



Research
Institutes

Discoveries in Safety™

2023 Impact Report

Bringing Safety Science Research to Life



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and Chief Research
Officer message

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A Message From Chris Cramer

As we celebrate our [130th anniversary](#), many UL Research Institutes milestones from the past year come to mind — from our move into a [new Evanston, Illinois, headquarters](#) to the success of our [first ULRI Annual Research Symposium](#), which engaged both internal and external participants.

Yet I'll focus here on a single marker that directly or indirectly touches almost every aspect of our work: our [published endorsement](#) in 2023 of open science principles. Though we have long followed open science practices, our public embrace of these principles during the federal government's first designated [Year of Open Science](#) expresses our enduring commitment to making scientific research accessible to everyone for the public good.

Why now? First, everyday life in today's world requires a fundamental understanding of science — indeed, it's become a truism that science isn't just for scientists anymore. To foster smart choices and informed decisions, our understanding of scientific concepts and practices must be based on accurate, readily available information. Easy access to research findings has become a necessity if we are to have the surety to act upon them.

Open science also responds to today's increasingly urgent public safety challenges. These challenges are complex as well as global in scope and cannot be resolved by any one organization. By sharing our research processes, methods, data, code, and findings as openly as possible, we aim to accelerate the discoveries that will help create the safer and more sustainable world that our mission envisions.

We're in good company. Since the General Conference of UNESCO added impetus to the decades-old open science movement by adopting the [Recommendation of Open Science](#) in November 2021, numerous U.S. agencies have advanced the Year of Open Science launched by the White House Office of Science and Technology Policy in January 2023. Higher education institutions such as Harvard University, Massachusetts Institute of Technology, and the University of Minnesota also have embraced open science.

Here at ULRI, our open science commitment means in practice that we:

- Publish in open access journals, with an eye toward discoverability
- Self-publish our technical reports to disseminate information without paywalls
- Support use and reuse of our research
- Share educational content

It is in the spirit of open science that this report shares our research and its impact. I encourage you to read further about our focus on three [grand challenge commitments](#), our scientifically rigorous approach to the advancement of public safety, and the varied ways in which we disseminate our findings and partner for greater safety science impact.

I am confident that with collective action we will meet today's numerous safety challenges and together build a safer, more sustainable future.



Christopher J. Cramer
Interim President, Chief
Research Officer
UL Research Institutes

A tribute to former President and CEO Terry Brady

Terry Brady, our former president and CEO, [retired](#) at the end of 2023 following years of leadership that culminated in our organization's historic transformation.

When I joined Terry Brady's leadership team three years ago, UL Research Institutes (ULRI) — then called Underwriters Laboratories Inc. — was on the cusp of significant change. Within a year, our Board of Trustees announced its decision to make a [landmark \\$1.8 billion financial commitment](#) to dramatically expand both the scale and scope of our own activities as well as to launch [UL Standards & Engagement as a nonprofit organization separate from ULRI and from newly rebranded UL Solutions](#).

That was just the start. We have spent the last two years transforming and scaling up ULRI's research institutes to better address the myriad safety challenges the world faces, and Terry's visionary leadership was key to making it happen.

He was instrumental in expanding our capabilities, overseeing our reconstitution, and clarifying the unique role that each organization within our enterprise plays as we work for a safer world. As a recognized thought leader in global safety science, Terry also partnered with scientific leaders around the world to develop insight and solutions to today's most pressing problems.

I feel privileged to have worked with Terry during his stewardship of our organization's public safety mission. With gratitude, I — and all of us at ULRI — wish Terry well in his retirement.

Building the Foundation of a Safer Future

Our world faces critical challenges. As ULRI grows to address these evolving public safety risks, we're focusing our safety science expertise on the following three global challenges.

Building resilience for a sustainable future

[Read more](#)

Advancing individual and societal health in the 21st century

[Read more](#)

Promoting safety at the human-digital interface

[Read more](#)

Read more to learn about the ULRI research institutes and offices that are tackling worldwide safety issues to build the foundation of a safer future.

