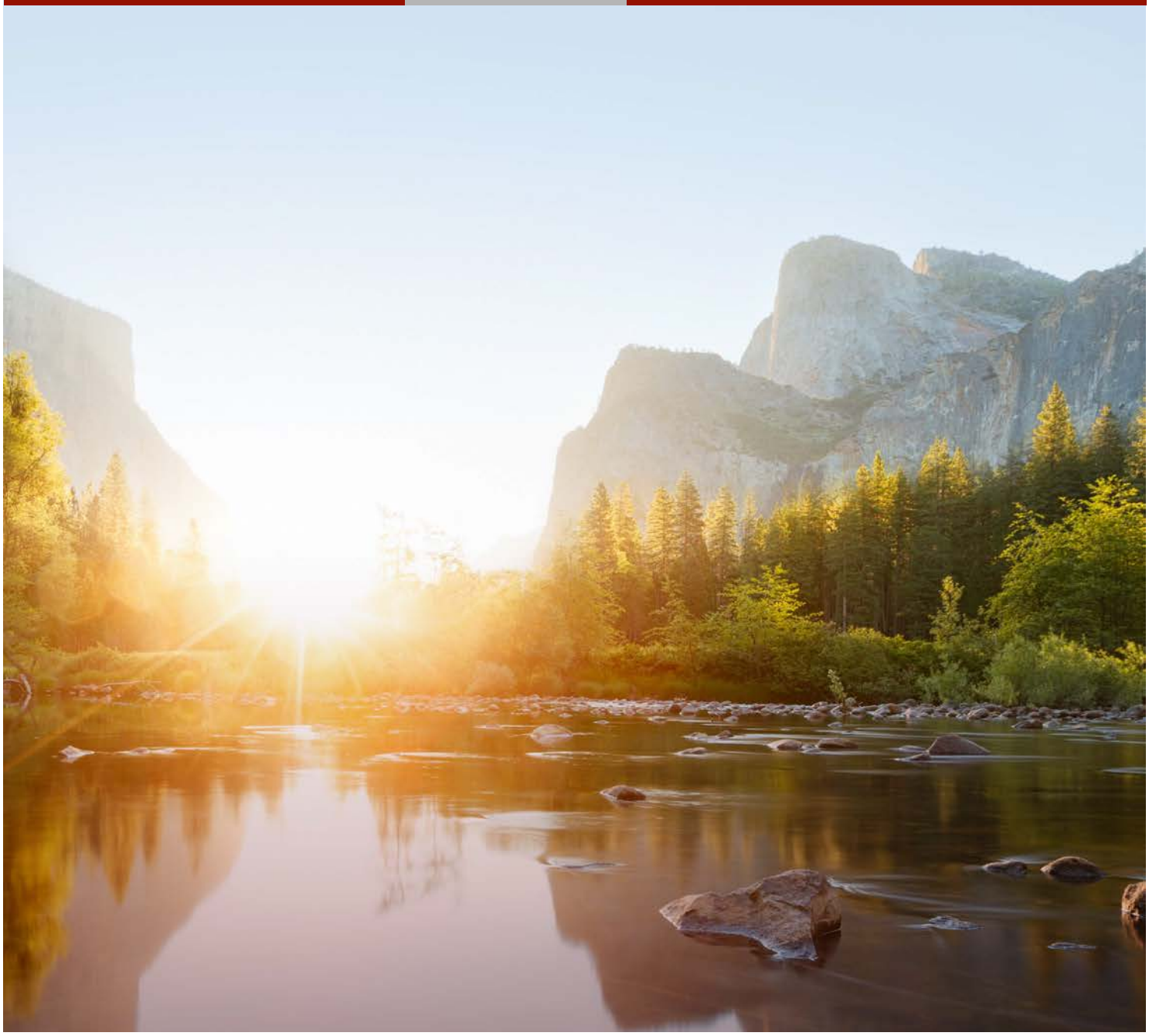
WATER IN THE WEST

Strategic Plan 2014-2018

A Program of Stanford's Woods Institute for the Environment and the Bill Lane Center for the America West



Stanford WOODS INSTITUTE for the ENVIRONMENT

STANFORD UNIVERSITY THE BILL LANE CENTER FOR THE AMERICAN WEST

OVERVIEW

Mission

Water in the West bridges the gap between research and practice to create and promote the adoption of effective solutions to the threat of water scarcity in the American West.

