HARVARD-CHINA PROJECT
on Energy, Economy and Environment

HARVARD-CHINA PROJECT NEWSLETTER

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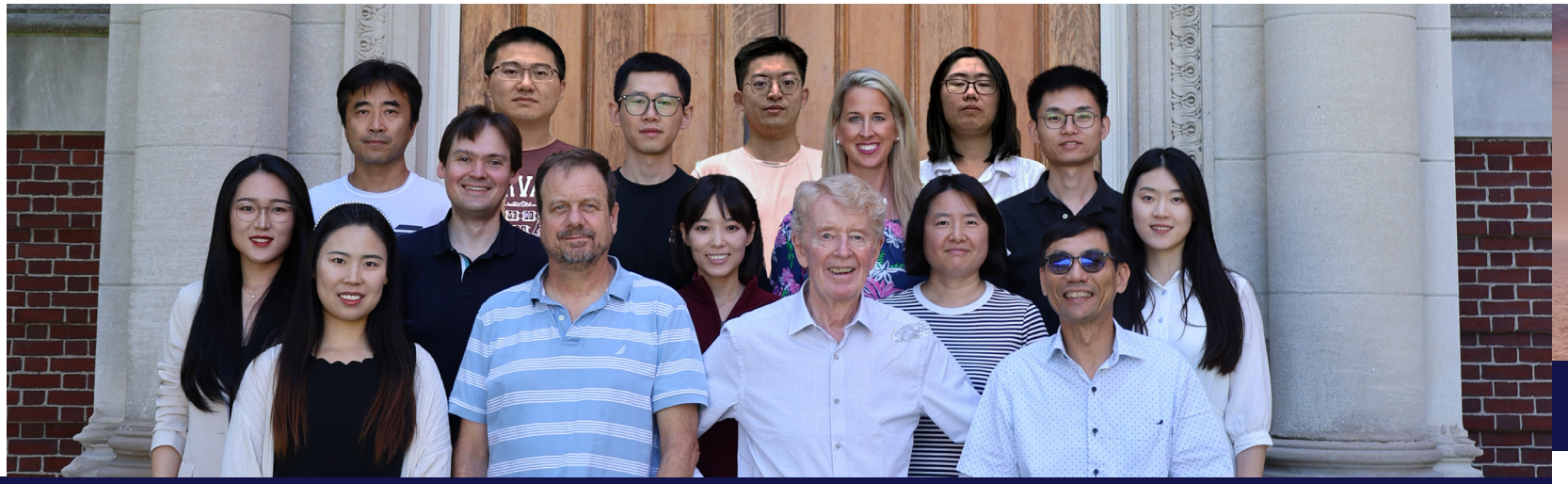


LETTER FROM THE EXECUTIVE DIRECTOR

Resuming Visits to a Reopened China

After almost continuous lockdowns since 2020, the Harvard-China Project was finally able to return to a reopened China this past April. As soon as it again became possible, I spent three weeks in 5 Chinese cities meeting nearly 75 friends and collaborators, most of them research alumni of our program. China Project economist Mun Ho made a quick trip of his own and we joined up in Beijing, holding meetings on ongoing and new projects and enjoying a dinner reunion with about 25 colleagues, some coming in from distant cities like Nanjing, Wuhan, and Xian to reconnect again. The trip took me also to Shanghai, where we held a smaller reunion, and to Hong Kong, Zhuhai, and Tianjin. We are proud of the active alumni research network our program has built in China and are thrilled to be able to meet face to face again.

One objective of the trip was to gauge the extent political tensions between the U.S. and China might impede collaborative research on climate and environment going forward. We were at least hopeful that the effects would not be severe, as our joint research productivity had remained strong throughout three years of pandemic, thanks in part to Zoom.

But meeting in person, the pent-up enthusiasm for not only continued but expanded research engagement was palpable, beyond our highest expectations. The sense in both China and the U.S. is that climate-related topics are a sweet spot for academic collaboration, comparatively insulated from concerns affecting some scholarly domains. As importantly, our colleagues share a belief that the world simply cannot afford for its two largest research communities on climate and environment to stop learning from each other and seeking new insights together. Within the China Project research community, disengagement seems not an option, and we instead look forward to another 30 years of collaborative partnership.

Chris P. Nielsen (above) is the Executive Director of the Harvard-China Project. Michael B. McElroy, Gilbert Butler Professor of Environmental Studies, is the Faculty Chair.

NEW HCP RESEARCH

Integrating Offshore Wind into China's Grid Can Further Carbon Neutrality Goals

New *Nature Communications* research models grid integration of offshore wind

Offshore wind power offers a promising solution to the challenge of decarbonizing coastal China. China's coastal provinces, though small in land mass, are home to 76% of the population; they are also responsible for 72% of total national power consumption and 70% of total CO_2 emissions. Transitioning the coastal areas away from fossil fuels is one of China's core challenges for achieving carbon neutrality by 2060, and offshore wind power may hold the key.

New research published in *Nature Communications* develops a bottom-up model to test the capabilities of the grid to accommodate renewable power variability and to design the optimal investment plans for offshore wind power. The new paper from the Harvard-China Project on Energy, Economy and Environment, a U.S.-China collaborative research program based at the Harvard John A. Paulson School of Engineering and Applied Sciences, and collaborators at Huazhong University of Science and Technology (HUST) in China is one of the first to analyze opportunities for province-by-province grid integration of renewables at elevated levels of offshore investment.

