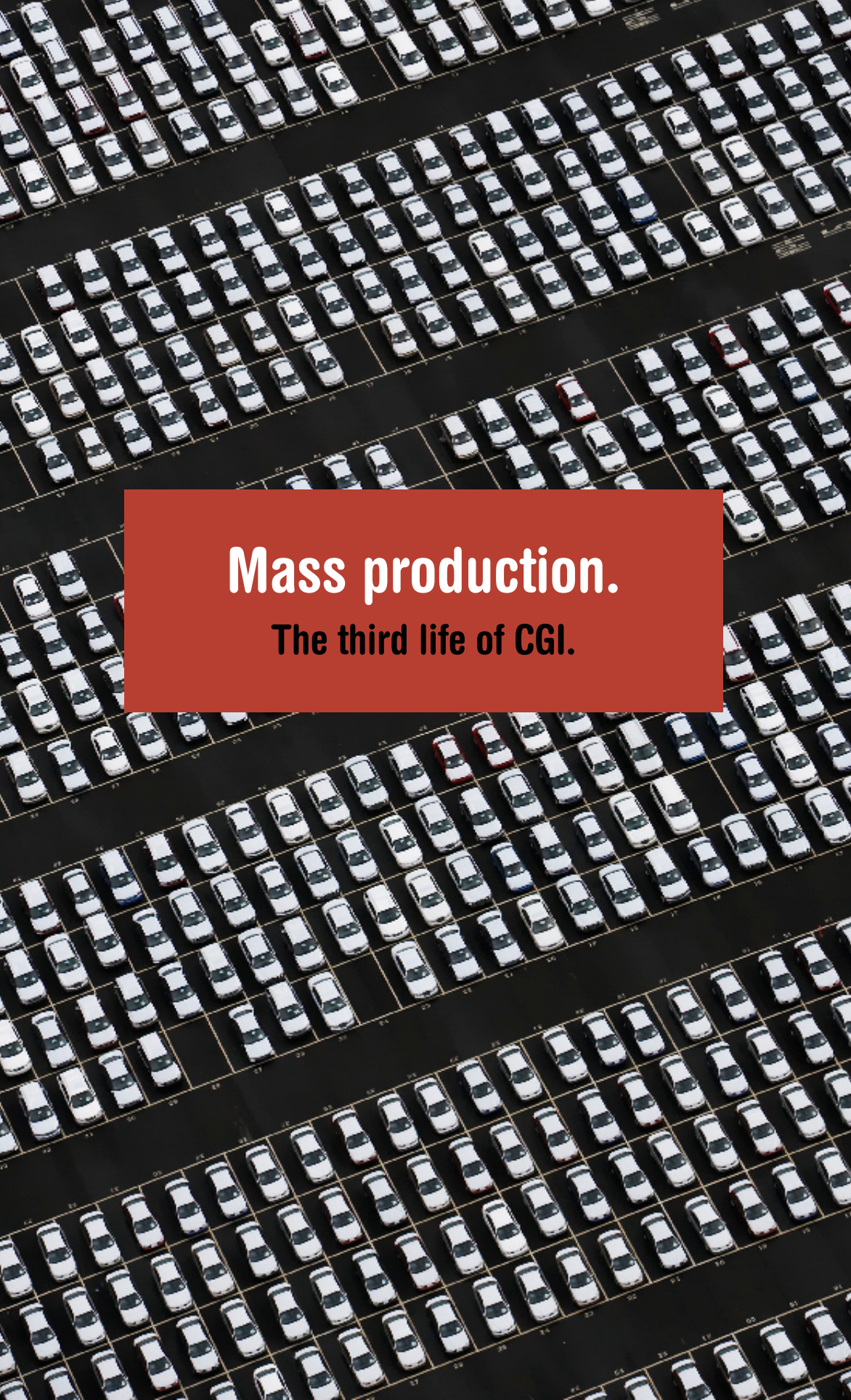


Mass production.

The third life of CGI.

The automotive industry is facing a dilemma.

