Earth and Environmental Systems Institute (EESI): Strategic Plan 2020-2025

Science Informing Solutions

The 2020-2025 Strategic Plan describes seven initiatives as summarized below:

1. EESI Will Seek to Increase Faculty, Student, and Staff Diversity
2. EESI Will Provide Support for Broader Impacts and Extend Opportunities for Virtual Meetings
3. EESI Will Transform Faculty-Student-Staff Interactions
4. EESI Will Develop New Expertise to Project Environmental Change
5. EESI Will Forge a Dedicated Convergence Research Collaboration Space (JEWEL)
6. EESI Will Grow Expertise in the Area of Data Analytics for Environmental Systems
7. EESI Will Grow Expertise in the Area of Environment and Human Well-Being

What is EESI?
The Earth and Environmental Systems Institute brings together faculty and students who are interested in crossing scientific boundaries to understand the Earth and how we live with it. In the next five years, we will grow our intellectual environment to foster diversity, inclusivity, groundbreaking research, outreach to stakeholders, staff satisfaction and efficiency, and excellence in education.

Although the specific numbers vary somewhat over time, EESI currently hosts 21 tenure-line faculty associates, 17 research faculty associates, 8 postdoctoral students, and 11 administrative staff. EESI also provides support to additional students that are not enumerated here (the term "students" throughout this document is used to include undergraduate, graduate, and post-doctoral students). Thirty-seven (37) additional faculty at Penn State choose to interact with the Institute as EESI affiliates by signing up for our emails and participating in EESI functions and research. Even more faculty attend our functions and interact with associates yearly on an *ad hoc* basis. To achieve its goals, EESI receives approximately $1 million/year in University funds, most of which are used for faculty salaries. The Institute also brings in about $3 million/year in extramural funds that support EESI activities.

Over its lifetime, EESI has been extraordinarily successful in generating world-renowned science and attracting and retaining some of the best researcher-educators at Penn State. Our Vision and Mission statements are summarized below.

EESI vision and mission

Vision*: EESI advances fundamental Earth system science to inform solutions for environmental challenges.*

EESI's mission is*:*

1. *To encourage examination of the links between Earth's chemical, physical, geological, biological, and social processes from atomic to global scales by supporting faculty and student research investigating human and natural systems;*

2. *To disseminate research findings through publications, presentations, websites, workshops, videos, seminars, testimony to public institutions, laboratory assistance, field trips, and advice to public and private organizations;*

3. *To provide insights for the public, the broader scientific community, government, and community organizations to benefit stakeholders within Penn State and in the world beyond.*

University and EESI values
INTEGRITY – We act with integrity in accordance with the highest academic, professional, and ethical standards.
RESPECT – We respect and honor the dignity of each person, embrace civil discourse, and foster a diverse, inclusive, and safe community.
RESPONSIBILITY – We act responsibly and hold ourselves accountable for our decisions, actions, and their consequences.
DISCOVERY – Through advanced research and scholarship, we seek and create new

knowledge and understanding, and foster creativity and innovation, for society's benefit.
EXCELLENCE – We strive for excellence in all of our endeavors as individuals, an institution, and a leader in higher education and research.
COMMUNITY – We work together for the betterment of our University, the communities we serve, and the world.

2019-2020 Strategic Planning process

The Institute director, Susan L. Brantley, hosted two lunch meetings during summer 2019 (August 5 and 13) for any EESI faculty associates who wanted to attend. At the lunches, the Director solicited initial ideas for designing a strategic planning process. One decision was to hold a retreat in the fall. Brantley and the Strategic Planning Committee (see below) held planning phone calls on October 9 and November 15, 2019, to plan the retreat. As a result of the meetings, the Institute invited all EESI associates and affiliates to a three-quarter day retreat on November 25, 2019, at a local farm-to-table venue. Twenty-seven retreat attendees brainstormed, presented, and prioritized initiatives for the Strategic Plan. Retreat participants also identified the need to revise EESI's vision statement to meet current and expected future challenges.