China's onshore wind investment, accounting for over 80% of national and 30% of global wind commitments, has both significantly less output in winter and limited grid flexibility. Other zero-carbon energy sources like solar and nuclear power also have financial, geographic, and safety constraints. Offshore wind, on the other hand, can provide a more optimal renewable energy resource.

"The results indicate that at least 1000 GW of offshore wind capacity could already be available at a levelized cost below that for nuclear units in China," explains Michael B. McElroy, Gilbert Butler Professor of Environmental Studies and chair of the Harvard-China Project. "We found that offshore wind investment levels could be more than double the current government target."

"Deployment of offshore wind farms in China could not only provide the largest market for the global wind industry in the upcoming decade, but it could offer also an important building block for China to transition away from fossil fuel-based energy systems."

To create the optimal deployment plan for offshore wind, the researchers led also by Prof. Xinyu Chen of HUST designed a high-resolution assessment model of China's provinces. The model combines a refined analysis of offshore wind resources and economics; considers the micro siting of wind farms with optimization of the delivery system; and simulates hourly power system demands, identifying optimal plans for provincial investments in offshore installations, transmissions and storage.

The modeled system doubles current offshore wind investment by 2030. It also improves current provincial deployment plans for offshore wind, shifting part of the investment from Guangdong to provinces such as Jiangsu and Zhejiang. As a result, the plan could boost national renewable penetration from 31.5% to 40%, at a cost lower than that anticipated in the current plan. By 2050, offshore wind capacity in China could reach as high as 1500 GW.

"China has abundant wind resources and favorable bathymetrical conditions to develop offshore wind power," says Xinyang Guo, a fellow with the Harvard-China Project, Ph.D candidate at HUST, and first author of the paper. "Deployment of offshore wind farms in China could not only provide the largest market for the global wind industry in the upcoming decade, but it could offer also an important building block for China to transition away from fossil fuel-based energy systems."

Research Cited: Xinyang Guo, Xinyu Chen, Xia Chen, Peter Sherman, Jinyu Wen, and Michael McElroy. 2023. "Grid integration feasibility and investment planning of offshore wind power under carbon-neutral transition in China." *Nature Communications*, 14, 2447.

HCP Awarded Three Grants from Energy Foundation China

The Energy Foundation China, a charitable organization registered in California, U.S., has been working since 1999 on furthering China's sustainable development. Three separate grant projects by the Harvard-China Project were chosen for funding by EF China, allowing for a research focus on energy-technology innovations; carbon targets; and the decarbonization of heavy industry.

The first grant is for "The Project on Technological Systems and Innovation Policy for Climate Neutrality," which is a three-year project focused on deep-decarbonization pathways in the United States and China. The project aims to identify the energy-technology options that could play a large role in meeting both countries' mid-century emission reduction targets. The research is a collaboration between the Science, Technology, and Public Policy Program at the Harvard Kennedy School; the Harvard-China Project; and the Institute of Climate Change and Sustainable Development at Tsinghua University.

The second project, "China Industry Relocation and Regional Development under the Double Carbon Targets," will work with collaborators at Tsinghua University to evaluate the future scenarios of China's low-carbon regional development and potential relocation. The project endeavors to help plan for meeting the dual-carbon targets by using scenario analysis tools, and it will guide local governments to invest and plan for low-carbon industries based on the national conditions.

The third project, "Advanced Technologies for Decarbonization of China's Iron and Steel Sector," assesses advanced mitigation technologies to reduce carbon emissions in heavy industries in the coming decades. This project adopts a comprehensive framework to explore the important and challenging issues in China's iron and steel sector; evaluate the particular potential of clean hydrogen in China's iron and steel sector; and provide policy and technology recommendations based on the cost-effectiveness of advanced technologies.

COLLABORATIVE RESEARCH

PNAS: An Early Warning System for Joint Heat and Ozone Extremes in China

High temperatures exacerbate ground-level ozone production, resulting in a deadly combination of extreme heat and poor air quality that is especially dangerous for children, seniors, and people suffering from pre-existing respiratory illnesses.

Like most of the globe, China is dealing with increasing temperatures and longer and more frequent heat waves. But, because of its rapid, energy-intensive development, it's also seeing increased production of the main precursors of ozone, volatile organic compounds (VOCs) and oxides of nitrogen (NOx). In a country as populous as China, this combination poses a serious threat to human health, especially in large urban areas such as Beijing.

Now, a team of collaborating researchers from the Harvard-China Project at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) and Hong Kong Baptist University has identified large-scale climate patterns that could be used to predict the co-occurrence of extreme heat and ozone days in China months before they occur. Like predictions for hurricane and wildfire seasons, the forecasts could help the government prepare resources and implement policies to mitigate the severity of the season.

"Our research could have important implications in the future that would allow agencies in China to prepare for high summer heat and ozone in springtime."

The research was published recently in the *Proceedings of the National Academy of Sciences*.

"We've already seen record-breaking heat waves around the globe this summer, including in China, where local emissions have led to substantial ozone pollution," said Fan Wang, a visiting fellow at SEAS and the Harvard-China Project, Ph.D. candidate at Hong Kong Baptist University, and co-lead author of the study. "Our research could have important implications in the future that would allow agencies such as the Ministry of Ecology and Environment in China to prepare for high summer heat and ozone in springtime."