Vision

We envision a world, in the near future, where water is managed in a way that satisfies urban demands, fulfills the needs of agricultural production, and restores ecosystems – free from the conflict common in the history of western water allocation.

Our vision requires that:

- Every gallon of freshwater withdrawn for human use is optimized for maximum benefit.
- Innovation and change are no longer viewed as impossible or intractable.
- Water organizations, markets, and regions are functional, coordinated, and integrated.
- Groundwater is sustainably managed.
- Freshwater ecosystems are restored and protected.

What Sets Us Apart

Stanford University brings four key assets to solving the West's water scarcity challenge:

- World-class faculty, researchers, and students across an extraordinary breadth of disciplines.
- Experience and a proven track record of fostering interdisciplinary research.
- Geographic focus that spans the entire West.
- Reputation and credibility capable of unifying and influencing a broad range of leaders in the water field.

How We Effect Change

We drive change by harnessing Stanford's talent and energy to develop new knowledge, policies, and practices that will help achieve our vision in the following ways:

- Find solutions to water scarcity by conducting research in policy, management, and technology.
- Focus Stanford students on the issues of water scarcity and sustainable water management.
- Use communications to advance new ideas and create tools.
- Build strong partnerships to inform policy makers, water managers, and NGOs.

Four Areas of Focus

- Sustainable Groundwater
- Water and Energy
- Watershed Health
- Water Management and Allocation

FOCUSING STANFORD'S RESOURCES ON LASTING SOLUTIONS

Stanford University created Water in the West in 2010 to address the West's growing water crisis and to design new solutions that move the West rapidly toward a more sustainable water future. A joint program of the Stanford Woods Institute for the Environment and the Bill Lane Center for the American West, Water in the West focuses the resources of one of the world's preeminent research institutions to address one of the most urgent questions about the West's future – how the region can continue to thrive despite growing water scarcity.

The American West is an arid region to begin with; explosive growth and increased drought are contributing to a mounting water crisis. Research can help solve the crisis, but research is not enough. Water in the West bridges the gap between academic research and applied solutions by creating new practical tools and forming strong partnerships to inform policy makers, water managers, and environmental groups.

While there are a number of prominent water research centers around the country, most are housed at state universities and tend to focus on water resources of their home state. Recognizing the need for crosscutting solutions, Water in the West works regionally across the entire Western United States to solve long-term water issues that demand regional vision with local adaptation. Stanford is strongly rooted in California, but its reputation, vast alumni network, and other partners enable it to work across state boundaries for a broader geographic impact.

The University's breadth of expertise and research excellence makes it uniquely capable of addressing the complex mix of problems confronting western water management. With faculty and student researchers spanning a broad range of relevant disciplines, Water in the West focuses expertise from the fields of engineering, law, economics, political science, business administration, geophysics, hydrology, environmental systems, and communications on a single goal: sustainable water management.

Using the Stanford Campus to Pilot New Ideas

In many ways, the Stanford campus serves as a laboratory for western water challenges. In March 2014, Stanford broke ground on the Codiga Resource Recovery Center, a pilot-scale facility to study new wastewater treatment technologies.

Researchers will use the facility to test whether by-products of water purification, such as methane, can be used to power wastewater treatment plants of the future. For example, Stanford postdoctoral researcher Yaniv Scherson is piloting a process that "turbocharges" methane combustion by adding nitrous oxide created from the ammonia in wastewater.

Researchers will also work to develop small, mobile, wastewater treatment technologies that can be used to create more distributed, efficient treatment systems to divert sewage and treat it for use as recycled grey water in locations where such water is most needed.