After the retreat, participants developed text to describe the prioritized plans and collated them together in a shared document. Leads were chosen for each prioritized topic. Each lead presented the proposals in a more developed format at a 2.5-hour town hall attended by approximately 30 associates and affiliates on January 20, 2020 (all associates and affiliates were invited). After the town hall, participants completed a survey to rank initiatives. Text for the Strategic Plan was edited, including deleting some ideas and amplifying others, by initiative leads identified at the town hall and retreat.

Brantley presented the top five initiatives to the College's Executive Committee on January 28, 2020. EESI's administrative support coordinator, Tracy Bernier, presented the results to Institute staff on January 29, 2020, and collected staff input for the Strategic Plan on January 29 and March 11. During this period, the written Strategic Plan was updated and modified by the Strategic Planning Committee and the Director, and by leads identified at the town hall and retreat.

One major part of the work for EESI associates after the retreat was to work on a shared document to update the EESI vision statement. The Strategic Planning Committee narrowed the list down and invited associates, affiliates, and staff to review it at a working lunch on February 24, 2020. The 15 associates, affiliates, and staff members who attended reviewed the suggestions and developed a new vision statement.

On March 30, an online meeting was held for associates and affiliates who had participated in the town hall and retreat to critique the emerging Strategic Plan. A penultimate document was produced the week of April 2, 2020, and revised multiple times by Brantley, Tutella, Nicholas, and Bernier for presentation to EESI's Advisory Committee during the week of April 17, 2020. A finalized version was presented again to all EESI associates and affiliates, and a final version was delivered to the Dean of the College of EMS on May 30, 2020.

Personnel and constituents included in the planning process
Strategic Planning Committee: Susan Brantley (Geosciences), Richard Alley (Geosciences), Jennifer Baka (Geography), Kenneth Davis (Meteorology and Atmospheric Science), Robert Nicholas (EESI research faculty), Francisco Tutella (EESI staff), Tracy Bernier (EESI administrative staff).

All EESI associates and affiliates were invited to participate. Additional personnel who attended at least one of the events include Sridhar Anandakrishnan, Seth Blumsack, Guido Cervone, Steve Crawford, Roman DiBiase, Jenni Evans, Karen Fisher-Vanden, Chris E. Forest, Jose Fuentes, Bernd Haupt, Casey Helgeson, Chris House, Sarah Ivory, Jim Kasting, Klaus Keller, Lee Kump, Laifang Li, Douglas Miller, Thomas Murphy, Andrew Nyblade, David Pollard, Melika Sharifironizi, Erica Smithwick, Vivek Srikrishnan, Alan Taylor, Denice Wardrop, Timothy White, Peter Wilf, and David Yoxtheimer.

Publicity for the plan
The Institute promoted the plan through meetings, a retreat, a town hall, online meetings, and working lunches. The Institute made the draft Strategic Plan and vision statements available online to all EESI researchers.

Plan approved by
Susan L. Brantley, Director

Goal 1: EESI Will Seek to Increase Faculty, Student, and Staff Diversity

EESI will foster multiple initiatives to enhance diversity of its personnel and the feeling of inclusion within the Institute and College (EMS). The EESI Environmental Scholars program has been especially successful in increasing diversity in the student body: 10 of the 12 current EESI Environmental Scholars are female, and five of the 12 come from underrepresented groups in the environmental sciences. One Environmental Scholar was named a Sloan Scholar in 2020 by the Alfred P. Sloan Foundation. In addition, more than a quarter of EESI faculty associates are female, including the five most recently hired associates. Several of these female faculty hold leadership positions as center and institute directors. However, only 11% of EESI associates come from underrepresented minorities. EESI shares the University's commitment to advancing inclusion, equity, and diversity and aims to build upon recent efforts to create a diverse community through the following activities.

Objective 1.1: Increase diversity of EESI Environmental Scholars

The EESI Environmental Scholars program has been successful in attracting excellent graduate students to the College of Earth and Mineral Sciences, and it has also been successful in growing diversity. The program provides a way to increase diversity within the Institute and the College, and also to engage students in Institute activities.