The research team, led by Michael McElroy, the Gilbert Butler Professor of Environmental Studies at SEAS and the faculty chair of the Harvard-China Project, and Meng Gao, professor at Hong Kong Baptist University and former postdoctoral researcher at SEAS, looked to past meteorological data and daily ozone levels to spot patterns that could be used to predict the season.

Because of the lack of long-term daily observations of ground-level ozone concentrations, the researchers used a sophisticated machine learning model to reconstruct levels back to 2005. Using this dataset, the team identified patterns in sea surface warming in the western Pacific Ocean, the western Indian Ocean and the Ross Sea, off the coast of Antarctica, that preceded summers with high heat and ozone in northeast China, including Beijing.

Warm sea surface temperatures in these regions lead to a decrease in precipitation, cloud cover and circulation across this region of China, known as the North China Plain, which is home to roughly 300 million people.

"These sea surface temperature anomalies influence precipitation, radiation and more, which modulate the co-occurrence of heat waves and ozone pollution," said Gao, co-first author of the paper and associate of the Harvard-China Project.

The team's model correlated these anomalies with increases in heat waves and ozone about 80 percent of the time.

Governmental agencies could use these predictions to not only issue warnings for human health and agriculture but to reduce the components of ozone and its precursors in the atmosphere before the extreme heat waves hit.

"The ability to forecast prospects for unusually hot summers and unusually high levels of summertime ozone in China simply on the basis of patterns of temperature observed months earlier in remote regions of the ocean is truly exciting," said McElroy.

By Leah Burrows, Harvard Paulson School of Engineering & Applied Sciences Communications

Research Cited: Meng Gao, Fan Wang, Yihui Ding, Zhiwei Wu, YangYang Xu, Xiao Lu, Zifa Wang, Gregory R. Carmichael, and Michael B McElroy. 2023. "Large-scale climate patterns offer pre-seasonal hints on the co-occurrence of heat wave and O3 pollution in China." *Proceedings of the National Academy of Sciences* (PNAS), 120, 26.

IMAGE: DENSE SMOG CLOUDS OVER CHINA. BY ALEXANDER GERST

UNDERGRADUATE RESEARCH

In His Own Words: HCP Research Assistant Andres Gonzalez '24 on Modeling Hydrogen

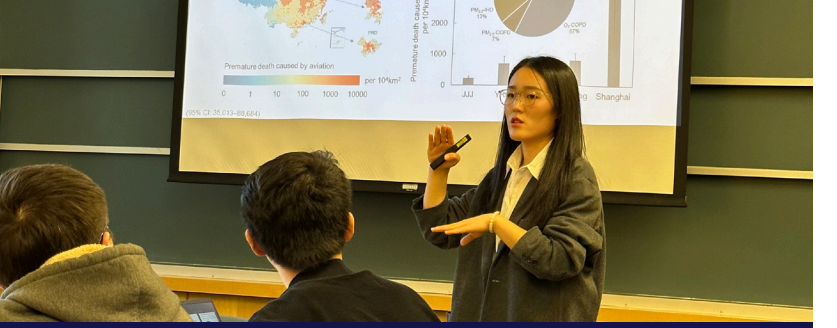
My favorite conversations at Harvard have all been on the future of energy systems. For a long time now I have been interested in hydrogen, which evolved early in my college career. During the pandemic there was plenty of free time to explore and research alternative fuel sources, and I enjoyed learning about what SEAS offers in the energy sector – particularly the work from professors like Dr. Michael McElory and Dr. Michael Aziz.

The research we are working on at the Harvard-China Project is exploring cost calculations that can be used to determine the total costs for transporting hydrogen via pipelines from a location of production to a location of consumption. This is a small piece of our overall research: trying to determine the best method to develop hydrogen infrastructure in particular locations. We are going from a single station producing its own hydrogen to a wide network of gas pipeline supply stations and finally comparing the costs and feasibility of the infrastructure. We have been adding on to the research from the 2022 summer and we do this to tell the full story of hydrogen.

Throughout this research I have had the pleasure of working with Dr. Haiyang Lin. He has been an integral part in my mentor system with whom I always come to with questions and he responds with guidance. Not only that, he is a very caring and very inviting person who promotes a welcoming environment. He has greatly impacted my experience in a positive way. I am thankful for having a mentor like Dr. Lin and for everyone else at HCP.

Research challenges always present themselves at inconvenient times; however they also present new opportunities. One of my favorites has been creating models using Matlab to determine the lowest cost for hydrogen. This has been exciting because we finally connect all the work that has been done before to produce actual results based on our own calculations. We took the cost equations and, using our own inputs, developed and optimized the system. This shows how much hydrogen would cost to be produced and transported based on a hypothetical infrastructure layout. When both the numbers and the validation methods line up, it is a very satisfying moment.

As I am in my senior year, I know that time will fly by. I have hopes of achieving some great things and have set two main goals. The first is that I actually want to become an expert on hydrogen. As the world transitions to renewable resources, I hope that my work here with HCP and my research to come in the future will allow me to be a resource. In addition, being a mechanical engineer with an entrepreneurial mindset, I hope to eventually own a business where I can apply both my expertise and engineering knowledge.