All of these technologies will help create wastewater systems that are far more energy and water efficient than our current centralized sewage treatment plants. Stanford is also pioneering a variety of other water efficiency strategies on campus.

THE PROBLEM

Water scarcity defines the American West. It has long shaped the region's history and it is one of the most urgent resource challenges of our time. The region's water use and development of water resources has already led to ecosystem decline and overuse of limited freshwater resources.

Today, a growing population, more frequent droughts, and a changing climate pose new threats to water security. The region faces these 21st century challenges saddled with an antiquated water system created during the 19th and early 20th centuries, which is not adequate to meet modern needs. Data and information gaps further exacerbate the challenges confronting water managers and policy makers in the region.

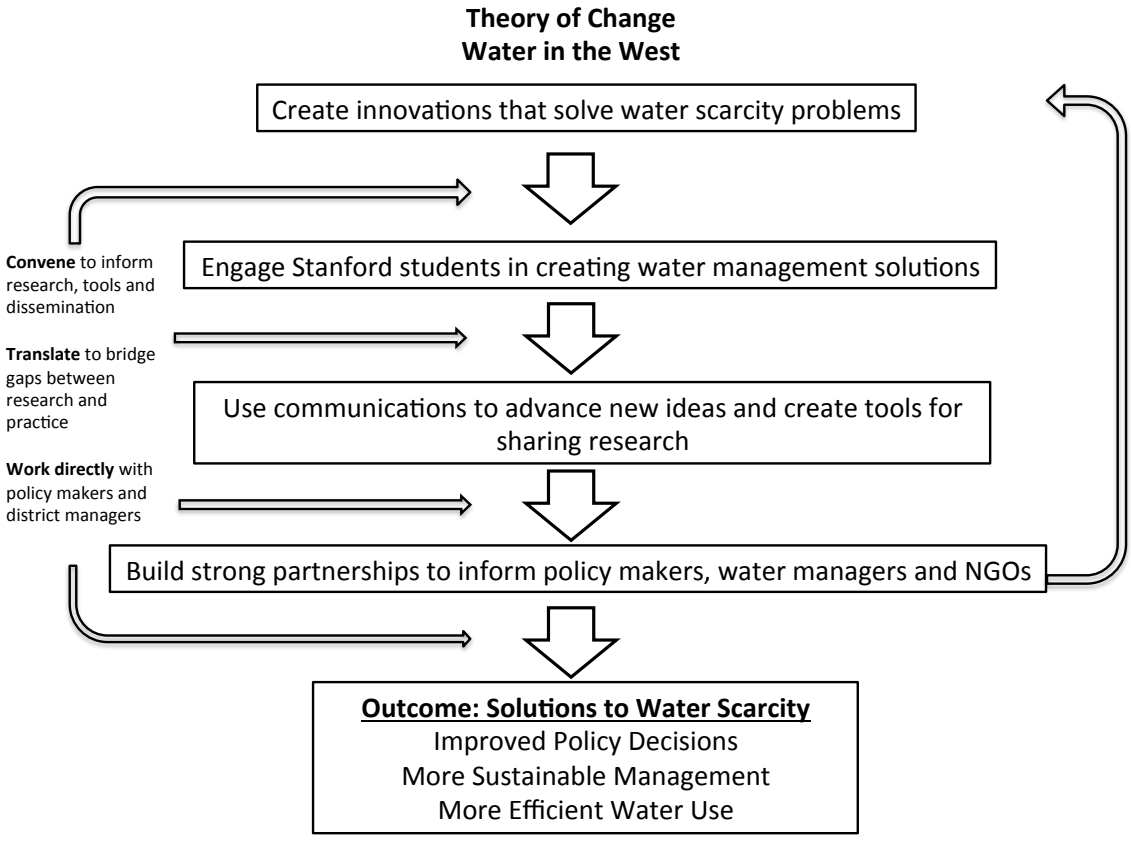
Making matters worse, efforts to address water scarcity have historically generated conflict among competing interests. Many water users view any proposed change to our current system as a threat to their water supply and their way of life. Common ground among agricultural, urban and conservation interests is hard to find, despite shared goals of a sustainable future.