Currently, the program provides top-up funds to recruit deserving graduate students who have been accepted into graduate programs associated with EESI. The program could provide larger top-up amounts than it has provided over the past six years and could consider providing scholars one semester of support. The semester of support could begin to foster Environmental Scholars as "agents of change" in the environmental sciences, especially if cohort-building events incorporated activities to generate such agency. The semester of funding could also support specific activities, including formal participation in the development and delivery of EESI's interdisciplinary EarthTalks seminar series (see below). A faculty mentor for the scholars or the series could earn teaching credit for working with scholars on the series. We could also provide travel support for Environmental Scholars to attend diversity-focused conferences such as the Society for the Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) during the semester they receive funds from EESI. Professional development seminars (for careers in academia, industry, NGOs, and government) for the environmental scholars, along with other EMS graduate students, could be developed and initially coordinated by an EESI faculty member. One possibility is that this faculty member might be the broader impacts and remote collaboration specialist (see Goal 2 below).

Key performance indicators

- Percentage of women among EESI Environmental Scholars
- Percentage of under-represented groups among EESI Environmental Scholars
- Number or percentage increase in EESI scholars attending diversity conferences
- Numbers of scholars / EMS graduate students attending development seminars
- Identification of a coordinator for the EESI Environmental Scholars program

Action items

- Host kick-off luncheon
  - At the beginning of the fall semester, EESI will host a luncheon for all EESI scholars and their advisors for the new scholars to meet their peers. At this luncheon, EESI scholars will learn about EESI, its affiliated departments, its research, and its activities, events, and resources. This early-semester event will act as an icebreaker to introduce scholars and advisors and to develop community.
- Establish distinguished speaker series
  - EESI will organize a new thematic professional development series focused on career path options in Earth and environmental systems science. For each seminar, an expert from academia, industry, government, or the nonprofit sector will be invited to share their career story with EESI scholars and graduate students from departments affiliated with EESI (i.e., not restricted to EESI Scholars). This will provide scholars with a broader perspective of the opportunities to having a successful and satisfying career in science after graduation.
- Run end-of-semester lunch and poster competition
  - EESI will host an event for all EESI faculty and students at the end of each spring semester where EESI scholars will present a poster to share their work.

Objective 1.2: Increase diversity of EESI faculty

EESI will work with the departments of Geosciences, Meteorology and Atmospheric Science, Geography, and Energy and Mineral Engineering to co-hire faculty members from underrepresented groups.

Key performance indicators

- Hire one or two faculty members from underrepresented groups

Action items

- Create a committee to write an advertisement and run a search.

Objective 1.3: Promote diversity of EESI staff through hiring

EESI will work to hire staff that represent the diversity of the Commonwealth.

Key performance indicators

- Hire staff members from underrepresented groups

Action items

- Create a committee to write advertisements and run searches as staff positions become available.
- Encourage and support committee members to receive training in diversity and inclusivity.

Objective 1.4: Explore remote work capabilities for staff work

EESI will explore how to improve remote capabilities for staff work on a case-by-case basis. Flexibility in work modalities might be another way to increase the diversity of our workforce and to enable work for new sectors of the population.

Key performance indicators

- Enable some staff, on a case-by-case basis, to work from home to promote family-friendly flexibility and lessen environmental impacts in a sustainable way

Action items

- Create a committee to investigate remote work needs, possibilities, and issues, and then begin implementation of remote capabilities for some staff.

Goal 2: EESI Will Provide Support for Broader Impacts and Virtual Collaboration

EESI will enlarge its presence with respect to broader impacts in collaboration with its associates and the College. EESI associates, external funders, students, and the rest of the University share goals for outreach and other broader impacts. In many cases, it would make sense for EESI associates to share resources to achieve these goals, and EESI could help in this regard. Possible efforts that could be shared include an expanded web and social-media presence, outreach to schools and other community groups and policymakers, additional programs for underrepresented groups, etc.

A major difficulty is a need for resources to provide the time and personnel to mount a serious effort; most faculty are substantially overcommitted and lack the time to take on such a task. At the same time, many or most of our research grants come from organizations that expect us to work on broader impacts, but these organizations typically fund one-off efforts that do not create sustained improvement, and are rarely evaluated for success or that produce scholarly research.