HCP RESUMES IN-PERSON SEMINARS

Seminars tackle climate resilience, electric vehicle efficiency, and more

This past academic year, the Harvard-China Project restarted its in-person and hybrid Research Seminars. This long-running interdisciplinary seminar series features public talks by both external and internal researchers.

Zhao Yang, who is our current postdoctoral fellow but was previously a new Ph.D. graduate at the National Engineering Laboratory for Electric Vehicles, Beijing Institute of Technology, kicked off the series in September. His talk explored the effects of a large-scale deployment of urban vehicles, including the efficiency of energy and battery material use.

In October, **Jingran Zhang**, HCP postdoctoral fellow, shared a presentation on the environmental impacts of Chinese and global aviation emissions of CO_2 and air pollutants. Zhang studies transportation energy and environmental issues, with a special focus on the global aviation sector.

Nicola De Blasio, senior fellow in the Environment and Natural Resources Program at the Harvard Kennedy School shared the past, present, and future feasibility of transitioning to a hydrogen economy. With more than 25 years of global experience in the energy sector, he is leads various Belfer Center projects on energy technology innovation and the transition to a low carbon economy.

Xiaoming Kan of the Department of Space, Earth and Environment at Chalmers University of Technology, Sweden, gave a November presentation on his research, which assesses renewable resource potential by incorporating social considerations for land-use requirements, heterogenous discount rate and electricity demand into the LCOE metric.

Arunabh Ghosh, associate professor of history at Harvard and a historian of modern China, concluded the fall semester lineup with a discussion on small hydropower, renewable energy, and rural development in the People's Republic of China from 1949-1979. By 1981, there were nearly 90,000 small hydropower stations in the country. His talk explored this history, situating it within the political economy and environmental history of the PRC.

Liang Emlyn Yang, now a Harvard-China Project visiting scholar, gave a February presentation on climate resilience in the Mekong Delta. He is a senior researcher in the Department of Geography at Ludwig Maximilian University of Munich, Germany, and his work explores urbanization, flood risks and resilience building in Southeast Asia and China.

Changgui Dong, an associate professor in the School of Public Administration and Policy at Renmin University, researches energy and environmental economics, technological change, policy evaluation and China's governance. His talk explored the impact of feed-in tariffs on solar PV and wind power development in China.

Haiyang Lin, postdoctoral fellow at HCP, shared his research on Texas' transition from a carbon emitter to green hydrogen exporter. His research contains detailed simulations and optimizations of green hydrogen supply scenarios, incorporating decarbonization of the power sector in Texas.

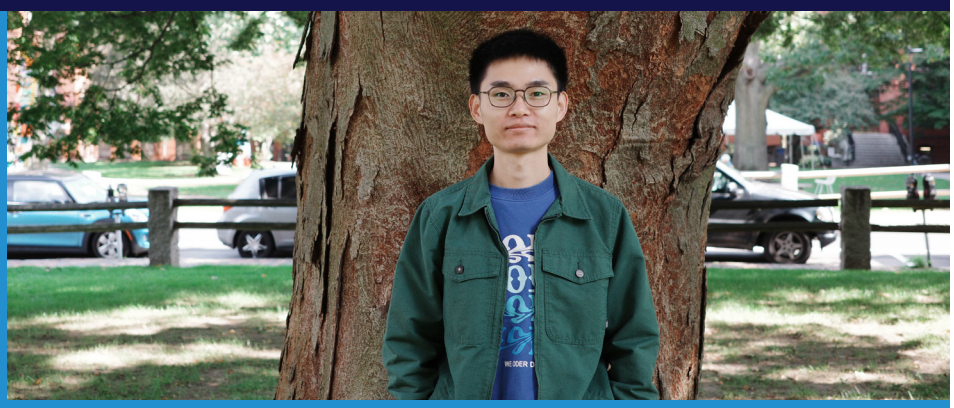
Ernani Choma, a research fellow in the Department of Environmental Health at the Harvard T.H. Chan School of Public Health and affiliate of the Harvard-China Project, focuses his scholarship on fine particulate matter air pollution risk assessment and on the health co-benefits of climate change mitigation. His March talk explored source-specific mortality attributable to $PM_{2.5}$ and the implications for global emissions control.

Xinyu Chen, an alumnus and associate of HCP and professor at Huazhong University of Science and Technology, rounded out the lineup. He is an electrical engineer whose research explores power systems and renewable energy. His talk explored the status and prospects of a power market reform in China, coupled with a carbon neutral transition.

IMAGES, CLOCKWISE FROM TOP LEFT: NICOLA DE BLASIO (HKS); JINGRAN ZHANG (HCP); ERNANI CHOMA (HSPH); HAIYANG LIN (HCP).

RESEARCHER SPOTLIGHT

Haiyang Lin, Postdoctoral Fellow



When each new Harvard-China Project researcher steps foot off the plane at Logan Airport, they are likely already acquainted with postdoctoral fellow Dr. Haiyang Lin. Even from nearly 7,000 miles away, Haiyang serves as a mentor to those in his home country, connecting with them via the texting app WeChat to make sure they are prepared for their arrival. This mentorship goes beyond his role as a scholar who focuses on the planning and design of renewable energy systems. And for Haiyang, this counsel doesn't conclude the moment they are appointed a desk in Pierce Hall; he enjoys collaborating with each fellow during their tenure in Cambridge. "We are all from different backgrounds, with diverse research interests, and I enjoy exchanging ideas with our fellows," explains Haiyang. "They know things I don't, and vice versa, so sharing this knowledge is very important to me."

