# Countdown to Cleaner Emissions

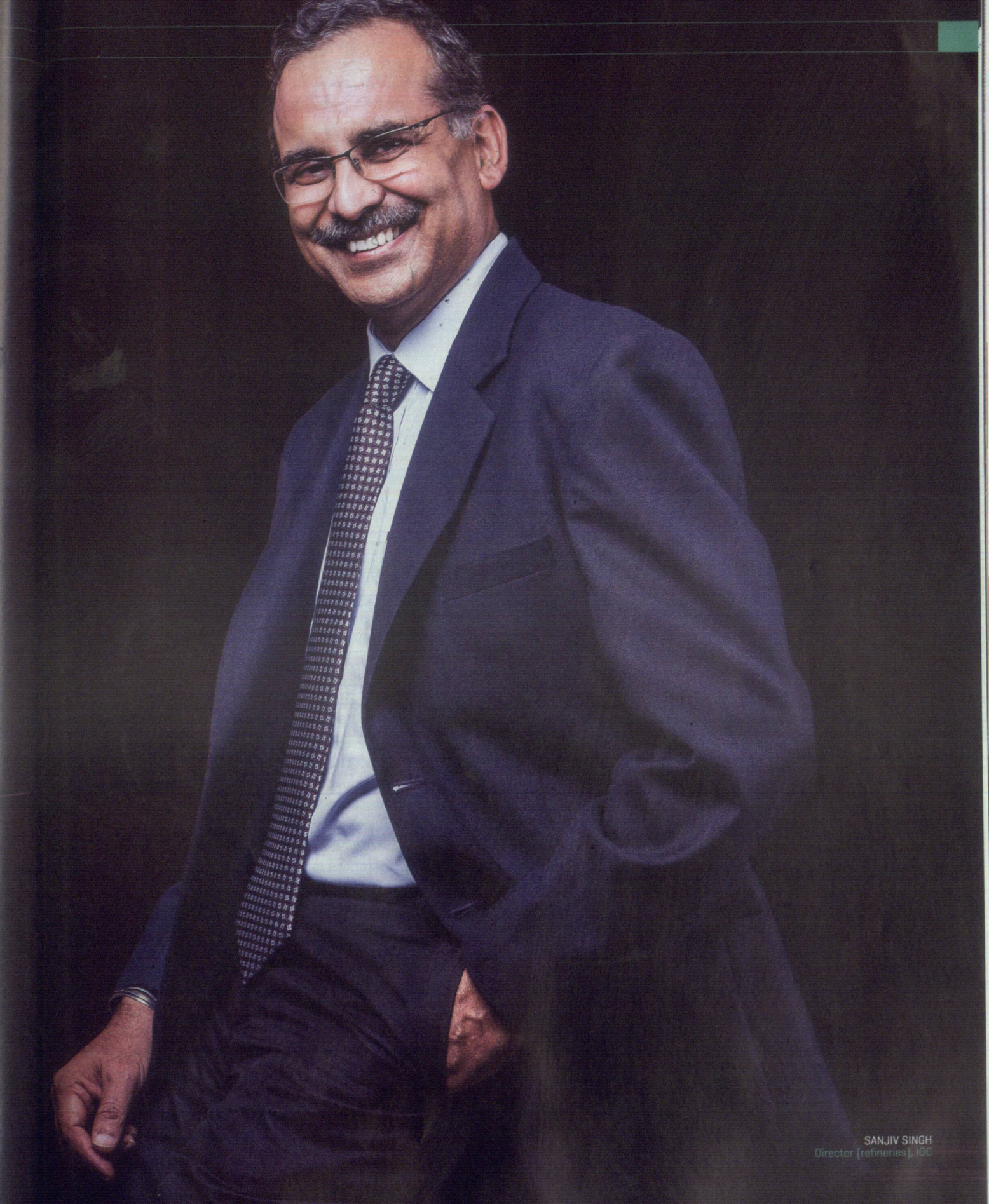
An almost arbitrary decision to leapfrog fuel standards has managed to disrupt two large industries—oil and auto manufacturing. It's good news for the environment, but for companies it means a huge drain on resources. And it all starts with INDIANOIL.

