

Racing to develop a new fuel



Audi Mileage Marathon. Photo: Shell

The emerging gas-to-liquids (GTL) industry has led to the development of a commercially viable technology that allows the conversion of natural gas into high-performance synthetic oil products, such as gasoil, naphtha and base oils for high-spec lubricants. These products are now proving themselves in a variety of demanding applications – notably, in the case of Shell, on the racetrack.

| by Alex Forbes

It's a grey October morning in New York's Central Park when my co-driver Lou Ann and I first get to see the car we'll be driving. It turns out to be an Audi A4 3.0 litre TDI, with a tankful of truly exotic fuel – 100% synthetic diesel made from natural gas at a plant in Borneo.

We are among the 50 or so journalists whom Audi has invited along for the first of four 'waves' of a coast-to-coast motoring extravaganza dubbed the Audi Mileage Marathon – which means we'll be driving from the Big Apple to Washington DC, then to Cleveland, and finally to Chicago. The entire event, involving 23 cars and close to 200 journalists, will culminate in Los Angeles in a fortnight's time.

Rain threatens as we listen to speeches from Audi executives and an over-exuberant Las Vegas celebrity – who, despite her winning smile, looks like she could use a good dinner or three. As the speeches draw to a close and as the first raindrops begin to fall, we settle into the cars and begin our epic mission – to help Audi convince the American motorist that diesel no longer means 'dirty, smelly and sluggish'.

Waved off by racing driver Emanuele Pirro, one of the Audi team that won Le Mans

in 2006, we set off – full of anticipation – to spend the next half-hour stuck in the traffic trying to get out of Central Park. OK, so two out of three ain't bad.

'Dieselisation' |

It's a fascinating fact that a new car bought in Europe today is more likely than not to have a diesel rather than a petrol engine – a trend

putting on a party as it is at making diesel-engine cars – whether for the race-track or the highway. 'Vorsprung durch technik' during the day gives way each evening to 'Vorsprung durch champagne'.

What's more, we're in a special car – sponsored by Shell. It's the only one with a huge Shell logo on the bonnet, 'GTL Fuel' decals on the rear wings and neat gas-to-

Audi has decided to spend several million dollars on what is essentially a massive publicity stunt

that has come to be known as 'dieselisation'. Much the same has been going on in a number of Asian markets.

In America, however, diesel is still seen as a fuel fit only for trucks. The number of diesel cars in the US is just 1-2%. Some motor manufacturers see this as a huge opportunity – which helps to explain why German car-maker Audi decided to spend million dollars on what a massive publicity stunt.

Lou Ann and I aren't complaining. We're about to find out that Audi is as good at

liquids (GTL) synthetic diesel fuel in the tank. For Shell this is yet another opportunity to get its GTL marketing message across. For us it's, well, neat.

The traffic eases and before long we're driving across the George Washington Bridge and find ourselves motoring south on the New Jersey Turnpike. Now, where have I heard that before? Oh yes, the Simon & Garfunkel song 'America': 'Counting the cars on the New Jersey Turnpike . . . they've all gone to look for America . . .'



Scenes from the Audi Mileage Marathon



Second-generation breakthrough |

In June 1992, Heiko Oosterbeek had just returned to work at the Shell research and technology centre in Amsterdam after a week's leave following the birth of his youngest daughter. He was then working on testing formulations for a cobalt-based GTL catalyst.

On June 16 he received the test results for a mix he had prepared a few days earlier. His lab journal for that day reads: 'Unbelievably high selectivity, we ought to double-check this in other equipment.'

Ten days later, having tweaked one of the preparation conditions for the mix, he found that the test results looked even better. The entry in his lab journal for June 26 reads: 'Selectivity is still ridiculously high, and now the activity is also very high.'

Oosterbeek's discovery became the basis for what the group now calls its 'second-generation Fischer-Tropsch catalyst'. Today, in the Gulf state of Qatar, Oosterbeek's

equivalents per day of upstream products such as condensate, LPG and ethane.

Pearl GTL is currently one of the largest construction projects under way in the Middle East, representing an investment of some \$18 billion. According to Andy Brown, the project's managing director, it is due to be completed 'around the turn of the decade'.

