportunities to optimise this are attracting OEMs to work with us. Our total funding is about 12 million Euros per annum of which about one third is coming through research projects.

Pascal, can you describe a recent project?

Maybe you have heard of the POWERFUL project? This was a Pan-European project leaded by Renault to develop new powertrain concepts targeting big cuts in CO2 reduction. For spark ignited (SI) engines the target was 40 percent lower CO2 emissions and 20 percent lower CO2 emission than the 2005 level for compression ignition (CI) engine powered vehicles.

These were real life emissions too, looking at amending test procedures, something that is more relevant now too!

Three different concepts were investigated: - ultra-downsized gasoline engine integrating VVA, advanced turbocharging and Direct Injection, a two-stroke downsized diesel engine integrating HCCI and low temperature combustion modes and finally, a combined combustion system based on a Compression Ignited engine designed to cope with a new fuel formulation. In this framework, the validation tests were performed right here at CMT-Motores Térmicos at the Universitat Politècnica de València.

What did you discover?

Pascal Tribotté - Our researchers did assess the potential of the two-stroke engine architecture as a solution for reducing pollutant emissions and fuel consumption compared to engines currently available on the market.

Ricardo Novella - What was really interesting was our ability to model advanced combustion concepts to a very accurate level, as alternatives to the conventional diesel architecture.

Frederic, how was this achieved?

We have access to a range of the very latest simulation tools and for this project what was crucial was accurate CFD software. Convergent Science's CONVERGE CFD is the most accurate tool we encountered. You have to remember that the kind of projects we are working on are very novel and few modelling programmes are capable of being able to cope with the very advanced models we want to validate. In this case it was a two-stroke injection diesel engine architecture running on a gasoline-like fuel. Modelling such cases typically involved building engines which is hugely costly and time consuming. And if it doesn't work you have a lot of scrap metal! Using CONVERGE made it easy to test and validate ideas before having a real engine. We found other benefits that worked well for a research function.

Ricardo, could you explain the benefits of using CONVERGE in this research?

I believe CONVERGE is unique in that it creates the mesh required to model the engine automatically. Creating the mesh has always been an issue in both education and industry. Before using CONVERGE we saw disparities between groups of students and even experienced engineers. By removing that disparity we have eliminated the variations and inaccuracies that have led to CFD being mistrusted.

Do you have a simplified version for students?

Ricardo Novella - No, we use a standard educational licence, which Convergent Science provides to universities. This enables students to use a real software package that they will maybe experience in the world of work. We find that the software is so simple to learn we have reduced training time by up to 80 percent and I think we have moved from 60 percent of our time doing computations and 40 percent analysis to the reverse. With more analysis we can use our time for investigating more ideas that may yield in combustion, fuel efficiency. We are very excited by the potential for Compression ignition (CI) engines and we continue to work in this field.

What is it about CI engines that appeals?

Pascal Tribotté - The simulations and real world testing we have been part of highlights a worthwhile efficiency advantage for CI over other SI versions. Their implementation would not be so complex as they can use gasoline with major infrastructure investment.

Francisco Payri - In Europe, there is still a challenge to balance the demand for gasoline and diesel. Introducing this kind of engine could redress that and as we have seen in recent weeks, there are more concerns about emissions from diesels. OEMs are often reluctant to commit to new architectures but a simulation that is validated and can be trusted can help to accelerate their adoption.

What is your next project?

Ricardo Novella - Yes the Pan-European REWARD project we can tell, as a way to go further ahead. The REWARD consortium is taking on the challenge of developing diesel powertrains and after-treatment technologies for the next generation of cleaner passenger cars and light commercial vehicles. It is the aim of the REWARD project to limit both exhaust pollutants, as well as improve the car's fuel efficiency.