[Dr. Jill Crisman leads DSRI](#)

Digital Safety Research Institute (DSRI) aims to partner with other safety-minded organizations to develop tools to help protect individuals from rapidly evolving digital threats. [Read more](#)



[Dr. Marilyn Black leads CIRI](#)

Chemical Insights Research Institute (CIRI) helps detect, reduce, and eliminate the dangers that environmental and chemical pollutants pose to human health. [Read more](#)



[Dr. Judy Jeevarajan leads ESRI](#)

Electrochemical Safety Research Institute (ESRI) examines the safety and performance limits of storage batteries and other renewable energy technologies while exploring ways to overcome those limits. [Read more](#)



[Dr. Steve Kerber leads FSRI](#)

Fire Safety Research Institute (FSRI) advances fire safety knowledge through field and laboratory studies, investigations, and modeling to address the world's unresolved fire safety risks and emerging dangers. [Read more](#)



[Dr. Stuart R. Miller leads MDRI](#)

Materials Discovery Research Institute (MDRI) studies new materials at the atomic, nano, and meso scales. Its research highlights both risks and applications, including ways we might harness new materials to advance sustainability, safety, and health. [Read more](#)



[Deepa Shankar leads the partnerships office](#)

Office of Partnerships builds out, oversees, and manages all major partnerships for UL Research Institutes, including competitive sponsored research activities, awards, prizes, the Advisory Board to the Chief Research Officer, our annual research symposium, and relationships with other key organizations. [Read more](#)



[Dr. Kelly Keena leads OREE](#)

Office of Research Experiences & Education (OREE) collaborates with our research institutes to create compelling educational materials and learning opportunities for secondary through postgraduate students — focusing on those who are traditionally overlooked and underrepresented in STEM education. [Read more](#)



Chemical Insights Research Institute

CIRI is helping people understand the dangers of wildfire smoke and the chemicals in that smoke. This is not just a local issue, it is a regional and national issue, and CIRI's work is integral for understanding the health impacts.

Birgitte Messerschmidt
Director of research
at the National Fire Protection Association

CIRI

As the effects of climate change intensify, wildfires are growing exponentially in areas where undeveloped forests meet community development — collectively known as the wildland-urban interface (WUI). More than 99 million people who live in the WUI face the threat of a disastrous wildfire that could cost lives as well as property and result in serious health consequences.

Through research and education, the Chemical Insights Research Institute expands our knowledge of WUI fires, their causes, their human health impacts, and the damage they do to our ecosystems. We share information on ways to design resilient buildings and communities and develop strategies to reduce the health risks posed by wildfires and extreme weather. We strive to mitigate WUI-related risks through our:

Advanced laboratories for WUI-related research

We have established new labs housing our Center for Exposure Science, the Center for Toxicology and Human Health, and the Center for Advanced Measurements, enabling us to characterize and measure human toxicity caused by emerging threats like wildfire smoke.

New studies focused on WUI fire health impacts

We've initiated research to identify airborne pollution caused by WUI fires, measure the cardiometabolic health consequences of exposure to wildfire smoke, and evaluate the toxicity of dust and residues in communities affected by wildfires.

Work to lay the groundwork for healthier buildings

In collaboration with the U.S. Green Building Council, we held a national workshop to develop a blueprint to foster safer and healthier and more equitable buildings and communities.

Coursework aimed at protecting WUI communities

Our online course, Wildfires in the Wildland Urban Interface: Exploring Resilience in WUI Communities, provides an overview of wildfires and WUI for architects, designers, and green professionals.

Knowledge sharing

We shared our expertise with federal and state agencies, designers, community planners, and health professionals during a workshop in Washington, D.C., called The Future of Fire Safety: The Intersection of Wildfires and Human Health.

Promotion of open science

With partners from the sustainability community, we developed a publicly available repository of information to strengthen community and health resilience in the face of wildfires and other natural disasters.