As one of the earliest members in his group at Shandong University, Haiyang made it his mission to aid others in their scholarship. During his doctoral work, he worked closely with more than five masters students and two Ph.D. candidates, offering critical insights and suggestions for their research and graduation. As Haiyang generously shared his knowledge and time, he too benefited immensely from this culture of collaboration and mutual support. He published more than 10 papers on integrated energy system optimization before he got his PhD degree. All of his efforts earned him the prestigious Research Star award at Shandong University, given to the top 10 a university of around 50,000 students.

It was during his undergraduate studies that he met Ronald Wennersten, a professor in industrial ecology at Shandong University, and his academic path pivoted. Growing up in Shouguang, China – the hometown of vegetables – Haiyang had an initial interest in engineering because it was "easier to find a job" for a student from a rural area like his. Haiyang embarked on what he says is more of a "traditional" career path in thermal power engineering; however, after learning about Professor Wennersten's green energy expertise, Haiyang realized that renewable energy systems and their corresponding interdisciplinary nature captivated him.

With the connections of Professor Wennersten, Haiyang accepted a visiting Ph.D. position in Sweden – and it was this international experience that eventually catapulted him to the Harvard-China Project. "Before Sweden, I focused a lot on publications. But when I came to Sweden, people were interested in why I was doing this – what drives me to study this as my career," explains Haiyang. "After that, I thought, I need to visit more places and try to figure out my research goal."

Haiyang came across the Harvard-China Project when searching for a location heavy on interdisciplinary studies. "The cross collaboration attracted me the most; that aspect is particularly unique and also particularly difficult to find at other places," he says. He was in touch with Professor Michael McElroy, chair of the Harvard-China Project, and Chris Nielsen, executive director. Now, four years after that initial contact, Haiyang is embarking on another year of research as a postdoc, and teaching climate and atmospheric sciences classes with Prof. McElroy. He gives both Chris and Mike credit for influencing his research at the Harvard-China Project, saying, "Mike is very good at guiding people around him, and I benefit a lot from his brilliant ideas. Chris is helpful all the time, and when I first arrived, I didn't have a topic to investigate, so Chris helped me build connections and find my role in the team."

Haiyang currently works to evaluate and optimize green fuel supply chains – particularly how that interacts with the grid and decarbonizes hard to abate sectors. "Our fundamental work is on renewable power generation – even if we study hydrogen or biofuels, we are supporting the integration of renewable power as the key demand." He began by doing distributive studies for small systems like buildings or communities, and is currently tackling big systems like provinces, states and countries. His recent paper, forthcoming, explores Texas' transition from a carbon emitter to a green hydrogen exporter. His research experience has covered the decarbonization transition for China, India, the U.S and most recently, Namibia, a southern Africa country positions itself as a regional leader in renewable power and green hydrogen. Ultimately, he says that coordinating both the supply side and demand side, to connect and regulate them in a cleaner and more efficient manner, drives his focus.

Looking ahead, Haiyang envisions a future working with students as a professor. "The best part of academia is that you're always learning from young, talented people who have cutting-edge new ideas," he explains. "I hope research will be my whole life – I want to learn new things and be helpful … that is the most exciting part of life's journey."

By Kellie Nault, Harvard-China Project

RESEARCH NEWS

Shi Chen is Named "Innovator Under 35"

Each year the MIT Technology Review scours the globe for the best and brightest young innovators, pioneers, inventors; each spring, they unveil their curated "Innovators Under 35" (TR35) list of their honorees. This year, former HCP fellow and current collaborator Shi Chen, postdoctoral fellow in the School of Environment at Tsinghua University, was named to the TR35 China list for her work on advancing renewable energy research.

Photovoltaic (PV) power, as the fastest-growing low-carbon energy, is expected to play an important role in achieving the global goals of net zero emissions. In order to make PV power a benefit to the global population and drive low-carbon transitions, Chen has created a technology for assessing the technological potential of PV power. Utilizing spatial big data, her research conducted a comprehensive analysis of PV power potential, particularly focusing on developing regions. Her work delved into the potential for regional cooperation while presenting innovative solutions aimed at steering away from traditional high-carbon pathways.

Chen has extended the potential assessment system in depth from the technical dimension to the economic and grid dimensions, successfully established a comprehensive whole-chain assessment system of PV power, and mined the spatio-temporal evolution features of technical, economic, and grid integration potentials of combined solar PV and storage.

Chen has embarked on further research focusing on the intricate interaction mechanisms between the environmental system and solar power generation. She developed an assessment system designed to analyze environmental factors influencing the spatio-temporal variability of PV power.

Collaborations Continue with New Scholars

The Harvard-China Project is back to full capacity post-pandemic, welcoming a host of new scholars this past spring and summer. With 30 years of collaborations with Chinese universities, many of these scholars and professors come to our program at the recommendation from our alumni collaborators overseas. Others find their way to our program via our annual application season for fellows, postdocs, and visiting scholars. No matter how they arrive in Cambridge, all of our scholars are committed to research at the nexus of climate, environment, energy and economy. They are studying a range of topics, including electric vehicles; global carbon economics; health and environmental science; and the impact of aviation emissions.

