

# Paving the Way to Innovation

## Executive Summary

The concrete sector currently accounts for roughly eight percent of global emissions.<sup>1</sup> Global annual demand for concrete is expected to grow from 14 billion to 20 billion cubic meters by 2050,<sup>2</sup> due to population increases and urbanization. By sticking with the status quo, this demand growth could increase annual carbon dioxide (CO<sub>2</sub>) emissions from 2.75 billion tons to 3.8 billion tons worldwide,<sup>3</sup> an increase roughly equivalent to the total U.S. industrial emissions in 2021.<sup>4</sup> This sector represents the building blocks and the glue to all economic growth, so deploying cutting-edge innovations and leveraging low-carbon domestic resources in this sector can deliver safe infrastructure that facilitates growth with lower or zero emissions. This report provides a comprehensive analysis and characterization of types of regulations, known as specifications, governing the use of concrete, cement, and asphalt in public works, and innovative solutions for how American producers can lead the world in lower emissions.

The U.S. is leading the world in the development of innovative low-carbon cement, concrete, and asphalt materials and practices. However, increasing the commercialization and adoption of innovative low-carbon concrete and asphalt mixes and established low-carbon replacements like supplementary cementitious materials (SCMs) and recycled asphalt pavement (RAP) in the public sector faces a key barrier: overly prescriptive specifications.

Prescriptive specifications are preset “recipes” set into law by state agencies, such as the State Department of Transportation (DOT), that producers must follow, and include limits on the type of and proportions of materials, such as SCMs, that producers can use. These specifications are set for individual projects by both state DOTs and often by private project developers. They have traditionally been used because they are relatively easy for the construction industry workforce to follow because of ease of implementation for the workforce but need to be modernized now that developers have access to comprehensive tests, advanced knowledge of construction materials and modern technologies. Unfortunately, by requiring the use of specific types or quantities of materials, prescriptive specifications prohibit using alternative products or practices that can achieve the same performance with a potentially lower cost and lower carbon intensity. Therefore, there is a compelling need to modernize these specifications to commercialize safe, low-carbon concrete and asphalt.

On the contrary to prescriptive specifications, performance specifications have been developed by State DOTs, the Federal Highway Administration (FHWA), industry and specification-setting bodies to modernize specifications and lower barriers to entry for materials with lower emissions.<sup>5</sup> Performance specifications require producers to deliver materials with certain strength, endurance and performance qualities instead of requiring a preset recipe. By adopting performance specifications, both old and new producers have the flexibility to design their products as they see fit and use novel, lower-carbon cement, concrete, and asphalt materials.

This report’s authors documented material standard specifications from each State’s DOT and assessed the prevalence and restrictiveness of these regulations governing the use of concrete, cement, and asphalt in public works. The analysis found that there is at least one type of prescriptive requirement for cement and concrete that exists in every state across the U.S., and that 48 states have some form of prescriptive requirements for asphalt. This analysis sheds light on the extent to which these specifications can potentially support or prevent concrete and asphalt decarbonization and how prevailing prescriptive specifications maintain a status quo that hinders innovation.

# Paving the Way to Innovation

Updating prescriptive specifications towards performance specifications in the U.S. has the potential to unlock emissions reductions and materials savings for producers and taxpayers. As an example, widespread adoption of RAP can avoid 140,000 tons of CO2 emissions annually;<sup>6</sup> the equivalent of 30,500 cars being taken off the road in one year,<sup>7</sup> while increasing SCM usage in concrete reduces emissions by up to 70% relative to concrete made just from Portland cement.<sup>8</sup>

This regulatory change can also help position the U.S. to continue leading the world in developing the low-carbon materials that make up the building blocks of the future. The following three categories of actions can accelerate the adoption of performance specifications:

- **Bolster Technology Validation and Deployment:** The federal government can leverage existing funds to incentivize State DOTs to modernize specifications towards performance specifications and conduct demonstration projects to de-risk the use of new materials. This approach prioritizes safety while providing demand certainty to domestic concrete manufacturers and innovators.
- **Facilitate Workforce Development:** Federal agencies, universities, and industry stakeholders can facilitate education and workforce training and development to accelerate the adoption and implementation of innovative practices and technologies.
- **Streamline Specification Development and Expand Testing Availability:** The U.S. DOT can conduct basic research and development on the performance characteristics of supplementary cementitious materials (SCMs) to update testing and validation for performance specifications.