Digital Safety Research Institute

DSRI

The Digital Safety Research Institute (DSRI) strives to increase public safety in today's rapidly growing digital ecosystem. Through safety assessments, safer ecosystem design, and safety education and tools, DSRI collaborates with others to help people better protect themselves from emerging digital threats.

Our collaborative efforts include:

Partnership with AIID

We recently announced an agreement with the Responsible AI Collaborative to advance the [AI Incident Database \(AIID\)](#), which collects and disseminates information on harms or near harms caused by artificial intelligence (AI) systems in an effort to prevent or mitigate potential harms in the future. Under this agreement, DSRI is continuing to develop the code which underlies the AIID website. Findings in a recent study conducted by Carnegie Mellon University in Pennsylvania suggest that the AIID could be a useful resource for teaching ethics and increasing awareness of the negative effects AI can have.

CASMI research hub

We are continuing our collaboration with the [Center for Advancing Safety of Machine Intelligence \(CASMI\)](#) at Northwestern University in Illinois, which leads and coordinates research across about 10 universities with the aim of incorporating safety and equity into the design, evaluation, and development of machine intelligence technologies.

“The investment in these projects not only moves the work in digital safety forward, but it also establishes the foundation for a new community of researchers all focused on how to operationalize safety in the online world.”

Dr. Kristian Hammond

CASMI director and Bill and Cathy Osborn professor of computer science at Northwestern University

Electrochemical Safety Research Institute

ESRI

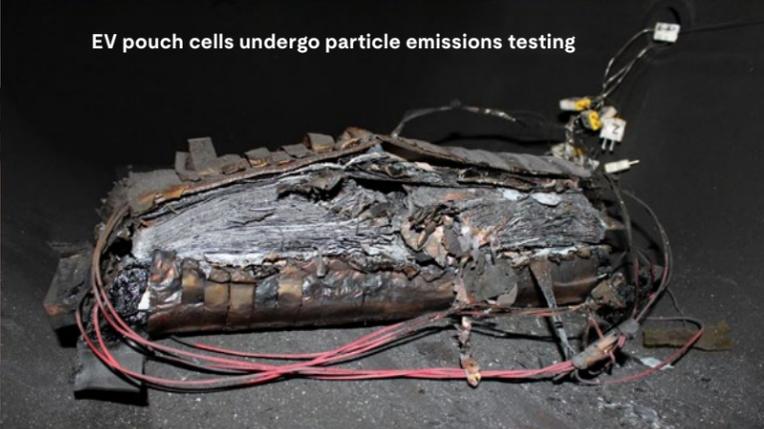
“Research is so important for the fire service because we rely on that data. It’s a budget driver as well as a safety component — we are relying on that to reduce our incident times.”

Jasen Dodson
Battalion chief for the Loudoun County Combined Fire and Rescue System in Virginia and speaker at the Latin America Battery Safety Summit

Our Electrochemical Safety Research Institute supports a safe transition to a clean energy world by sharing our energy storage research and expertise with industry experts and policymakers from around the globe. These are some of the 2023 venues through which we shared our knowledge:



EV pouch cells undergo particle emissions testing



Latin America Battery Safety Summit

Supporting Latin American efforts to establish a safe and sustainable electric vehicle ecosystem, we partnered with UL Standards & Engagement to share our electric mobility safety knowledge with automotive industry, government, research, and other stakeholder organizations at [this two-day event](#) in Mexico City.

Consumer Product Safety Commission (CPSC) lithium-ion battery safety forum

Dr. Judy Jeevarajan, ESRI’s vice president and executive director, was among six panelists who discussed the science and history of lithium-ion batteries, safety recommendations, counterfeit battery issues, and other related topics during a July 2023 [CPSC hearing](#) on the growing challenge of battery safety. At the end of the hearing, several commission members expressed support for mandatory lithium-ion battery standards.

Global EV Battery Safety Forum

For several years, we have partnered with a number of Indian organizations and government entities to strengthen lithium-ion battery fire safety as battery power gains traction there. Among the venues at which we shared our battery safety expertise in 2023 was a [global conference](#) held by the India Energy Storage Alliance in New Delhi, India, which attracted participants from the global academic, research, business, manufacturing, and industrial sectors as well as consumers.