How exactly will automakers deal with the simultaneous pressure from customers to make lighter, more powerful vehicles – and from society to make them more fuel-efficient and more lenient on the environment?

How, at the same time, can they make their own production processes more expedient and more cost-efficient?

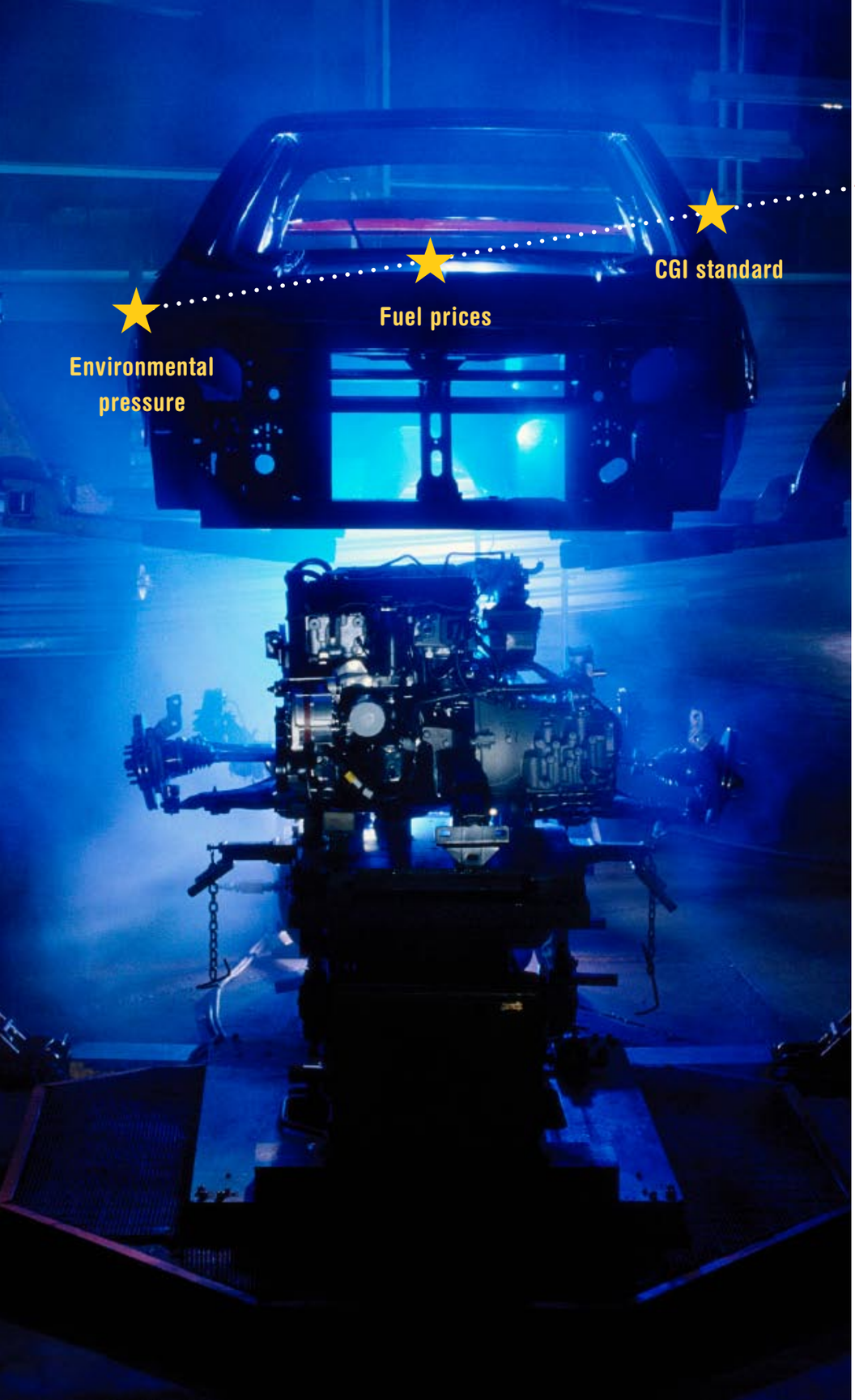
Only a special iron can solve it.