*By* **ASHISH GUPTA & KUNAL N. TALGERI** / *Photograph by* **YASIR IQBAL**

**WHAT DOES IT TAKE** to get a behemoth to sprint? Answer: a goad. Indian Oil Corporation (IOC), the country's largest company, and No. 1 on the *Fortune India* 500, is used to moving at a sedate pace. Like most public sector undertakings, IOC is happy to set up committees to deliberate and ponder upon issues. But when the government cracks the whip, even a giant like IOC must react.

What the government has done is to advance the implementation of Bharat Stage VI emission norms to 2020 instead of 2024, bypassing BS V entirely. (BS V was to come into force from 2019.)

Before we get any further, a quick look at the Bharat Stage norms may be useful. Introduced 16 years ago, these rules are meant to regulate (and control) air pollutants from vehicle engines and generators. The emission standards are set up by the Central Pollution Control Board, and are based on European regulations. The government had laid out a road map for the phased implementation of BS norms—till it decided to skip a step. Meanwhile, there are parts of the country still not on BS IV. Oil companies provide both BS III and BS IV fuel to different regions. The deadline for BS IV pan-India is April 2017.



SANJIV SINGH
Director (refineries), IOC

Why did the government take this drastic step? According to a report by the Environment Pollution (Prevention and Control) Authority (EPCA), "Quick implementation of Euro 5 and Euro 6 emission standards is needed because diesel emissions close gap with petrol emissions only at the Euro 6 stage to address the toxic risk."

To explain the science: BS IV and BS VI have far lower sulphur content than BS III. In diesel, the sulphur content is progressively reduced from 350 ppm (parts per million) in BS III to 50 ppm in BS IV and 10 ppm in BS VI. In petrol, the sulphur spec gets reduced from 150 ppm to 50 ppm to 10 ppm.

The leap in technology needed to move to BS VI is likely to cost oil companies a cool Rs 50,000 crore at least; some reports estimate the cost at closer to Rs 80,000 crore. For IOC alone, the switch from BS IV to BS VI will entail upgradation expenditure of Rs 13,000 crore, and another Rs 7,000 crore to make all refineries BS VI compliant.

A **LOT RIDES ON** Sanjiv Singh, director (refineries), IOC. A cheerful, unflappable engineer, Singh is the person who will be in charge of IOC's move to the new norm. He'll have to make sure BS VI fuel is ready for distribution to automakers by 2019, giving vehicle manufacturers one year of testing their vehicles with the fuel. Such a transition requires five years at least. "Such a quantum jump within a span of three years is being attempted perhaps for the first time by any country in the world," says Singh.

The major pain will be felt by the refineries. "We have different processes, where we have seven or eight different streams of diesel." In these streams, there are different quantities of sulphur—in some it is 10 ppm, in some zero, and in others it is nearly 500 ppm. "We mix them in different ratios and add properties to make the final diesel components. So when we have to make diesel with 50 ppm, or petrol with 10 ppm, all the streams will have to be further hydro-treated. We have to take out the sulphur from all the streams." Hydro-treatment is an established refinery process for reducing sulphur and nitrogen. BS VI requires oil refiners to bulk up their hydro-treatment units. "We will either revamp the existing units or add new ones. To make these additions while running a refinery is a challenge." The issue: installing it in a time-bound manner, without impacting refinery operations, so that there is no disruption in supply.

Auto companies are sceptical that this will happen. "We have Euro 6 engines; there will be some issues in getting them programmed to the Indian driving cycle. That will take some time, but we are getting ready. My only doubt is if oil and gas refineries can change their configurations from Euro 4 to Euro 6. Can it be done in four years pan-India?" asks Shekar Viswanathan, vice chairman and whole-time director of Toyota Kirloskar Motor.