Fire & Security India Expo

At this 2023 [trade expo](#) in Mumbai, India, ESRI collaborated with UL Standards & Engagement to co-lead a demonstration that brought to life how lithium-ion battery fires can reignite even after they are initially extinguished. The demo was designed to share critical knowledge with India’s Maharashtra Fire Services to help them update their fire mitigation guidelines.

International Battery Materials Association (IBA) meeting

We shared our research into the characteristics and behavior of lithium-ion battery fires and smoke and particle emissions from thermal runaway of lithium-ion cells and modules at the [2023 annual IBA meeting](#) in Texas, which we also co-sponsored.

International Battery Seminar

At this [Florida event](#), we shared our expertise on lithium-ion battery safety with more than 2,100 people representing original equipment manufacturers, battery developers, and other sectors involved in the battery industry.



Fire Safety Research Institute

FSRI

FSRI has become the go-to source for ground truth on fire risks associated with lithium-ion technology. Through their baseline research, post-incident evaluation, and rapid socialization of findings, FSRI is providing insights to firefighters that keep them and the public safe.

Dr. Lori Moore-Merrell
U.S. fire administrator

”

Lithium-ion battery fires differ from traditional fires — they move faster, emit different gases, and are harder to extinguish using existing fire suppression techniques.

Our Fire Safety Research Institute (FSRI) works to understand and mitigate the fire safety risks that lithium-ion batteries — used in everything from electric vehicles to energy storage systems — may pose if they fail and go into thermal runaway, which can cause fires and even explosions. By closing the lithium-ion battery fire dynamics knowledge gap, we will help firefighters develop tactics to effectively control and suppress these fires and manage their hazards.

FSRI's battery fire safety efforts include:

Fire Safety of Batteries and Electric Vehicles study

In this study, we are conducting full-scale experiments to obtain information on electric vehicle (EV) fire dynamics in order to devise safe and effective EV fire control strategies.

Examining the Fire Safety Hazards of Lithium-Ion Battery Powered E-Mobility Devices in Homes study

Partnering with the Fire Department of the City of New York, we're learning about the dynamics of fires involving lithium-ion powered e-mobility devices with the goal of improving first responder and occupant safety.

Impact of Batteries on Fire Dynamics research project

In this project, we're examining the potential explosion hazards of a lithium-ion battery cell that goes into an uncontrollable self-heating state called thermal runaway.



'Take C.H.A.R.G.E. of Battery Safety' public fire safety education campaign
Launched in November 2023, "Take C.H.A.R.G.E. of Battery Safety" teaches the public how to prevent and mitigate fires involving lithium-ion batteries.

Materials Discovery Research Institute

MDRI



The MDRI has assembled an impressive multidisciplinary team of researchers and built an advanced lab to accelerate discoveries that will address some of the most challenging problems at the intersection of energy and sustainability. Their goal-oriented approach is progressive and bodes for success. I can't wait to see the results that will come out of this effort.

Dr. Alán Aspuru-Guzik
University of Toronto chemistry and computer science professor

A state-of-the-art laboratory that accelerates discovery

We are creating a highly advanced materials discovery laboratory that leverages artificial intelligence and automated instrumentation enabling high-throughput experimental techniques that can generate results far more quickly than traditional testing methods.



By whichever measure you use — global average temperature, changes in rainfall patterns, or the frequency of extreme weather like droughts or floods — the adverse impacts of humanity's reliance upon fossil fuel resources are clear.

As we strive to develop both resiliency and sustainable energy sources in the face of these challenges, our Materials Discovery Research Institute (MDRI) aims to accelerate the discovery of materials that will lead to transformative solutions. Working from the ground up, MDRI is building the capacity to revolutionize how we innovate materials and will enable a more sustainable future.



Focused collaboration

We have launched a collaborative research project with the University of St. Andrews in Scotland focused on accelerating the discovery of new types of porous materials — known as zeolites — that may potentially revolutionize clean energy production, storage, and consumption.

