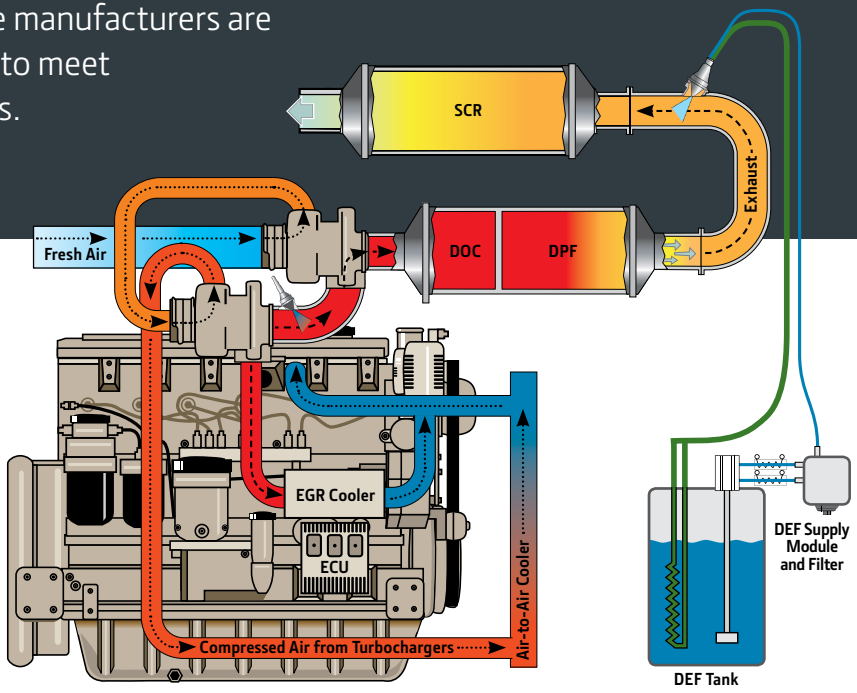
John Deere Power Systems

# Aftertreatment Solutions in a Stage V Landscape

The role of aftertreatment technologies continues to evolve as the industry prepares for upcoming emissions regulations. With EU Stage V on the horizon, engine manufacturers are refining their aftertreatment packages to meet regulations and deliver on market needs.




## Aftertreatment today

### *Varied approaches with/to aftertreatment solutions*

For previous emissions tiers, engine manufacturers took various approaches in order to meet current regulations.

Specifically in regards to Tier 4 regulations, some manufacturers chose to calibrate their engines to produce less particulate matter (PM) emissions out of the engine, which reduced or eliminated the need for treating PM downstream of the engine. This approach increased engine combustion temperatures and NOx emissions out of the engine, requiring higher levels of diesel exhaust fluid (DEF) to treat the increased NOx downstream of the engine in a diesel oxidation catalyst (DOC).

**Final Tier 4/Stage V**

- Electronic unit injector (EUI)
- High-pressure common-rail (HPCR) fuel system
- Air-to-air aftercooled
- Cooled exhaust gas recirculation (EGR)
- Variable geometry turbocharger (VGT)
- Series turbochargers
- Diesel particulate filter (DPF)
- Exhaust temperature management (ETM)
- Selective catalytic reduction (SCR)

Other manufacturers chose to utilize cooled-EGR and an engine calibration that reduced both engine combustion temperatures and NOx out of the engine. This calibration resulted in increased PM out of the engine, which is then reduced downstream with an exhaust filter consisting of a DOC and a diesel particulate filter (DPF).

John Deere developed the Integrated Emissions Control System (IECS) to balance PM and NOx reduction out of the engine. This optimization allows the engine to deliver the highest level of engine performance and world-class fluid economy while meeting stringent emissions levels mandated in all regions of the world — today, tomorrow, and into the future.

### *Does regeneration impact engine performance?*

With the integration of DPF systems on the rise across more engine manufacturers, regeneration cycles are also becoming a more frequent point of conversation. And the industry wants to know, "will regeneration cycles change how I use my engine?"

Essentially, there are two types of regeneration cycles — passive and active — both of which shouldn't have an impact on end-user experience.

Diesel particulate filters trap particulate matter that exists in the exhaust stream, much of which is cleaned during regular operating conditions through passive regeneration. However, over time, the filter reaches a point where it needs to be cleaned by raising exhaust temperatures, otherwise known as active regeneration. An active regeneration cycle will happen automatically without operator action. This automated process won't affect normal operation and will only be noticeable by an information indicator when it is in process. However, it is also important to note that users should not override an active regeneration cycle when it is already in process.

When left under normal operating conditions, the system will run as it should. Let the system work — including letting it run through necessary regeneration cycles — and in most cases users should experience uninterrupted operation.

# Aftertreatment in light of Stage V

### *The role of DPF*

Becoming informed about new technology, whether through conversations with engine manufacturers or product research, will generally ease the transition through Stage V. In fact, many of these "new" technologies have been implemented in both the on- and off-highway market for some time.

John Deere Power Systems adopted DPF technology as part of an integrated emissions control system because John Deere believes it is the best solution for most applications. By treating NOx and particulate matter downstream of the engine, John Deere engines with DPF are optimized for increased torque response, low-speed torque and fluid efficiency, as well as provide responsive power at higher altitudes.

John Deere has been employing DPF technology since Interim Tier 4/Stage IIIB and has applied those learnings to optimize design and packaging through Final Tier 4/Stage IV and into Stage V. John Deere is leveraging a new advanced filter substrate and high-performance catalyst and advanced control technologies to enable the downsizing of aftertreatment systems. A compact mixer design also contributes to greater package flexibility and easy installation.

