

Early Career Scientist Award

Meant to spotlight the discoveries and remarkable work of someone having more recently started on their path of scientific discovery. We look for significant demonstration of initiative, Inspiration, collaboration skills, and other skills and attributes, including the ability to inform and inspire others.

Dr. K. Shankari

THE NOMINATION'S COMPELLING FACETS OF THIS PERSON'S RESEARCH

Dr. K. Shankari is a recognized subject matter expert in open-source computer systems for sustainable transportation, with over 30 publications, reports, and peer-reviewed posters to her name. Her research in the unconventional interdisciplinary field of computational mobility focuses on collecting, analyzing, and influencing travel behavior. This not only supports the decarbonization of the United States' transportation sector, but the buildout of vital transportation infrastructure that will improve the lives of innumerable people across the world. Her groundbreaking research works to understand holistic community-specific mobility insights, inclusive of micromobility travel modes, and their energy consumption. She does this by enabling the collection of rich, end-to-end, multi-modal data, which has historically been exceedingly difficult to gather methodically. Her work is gaining traction as state, local, rural, and international communities increasingly reach out for partnership opportunities involving micromobility programs and incentives that benefit underserved populations. At the core of this work is Dr. Shankari's development of a novel modular open-source platform called the National Renewable Energy Laboratory (NREL) Open Platform for Agile Trip Heuristics (OpenPATH), formerly known as "e-mission."

NREL OpenPATH is a monument to Dr. Shankari's vision to uniquely empower communities with the ability to collect and understand their own travel data for the purpose of achieving their locally relevant sustainable mobility goals—an ability that did not exist before the tool's inception. The tool was accordingly designed for long-term use by a broad spectrum of community residents, powered by constant and automated data processing, individualized travel logs that take all modes of travel into account, and comprehensive multi-metric travel insights. Most importantly, Dr. Shankari designed the tool as a free, easy-to-access smart phone application that can be continuously improved upon and customized. Whereas many might opt to commercialize the product and keep the source code private, she chose to develop the tool as a free open-source product. By removing financial barriers, her tool democratizes access to transportation data collection; its open nature enables transparent data collection and analysis, and its developer community invites collaboration on tool improvements such as accessibility.

Her ardent interest in equitable access to transportation and related data was cemented through nearly a decade of advocacy during her doctoral program. She attended her local bicycle and pedestrian advisory committee as a private citizen to stay up to date on and raise concerns about transportation safety and infrastructure. The City Council then selected her to serve on a five-person committee that presents recommendations regarding local transportation matters and proposals. During this time, she saw the limitations of transportation data collection with existing mechanisms, especially for bicycle and bus infrastructure proposals where car-oriented data models dominated the discussion. Dr. Shankari formulated the idea for what would later become



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Started in 2009, the annual Governor's Awards for High-Impact Research celebrates the brilliant ground-breaking discoveries and innovative research from Colorado's ecosystem of federally-funded laboratories and institutions.

Organized by CO-LABS, each year's event spotlights the men and women creating our future through brilliant technological and engineering discoveries in aerospace, energy, agriculture, public health, weather prediction, wildlife ecology, communication, earth science and dozens of other fields of research right here in our communities.



THE NOMINATION'S COMPELLING FACETS OF THIS PERSON'S RESEARCH (CONTINUED)

NREL OpenPATH from this deficit in data that omitted the perspective of non-car users. She made it her mission to give transportation planners and stakeholders a tool that could provide a complete view of travel behavior by collecting data across all trips and all modes and calculating the corresponding carbon footprint.

Dr. Shankari's research is pioneering and exceptional, merging the disparate fields of computer science and urban planning with a passion for making transportation accessible to all. The NREL OpenPATH tool calculations are the first of their kind—homing in on improving the efficiency of transportation systems holistically and inclusive of understudied modes such as micromobility. In contrast to the transportation sector's tendency to collect data on and optimize infrastructure for larger vehicles in urban areas, Dr. Shankari's research bridges the data gap in real-world travel behavior in underrepresented, rural, and even remote communities. This can help address disparities in how transportation projects are funded and shift from a car-centric to a people-centric view of transportation decarbonization. With more than 15 communities around the world directly leveraging NREL OpenPATH to inform their micromobility programs and incentives, the tool is undeniably accomplishing its goal of improving access to often overlooked data. New collaborations are anticipated to follow as the tool continues refinement and will amplify the impact of Dr. Shankari's research.