A Capitol journey |

It turns out that my co-driver Lou Ann Hammond, who lives in California, runs a motoring website called carlist.com. She's fascinated by the fuel we have in our tank and posts the first of several reports on her website. We reach Washington DC to find that our hotel is within sight of the Capitol.

But first we have to stop and re-fuel. As we reach the appointed garage, we are greeted by a team of technicians who record crucial data. They break the signed seal on the tank, fill it (not with neat GTL, this time,

crawling along at a snail's pace (and without unscheduled re-fuelling stops or hiring surreptitious tow-trucks). But I find it impossible not to try out what the combination of special car and special fuel can do – and floor it more than once. We are the first car to reach the garage, and our mileage score turns out to be, well, disappointing. Looking on the bright side, we are lucky not to have been pulled over for speeding. Others have. Obviously they weren't going fast enough.

Big bang |

On Christmas Day 1997 an explosion tore through the Bintulu GTL plant in the Malaysian state of Sarawak on the island of Borneo. It had come on stream in 1993, with a capacity of 12,500 bpd, and operated without problems for four years. Now it had become a victim of the vast forest fires in Indonesia that cast a pall of smoke over much of southeast Asia. Smoke particles from these fires had been accumulating in an air separation unit, a large piece of kit that produces oxygen. The explosion severely damaged the GTL plant, and large chunks of metal landed in the town several miles away.

Shell consoled itself by pointing out that the explosion had nothing to do with its GTL technology, but it still took three years to rebuild the plant. But there was a silver lining even to this smoke cloud. It gave Shell a chance to replace the catalyst it was using in the plant with Oosterbeek's more productive version. And Shell's

Pirro assures us his reflexes are up to the task, but keeps turning around to talk to the camera'

catalysis work has become one of the foundation stones for the Pearl GTL project, which will be the world's largest by far, producing 140,000 barrels per day of synthetic gasoil, naphtha and base oils along with 120,000 barrels of oil

but with Shell V-Power), re-seal it, and sign the seal. They do seem to be taking matters very seriously. More so than we are, I feel. Our task on this marathon is supposed to be to get the most economical fuel consumption out of the car without

decision to show off its revitalised plant gave me a chance to see for myself what GTL technology had to offer.

It was in the spring of 2000 that Shell decided to take a party of journalists to see the newly rebuilt Bintulu plant, now with a capacity of 14,700 bpd. It was a memorable trip, involving three flights, each in successively smaller aeroplanes. The first, to Kuala Lumpur, was in a 747. The final flight, from Kuching, state capital of Sarawak, to the town of Bintulu, was in a small propeller-driven plane. It was my introduction to a technology that I now follow avidly – and to small propeller-driven planes.

Back to the future |

It was in the 1920s that two German chemists – Professor Franz Fischer and Dr. Hans Tropsch – devised one of the processes necessary for the conversion of short-chain hydrocarbon molecules, such as natural gas, into long-chain hydrocarbons.

While there are several technologies that can be used to convert natural gas-to-liquid products, the term GTL is most often used to describe the use of Low-Temperature Fischer-Tropsch (LTFT) technology for the conversion of natural gas into ultra-clean, high-performance synthetic products. These products include transportation fuels such as synthetic diesel and kerosene, petrochemical feedstocks such as naphtha, and base oils for high-spec lubricants.

Eight decades on, there are just three Fischer-Tropsch GTL plants of commercial scale in operation: Shell's 14,700 bpd Bintulu plant in Malaysia, PetroSA's 22,500 bpd Mossel Bay plant in South Africa (a High-Temperature Fischer-Tropsch plant that produces gasoline and aromatics), and the 34,000 bpd Oryx GTL plant in Qatar, a joint venture between Qatar Petroleum and South Africa's Sasol

Their combined capacity makes GTL a very small industry today. However, if another two projects currently under construction – Shell's Pearl GTL project in Qatar, and the Chevron/NNPC Escravos project in Nigeria – come on stream before the end of 2012, capacity will rise to around a quarter of a

million barrels per day. This would make GTL a small but nevertheless significant industry in the context of a world-wide diesel market of around 15-16 million bpd.

