

Critical Manufacturing Challenges in Energy Applications

How complex metal and ceramic designs become validated into scalable production

In energy applications, the most important additive manufacturing question is no longer whether a machine can print a complex shape. The real question is whether a difficult part can move from concept to a repeatable, production-ready process with the dimensional control, material performance, and manufacturing discipline required in a high-consequence environment. For metal and ceramic applications especially, the challenge is rarely printing alone; it is understanding how powder behavior, densification, shrinkage, post-processing, and inspection interact to determine whether a part can be qualified and produced consistently.

Arc Impact is a global leader in advanced binder jet manufacturing, focused on turning complex metal and ceramic designs, such as silicon-carbide-based components, into qualified, repeatable production programs for energy and other demanding markets. In this sector, that focus matters because many of the most promising opportunities involve parts that are difficult to machine, difficult to cast, or difficult to produce repeatedly once geometry, operating conditions, and material requirements become more demanding. Through its AM2 Production framework, Arc Impact works with manufacturers to define the application, engineer the workflow, and prove that a given route to production can meet technical and business requirements.

AM2 Production focuses on evaluating candidate parts, optimizing designs and workflows, validating both technical performance and the business case, and then scaling into sustained production. In practice, this extends beyond the as-printed part to include upstream and downstream steps, such as powder selection, sintering strategies, machining, and finishing, so that manufacturers are qualifying a complete path to the final component, not just a build file.

One reason this approach is necessary is that energy programs often fail or stall not because the initial part cannot be made, but because the process around that part is not stable enough to validate. AM2 Production addresses this by structuring adoption as a staged pathway that begins with benchmarking and initial qualification, then moves through workflow optimization, technical and business validation, and finally production deployment and scale-up. For engineering teams in energy industries, that framework reflects how real manufacturing decisions are made: around risk reduction, repeatability, and the ability to transition from development into controlled, auditable output.

Silicon carbide is a clear example of why this application-first strategy matters. Advanced ceramics such as silicon carbide sit at the intersection of demanding material behavior, tight tolerances, and harsh thermal and mechanical conditions, making them difficult to address with conventional manufacturing routes. For energy hardware, that combination is especially important in applications that must remain dimensionally stable and mechanically robust under high temperature, corrosion, wear, and thermal cycling. Across applications ranging from thermal management and heat-exchanger components to other high-temperature and high-performance systems, Arc Impact positions its X-Series binder jet systems around the densification of complex metallurgical and ceramic systems, including non-oxide ceramics such as silicon carbide, with open-parameter development to fine-tune powder morphology, binder saturation, and sintering

profiles. The goal is not simply to demonstrate that silicon carbide can be printed, but to qualify robust manufacturing paths for high-value components that depend on it.

Within this broader solutions framework, the X25Pro™ and X160Pro™ function as complementary platforms that support different stages of application maturity and scale. The X25Pro™ provides a mid-sized environment well suited to benchmark parts, and early-phase energy programs where the immediate objective is to establish process understanding, refine densification behavior, and build confidence in dimensional outcomes. Once a workflow has been proven out, the X160Pro™ carries the same binder jet logic into a larger production envelope, enabling larger parts, larger batches, or arrays of parts when the conversation shifts toward throughput, cost per part, and supply-chain resilience.

That progression is important because not all energy applications ask the same question at the same time. Early on, the challenge may be proving that a difficult geometry in metal or technical ceramic can be processed within specifications to justify further investment. Later, the emphasis may shift to demonstrating that once a material and geometry are understood, the workflow can scale without losing dimensional control or throughput efficiency. By mapping applications across the AM2 Production pathway and deploying the X25Pro™ and X160Pro™ where they add the most value, Arc Impact gives manufacturers a way to move from first article to serial production without changing the underlying manufacturing logic.

The same application-driven philosophy extends to process control and measurement. Arc Impact surrounds its binder jet platforms with a broader production environment designed to improve part accuracy and support scan-based deformation correction and tolerancing, so that dimensional performance after sintering can be predicted and managed rather than left to trial and error. For energy product stakeholders, this is often where a promising additive concept either becomes a manufacturable reality or fails to meet validation criteria, and where partnering with Arc Impact can mean the difference between a single prototype build and a qualified, production-ready solution.

About Arc Impact:

Arc Impact is a global leader in application-driven, end-to-end additive manufacturing solutions, specializing in binder jetting, materials science, powder metallurgy, and ceramics. Built on a proven technology lineage shaped by the early pioneers of industrial binder jetting, the company partners with manufacturers to integrate additive technologies into complex production environments. Arc Impact combines powder-based and bound-metal platforms with advanced sintering furnaces and proprietary software to deliver tightly controlled, repeatable production workflows. With cradle-to-grave support spanning materials selection, process qualification, and downstream ecosystem integration, Arc Impact guides critical applications from concept through full-scale serial production, strengthening a resilient and agile industrial base.

To learn more about Arc Impact, visit www.arc-impact.com.

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