EESI will explore how to create a larger presence with respect to broader impacts, evaluation of such impacts, and scholarship on such impacts by promoting concerted joint efforts to pool broader impacts funding from multiple grants and PIs. This might, for example, involve many participants from EESI who write successful proposals asking for 5% of the cost as broader impacts. The grants could generate enough funds to support committed people creating highly impactful activities.

Each participating proposal, investigator, or team would need to describe a customized contribution to the effort, together with a pooled effort for larger programs. Information would be hosted on the EESI website or social media feed: a live feed-from-the-field (or lab, or computer lab), a podcast that could be supplied to schools, or a “visiting speakers bureau” that would be available for talks (in person or remotely) to schools and community groups. Alternately, a science-pub or other similar efforts could be developed. This is NOT suggesting that all of these must be done, but that EESI grow its outreach presence to reach multiple stakeholders, based in large part on content from EESI-affiliated research that would augment the effort through broader impacts funding from federal agencies.

EESI could also pursue something larger, perhaps building on the highly successful Space Grant WISER-MURE-FURP Penn State Undergraduate Research Experiences, and perhaps by targeting local governments, K-12, or other stakeholders. An evaluation component leading to scholarship would be important, perhaps teaming with faculty or staff in the College of Education to sponsor graduate research on the effectiveness of the efforts.

At the same time that EESI associates seek to enhance their broader impacts locally and globally, they also recognize that travel to collaborate with scientists worldwide is not sustainable. EESI could facilitate remote collaborations and broaden Institute impact beyond Penn State through dedicated support for virtual meetings, workshops, and conferences. Effective facilitation of large, complex, online events requires more than simply a working knowledge of a particular videoconferencing application. It also requires coordination of

participants, activities, and multimedia content within a shared platform and the capacity for debugging multiple interacting technologies in real time. While the need for such support has clearly grown in recent years (and has been discussed by EESI associates), the COVID-19 crisis has both amplified and highlighted this need. Providing this support would have the added benefit of lowering the CO_2 footprint of EESI and its associates and could also improve remote teaching opportunities as described under Goal 3 below.

EESI envisions hiring or funding a dedicated person to fill the role of a Broader Impacts and Remote Collaboration (BI/RC) Specialist. This would require funding to launch and a commitment from a large group of EESI PIs to join in the effort to bring in broader impacts and remote collaboration funds through current or future grants.

EESI wants to broaden its impact, and funding agencies require broader impacts, so EESI must find a way to work together to achieve these goals. One of the benefits of this effort would be to build community among EESI associates. Of particular interest would be an effort to unite the faculty involved in the various centers into a cohesive community. At the same time, the emphasis on support for remote collaboration would serve to strengthen ties between EESI associates and the broader scientific community.

Objective 2.1: Facilitate broader impacts and remote collaboration
We will first identify a champion among the EESI associates who will be paid to identify existing broader impacts efforts spread across the EESI community, and then interview PIs to learn what is and isn't working. With this information, the champion will host a half-day brainstorming session to decide what kind of person should be hired as a BI/RC specialist. Then a search will be run for the BI/RC specialist. Once hired, the specialist would run small workshops to determine what efforts should be moved forward. Then, the specialist will build a menu of actions that can be included in proposals and work with the PIs and their students or postdoctoral scholars to implement the broader impacts and more effective remote collaboration.

Key performance indicators
- Fund an EESI associate as a BI/RC champion
- Champion identifies EESI's ongoing BI/RC efforts
- Champion runs half-day brainstorming session
- EESI runs a search to hire a BI/RC specialist
- EESI hires a BI/RC specialist
- Specialist runs small workshop, builds menus of BI activities, and teams with other entities on campus to evaluate the BI successes and failures

Action items
- Identify and pay a champion, run brainstorming event, create a committee to decide the kind of person to hire, write an advertisement, and run a search.
- Hire the BI/RC specialist and introduce the individual to EESI associates.
- Explore how to work with entities on campus to evaluate the BI project.
- Conduct and publish the results of the evaluation.
- Pilot and evaluate several remote collaboration events.