If all parties involved are unable to overcome historic barriers and embrace necessary changes and compromises, westerners could miss a critical window of opportunity. If we do not achieve more rational, sustainable water management soon, droughts and water shortages will cause further economic dislocation and greater ecosystem decline, all against a backdrop of conflict.

How Water in the West Effects Change

In order to achieve our vision of a sustainable water future, the West needs new technologies, policies, practices, and laws that are more flexible and efficient than our current systems. Water in the West is built on the fundamental strengths of Stanford University: its students and faculty. Across departments and disciplines, the program focuses attention and resources on sustainable water management in the Western United States by creating and advancing practical, timely, and relevant solutions that shape policy and support water managers.

To achieve impact, the program is shaped and driven by a sense of urgency and a clear theory of change.



To advance this theory of change – and bridge the gap between academic research and applied solutions – Water in the West uses an integrated suite of communications tactics to improve policy decisions and achieve more efficient water management. *Convening* is used to inform the research agenda and disseminate new information and tools. *Translation* helps bridge the gap between research and practice. *Direct engagement* with policy makers and water district managers supports strong partnerships. Collectively, these tactics help drive the theory of change, which is detailed below:

- **Create solutions that address water scarcity and promote sustainable water management** through research in policy, management, and technology. Stanford researchers (faculty, graduate students, and visiting scholars) work to create policy, management, and technological innovations that promote sustainable water management in the West. Because of its home in the Stanford Woods Institute for the Environment and the Bill Lane Center for the American West, Water in the West brings together researchers from a variety of fields to collaborate on challenging water management issues and to develop integrated, lasting solutions. Scholars in such fields as geophysics, engineering, law, economics, and political science participate in Water in the West's multi-disciplinary research efforts. Water in the West constantly works to pull new faculty and new departments into research that may help solve the West's growing water crisis. We also create partnerships with researchers at other institutions to fill gaps in Stanford's expertise and maximize the impact of our work.

- **Focus Stanford students on creating water management solutions.** Stanford undergraduate and graduate students are among Water in the West's most valuable assets. Water in the West provides a way for students, from a variety of disciplines, to focus their research and educational interests on sustainable water management, water efficiency, and addressing water scarcity. This work contributes solutions for today while educating the next generation of leaders and researchers to steward our water resources in the future.

- **Use communications to advance new ideas and tools.** Water in the West uses strategic communications to ensure that research is translated and shared in ways that make it useful for water managers, policy makers, and other audiences. The West's impending water crisis is too urgent to rely on traditional outlets for academic research. Efforts to put our research to work include convening leaders and managers, producing concise and digestible reports for policy makers, and developing information-rich web-based dashboards that provide timely data and analysis on key western water issues.

- **Build strong partnerships to inform policy makers, water managers, and NGOs.** Water in the West builds partnerships between Stanford researchers and water managers, policy makers, and NGOs. These partnerships shape Stanford's research by informing faculty and students about the most pressing water problems and the new knowledge needed to solve them. Once the research is complete, partners provide an immediate audience and a direct path for disseminating results to a broader audience and shaping decisions. We also work closely with water managers, government agencies, and NGOs to implement new solutions and technologies.

"Uncommon Dialogues" Build Partnerships in the Field

In 2011, Stanford University began a series of "Uncommon Dialogues" related to groundwater management in California, the Western United States, and Australia. These meetings brought together water managers, government officials, and researchers to discuss central policy, scientific, and political challenges to sustainable groundwater management. The dialogues, and the relationships they helped to create, continue to yield important results today.

Relationships between Stanford researchers and groundwater managers identified key data needs and helped scope remote sensing research being conducted by a Groundwater Evaluations and Management group from Stanford's Geophysics Department. The dialogues helped inform managers in California of solutions employed in other arid regions, and resulted in a series of reports identifying and analyzing key policy tools. Many of these proposed policies are part of groundbreaking statewide groundwater legislation being considered in Sacramento with buy-in from water managers who attended the dialogues.