The answer lies in a different method for manufacturing engines (and many other car components). A method based on a very special material – CGI (compacted graphite iron). That's because, in its third life, CGI is now ready to take on the big jobs. And the big responsibilities posed by mass production.

With Graphyte® Flow, a unique 3rd-generation CGI production system, the total manufacturing cost of an average diesel engine can be slashed by a solid 15%. The savings arise from using less iron per engine block, less alloy, less energy, less manpower. From generating less scrap. And from offering superior machining properties.

The result is a smaller, lighter engine of higher quality for higher combustion pressure and higher performance.

An engine that's just what the automotive industry needs to resolve one of its most compelling dilemmas.



The planets are aligned for producing a cleaner, leaner and meaner diesel.

For years, you've been hearing about The Perfect Diesel Engine.

The one that delivers more power despite smaller dimensions and lower weight. That consumes less fuel and emits fewer greenhouse gases.

You've been hearing that this engine gets its attractive properties from CGI – compacted graphite iron. The wonder material.

So when will the time finally be right for using CGI technology to actually produce that cleaner, leaner and meaner diesel?

The answer is: Now. For four very good reasons.

★ More demanding emission laws are coming into effect every few years, both in Europe and the US. Very soon, merely switching from gasoline fuel to diesel fuel will no longer be enough to reduce CO_2 and other hazardous emissions. The diesel fuel needs to be more fully combusted, which requires higher operating temperatures and pressure. Exactly what CGI delivers.

★ No one doubts that soaring oil prices are here to stay – indefinitely. The high-pressure, high-temperature combustion that CGI makes possible in diesel engines will cut fuel consumption – as will their lower weight and smaller dimensions (by reducing the size and weight of the vehicles).

★ A factor that has delayed the global deployment of CGI (for example in the automotive industry) has been the lack of a standard definition of the material. Different countries have applied different standards.

That's now history. Today, there is ISO 16112.

This international norm carefully specifies five CGI variations – including their alloy content, their metallurgical properties and their target applications.

Thanks to ISO 16112, the world can safely open up to CGI.

★ Mass-producing engines and engine parts requires mass-production processes. With earlier CGI production systems, the foundry process was exact enough to allow commercial manufacturing. But only in low volumes.

Today, the third generation of CGI systems makes mass production truly viable. The process becomes fast, predictable and highly automated, with less downtime. It uses less alloy, less energy and less manpower.

The first real contender in this new CGI generation is Graphyte Flow.

It's not that hard to produce a CGI engine block.

The fundamental concept of mass production is, of course, predictability. The assurance that each unit produced is identical to every other. Knowing this – rather than guessing or hoping it – is the very core of mass-produced quality.

Despite its many undisputed metallurgical advantages, CGI has so far not lent itself to mass production. The prevailing method has been based on a cumbersome two-step manual process. It's been time-consuming, difficult to control and – above all – not predictable.