Goal 3: EESI Will Transform Faculty-Student-Staff Interactions

EESI will transform how faculty, students, and staff interact through seminars and courses. EESI will encourage more faculty-student interactions to prepare students for interdisciplinary collaborations in the workforce. The Institute also will give students opportunities to explore professional possibilities outside academia by encouraging them to interact with visiting scientists both on-campus and online. Finally, the Institute wants to make it easier for faculty and staff to complete their jobs both remotely as well as in-residence.

Objective 3.1: Transform EarthTalks into a Course

During at least one semester each year, EESI hosts a Monday afternoon seminar series named EarthTalks. This series will be transformed so that in some semesters it is not just a seminar series but also a class; for example, a graduate-level course that in some years could include a debate component or an Earth 400 undergraduate-level keystone course that targets the Earth Science and Policy major. The series' revised goals will include increasing student engagement with personnel across Penn State and EESI, as well as outside speakers if they are invited. The number of visiting researchers who take part in the series for the entire semester or a part of the semester would be determined by the goals of the course, the funds, and the time commitment. One option might be to teach the class as a science communications class built around EarthTalks. This would help increase attendance and may help the series become more visible.

The EarthTalks seminar series is an excellent venue for presenting information related to the Earth and environmental sciences, climate change, climate/energy policy, landscape ecology, and the food-energy-water nexus (among other topics). Instead of using EarthTalks to cover the entire set of research foci, however, EESI could consider using the talks to target specific areas. An obvious target might be the general area of climate change and energy use. If climate change were made the focus of the seminar series, it might also be possible to use EarthTalks to provide some cohort-building opportunity for graduate students enrolled in the Climate Science dual-title graduate program.

One way to use EarthTalks to focus on a topic like climate change would be to fund high-profile outside speakers. At present, the series is supported with $5,000 of EESI funding; this allotment could be raised to increase the profile of speakers. With additional allotted funds, advertising for EarthTalks seminars could be increased. Advertising could include the weekly "This Week" newsletter sent out by EESI's administrative support assistant, social media posts, fliers posted on each floor on the bulletin boards in EMS buildings, via electronic boards, through announcements shared with graduate student associations to attract more students, and via advertisements in the Collegian and other local news outlets. Individual faculty members should be encouraged to invite their students to participate in the EarthTalks and even meet with the speakers.

The series does *not* need to be offered every semester, but it should be offered every year. Each semester, a champion for the series should be identified and given support to run the series. Incentives could be offered to increase associates' willingness to take on the duties of recruiting speakers. These could include one or more of the following: salary support, graduate student stipend support, and/or increased control over the choice of speakers.

The series does *not* need to be an in-person seminar series. Given the success of the remotely delivered EarthTalks during the Spring 2020 COVID-19 crisis, EESI should explore whether EarthTalks could effectively be delivered as webinars, panels, or debates from time to time.

Finally, many of the proposed topics, including the energy/climate nexus, are not the sole purview of faculty in EMS. Other colleges within the University have people working on these problems, too. We need to target the advertisement of EarthTalks with individual colleagues across the University. EESI members can participate in sending the announcements of individual EarthTalks to interested colleagues in other colleges (e.g., Agriculture, Engineering). We also need to let the broader Penn State community know about EarthTalks.

Key performance indicators

- Significant levels of attendance at EarthTalks events
- Heightened awareness of globally important environmental problems such as climate change
- Associated class draws a significant number (at least 10) of students each year

Action items

- Each fall the EESI Director should identify someone to run the class in the spring and provide funds or other resources to support the effort.

Objective 3.2: Reach beyond Penn State

The EarthTalks series provides excellent teaching and learning opportunities for the Penn State community as well as outside stakeholders. To take advantage of these opportunities, we should use the series to reach broader stakeholder and scientific communities. EESI will push distribution of the seminar recordings to a national or international audience via its website and social media channels. EESI could also explore whether EarthTalks could be part of shared courses among universities nationally. If this “shared-among-universities” approach proves to be a successful model for a course, EESI could help associates to similarly share their courses with other universities that might want to co-host co-taught classes.