"The big issue is oil companies are not promising us they will provide petrol and diesel of exactly the same quality as Euro 6," says Raman C.V., executive director (engineering), Maruti Suzuki. He says his company has made repeated requests for parity in Euro and BS standards, "otherwise it will affect the efficiency and performance of our car engines." The Euro 6-compliant engines cannot be used in India, Raman says, "because the road and weather conditions are different. So we have to test the engines in these new conditions."

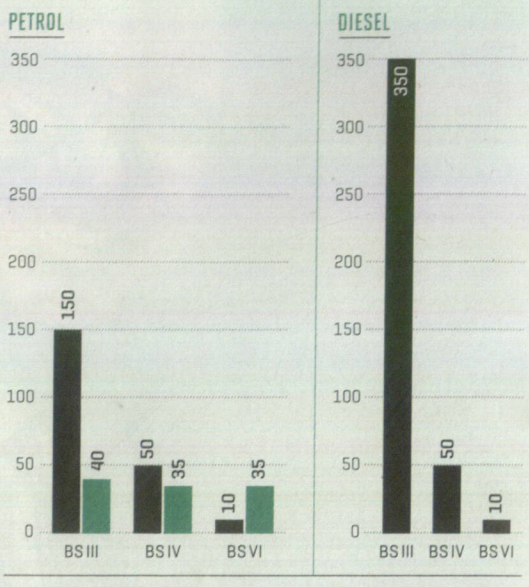
Singh says it's easy for the BS norms to mirror the European ones, "but if I follow Euro VI blindly, my LPG production comes down, my diesel production comes down". But minor tweaks and deviations from the Euro norms could mean an increase in domestic diesel production. "Why should we not do so? Somebody else is making money because of India's imports."

Singh says IOC will not be a roadblock to automakers. "We can give BS VI fuel in small quantities for trials to the auto companies in a timely manner."

**WHEN PASSENGER VEHICLE** makers planned production for BS V with the erstwhile 2019 deadline, it entailed adding a 'diesel particulate filter' (DPF).

## HEAVY FUEL

The accepted sulphur and aromatics levels in petrol and diesel across BS levels




*particles per million; Source: IOC

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— **Shekar Viswanathan,** *vice chairman, Toyota Kirloskar*

# 50,000

**THE NUMBER OF PETROL PUMPS THAT WILL NEED TO BE FLUSHED OUT BEFORE BEING LOADED WITH BS VI FUEL**

For BS VI, the engine compartment, and perhaps even vehicle dimensions, may call for changes because of a new component called the SCR, or selective catalytic reduction. This converts harmful nitrogen oxides in diesel emissions by a catalytic reaction, into benign nitrogen gas, water, and tiny amounts of carbon dioxide. This could lead to a peculiar Indian problem.

Local tax laws have favoured cars that are less than 4 metres in length. But for BS VI, the car configuration may require vehicles to breach the 4 metre mark. Raman doesn't see this being a problem. Neither does the government. In fact, speaking to the media about the decision to move to BS VI, transport minister Nitin Gadkari said the decision was unlikely to have a negative impact on automakers; most of them already produce Euro 6 compliant engines in India for export. Even so, carmakers have to start preparing a new slew of cars for BS VI, and get them ready in three years.

Auto component makers Bosch, Denso, and Delphi will be vital for the switchover to BS VI, which means they have even shorter time frames to localise design and performance of the SCR and particulate filters. "It will have to be imported because the Indian players will not be able to localise them immediately," Raman says. Global suppliers will have to set up factories, which means added expense.

