EXHIBIT S

UNIVERSITY OF CALIFORNIA
LOS ANGELES

Opportunities to remediate carbon for improved air quality

Presented to Audi CO_2 Cy Pres Settlement Fund

UCLA

Executive Summary

The Right Place

As one of the most creative and diverse states in the country, California is an ideal environment in which to pilot carbon remediation initiatives that can be replicated nationally and globally. In Southern California, where 24 million inhabitants suffer from notoriously poor air quality, we have an unparalleled opportunity—even an urgent need—to convert settlement funding from an Audi CO_2 cy pres award into large-scale community benefit through reduced emissions. As the region's epicenter, the City of Los Angeles (LA) has announced plans to rely solely on carbon-free, renewable energy by 2045. This shift—which includes eliminating fossil fuel plants, electrifying transportation, and increasing dependence on alternative energy sources, such as wind and solar power—is expected to significantly reduce pollutants and associated health risks. However, there are lingering challenges to achievement—and University of California, Los Angeles (UCLA) has disruptive solutions.

The Right University

The nation's #1 public university,[1] UCLA is dedicated to creating a healthier, more equitable, more sustainable world for future generations. Renowned for its optimism and innovation, UCLA is uniquely poised to make transformative progress. Each of the following initiatives, to be taken up by cross-disciplinary UCLA teams, fills a void in realizing LA's ambitious goal; provides solutions to carbon dioxide remediation and improved air quality; is scalable; and will generate beneficial environmental knowledge that can be applied to other megacities.

We have the mission: serving the greater good for 100 years.

We are part of the vision: sustainable megacities through the UCLA Sustainable LA Grand Challenge.

We have the leadership: home to luminaries in all fields relevant to carbon remediation and sustainability, all on one campus.

1: Source: *US News and World Report*, 2022 Best Colleges rankings.

Four Ways Forward

	OPPORTUNITY	FUNDING REQUEST
#1	***Accelerate new technology to reduce atmospheric CO_2***	**$1,500,000**
	Under the direction of 2021 XPRIZE recipient Gaurav Sant, the UCLA Institute for Carbon Management seeks to accelerate progress on an emerging technology that extracts dissolved CO_2 from seawater to reduce atmospheric accumulation. Within two years, the team expects to advance work on a prototype that will use renewable energy and cause no change to the oceans' pH levels.	
#2	***Pilot an infrastructure grid to reduce heavy-duty truck emissions***	**$2,000,000**
	The United States lacks sufficient infrastructure to support its move toward electrified heavy-duty trucks, which could mitigate emissions by 20-30 tons per truck each year. Utilizing a software-based smart charging methodology developed over the past 10 years at UCLA, a two- to three-year pilot will determine optimal grid management to ensure truck drivers and fleet operators receive adequate electric fuel, while maximizing use of renewable energy sources and minimizing regional emissions.	
#3	***Pioneer a program for zero-emissions community zones***	**$1,000,000**
	An interdisciplinary team will confront unequal access and systemic injustices that limit the adoption of zero-emissions vehicles and broader clean transportation policies by pioneering zero-emissions community zones in some of Southern California's most vulnerable communities. This two-year project would be the first quantifiable study of zero-emissions zones' impact on ambient air quality and would comprehensively address policy barriers in addition to social, physical, governance, and financial challenges to produce a replicable, scalable, and equitable roadmap for establishing zero-emissions zones throughout North America.	
#4	***Capture excess energy for durable, renewable fuels***	**$1,000,000**
	UCLA experts are developing a long-duration, high-density, and low-cost energy storage solution to overcome one of the most significant barriers in transitioning to carbon-free electricity: harnessing overproduction of daytime renewable electricity to generate carbon-neutral fuel. Within three years, the team will pilot its solution in a metropolitan area the size of Los Angeles, and evaluate optimal scenarios for replication across the globe.	
	Total to fund all opportunities	**$5,500,000**

Opportunity #1

Accelerate new technology to reduce atmospheric CO_2

$1,500,000

Global CO_2 emissions into the atmosphere are on the order of 36 billion tonnes annually, attributable in roughly equal parts to heavy industry operations and fossil fuel-based power plants, buildings and the built environment, and transportation. Advances in the hydrogen economy, electric transportation, and renewable energy are expected to reduce CO_2 emissions associated with homes, commercial buildings, already-electrified industrial processes, and land-based transportation in the coming decades. However, emissions from many heavy industries—along with air and marine transportation—remain the same. Even if 100% of land-based transportation is powered by renewable electricity by 2050, the world would need to remove an additional 10-20 billion tonnes of CO_2 annually through the end of the 21st Century to meet its global climate goals (limit warming to a 1.5 degrees Celsius threshold).