On to Ohio |

Day Two and Lou Ann has managed to engineer things so that Emanuele Pirro will be driving our car. My previous experiences of being in the same car as a racing driver have always been nerve-racking – and this one is no exception. Even Lou Ann – especially Lou Ann – is worried by Pirro's habit of driving bumper-to-bumper behind a large truck to get the fuel-economy advantage of being in its slipstream. Ironically, his competitive instinct is the cause: if the target is fuel efficiency, he's happy to pursue that with the same determination that it takes to win Le Mans. Personally, I'd rather he

A few months later, the feat was repeated when the Audi R10 won Le Mans, the world's most famous endurance race – driven by Pirro, Frank Biela and Marco Werner. Again, it was the first time that the race had been won by a diesel-engine car; again, the car was running on a GTL blend. For the 2007 race, the organisers ruled that the car appeared to have an unfair advantage and insisted that its fuel tank volume be reduced by 10%. Again, the Audi won.

Because of the chemistry involved in the conversion of natural gas into synthetic oil products using the Low-Temperature Fischer-Tropsch (LTFT) process, the end-products are superior to those produced by a conventional refinery in two important ways: they are cleaner, which has implications for pollution reduction; and they have superior chemical properties that

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floored it, but who am I to tell a Le Mans winner how to drive.

On the plus side, Pirro is happy to be interviewed while driving. So with Lou Ann on video, and me on sound, we dice with death, six inches behind a huge truck, while doing our best to get good 'footage'. Pirro assures us his reflexes are up to the task – he is, after all, a racing driver – but keeps turning around to talk to the camera.

Win-win-win |

When the Shell-sponsored Audi R10 crossed the finish line ahead of all the other contenders in the US Sebring endurance race in March 2006, it sent out a marketing message that money on its own could not have bought.

It was the first time that a diesel-engine car had won the race. More specifically, the car was running on a diesel blend containing GTL produced by Bintulu. The victory demonstrated how far diesel engines and diesel fuel have come in recent years.

can deliver performance improvements. For example, synthetic diesel has a cetane number – a measure of how regularly the fuel burns – of around 70, which compares with around 50 for refinery-produced diesel.

Really cool |

I ask Pirro what it was like to win Le Mans. 'I've been an Audi driver for many years, so I know how serious Audi is. But when they told me, top secret, that there was this idea [to develop a diesel-engine racing car] I almost fell off the chair. At the time diesel was associated with medium-performance cars, something for trucks. But because it was Audi telling me, I thought this would be an unbelievable opportunity to be part of a project that would be a first in the history of motor racing. The first win at Le Mans was really cool. I couldn't believe it.'

What difference is there between a petrol-engine car and a diesel-engine car? 'Oh, big time. The shifting point is round about 4,500 rpm, which is stunningly low. Yet the



Alex and Lou Ann. Photo: Shell

torque starts very early. The engine itself is smooth, balanced, quiet. When you apply the power, the boost builds up, then you have this really big push, which is not too easy to control, and the power keeps on the same level for a while. So the power range is not that wide, but it is consistent from the moment you apply the throttle to the moment you have to upshift.'

The road ahead for GTL |

As for the GTL industry, it has taken decades get to the point where commercial-scale plants have become possible. And still the challenges are immense. The Qatar Petroleum/Sasol project in Qatar, Oryx, was inaugurated in 2006 but is still struggling to ramp up production to full

capacity because of unexpected technical problems in the Fischer-Tropsch reactors that are at the heart of the plant.

In Nigeria, the Escravos project is facing delays and cost over-runs and is unlikely to come on stream much before 2011.

Shell, meanwhile, is about half-way through construction of its Pearl project, which covers an area the size of London's Hyde Park. If the project works as planned, it will be very profitable indeed if oil prices stay at the levels we have seen over the past year.

Other players are planning more projects, but most are still in relatively early stages, giving Shell and Sasol a big technology lead.

On to Chicago |

Day Three, the last day of the first wave of the Audi Mileage Marathon, sees us set off from Cleveland to Chicago. When yesterday's scores are read out at breakfast, we learn that we managed 41.3 miles per gallon yesterday, an impressive figure for a car with a three-litre engine.

We get to Chicago, where once again it's 'vorsprung durch champagne' to celebrate the completion of the first wave.

In the morning, it's time to hand over the cars to the next wave of journalists, who will take them on to the half-way point, Denver, via Memphis, Dallas and Amarillo. I bid Lou Ann farewell and set off for O'Hare International Airport – and home. ■