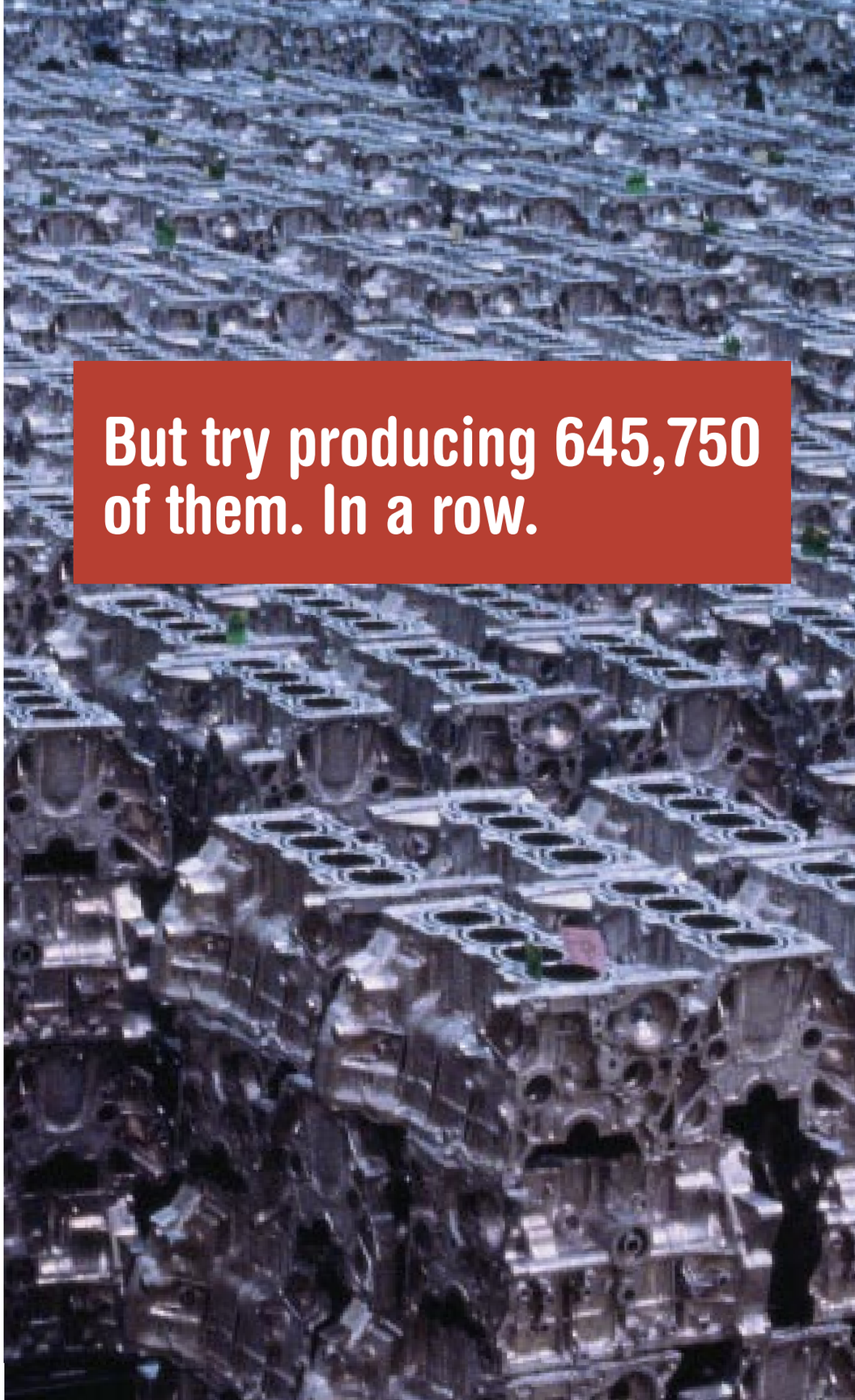
Graphyte Flow creates a paradigm shift in predictability – making it a true industrial manufacturing process for CGI.