The world desperately needs a disruptive solution to ensure CO_2 is removed across all sectors to effectively mitigate climate change. Housed within UCLA Samueli School of Engineering, the Institute for Carbon Management seeks **$1.5 million to accelerate progress on an emerging technology that utilizes seawater to reduce accumulation of atmospheric CO_2.**

This novel pathway to carbon management—one of many undertaken by the institute—exploits the ocean-atmosphere equilibrium of CO_2, as well as the abundance of divalent alkaline cations in seawater. The team leverages these attributes to electrochemically force carbonate (e.g., Ca-, Mg-carbonates) precipitation, consuming dissolved CO_2 and locking it in minerals; the decarbonated seawater is then capable of absorbing more atmospheric CO_2. Further, the water's alkalization also generates H_2(g), a clean fuel.

The seawater technology provides a more sustainable solution than traditional methods of diffuse CO_2 abatement, such as sorbents and solvents, which are cost-prohibitive due to the thermodynamic penalty associated with demixing CO_2 from air; carbon-intensive manufacturing; and the uncertainty and risk associated with the release and leakage of captured and geologically stored CO_2, as well as the lack of pipeline infrastructure needed to convey it. A $1.5 million investment will advance a pilot-system prototype expected to achieve 25 kg of CO_2 removal from seawater per day (eventually scaling to 1 tonne per day). The seawater technology durably and cost-effectively removes accumulation of CO_2, works in unison with the electrification of the transportation sector, and can be completed with renewable energy and no change to the ocean's pH levels.

Opportunity #2

Pilot an infrastructure grid to reduce heavy-duty truck emissions

$2,000,000

Nationally, 30% of road-travel emissions come from freight-carrying trucks. The Los Angeles Basin has one of the worst air qualities in the country due to emissions from 18,000 internal combustion engine trucks in and around the Ports of Long Beach and Los Angeles. As the country moves toward electrified trucks, it lacks sufficient infrastructure to charge them. **A $2 million investment can change that.**

Funding will create a project to demonstrate a Smart Charging Regional Network at a pilot scale that ensures truck drivers and fleet operators receive adequate electric fuel to serve their delivery needs while maximizing use of local renewable energy sources and minimizing regional emissions. Leveraging existing technology and partnerships, UCLA Samueli School of Engineering's machine learning- and data science-based approaches integrate distributed energy resources (DERs) at identified electric vehicle (EV) charging sites to perform real-time modeling and infrastructure management that enable grid resilience and minimize the need for large infrastructure upgrades. Specifically, $2 million will allow UCLA researchers to model and simulate EV truck activity within a 75-mile radius around the Ports of Los Angeles and Long Beach, develop recommendations for charging locations based on the results, acquire one high-speed charging station, and work with utility hosts to install and monitor the charger's activity.

A software-based smart charging methodology—the WINSmartEV™ system—developed over the past 10 years at UCLA Samueli's Smart Grid Energy Research Center (SMERC) will monitor, control, and manage EV charging, providing an underlying framework to support the regional network. The project objectives include determining optimal ways to manage charging infrastructure in the context of the driver's pickup and delivery objectives, and achieving costs of $500/kW and charging goals of 100 miles/10 minutes.

The research carries significant technological, environmental, and societal implications. The distributed software system, along with advanced fast charging, creates a new framework to support and accelerate the rapidly expanding EV industry worldwide, extending beyond trucks to include buses, cars, and vans. Replacing diesel drayage trucks with electric power mitigates emissions by 20-30 tons per truck each year, resulting in reduced atmospheric carbon dioxide; rerouting trucks based on their energy consumption instead of driving time further reduces emissions. Mitigating emissions benefits disadvantaged communities located near goods-movement truck activity, whose citizens disproportionally suffer health impacts of emissions exposure, representing a key step toward environmental

justice. Further, the network creates regional jobs and economic activity—from short-term infrastructure design and installation to long-term charging station maintenance—and opportunities for community revitalization near charging hubs and highways.

Already, 35 partners—from Amazon to Peterbilt and from Southern California Edison to California State University, Long Beach—have expressed strong support for UCLA's leadership in this realm. Philanthropic support of $2 million will provide significant momentum to this public-private endeavor, which also seeks funding from a range of government and private sources.