Fellows applications will be online in December to join our academic year 2024-25 cohort. Visit our website for more details.

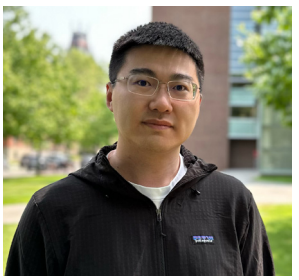
Jingran Zhang, Postdoc, Environmental Science

Jingran Zhang, a postdoc who earned her Ph.D. from Tsinghua University, considers the aviation sector among the most challenging field in terms of carbon neutralization. She aims to develop comprehensive assessments on the current environmental and climate impact of aviation emissions and potential mitigation measures towards a low-carbon and clean transportation landscape. For her, being part of HCP has been particularly rewarding because of the supportive environment - despite coming from diverse backgrounds, she says that they all share a common goal of creating a sustainable future. If she has questions about economics or energy, there's always someone knowledgeable to chat with.

Ernani Choma, Research Affiliate, Health Risk

Ernani Choma is a research fellow in the Department of Environmental Health at the Harvard T.H. Chan School of Public Health. His research focuses on health risk assessment, with a primary interest in the use of risk assessment to inform policy decisions. Choma's research has focused on fine particulate matter air pollution and on the health co-benefits of climate change mitigation, especially on the transportation sector, where he has assessed health benefits achieved by past regulation and new technologies, such as vehicle electrification and automation. He is also currently working to quantify the health benefits that can be achieved by reducing urban heat islands. He has participated in several international efforts to improve the quantification of the health effects of fine particulate matter in life cycle assessment and other emission reduction and policy analyses.

Yang Zhao, Postdoc, Transportation Electrification



Yang Zhao is a postdoc in Harvard-China Project who received his Ph.D. from Beijing Institute of Technology. He has worked on the operating behavior and energy use patterns of urban electric vehicles. He is currently studying how large-scale deployment of carbon-neutral vehicle fleets will impact future road transportation and energy systems in different regions. He is also focusing on the development of charging infrastructure in the U.S. and China, as he believes now is the critical time to develop infrastructure for carbon-neutral targets. He appreciates the interdisciplinary collaboration in Harvard-China Project, as experts in different fields can exchange their ideas, which enables him to have a more comprehensive understanding of research in specific fields.

Jiarong Li, Postdoc, Electrical Engineering

When Jiarong Li from the Department of Electrical Engineering at Tsinghua University first began her Ph.D. studies, she set out with the goal of having her future home powered by solar-to-hydrogen, through the cultivation of sunflowers in her yard. She has been focusing on power-to-hydrogen for over seven years along with a bottom-up methodology of experiments and modeling operations and planning of a novel future energy system dominated by power and hydrogen. At Harvard, Jiarong wants to take a top-down view under the highly interdisiplinary nexus of energy-ecology-environment-economy to explore the influence and interaction of energy systems with nature. She looks forward to "synergizing" with all HCP colleagues from diverse backgrounds!

Naixin Huang, Ph.D Candidate, Economics

Naixin Huang is a Ph.D. candidate in economics from Tsinghua University. Her research with HCP research associate Dr. Mun S. Ho and visiting Prof. Jing Cao focuses on the global carbon price floor's welfare effects and optimal design. The 2°C goal is challenging to reach, and it will be essential to consider the international differences in mitigation costs and benefits. IMF (2021) proposes a system of global carbon prices in which countries at different economic levels assign different carbon prices. Using a global trade model, she and colleagues seek to illustrate the impact of such a differentiated price floor system. Then, they seek an alternative design for the worldwide carbon price floor. Besides the global carbon price floor, she and visiting Prof. Jing Cao also researched international climate finance's welfare effects and optimal design.

Fan Wang, Ph.D Candidate, Atmospheric Science

Fan Wang is a Ph.D. candidate from Hong Kong Baptist University (HKBU). He works with Prof. Michael B. McElroy and Prof. Meng Gao from HKBU on global climate and environmental impacts of stratospheric aerosol injection (SAI). SAI has been the most-researched radiation management method that could curb global warming to below the critical threshold of 1.5 °C, yet other climatic, environmental and ecosystem impacts have not been well evaluated, making this strategy still controversial. Fan uses the CESM2 model coupled with complete atmospheric, land surface, and oceanic processes to simulate earth system feedbacks to the eruption of Mount Pinatubo in 1991 to evaluate the impacts of SAI on global climate and environment.

Xiuli Liu, Visiting Scholar, Economics

Xiuli Liu is a professor from the Academy of Mathematics and Systems Science, Chinese Academy of Sciences. She studies complex system modeling and forecasting in the macroeconomy, natural resources, environment and population; input-output analysis and econometric modeling; and policy simulation and decision support.

Xiuli is grateful to collaborate with Professor Michael B. McElroy, Chris P. Nielsen and Mun S. Ho, and for the help of Kellie Nault, and other colleagues at HCP for their invaluable suggestions, cooperations and assistance during her time at Harvard.