"It is hard (for automakers) to make strategy in such a context," says Abdul Majeed, partner at consulting firm PwC in Bengaluru. "Fuel efficiency, emission, and safety will drive new vehicle design and production in the next three years," he adds. For a five-to-seven year period, they have to innovate for autonomous vehicles and the connected car even as they stand to gain little from the investments thus far. The auto industry also has to prepare for

PHOTOGRAPH BY **BANDEEP SINGH**

CAR COMPANIES HAVE BEEN WORKING TO REDUCE EMISSIONS, AND MANY ALREADY HAVE EURO 6-COMPLIANT ENGINES. THE BIG QUESTION IS IF OIL COMPANIES CAN SUPPLY THE FUEL.

a different generation of technology challenges: cab aggregators that will feast on pessimism surrounding car purchase. Nobody right now is betting long term. "Regulatory uncertainty will create trouble for everyone," says Majeed. For the next three years, all energies will be on maximising market share.

There's another problem that's unlikely to disappear soon. "Customers buy vehicles from cities where BS IV is not applicable, then bring and run them in bigger cities," says Majeed. "So you still have BS II and BS III vehicles running in large cities [where BS IV is in force]." Singh elaborates: "The benefit of superior engines running with superior fuels will be significant only when a substantial percentage of BS VI compliant vehicles run on road."

To ensure that there is a perceptible benefit, the government and regulators have to devise a scrapping policy to phase out cars that have engines for BS III fuel. "The Supreme Court [in a 1998 judgment] ordered that the government should set up inspection and maintenance centres to check the roadworthiness of vehicles," Raman says. Unfortunately, there is only one such centre in the country. "While we work to reduce hazardous substances and raw materials, there has to be a process by which you know which vehicles need to be taken off the road."

PHOTOGRAPH BY **BANDEEP SINGH**

**M AHESH CHANDER MEHTA**, better known as M.C. Mehta, has been a Supreme Court lawyer and activist in environmental protection. In 1985, in a writ petition, Mehta moved the Supreme Court, challenging administrative slack in the National Capital Region, and called for action against

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THE NUMBER OF REFINERIES THAT INDIANOIL OPERATES ACROSS THE COUNTRY

98.9%

CAPACITY UTILISATION ACROSS INDIANOIL'S REFINERIES

vehicles that emit carbon monoxide and nitrogen oxides, lead, and smoke. Several orders and directions by the Supreme Court since are based on his writ petition.

In 1998, the apex court ordered Delhi's public transport authorities to replace diesel with compressed natural gas (CNG). It held that three-wheelers and taxis should run on clean fuels by April 2000. That same year, the Ministry of Environment and Forests had formed the EPCA, chaired by Bhure Lal, then secretary of the Central Vigilance Committee. The EPCA comprised the transport commissioner, director of the Centre for Science and Environment, a representative of auto manufacturers, and the chairman of the Central Pollution Control Board. The principal task: to deal with environmental issues pertaining to the National Capital Region.

A Supreme Court order dated April 16, 1999, cited the Bhure Lal Committee report, and pointed out that private (non-commercial) vehicles comprise 90% of the vehicles plying in Delhi. More than 90% of the nitrogen oxide and particulate matter from vehicular exhaust in Delhi is due to diesel emissions, it stated. "More private vehicles are turning to diesel as the fuel of choice primarily because of the price differential between diesel and petrol," the court stated.

In a February 2014 report, the EPCA noted that the price gap between CNG and diesel had narrowed, considerably hurting the CNG programme in the late '90s. Data sourced from the Society of Indian Automobile Manufacturers (SIAM) confirms this.

Diesel passenger vehicles accounted for 58% of vehicles sold in 2013-14, when diesel prices dropped and petrol prices soared. That dropped to 53% and 48% in the following financial years. More worrying, sales of utility vehicles between April 2011 and March 2014 saw a 96% preference for diesel. Consumers saw price and mileage benefits in diesel. By 2015-16, the Supreme Court had called for a ban on new diesel vehicles (starting with large SUVs), and came down hard on diesel taxis. Sales of diesel utility vehicles came down to 87% of all vehicles sold.

"Rapid motorisation based on poor-quality fuel and vehicle technology will make air pollution trend irreversible," the EPCA report of 2014 noted, adding that only 38 cities (including the satellite cities in NCR) get Euro IV or BS IV fuel vehicles. The switch to BS VI is important for the future of diesel engines because it means cleaner emissions.

