Center for RESTORation of soil Carbon by precision biological strategies (RESTOR-C)

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Soil carbon represents a vast global carbon reservoir that has become depleted through human activities. To harness this natural carbon sink and advance toward the cost and scale goals of the DOE Carbon Negative Shot, RESTOR-C will develop plant- and microbe-based strategies to increase accumulation of persistent carbon in soil. These strategies are designed to increase the amount of atmospheric carbon fixed by plants and increase the amount of the fixed carbon that is channeled belowground as soil persistent carbon.

To accomplish this goal, the Center will apply cutting-edge molecular and computational methods to overcome key obstacles to persistent carbon storage across four Divisions: The *Soil Division* will explore the chemical, biological and environmental factors that govern the persistence of carbon in soils, to enable the development of stable, long-term carbon storage solutions with a focus on arid and marginal lands. The *Plant Division* will design plant genotypes that efficiently capture and sequester carbon, through a combination of increased photosynthetic efficiency and optimized root characteristics. These efforts will focus on sorghum, a stress-tolerant bioenergy crop that can grow in a range of soils and climates with minimal nutrient inputs. The *Microbial Division* will identify and optimize microbial communities to promote carbon retention in soil using advanced genomic technologies and artificial intelligence-guided high-throughput experiments. Finally, the *Scaling and Impact Division* will model, predict, evaluate, and optimize cost and scale of soil carbon sequestration approaches. This work will build and connect multi-scale models of carbon dynamics and economic feasibility to predict the impact of carbon sequestration approaches, evaluate strategies, and test approaches at the field level.

This research will break new ground in multidisciplinary research, leveraging unique expertise at two national laboratories and four university partners, including two minority serving institutions, to integrate recent developments and make scientific breakthroughs spanning the biological, ecological, chemical, and computing sciences. At the end of the four-year period, the Center will have validated plant-microbe strategies to increase carbon at target field sites in California and New Mexico, as well as a dramatically expanded knowledge base and set of capabilities to rapidly extend these approaches to other locations and crops. In the long term, these methods have the potential to restore carbon in US agricultural lands, forging the way toward a carbon negative future.

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