PROMOTING SOLUTIONS

Solving pressing water management problems is central to the mission of Water in West. Research is only one step in this process; devoting resources to communications, partnerships, and direct engagement is also critical to make sure that good ideas actually solve problems.

Water in the West shares the results of its research in numerous ways: by producing short, digestible recommendations that integrate Stanford research with other work in the field; engaging scientific and popular news media to help advance noteworthy solutions; hosting conferences and meetings to grow the community of practice among water leaders region-wide, and working directly with officials, NGOs, and water managers on the ground. We are also creating new ways to convey information and data about western water that will be compelling to policy makers, media, and the public. Emerging methods for linking large data sets to visual, web-based dashboards can shed new light on that data, play a role in policy debates, and inform the public. Our Western Water Dashboard initiative works to find new opportunities to analyze data about the most salient water challenges and convey that analysis in the most compelling way to the audiences that need it most.

PROGRAM FOCUS AREAS

Water in the West is organized around four main program areas, although much of the work cuts across one or more of these areas.

SUSTAINABLE GROUNDWATER

WATER AND ENERGY

WATERSHED HEALTH

WATER MANAGEMENT AND ALLOCATION

These four program areas, detailed below, are closely related and routinely overlapping. They are only intended as a starting point for organizing the program, not as truly separated "departments." Intrinsic to each is an urgency to promote solutions and improve water management.

Sustainable Groundwater

Groundwater provides up to 30 percent of the West's water supply – more during periods of drought. Throughout the West, we are pumping groundwater at unsustainable levels and drawing down aquifers. This practice jeopardizes the primary water supply for many communities, and also makes groundwater unavailable during times of drought when it plays a critical role as a buffer against surface water shortages.

In many places, groundwater is also managed separately from surface water, ignoring both the physical connections between aquifers and streams and the efficiencies that would be gained from managing groundwater and surface water in an integrated fashion. Groundwater is managed unsustainably, not just because of inadequate laws and institutions, but also because of the difficulties in collecting good data about aquifers and their connections to surface water and ecosystems.

Improving data collection technology, aquifer models, and groundwater regulation and management is a critical part of achieving our vision of sustainable and adequate water supplies in the West. Water in the West integrates research in law and policy, geophysics, engineering, and economics to identify and develop solutions to the challenges facing groundwater management. In collaboration with the Center for Groundwater Evaluation and Management in the School of Earth Sciences, Water in the West is working closely with groundwater managers throughout California and other parts of the West to develop new technologies for collecting information about groundwater and putting that information to work in groundwater management decisions. We will grow this work, and also study its use in resolving disputes about groundwater allocation and reforming groundwater management and policy.

A New Tool for Tracking Saltwater Intrusion into Groundwater

A team of researchers led by Stanford Geophysics Professor Rosemary Knight is deploying a new technology – called electrical resistivity tomography (ERT) – to study saltwater intrusion into coastal aquifers in California.

More than 80 percent of water supply on the Central Coast of California comes from groundwater, but coastal aquifers subject to overdraft are highly susceptible to saltwater intrusion from the ocean. ERT is a powerful tool to improve data available to groundwater managers, offering much more robust data than individual monitoring wells by providing a continuous evaluation of an entire cross-section of the aquifer. It also has the potential to be far less expensive than monitoring wells.

Professor Knight's team has successfully completed a pilot project along 6.8 km of the coast of Monterey Bay. In the fall of 2014, the project will be expanded to include 40 km of the coast. The more robust data from this technology can reduce the uncertainty of groundwater models, so managers can make decisions based on a more accurate prediction of the future.

Water and Energy

Water and energy use are strongly linked, as withdrawing, transporting, and treating water requires large amounts of energy. Conversely, energy production and extraction can also require large amounts of water. Despite these relationships and interdependencies, energy and water resources are managed separately. A sustainable future demands fully integrated management of water and energy.