Part of this fine-tuning is what makes the tool especially remarkable. Constructing transportation behavior models is a challenging task that depends on a sophisticated network of interdependent inputs. Progress on creating a trustworthy behavior model is often stymied by the lack of high-quality public datasets. Dr. Shankari led a team to develop MobilityNet: a robust platform to holistically evaluate the accuracy of the data collected through the NREL OpenPATH tool while preserving data contributor privacy. With over 1,080 hours of artificial trips, control phones, and repeated travel data from the two most popular operating systems—Android and iOS—the publicly available data and analysis is a move towards common ground for multi-modal mobility research. Leaving the platform open to others to evaluate their algorithms is a testament to her enduring effort to enhance both the quality and accessibility of all her work.

WHAT STANDS OUT AS INSPIRING, INFLUENTIAL AND/OR UNIQUE REGARDING THIS PERSON'S RESEARCH CAREER SO FAR

Dr. Shankari overcame many challenges to carve an inimitable space for herself in an interdisciplinary field with immense impacts to the livelihood of countless people. Born and raised in a dense urban environment outside of the United States, the very first bicycle that she received in the eighth grade would go on to become her primary means of mobility through college and her first few years in the workforce, and ultimately the root of her passion for equitable transportation. When she first attempted to pursue a doctoral degree, a family crisis prompted her to drop the program and pursue a career in industry that would allow her to support her family. It was only after decades had passed that Dr. Shankari's familial situation stabilized to where she could act on her intensifying resolve to help mitigate the impacts of climate change in any way she could and return to academia. She proceeded to take a sabbatical from industry and meet with various professors until she found two co-advisors who wholeheartedly believed in her vision for equitable access to transportation through advanced systems data collection and computation. They supported her throughout her Doctor of Philosophy program and introduced her to researchers in the fields of transportation and urban planning to deepen her knowledge in the mobility sciences. They also encouraged her to mentor undergraduate students through the Summer Undergraduate Program in Engineering Research at Berkeley (SUPERB) and Undergraduate Research Apprenticeship Program (URAP) to channel her enthusiasm for student career development.

However, she found it challenging to explore interdisciplinary research as a graduate student. She persevered in her desire to specialize in use-inspired transportation research and real-world software deployments with broad impact, but unlike established researchers, she had not yet built a reputation in an academic discipline. Dr. Shankari was met with skepticism for her divergent endeavor to incorporate mobility and computer science aspects into her publications without an academic track record in either field. Widespread usage of her tool as a software engineering product by mobility science experts was not forthcoming, and neither was widespread acceptance of her concept as sufficiently novel and intellectually stimulating by computer science experts. She was further demoralized by the disinterest from industry

WHAT STANDS OUT AS INSPIRING, INFLUENTIAL AND/OR UNIQUE REGARDING THIS PERSON'S RESEARCH CAREER SO FAR (CONTINUED)

sponsors due to her insistence on eschewing commercialization in favor of transparency and accessibility for her project. These negative responses to her work translated into a slew of rejections during her post-graduate job search—turned down by the computer science, civil engineering, and data science departments from over 30 universities and industrial research laboratories. The path to find an institutional home for her research was unclear.

These initial setbacks nearly drove Dr. Shankari to return to industry when she discovered the like-minded interdisciplinary and impact-focused research cohorts at the U.S. Department of Energy (DOE)'s National Renewable Energy Laboratory. With support from NREL and DOE, she successfully converted her doctoral research artifact into NREL OpenPATH, a practical tool that communities can access and customize at no cost to them. As community deployments of NREL OpenPATH and engagements continued to increase, so did the real-world datasets, and she seized the momentum to conduct use-inspired research—Pasteur's quadrant—that was not possible before with smaller datasets. Today, she continues to further extract and address generalizable research problems from the field deployments of NREL OpenPATH to improve usability, scalability, and scientific rigor.

Since joining NREL, she has been instrumental in leveraging NREL OpenPATH for multiple projects by engaging with impactful partners and other NREL researchers. Her collaboration with the Colorado Energy Office to collect data for their first electric bicycle pilot led to the deployment of hundreds of electric bicycles to low-income essential workers during the pandemic. Evaluation using NREL OpenPATH was central to this pilot, as well as the expanded pilot, permanent program, and distribution of rebate incentives. Within NREL, the availability of the electric bicycle program data and the tool itself as a data collection platform led to several interdepartmental projects that explore the potential of next-generation travel modeling through leveraging location history data. On top of promoting collaborative projects within the organization her media outreach efforts have similarly boosted the visibility of the laboratory. Metrics tracked by NREL tell a story of high engagement with her work, culminating in more than 4,000 pageviews across yearly NREL news articles and more than 10,000 impressions on corresponding posts across NREL social media accounts.