Key performance indicators

- EarthTalks recordings are viewed by participants nationally or internationally
- Social media metrics show upsurge in engagement

Action items

- EESI explores new ways to advertise EarthTalks within and beyond the Penn State campus.
- EESI records each EarthTalks seminar/panel and distributes the recording via social media.
- EarthTalks series that are promoted as courses could be coordinated and cross-listed as courses at other universities as well as at Penn State.

Objective 3.3: Enhance opportunities for remote teaching and working

The onset of the COVID-19 crisis led Penn State faculty, students, and staff to work remotely without any preparation. We learned that many activities can be accomplished remotely and that this can save time and energy while reducing carbon dioxide emissions. We also experienced that there is a learning curve for working remotely. EESI will seek to grow an environment that nourishes work both on campus and at home as appropriate.

Key performance indicators

- EESI will provide opportunities and resources to help faculty, staff, and students become proficient in working in a hybrid environment that includes both on-campus and remote modalities, as appropriate on a case-by-case basis
- Satisfaction among faculty, staff, and students will grow as the possibility of remote work is provided on a case-by-case basis
- EESI's greenhouse gas footprint will decrease

Action items

- Staff evaluates when remote work makes sense in coordination with the Director and administrative staff.
- EESI provides resources to improve the ability for faculty, staff, and students to work in a hybrid modality (remote and on-campus) as appropriate

Goal 4: EESI Will Develop New Expertise to Project Environmental Change

EESI will hire experts who specialize in quantitative projections of environmental change. This will focus on understanding, mitigating, and managing the effects of climate and other types of environmental change on vulnerable communities and areas such as coastal regions, cities, and rural localities. In particular, EESI might target communities where livelihoods are based on resources lying at thresholds of food-energy-water systems. This effort will include faculty hires in data assimilation, environmental modeling, and Earth-system observations targeting areas within EESI's associated departments (Meteorology and Atmospheric Science, Geosciences, Energy and Mineral Engineering, Geography). One specific area of interest is *Projecting Water Resources in the Face of Climate Change*. This effort would strengthen EESI's leadership in the critical area of climate change impacts and adaptation.

The phrase "*environmental projection*" is meant to include everything from prediction to forecasting to Earthcasting (a phrase recently coined to indicate projection of change into the future for Earth surface systems). The accuracy of environmental forecasting, and especially weather forecasting, has greatly improved in recent decades, due largely to the development of data-assimilation techniques that combine available data with models to improve both. Modern 72-hour hurricane-track forecasts are more accurate than the 24-hour forecasts of 40 years ago, for example. Such forecasts are transforming what once would have been a disaster into a modern capacity to prepare, warn, and evacuate. This yields huge savings in both lives and resources.

Experiments to investigate ecosystem state and function are currently designed hand-in-hand with data assimilation to optimize model-data syntheses. Penn State (especially the Department of Meteorology and Atmospheric Science and the Penn State Center for Advanced Data Assimilation and Predictability Techniques [ADAPT]) has led a number of important advances in data assimilation. Substantial effort is focused on developing multi-variable observational benchmarks for Earth system models to project change into the future. EESI will promote the use of data assimilation to inform environmental projections, including the use of observations ranging over timescales from deep time to human time where appropriate.

Coastal flooding, riverine flooding, urban heat waves, ecosystem and natural resource vulnerability and adaptation, soil erosion and land sliding, urban and rural air quality, and renewable energy systems are all environmental forecasting challenges that could be addressed under this initiative and would map onto the collective strengths of departments in the College of EMS.

Objective 4.1: Hire faculty with expertise in environmental projection.
Hire three full-time faculty members with expertise in environmental projection and with interest in leading collaborative efforts that span a broad range of disciplines relevant to climate change or environmental change. Specialists should have expertise in topics such as impacts, adaptation, and projections for the future that might incorporate data from deep time to human time. Disciplines related to climate change should be a particular target.

Key performance indicators
- Targeted hiring of three new faculty members in the area of environmental projection

Action items
- Form interdisciplinary committees to write job descriptions.
- Run the three searches in 2021, 2022, and 2023.
- Recruit and attract new faculty hires.