In 2014, Water in the West began a joint program with ReNUWit (a National Science Foundation-funded research consortium focused on reinventing the nation's urban water infrastructure) that focuses on the nexus of water and energy. The goal of this partnership is to explore integrated policy tools for incentivizing the adoption of new technologies that promote energy efficiency through water conservation while reducing energy consumption in the treatment and use of water.

Our researchers are developing a variety of systems and tools to reduce energy use in water management and to increase energy efficiency by improving water efficiency. Water in the West's Director of Urban Water Policy is working closely with ReNUWit to create and study policy tools that will promote adoption of these innovative approaches.

In the coming year, Water in the West will build on this partnership to develop a research initiative that focuses more broadly on the water energy nexus. Potential topics for work will include studying the comprehensive water footprints of different future energy production scenarios for the West and also finding new ways to reduce the energy and climate impacts of new sources of water.

Watershed Health

The Colorado. The Columbia. The Missouri. The Sacramento. The names of these rivers alone evoke a sense of grandeur and history. However, humans have heavily manipulated the rivers of the West and their waters, first to sustain settlement, and then to accommodate explosive economic and population growth. Dams, water withdrawals, changes in hydrology, degraded physical habitat, and other factors have altered these watersheds and profoundly harmed their ecological health.

In the last 20 years, dozens of fish and other aquatic species have been listed as threatened or endangered, causing federally imposed limits on hydropower generation, irrigation, and other water uses, and leading to some of the most intense natural resource conflicts in the nation. In many places, the health of these river systems, the implementation of the Endangered Species Act, and other laws, are seen as directly conflicted with economic stability.

Water in the West seeks to address a central question: can we satisfy growing urban demand for water, maintain existing agricultural production, and sustain rural communities, while at the same time restoring rivers and protecting a growing recreational economy? Allocating water and water rights to accomplish these goals will require better science, policies, practices, and decision-making. Our interdisciplinary work will strive to find solutions to the difficult problem of preserving rivers and streams while supplying adequate water to cities, farms, and ranches.

Improving Streamflows in the Sun River

In the spring of 2014, a team of Master's students in the Civil and Environmental Engineering program tackled the difficult issue of improving water management to enhance streamflows and ecosystem restoration on the Sun River in Montana. Withdrawals from two irrigation districts and a large ranch have depleted the flows of the river. A local watershed group has been working with irrigators to fund the installation of more efficient irrigation infrastructure, such as replacing leaky ditches with pipes.

Under the supervision of Professor David Freyberg, Stanford students are studying how to translate these irrigation efficiency improvements into increased streamflow targets and are working to develop a model to determine how to change the management of three reservoirs at the top of this stretch of river to achieve these higher streamflows. This work exemplifies the direct role that Stanford students can have to help solve difficult management problems in to meet the needs of irrigators and ecosystems.

Water Management and Allocation

Efforts to rationally manage water in the West – allocating water to the most valuable uses, both human and ecological – are hampered by a lack of data, fragmented governance, and the West's rigid prior appropriation system. To find tools that make water management and allocation more effective and efficient, Water in the West will conduct research on several fronts:

- Build an initiative to create more flexible water governance policies and tools to help the West adapt to the impacts of climate change, including more-frequent and severe droughts that are likely to affect the region in the future.
- In partnership with ReNUWit, explore innovative policies to promote urban water efficiency, recycling, and management.
- Study new models for water pricing and other market-based mechanisms for implementing water efficiency and other management goals.

Creating Economic Models to Promote Water Efficiency

Professor Frank Wolak from Stanford's Economics Department is currently developing an econometric model of retail water pricing. This tool will enable researchers and water managers to evaluate the effectiveness of different retail water price structures at achieving a variety of objectives, including water efficiency and project finance.

Although a great deal has been written on changing water pricing to accomplish specific efficiency goals or better reflect the true cost of water, this model's unique strength is the extensive data set that on which it is grounded – researchers have collected retail water bill and usage data from utilities across the country.

IMPLEMENTING OUR VISION

To achieve our vision of sustainable water management in the western United States, Water in the West will focus on the following objectives over the five-year period:

- **Conduct interdisciplinary research** to develop transformative new ideas and tools that will revolutionize the way we envision sustainable water management, use, and allocation in the West.