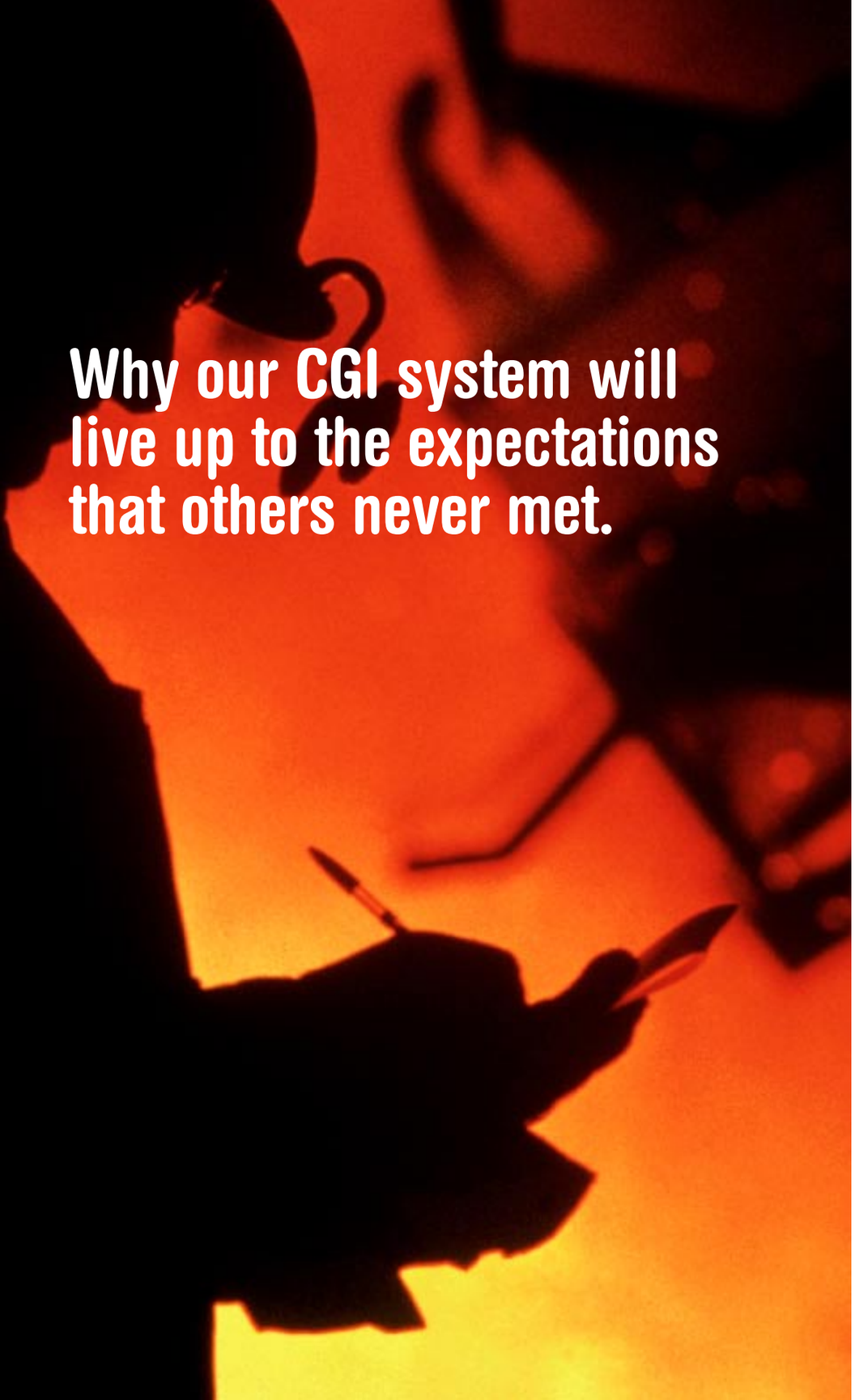
★ Because the magnesium treatment of the iron melt happens inside the mold, the process becomes easier to monitor and control. Until now, reaching the 80% compacted graphite content prescribed by ISO 16112 has required keeping track of 31 different process variables. With Graphyte Flow, these variables are 30% fewer, reducing both the complexity of the process and the risk of unexpected errors.

★ And because Graphyte Flow involves only one step, the probability of getting the right result increases dramatically – with no need for last-second operator interventions and adjustments. Graphyte Flow guarantees that the base iron in the melt remains 100% consistent, in terms of nucleation and other key properties. Therefore, adding the exact same amount of magnesium in the exact same place inside the mold yields the exact same result. Time and again.

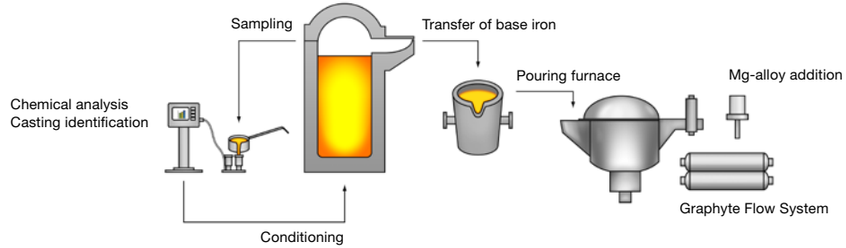
★ Also, because the Graphyte Flow process happens more rapidly at lower temperatures, it inhibits the nucleation of slag in the iron. Result: consistent melt and even output quality.