Objective 4.2: Strengthen existing interdisciplinary collaborations across timescales
EESI excels partly because it incorporates a broad spectrum of researchers in the Earth sciences who are interested in variability and change from short- to long-timescales (i.e., from human time to deep time). These communities already interact but could strengthen their ability to integrate and extrapolate across timescales: cooperation could be particularly strengthened among communities such as weather forecasting, climate and Earth systems modeling, astrobiology, ecosystem-environment-natural resource modeling, integrated assessment modeling, and climate risk management communities.

Key performance indicators
- Grow the community that taps into space science opportunities
- Run EarthTalks series that bridge between these target areas
- Develop EMSC courses on these broad-ranging topics
- Grow the cadre of EESI scientists using high-performance computational resources
- Grow the cadre of EESI scientists using remote sensing to understand planetary change

Action items
- EESI will continue working to enhance computing and supercomputing resources for associates.
- EESI will stimulate more outreach from space scientists within the Institute to build bridges to atmospheric sciences.

Goal 5: EESI Will Forge a Dedicated Convergence Research Collaboration Space (JEWEL)

EESI will build a physical space that is an exciting and efficient space to work for promotion of transdisciplinary collaborations that extend beyond the College of Earth and Mineral Sciences. These collaborations will include EESI associates, affiliates, and students as well as faculty from other colleges, community stakeholders, and industry, government, and non-profit partners. Such a space would encourage regular, face-to-face interactions among partners, but it could also be a space that facilitates online meetings (e.g., with electronic white boards, visualization and spaces empowered by artificial intelligence utilities, and remote meeting and collaboration facilities). Enhancing EESI's West Campus location would immediately draw together EESI participants. Growing the remote-meeting capabilities would have the ancillary attribute of creating a more sustainable work enterprise congruent with EESI's environmental goals. The new space will be called the Joint Energy-Water-Environment Laboratory, or JEWEL.

Such a facility would include dedicated office space for research faculty, support staff, postdoctoral scholars, and other students whose efforts are primarily dedicated to such projects, with additional offices reserved for visiting scholars and for use of Penn State faculty during "in town sabbaticals" or "cross-campus work visits." It would include flexible meeting and videoconferencing spaces, a variety of open-plan and private "hot desks" for collaborators with offices elsewhere on campus or in town, and a flexible facility to support day-to-day use as well as special events. Creating a warm, welcoming, modern environment that encourages postdocs and other students, faculty, and stakeholders to spend time working together in a shared space (both in-residence and online) would be the primary focus of this effort.

Numerous EESI associates have suggested that siting a space such as JEWEL in a new location near center campus would enhance the impact by making it more readily accessible to other PSU collaborators. In that regard, a new dedicated building would be desirable. However, establishing a centrally located building on campus involves a long-term effort with a typical planning horizon of more than a decade. In the interim, EESI should take steps now to enact JEWEL using currently available space. Initial steps are already well underway with the planned renovation of EESI's 2nd floor suite. This renovation will include an updated social area, a larger and more open conference room, and a revamped common space designed to encourage conversation and collaboration. We are also discussing how to enlarge this prototype first-step version of JEWEL through a major renovation of EESI's current 3rd floor suite. As currently envisioned, this larger version of JEWEL would incorporate all the features described above and could serve as a testbed or prototype for future facilities on central campus. Planning for development of JEWEL should occur with significant involvement from center directors and other EESI stakeholders.

Objective 5.1: Establishing JEWEL 1.0
Design, create, and launch the Joint Energy-Water-Environment Laboratory (JEWEL) within EESI's current second- and third-floor spaces in EES building.

Key performance indicators
- Increased activity of non-EES EESI researchers working within EESI's renovated second- and third-floor suites

Action items
- Finish the already-designed second floor renovation as the first step toward JEWEL.
- Convene a pre-design scoping committee for the third floor renovation.
- Confirm previously dedicated funding for JEWEL.
- Work with Office of Physical Plant and architects to design JEWEL.
- Complete renovation and construction of JEWEL.

Objective 5.2: Establish JEWEL 2.0
Secure support for, design, create, and launch a second manifestation of JEWEL in a central campus location to promote transdisciplinary Earth and environmental systems research within EMS and across the University. This JEWEL 2.0 might be bigger and better than JEWEL 1.0, or it might alternately be just another location with all the same capabilities as JEWEL 1.0. This latter idea builds on the idea that we want to enable environmental researchers to move around campus seamlessly while completing research using collaboration technology.