### *A new global industry standard*

The engine industry expects that Stage V regulatory limits will require use of wall flow particulate filter technology — meaning that all manufacturers will start reintroducing DPF technology into their designs, regardless of how much experience they bring to the table.

Because of the extensive background using DPF technology from John Deere, OEMs can rely on its field-tested experience. And by choosing John Deere, OEMs benefit from more than one billion hours of real-world field testing, on- and off-component testing, and innovations like damage modeling — streamlining the process altogether.

In order to meet Stage V regulations, all John Deere engines are equipped with a DPF. The John Deere modular building block approach to emissions control is proven, and it has led to a DPF solution that is capable of complying with the requirements indicated in the EU Commission's proposal COM (2014)581. Currently, DPF is the only commercially available technology that allows manufacturers to meet Stage V engine requirements.

***John Deere Power Systems has more than***
***1 billion hours***
***of experience using DPF in the field.***

By continuing to leverage the modular building block approach, John Deere can provide application flexibility to help OEM customers meet their machine design goals as emissions regulations continue to evolve. John Deere will also be applying DPF technology outside of North America and the EU where stringent emissions controls are adopted.

Along with its expertise, OEMs can leverage the global footprint of John Deere to grow their worldwide business.

# Integration matters

## *Balancing market needs and industry regulations*

For the last 15 years, diesel engine development — and the technologies that come along with it — has largely been influenced by various upcoming emissions regulations. Now that the industry is largely beyond the majority of new emissions regulations, manufacturers like John Deere can instead focus on leveraging developed technologies to optimize products to best address market and customer needs. Because of this, OEMs will benefit from continual product improvements and advancements.

## *Power of choice*

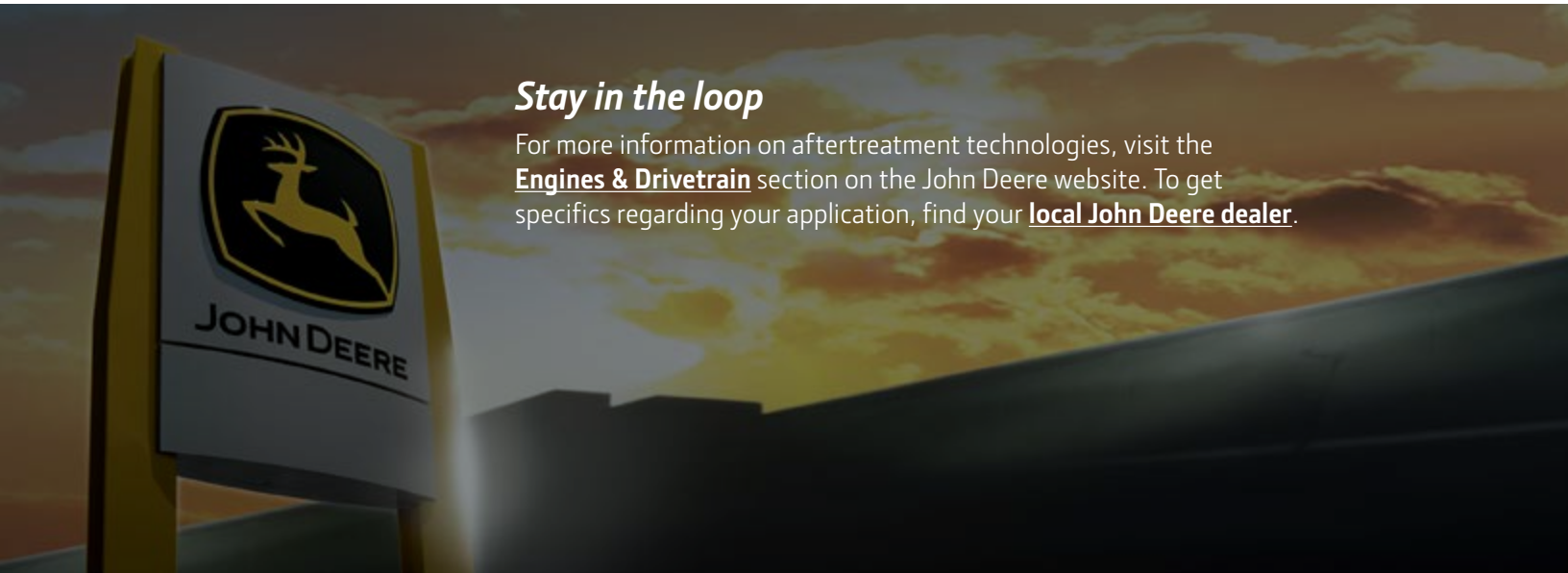
Final Tier 4/Stage V aftertreatment technologies from John Deere are optimized for flexible integration and offer reduced packaging and weight from previous Final Tier 4/ Stage IV solutions.

John Deere also offers aftertreatment options below 174 hp for OEM customers. Depending on the application and customer requirements, the Integrated Emissions Control System can be equipped with or without a DPF while still meeting emissions regulations. For non-Stage V applications, the Integrated Emissions Control System can deliver more power density and improved low-speed torque while leveraging combustion optimization that eliminates



the need for DPF — ultimately giving customers the power of choice between DPF and no-DPF solutions when looking to easily integrate their new engine.

Combining both the engineering and application expertise of John Deere with its flexible packaging options, OEMs can be confident no matter what they choose. John Deere is committed to delivering your specific application needs, while remaining emissions compliant.




## *Stay in the loop*

For more information on aftertreatment technologies, visit the **Engines & Drivetrain** section on the John Deere website. To get specifics regarding your application, find your **local John Deere dealer**.