My Summer Abroad: HCP Resumes Undergrad Research Assistantships at Three Chinese Universities

For the first time since 2018, the Harvard-China Project and the Mignone Center for Career Success funded eight weeks of undergraduate research at our partner universities in China. Shawn Mobley '26 and Anna MacLennan '25 worked with Professor Xi Lu at Tsinghua University; Millie-Mae Healy '24 was mentored by Professor Jintai Lin at Peking University; Julia Mansfield '25 and Justin Xu '25 worked under Professor Meng Gao at Hong Kong Baptist University. They shared their experiences in this edited transcript - visit our website for the full conversation.

HCP: Can you share an overview of your project?

Shawn Mobley: Initially, the plan was for me to work on one project for all eight weeks of the program. However, I ultimately got to work on a couple different projects, which allowed me to explore different facets of quantitative environmental research. My [main] focus was on an ongoing project that my assigned Ph.D. student, Ziwen, is in charge of. Her project analyzes **life-cycle carbon emissions from wind power** across provinces and regions in China. This project calculates life-cycle carbon emissions for every province and region in China and, critically, considers inter-provincial flows of materials. My role for this project was, and will continue to be, as an editor for the final report.

Anna MacLennan: This summer, I worked with one of Professor Lu's amazing Ph.D. students on a paper examining China's potential **pathways to carbon neutrality** by 2060. It modeled different outcomes based on policy measures such as immediately phasing out coal power, lowering the cost of renewable energy sources, implementing carbon taxes, and combinations of those options. The research really helped evaluate the effects of those policies, such as their associated emissions reductions, electricity prices, etc.

Julia Mansfield: The fundamental goal of my research project was to explore **the influence of fossil fuel emissions on precipitation trends** in China. The key types of data I utilized were precipitation data taken from satellite measurements and pollution data measured on the ground by stations throughout China. I compared the trends that I observed in a more populated and industrialized eastern region of China with a region of the same size in western China. Both regions showed a decrease in sulfur dioxide pollution since 2013, and the eastern region has consistently remained more polluted as compared to the western region.

Justin Xu: This summer, I worked on a project that centered around analysis of the **frequency of drought occurrences**. By looking at historical data as well as predictive models of soil moisture, I was able to explore

the changes in the rate of flash droughts in different geographic areas around the world.

Millie Mae: My research project involved **investigating NO_x emissions** around the world between 2018-2021. I was given a lot of freedom to decide what to pursue so I largely focused on areas in China and America I have visited pre-covid.

HCP: How did the HCP overseas collaborators contribute to your experience?

Anna MacLennan: It was fantastic to meet Professor Lu and his Ph.D. students! Not only were they incredibly kind and welcoming, but they also went out of their way to engage with us and to help us navigate our time in China.

Julia Mansfield: Dr. Meng Gao mentored me throughout the duration of the project. He was very helpful in guiding me towards resources that were asking similar questions to the ones I would be exploring, so I was able to learn from the work of others. He answered my questions and trusted me to work through many problems on my own.

HCP: What was most rewarding?

Shawn Mobley: The most rewarding aspect of my research was reading through the first major section of the paper I edited once it had gotten approved by Prof. Lu. With each re-read beforehand, the ideas were starting to flow much more nicely, and progress on the whole was steadily being made. After so many rounds of revisions, it truly started to feel like I'd meaningfully contributed to the creation of real academic work.

Julia Mansfield: The most rewarding aspect of my research was seeing the questions that I posed at the beginning of the summer be represented in easily read and interesting graphs by the end of my time in Hong Kong. Seeing the framework of the research be populated with concrete results is a super gratifying feeling.

Justin Xu: What was most rewarding was coming into the project as a mechanical engineering concentrator — that is, having no prior experience in computational earth science work — and applying and honing skills that are widely applicable across all science and engineering disciplines.

HCP: What were your overall thoughts about international research?

Shawn Mobley: The opportunity to spend two months in China at this moment in history is truly remarkable, especially as I was able to actually collaborate with Chinese scholars on international issues of ever-increasing importance. Between the political tensions, the aftermath of the COVID-19 pandemic, and the pressing nature of the global environmental crisis, I believe this experience came to me at an incredibly critical time and presented me with the unique possibilities few have ever had or will ever have.

Justin Xu: Researching in one of the densest cities in the world, Hong Kong, certainly provided a constant reminder of human impacts on the climate. Overall, researching internationally provided an effective cultural exchange that brought new perspectives to the research that would not have otherwise been possible.

HCP: What was most memorable part for you?