★ The process control system driving Graphyte Flow even learns from its own imperfections. Through AI technology, any irregularity in any variable that's been encountered and corrected by the operator is stored by the system and will help fine-tune the controls even further. Over time, this virtually eliminates the risk of operator errors.





Why our CGI system will live up to the expectations that others never met.



The first generation of CGI production never made it beyond the lab environment. For good reasons.

The challenge of finely balancing the dosage of magnesium against the generation of oxides, sulfides and other compounds affecting the melt proved too complex for manual control methods.

With the advent of computer-based control systems, early CGI proponents claimed to master the process and promised commercial production. Some major foundries believed these claims and promises and wanted to bring the benefits of CGI production to the automotive industry.

Expectations were high all around. Unfortunately, they weren't met by far. This second generation of CGI failed to meet the basic industrial requirements: high speed, low cost and high predictability.

Which is precisely what Graphyte Flow – the third generation – was developed to address. It will, at last, live up to your expectations of CGI, and turn test production into mass production.

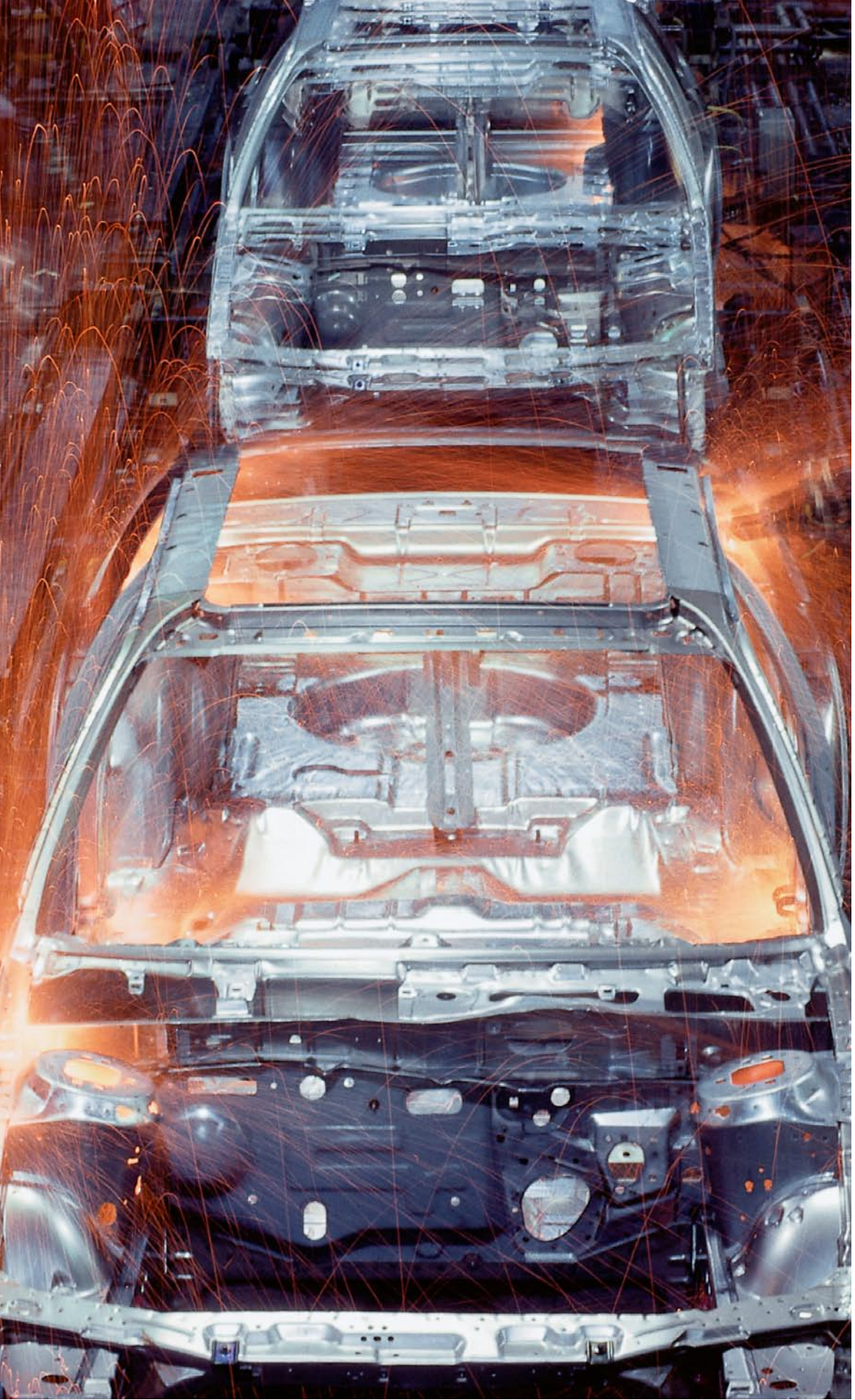
★ Graphyte Flow creates a streamlined industrial process throughout the foundry. The workflow is compressed and logistically efficient, with few physical displacements of the melt on its way from furnace to mold.