But diesel has its defenders. When the National Green Tribunal banned registration of new diesel vehicles in Delhi late last year, Pawan Goenka, Mahindra & Mahindra executive director, told reporters that only 0.5% of air pollution is caused by diesel.

So, is diesel being unfairly targeted? "India is a diesel-driven economy," says Singh. "Unlike refineries in the U.S. and Europe, refineries here are designed to produce more diesel than motor gasoline." Then again, there is no other country where 65% of petrol is used by two-wheelers.

**VEHICULAR EMISSION IS** just one subset of the green problem. Between 2000 and 2013, air pollution levels increased dramatically across India. The global nonprofit organisation Greenpeace attributed this to a number of factors: massive fossil fuel consumption, industrial growth, increase in vehicle numbers, and rapid expansion in construction activities, along with biomass burning at household level and in agriculture. In a May 2016 report, it highlighted the role of coal-based (thermal) power generation as one of the largest sources of sulphur dioxide ($SO_2$) and nitrogen dioxide ($NO_2$) emission in 2009-15, based on satellite data analysis.

"Identification of (pollutant) hot spots clearly indicates that large industrial clusters are the dominant sources of $SO_2$ and $NO_2$ emission growth, with huge capacities of new coal-fired thermal power plants as the main driver," the Greenpeace report stated, assessing Indian states with the highest emission levels.

Industry is responsible for nearly 90% of $SO_2$, 52% of $NO_x$ (nitrogen oxides) and 11% of the $PM_{2.5}$ (particulate matter) emissions load in Delhi. The Greenpeace report states that most of these pollutants are emitted from power plants. "The sulphate and nitrate particles formed from $SO_2$ and $NO_x$ pollution, respective-

"UNLIKE REFINERIES IN THE U.S. AND EUROPE, REFINERIES HERE ARE DESIGNED TO PRODUCE MORE DIESEL, AS COMPARED TO MOTOR GASOLINE."

—Sanjiv Singh, IOC

ly, are key contributors to the total PM2.5 pollution. In comparison, the most cited emissions (from vehicles) is responsible for approximately 1% of SO2, 36% of NOx, and 20% of the PM2.5 emissions load from the city, excluding emissions from sources outside the city boundary."

**GLOBALLY, THERE IS** no clarity or consensus on which fuel is environmentally sustainable, says PwC's Majeed. Petrol poses dangerous levels of carbon dioxide emissions, diesel emits high levels of nitrogen oxides and particulate matter, and CNG methane. Petrol has been the most available and preferred fuel in countries such as Japan and the U.S., whereas diesel demand grew in Europe and India. Even electric vehicles are frowned upon because their fundamental source of energy—electricity—is coal based.

For sure, the legislative and judicial controls on the fuel economy have led to a pause in the auto industry. BS VI has added another predicament in their production planning. "The 2000 cc diesel engine ban has brought about uncertainty," Majeed says. If the Supreme Court converts the ban into a diesel tax in the 1%-5% range, vehicle manufacturers can hope to amortise investments made towards their diesel vehicle output. But if it's at 7%-10%, the end price of the current vehicle output could touch an additional Rs 2 lakh. The 2020 deadline also gives a shorter time span for the BS IV (current) vehicles to be sold with this price surge.

Singh says fuel specifications have seen significant improvement since the emission control programme started in 2003. For petrol engines, one of the most critical specifications is the Research Octane Number (RON). "This has improved from 88 in BS II to 91, which is on a par with regular 91 octane gasoline required for Euro 6 emission norms," he says. Other critical specifications such as benzene and aromatics have also undergone considerable improvement from earlier limits specified in BS II.

"What we talk about is the octane number in petrol: There is a huge demand from automobile companies for Octane 95 for petrol," says Singh. But Euro 6 specifications call for retention of Octane 91 or Octane 96.