Opportunity #3

Pioneer a program for zero-emissions community zones

$1,000,000

Los Angeles is well known for its "car culture" and associated air pollution that is responsible for asthma, heart conditions, diabetes, poor birth outcomes, cancer, neurological problems, and premature deaths. Although air quality in Southern California has improved significantly over the last several decades, the region still experiences the worst air quality in the nation—especially the most vulnerable communities, which often are located next to major freeways and urban centers. One way to alleviate this burden is to transition to zero-emissions vehicles. Unfortunately, unequal access and economic injustices limit the adoption of zero-emissions vehicles and clean transportation policies. In response to these challenges, a UCLA-led interdisciplinary team of scholars proposes to accelerate improvements in air quality through the establishment of zero-emissions community zones. **A $1 million investment in this idea will pioneer a program in some of Southern California's most vulnerable communities and the creation of a replicable roadmap for establishing zero-emissions zones throughout North America.**

Unlike air quality policies, which are regulated at the state or regional level, zero-emissions zones can be driven by local communities, making them broadly adoptable once an informed model is developed. For the project, UCLA will partner with the Southern California communities of Pacoima, Watts, and Wilmington—collectively home to more than 210,000 people, and identified by the CalEnviroScreen as among the most disadvantaged communities in the state based on pollution burden and population characteristics. Each neighborhood has already received grant funds from the California Air Resources Board to propel their environmental justice efforts, ideally positioning them for participation in the project.

The UCLA team is made up of experts from public policy, urban planning, engineering, atmospheric science, and environmental health. This first quantifiable study of zero-emissions zones' impact on ambient air quality will enable the development of new and scalable algorithms to address physical, legal, institutional, and financial challenges. Specifically, $1 million will be used to assess policy barriers and behavioral responses to new policy within communities; identify incentives to facilitate zero-emissions vehicle adoption, as well as optimal charging station siting; create models that forecast changes in vehicle miles traveled, energy demand, emissions, ambient air quality, and mortality; quantify monetized health benefits; and launch an implementation plan in partnership with local community and government agencies. Measurable results include increases in the number of zero-emissions vehicles adopted and new charging stations installed, as well as

reductions in the number of vehicle miles traveled, emissions, and asthma and premature death rates.

Investment in this project will significantly improve environmental and health equity—especially in communities located next to traffic throughways or urban centers—and create a roadmap for locally initiated air quality improvement and adoption of zero-emissions vehicles. This project evolved through a series of "sandpit" workshops hosted by UCLA's Sustainable LA Grand Challenge aimed at developing high-impact urban sustainability solutions together with regional stakeholders and from the perspective of experts across academic disciplines. It was awarded a $25,000 seed grant from the sandpit competition.

Opportunity #4

Capture excess energy for durable, renewable fuels

$1,000,000

A cross-disciplinary UCLA team of engineers, economic and policy analysts, and public health experts recently won a $25,000 seed grant from UCLA's Sustainable LA Grand Challenge for their approach to solving the long-term energy storage problem that all major urban centers across the globe face as they transition to cleaner renewable energy sources such as wind and solar. **The team seeks an additional $1 million to further research on chemical energy storage systems** that efficiently capture excess electricity, water, and carbon dioxide (CO_2) and transform them into durable, renewable fuel (ethanol, hydrogen, methane).

Renewable solar and wind electricity production requires storage of the electricity produced during the day in a form that can be used at night. There is currently overproduction—and waste—of wind and solar electricity in Los Angeles County during the day. A $1 million investment will enable the team to design and produce a storage solution, and conduct economic and policy assessments on short- and long-term health impacts. These socio-economic studies are key in determining how such technology will be most efficiently used in our cities—as centralized devices at industrial facilities or as decentralized units in each neighborhood—and which product (ethanol, hydrogen, or methane) is best suited for the transportation, industrial, and/or residential sectors. This will enable research on specific renewable fuels and the development of a plan, including public policy recommendations, for implementation at the city scale.

The research team will leverage relationships fostered by UCLA's Sustainable LA Grand Challenge initiative with stakeholders such as Los Angeles County and City, utility providers such as Southern California Edison and the Los Angeles Department of Water and Power, community organizations, and industry to perform analyses and develop a practical solution. Within three years, the team will pilot a storage solution in a metropolitan area the size of Los Angeles and evaluate optimal scenarios for replication across the globe. Concurrently, the team will continue to seek funding up to $10 million for full research and implementation costs.

Investment in this project will contribute to reducing CO_2 emissions by solving the intermittent electricity problem associated with wind and solar to achieve 100% carbon-free electricity. Energy storage solutions will allow us to shut down fossil fuel-based power plants that are still indispensable today. This will reduce local pollution (carbon

nanoparticles, NOx, VOCs), and improve health equity near existing power plants. The CO_2-neutral fuel also may contribute to achieving carbon-free transport and thus reducing pollution associated with current non-renewable transportation fuels.

This project evolved through a series of UCLA Sustainable LA Grand Challenge-hosted "sandpit" workshops aimed at developing high-impact urban sustainability solutions together with regional stakeholders and from the perspective of experts across academic disciplines. It will result in a roadmap for chemical energy storage in Los Angeles, which can be replicated in urban cities across the globe.

Learn More

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Thank you for your consideration.