  For example, our research into new remote sensing technologies for studying aquifers has the potential to dramatically improve information available to make difficult groundwater management decisions.

- **Provide practical, timely, and focused solutions** to a diverse mix of NGO, government, and business partners, including new applied research, publications, and web tools that provide digestible and useful syntheses of Stanford's core research.

  For example, communication tools, such as our innovative groundwater visualizations and western water dashboards, will provide research results in ways that are compelling and clear to a variety of audiences.

- **Convene diverse groups of leaders, researchers, and managers** on water issues to advance Stanford's research and education mission and to contribute to solving the West's water challenges.

  For example, our "Uncommon Dialogues" have played a central role in advancing remote sensing fieldwork and building a consensus about new policy tools.

- **Create a western water curriculum for Stanford students** to "bring the field into the classroom," and give students the opportunity to actively engage in creating solutions to the West's water scarcity challenges.

  For example, Stanford law and engineering students have been working directly with NGOs and irrigation districts to provide better tools for private transactions to transfer water rights to environmental purposes.

Future Staffing and Resources

To fully realize this vision, Water in the West will require new resources, including:

- **Additional faculty.** While Stanford enjoys broad expertise, new faculty members in critical areas such as freshwater ecology and the behavioral sciences can further strengthen our ability to solve water challenges. *We are seeking funding for two senior fellows (permanent Woods Institute faculty positions).*

- **Early career fellows**. Recent graduates of PhD or professional programs will bring great energy and enthusiasm to running our research programs, organizing conferences, and conducting critical research, while at the same time gaining crucial skills for their careers. *We are seeking funding for four early career fellows – one for each of our four program areas.*

- **Visiting faculty.** A visiting fellowship fund at Water in the West would allow us to nimbly and strategically bring in scholars and practitioners with expertise that complements our current faculty for short-term stays. Such visitors would add fresh perspectives and viewpoints, build relationships that could lead to longer-term research partnerships, and provide a pathway for identifying and hiring new faculty. *We are seeking funding for a total of two visiting fellows each year.*

- **Student researchers.** Funding for graduate research assistants will be critical both to accomplish our research goals and to recruit students with necessary expertise from different departments who want to focus their research on western water issues. *We are seeking funding for three PhD fellows as well as a fund for undergraduate and graduate level research assistants.*

- **Communications capacity.** Communications and media outreach are essential to maximizing the impact of Stanford's work on western water issues. *We are seeking adequate funding for a full-time professional devoted to marketing and communications, including media relations and web tools*.

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Water in the West Team

PROGRAM STAFF

Leon Szeptycki	Executive Director
Geoff McGhee	Creative Director for Media and Communications
Newsha Ajami	Director of Urban Water Policy, Water and Energy Program Lead
Tara Moran	Research Associate
Janny Choy	Research Analyst
Athena Serapio	Program Coordinator
Debra Perrone	Postdoctoral Fellow

CORE FACULTY

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Craig Criddle	Environmental Engineering / Woods
David Freyberg	Environmental Engineering / Woods
David Kennedy	History / Lane Center
Peter Kitanidis	Environmental Engineering
Rosemary Knight	Geophysics / Woods
Dick Luthy	Environmental Engineering / Woods
Buzz Thompson	Law School / Woods
Frank Wolak	Economics

NON-RESIDENT WATER IN THE WEST FELLOWS

Rebecca Nelson	Law, Melbourne Australia
Burke Griggs	Law, Kansas

VISTING SCHOLAR

Jacqueline Peel	Professor, Melbourne Law School, University of Melbourne

PhD STUDENTS AND EARLY CAREER FELLOWS

Vanessa Casado-Perez Law	(JD Teaching Fellow)
Nicola Ulibarri	Emmett Interdisciplinary Program in Environment and Resources (PhD)
Phil Womble	Emmett Interdisciplinary Program in Environment and Resources / Law (PhD)

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