Office of Partnerships



Today's safety science challenges are both urgent and complex, beyond the scope of any one person or organization to resolve.

To foster the multidisciplinary collaboration required to tackle these challenges, our Office of Partnerships hosts our ULRI Annual Research Symposium to bring together research leaders of various organizations and scientific fields from around the world.

Our inaugural symposium in 2023 created a forum in which experts from more than 65 participating organizations and universities shared knowledge about climate change resilience and sustainability, the symposium's focus.

By providing a forum in which people from different research areas, disciplines, and organizations can synthesize their understanding, the symposium:

- Encourages collaborative research across disciplines and geographies
- Deepens our understanding of critical issues by creating a knowledge-sharing environment



It was a great experience to have scientists, educators, and businesses at the same event. The networking opportunities were great. I now have a better understanding of different outlooks from each field. I brought home to share not only the data and experience, but also great contacts for the future collaborations.

Symposium attendee



Office of Research Experiences & Education

OREE

This internship will impact my career in the future because it taught me to always strive for better in my work. I have learned to always push for the highest quality possible with a key attention to detail.

Jordan Pearson
FSRI multimedia intern hired full time in 2023



Our Office of Research Experiences & Education (OREE) builds the future of safety science through a mix of innovative educational programs, academic partnerships, and research experiences.

Through our deep relationships with educators, students, and early career professionals, we shape future generations from the middle school classroom to their entry into the professional world.

Among the programs we've developed to educate and engage young people are:

Xplorlabs

The [Xplorlabs](#) online educational platform, which engages students in a search for solutions to real-world safety problems, reached nearly 7,500 educators nationwide in 2023. We also updated two Xplorlabs learning modules last year based on teacher feedback, ensuring the modules reflect best practices in science education and adhere to national education standards.

Teacher Fellows program

Our Teacher Fellows program is part of our effort to build safety science and sustainability education resources across the country. In 2023, we established two fellowships that are increasing the use of Xplorlabs in classrooms and creating new sustainability resources through a partnership with Arizona State University. Through these fellowships, we collaborate with 18 teacher fellows — directly impacting 4,860 students each year.



2023 interns Jordan Pearson, at left, and Doug Mansen present posters at the 2023 ULRI Annual Research Symposium

Intern Engagement Initiative

Our Intern Engagement Initiative was launched in 2023 to create connection and belonging for ULRI interns and early career professionals. Developed in partnership with the Academy of Natural Sciences of Drexel University in Pennsylvania, the pilot program supported 10 interns and early career professionals across our institutes through professional development and mentorship.

Executive Leaders



Christopher J. Cramer
Interim President and
Chief Research Officer
UL Research Institutes



Ron Blaustein
Senior Vice President and
Chief Financial Officer
UL Research Institutes and
UL Standards & Engagement



Ronaldo Borger
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UL Research Institutes and
UL Standards & Engagement



Timothy J. Rivelli
Senior Vice President and
Chief Legal Officer
UL Research Institutes and
UL Standards & Engagement

Together with our research institute leaders, the executive leadership team carries out UL Research Institutes' mission to promote safe living and working environments throughout the world under the direction of Interim President and Chief Research Officer Chris Cramer and our Board of Trustees.

The leadership team's commitment to rigorous science, collaboration, education, and application of our findings ensures that everything we learn reaches the people who need it to make our communities safer.