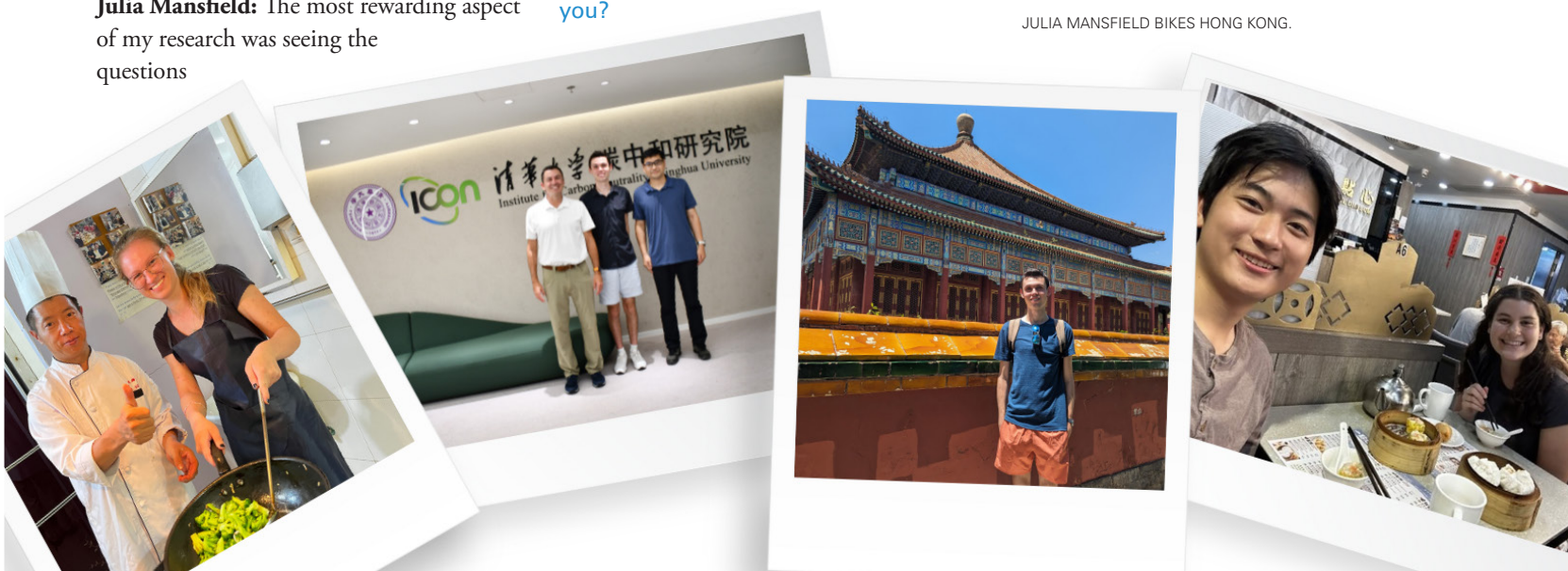
Shawn Mobley: For me, as an avid user of public transportation wherever I go, the incredible high-speed trains, subway systems, and shared bikes all throughout the country stand out to me the most.

Anna MacLennan: Alongside my academic research this summer, I was able to track down some of my own Chinese family history and then solo-traveled to Guangzhou and Jiangmen, two cities in southern China where my grandmother grew up.

Julia Mansfield: One of my favorite things that I did during my time in Hong Kong was take the ferry to a small Island called Cheung Chau. I went twice throughout the summer because I loved it so much! On one small island you can swim at an incredible beach, go on a hike around the island, and have delicious food including mango mochi, red bean buns (which they are famous for), and fresh seafood.

Justin Xu: I really enjoyed Hong Kong's nature and food. So many trails—including one aptly named "Dragon's Back" located along the ridge of a hill—were located within a short public transportation ride from the downtown area. Julia and I thoroughly enjoyed hiking and exploring the different parks and islands of Hong Kong. Each new park, of course, also brought new food experiences.

PHOTOS, CLOCKWISE FROM TOP LEFT: JUSTIN XU IN HONG KONG; SHAWN MOBLEY AND ANNA MACLENNAN WITH A GRADUATE STUDENT AT THE GREAT WALL; MILLIE-MAE HEALY IN BEIJING; JUSTIN AND JULIA MANSFIELD SAMPLE LOCAL CUISINE; SHAWN MOBLEY; SHAWN AND HIS FATHER POSE WITH PROFESSOR XI LU AT ICON; MILLIE-MAE COOKS TRADITIONAL DISHES; ANNA MACLENNAN TOURS CHINA; JULIA MANSFIELD BIKES HONG KONG.



CAMPUS NEWS

2023 Motsepe Presidential Research Accelerator Fund for Africa Awards:

Harvard-China Project Receives Funding for Research on Renewable Energy in Namibia

The Office of the Vice Provost for Research and the Office of the Vice Provost for International Affairs, in collaboration with the Harvard University Center for African Studies, have announced the 2023 awardees for the Motsepe Presidential Research Accelerator Fund for Africa, naming the Harvard-China Project one of its grantees.

Now in its third year, the fund has garnered interest from faculty across the University with broad-ranging research interests in Africa, confronting key challenges and opportunities facing the continent with innovative project proposals.

The Harvard-China Project Proposal: "Renewable Namibia: Exploiting Wind and Solar to Expand Domestic Energy Access and Exports of Zero-Carbon Energy" by Michael McElroy, Gilbert Butler Professor of Environmental Studies, with co-investigators Frank Keutsch (Harvard Paulson School), Chris P. Nielsen (Harvard-China Project), and Haiyang Lin (Harvard Paulson School) and the University of Namibia.

The Harvard-China Project aims to explore the feasibility of renewable power integration and hydrogen/ammonia production in Namibia to develop a practical roadmap to achieve low-carbon energy transition and growth. The investigation will: 1) assess the renewable resource endowment and development costs of target regions; 2) identify the least-cost path to integrate an expanding base of renewable power into Namibia's grid; and 3) seek feasible forms and supply chains for exporting energy to Namibia's neighbors and economies abroad.

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Ric Neo and Chen Xiang. 2022. **"State rhetoric, nationalism and public opinion in China."** *International Affairs*, 98, 4, 1327-1346.