76.5

MILLION TONNES

INDIANOIL'S TOTAL SALES IN 2014-15. THIS INCLUDES GAS, PETROCHEM, AND PETROL PUMPS

Auto manufacturers prefer Octane 95 to 91 because it allows engines to give more power. "Putting Octane 95 in cars running on Octane 91 engines brings no benefits." This is just one instance of the pushbacks from auto and the oil industries that will be rife in 2019.

**WHATEVER THE FUEL,** in discussions with the government, all manufacturers have felt the time frame is insufficient. "We will have to rush with development. Perhaps, another year would have been optimum," says Nalin Mehta, managing director of Mahindra Trucks. Mahindra Trucks is a joint venture of the Mahindra Group and Navistar, an American truckmaker that was hounded by legislative penalties to reduce the amount of nitrogen oxide and soot emanating from its diesel engines. In 2013, the Mahindra Group bought out

Race against time: The early deadline to impose BS VI has caught some car companies on the wrong foot.

the Navistar stake in the joint venture.

Its truck and bus engines are developed in Chakan, near Pune, based on the designs of MWM International Motores, the Brazilian subsidiary of Navistar International. "We pay royalty to Navistar for the engine technology, with a technology assistance agreement but manufacture the engines locally," says Mehta.

Over at Tata Motors, Tim Leverton, head, advanced and product engineering, says his company will see a significant increase in workload for its engineering teams. "Having invested strongly in the research and development for future emission reduction across the entire range of vehicles, we understand this technology, and it is available from our strategic supplier partners. However, the application to our vehicles is yet to be completed as it was until recently planned for 2024. This is a complex engineering task and our engineering teams have started working on critical programmes," says Leverton.

To meet the April 2020 deadline, IOC will have to start cleaning operations a few months before. "We will have to flush all our petrol pumps across the country. And by April 1, 2020, all the pumps will have BS VI fuels and other products," Singh says. For IOC, this involves 25,000 fuel stations, including some in remote locations. It's going to be a mammoth exercise in logistics. "If you look at the others like HPCL and BPCL, it goes up to 50,000-plus petrol pumps across the country." It is the world's largest customer interface. That's why taking the whole country to BS IV next year—right now, it is operational only in 38 cities—will be some sort of a trial run. "When we roll out the BS IV-compliant fuel across the length and breadth of the country, everybody will be confident of our abilities," says Singh. And then, perhaps, more people will believe that the move to BS VI will be painless.

IOC HAS LINED up consultants, including Engineers India, for all its projects. Even before the new norms came to be, it had done a feasibility report on what was required from all its refineries. "We are in the process of technology selection, which I think we should be doing very soon. It will be both Indian and global companies. We are also utilising our own technologies which our R&D has developed for diesel hydro-treatment. We are installing two units from in-house technology for the first time," Singh explains. Work on BS VI, including construction, will start full steam before March 2017.

The IOC management has an in-principle clearance from the board for budgets required for the upgradation of refineries even before the investment proposal. The onus is on being agile. So if a plant needs a new compressor, it can be ordered even before the investment money comes through because these are long-lead items that typically take up to 18 months to be delivered.

Global and domestic tenders have already been floated for various equipment that will be required for upgrading of the refineries, as well as modifications made in the unit or additional units—all that is required for producing Bharat Stage VI fuel.

At the distribution level, IOC is identifying the problems to solve. It transports a bulk of its products through underground multiproduct pipelines. This means the same line carries kerosene, aviation turbine fuel, diesel and petrol.

When the country is guzzling BS IV fuels, it is hard to transport the BS VI grade too in the same pipeline. "There will be a problem of contamination. Only when both diesel and petrol are completely converted into BS VI is it easier. But I cannot transport a BS IV product with a BS VI product," Singh says. This means quantities required by the auto industry before the deadline will have to be moved by other modes of transport, including by road in tankers.

It's going to be a lot of hard work, sure, but as Singh says when I leave his office: "If we don't pull this off by 2020, we will have nothing to sell."

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