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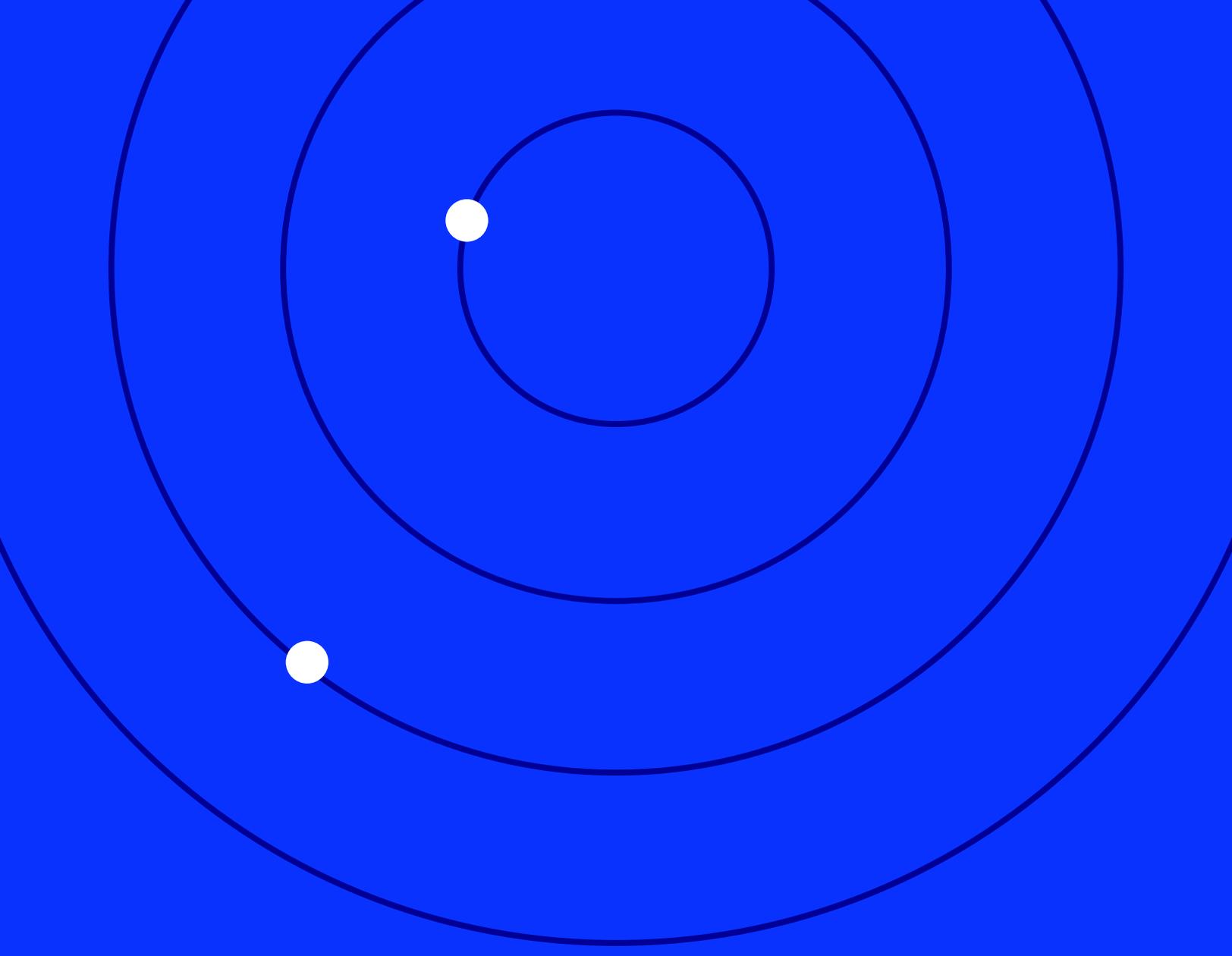
Governance of UL Research Institutes is directed by our distinguished Board of Trustees. Our board members bring their safety science expertise and deep knowledge of global issues to their thoughtful stewardship of our organization.

With his demonstrated leadership and advocacy experience, Chair James M. Shannon leads the board and helps drive our goals forward, encouraging transformative change for a safer and more resilient society.

We thank the board members for their support and counsel as we advance the UL Research Institutes strategic vision to be regarded as the preeminent institution addressing our selected grand challenges and broader public safety concerns.

Advisory Board to the Chief Research Officer

In 2022, Interim President and Chief Research Officer Chris Cramer created an advisory board to guide him as he leads the expansion of the research institutes and their collective impact on society.



EXPERIENCE ONLINE
ul.org/2023-impact-report



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