★ The melt is kept at a lower temperature, which requires less energy.

★ The reaction of iron and magnesium takes place inside the mold, not in an open ladle. This keeps the work environment free of smelly (and potentially harmful) fumes. Also, the base iron is left untouched, which means the same melt can be used for different CGI specifications.

★ By separating the Mg reaction from the melt, concurrent engineering becomes possible. The absence of a reaction ladle means that the iron and the alloy can be prepared in parallel, saving considerable time per unit poured. Another benefit is that in the event of an unexpected shutdown of the process, both the base iron and the magnesium can be fully recovered and reused.

★ The shorter and more rapid Graphyte Flow process even yields a superior CGI quality – virtually free of adverse carbides. This makes the material less brittle and more elastic, facilitating machining and reducing wear and tear on machining tools.



Graphyte Flow can double the profitability of the automotive industry.

(And that's just on the engine.)

The average net profit per vehicle produced by the world's 17 largest automakers is $26.78*.

The net savings per engine block produced with Graphyte Flow, rather than with the previous CGI generation, are 15% – or $26. That's around $5,2 million for a series of 200,000 SUVs. These savings occur in several dimensions.

★ Compared with producing engines the traditional way, CGI consumes less iron and fewer expensive alloys. The engines are smaller and lighter, allowing smaller, lighter vehicle designs.

★ In addition, compared with previous CGI generations, the high predictability of the Graphyte Flow process results in considerably less downtime and less scrap.

Less magnesium is needed – and no inoculation materials, thanks to the lower operating temperature.

Fewer process steps translate into higher output with less manpower. And the overall energy savings per unit produced are at least 15 percent.

★ Machining the engine blocks and cylinder heads is much simplified by Graphyte Flow, thanks to the slightly more elastic characteristics of the material. Wear and tear on valuable machining tools are greatly reduced.

Engines represent but one of many automotive applications for CGI and Graphyte Flow. Even despite a higher per-kilo cost of CGI engine blocks, compared with grey iron, the advantages of CGI are too compelling in terms of engine weight, size, performance, economy and emissions to be overlooked.

Several other major auto components – notably the chassis – are currently manufactured using ductile iron (where the magnesium content is even higher). By replacing the more expensive ductile iron with third-generation CGI, the per-kilo cost of these components can be drastically reduced.

In other words, not only will Graphyte Flow help make the auto industry more responsible in terms of emissions and fuel consumption, it will also pave the way for lower costs and higher profits.

*) *Source: PriceWaterhouseCoopers Automotive Institute, 2006*