A recent appointment to the new U.S. Joint Office of Energy and Transportation (Joint Office) likewise emphasizes Dr. Shankari's commitment to a holistic view of transportation decarbonization. The Joint Office recognized that although initial electric vehicle research in the transportation sector focused on vehicle drivetrains, a network of charging stations that consistently work as intended is paramount to overcome driver range anxiety and promote widespread adoption. Dr. Shankari was befittingly onboarded as the Principal Software Architect of the Standards and Reliability Pillar for her expertise in travel behavior and her personal experience as an early adopter of an electric car. In this position, she will guide the software aspects of building out a national network of interoperable and reliable charging infrastructure for electric vehicles. Her work in enabling this additional shift in travel behavior will affect positive change in overall transportation system efficiency and make traveling a better experience for all.

Finally, Dr. Shankari has been a prolific intern mentor through DOE's premier Science Undergraduate Laboratory Internship (SULI) program, Community College Internship (CCI) program, and within her NREL OpenPATH team. With more than 25 past, present, and incoming mentees, she mentored two to five students who aspired to be technicians and scientific researchers per term throughout the formal DOE programs. She now hosts one of the largest intern cohorts in her research department through the NREL OpenPATH projects. Indicative of providing excellent learning opportunities for the next generation of the science, technology, engineering, and mathematics workforce, Dr. Shankari was nominated by her mentees and honored as a top outstanding mentor in NREL's Center for Integrated Mobility Sciences.

Selected Research Papers of Significance:

Shankari consistently prioritizes highlighting her mentees' accomplishments and lists her mentees as first authors on many of her papers—a commitment she demonstrates through her papers published as a graduate student to this day.

- Allen, Michael and Shankari, K. 2023: Estimating Travel Energy Consumption Uncertainty Based on Inferred Travel Mode and Sensed Travel Length, Transportation Planning and Technology (invited to Bridging Transportation Researchers special issue)
- Kosmacher, Gabriel and Shankari, K., 2023: Evaluating the Interplay Between Trajectory Segmentation and Mode Inference Errors Transportation Research Record (to appear)
- Shankari, K., and Fürst Jonathan and Fadel Argerich Mauricio and Avramidis, Eleftherios and Zhang, Jesse, 2020: MobilityNet: Towards a Public Dataset for Multi-modal Mobility Research. ICLR Workshop: Tackling Climate Change with Machine Learning
- Zhang, Jesse and Sullivan, Jack and Vasudev Venkatesh P.B and Tse, Kyle, and Yan, Andy and Leyden, John and Shankari, K. and Katz, Randy. 2019 TripAware: Emotional and Informational Approaches to Encourage Sustainable Transportation via Mobile Applications 6th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation
- Shankari, K. and Bouzaghrane, Mohamed Amine and Maurer, Samuel M. and Waddell, Paul, and Culler, David E., Katz, Randy H.: 2018 e-mission: An Open-Source, Smartphone Platform for Collecting Human Travel Data Transportation Research Record, 2672(42), 1-12

Other Awards that Dr. K. Shankari has been awarded:

Dr. K. Shankari has garnered awards and honors for both research excellence and mentorship at the National Renewable Energy Laboratory (NREL). At NREL, she received the prestigious Director's Award for exceptional achievements in her OpenPATH project and commitment to mentorship based on written nominations from NREL associate and deputy laboratory directors in 2021. In the same year she was also honored as one of NREL's Top 15 Outstanding Mentors for her eager and unwavering support of her mentees' career growth, including enabling various opportunities to contribute meaningfully to research work, as well as helping her mentees gain credit for accomplishments through journal papers and conference presentations. Outside of NREL, in her previous career in the tech industry, Shankari and her colleagues were awarded four patents related to distributed resource management for data centers.



About CO-LABS:

Started in 2007, CO-LABS is a non-profit consortium of federal laboratories, research institutions, businesses and economic development organizations that provide financial and in-kind support for programs that promote the retention and expansion of Colorado's federally-funded scientific resources. Through events, economic analyses, strategic communications and networking activities we work to:

- PROMOTE Colorado as a global leader in research and technology
- EDUCATE the public about federal research labs' and institutions' impact, and importance of sustained funding for research
- CONNECT the labs, universities, economic development organizations and businesses to facilitate partnerships and technology transfer