Key performance indicators
- A design for a new, centrally located collaboration space to support transdisciplinary research is initiated and actively promoted by EESI and others across campus

Action items
- Create committees of researchers from across campus to discuss and promote JEWEL 2.0.
- Build support for JEWEL 2.0 and present the idea to campus decision-makers in upper administration in collaboration with other units on campus.
- Create a design committee to move JEWEL 2.0 toward completion.

Goal 6: EESI Will Grow Expertise in the Area of Data Analytics for Environmental Systems

EESI seeks to hire one or two tenure-line faculty who use new tools of data-driven science to understand land, water, and energy systems. Of particular interest are researchers using large volume datasets and techniques from data mining, machine learning, artificial intelligence, or deep learning, including work ranging from remote sensing at continental to global scales to groundwater chemistry evaluated at local or regional scales. We seek scientists interested in understanding patterns generated by data-driven analytics in terms of physical models. The successful candidate will choose to be a member of one of three departments -- Geography, Energy and Mineral Engineering, or Geosciences -- and will also be an EESI associate. We seek dynamic scientists who want to teach and lead in understanding big datasets focused on integrated topics like climate change adaptation, critical zone science, climate engineering/mitigation, energy-water-food nexus, land-ice-ocean-atmosphere modeling, or policymaking in the energy and environmental sector. We envision that the researchers will coordinate to offer a new suite of courses in environmental data analytics, co-listed in the departments named above, and aimed especially for environmental students in the College of Earth and Mineral Sciences.

Objective 6.1: Hire an environmental data analytics expert

EESI will hire an individual who specializes in data analytics for environmental systems research.

Key performance indicators

- Hire an Earth scientist who is a specialist in data analytics for environmental systems

Action items

- Create a committee to write a description and run a search.
- Hire a person and introduce the individual to the associates.
- Provide the scientist with adequate resources to begin at Penn State.

Objective 6.2: Hire a second data analytics expert in land-water systems

EESI will hire an individual who specializes in data analytics for environmental systems research.

Key performance indicators

- Hire an Earth scientist who is a specialist in data analytics for environmental systems, but with a different focus than the first hire

Action items

- Create a committee to write a description and run a search.
- Hire a person and introduce the individual to the associates.
- Provide the scientist with adequate resources to begin at Penn State.

Objective 6.3: Offer new courses in environmental data analytics
EESI's new hires will begin to teach courses for upper-class EMS undergraduates and early-career graduate students in data analytics for environmental systems research.

Key performance indicators
- The number of EMS students enrolled in EESI data analytics classes increases

Action items
- Each EESI faculty hire in data analytics will design a course.
- Each course will be run as an EMSC 497 course and then will be transitioned into a course with its own number and taught consistently.

Goal 7: EESI Will Grow Expertise in the Area of Environment and Human Well-Being

EESI seeks to hire a faculty member who specializes in environmental science related to human well-being. Of particular interest is research involving innovative approaches that bring together social science, biological science, and physical science to understand human society in the context of its physical environment. We expect the successful candidate will use tools from the physical, biological, and social sciences to advance human well-being. We seek scientists interested in understanding environmental science and how humans impact (and are impacted by) the environment. A focus on decision-making that promotes human well-being will be emphasized. Specific foci might include climate change, the disease-weather connection, environmental health, water-energy-human health, water and human health, international relations with respect to environmental change, etc. The successful candidate will choose to be a member of one of four departments (Geography, Meteorology and Atmospheric Science, Energy and Mineral Engineering, or Geosciences) and will also be an EESI associate. We seek dynamic scientists who want to teach and lead in understanding challenges related to human-environment interaction focused on human well-being. We envision that the new researcher will coordinate with other new hires on campus working in the areas of environmental science and human health.

Objective 7.1: Hire an environmental and human well-being expert

EESI will hire an individual who specializes in environmental and social science dedicated to improvement of human well-being. The successful candidate will choose to be a member of one of four departments (Geography, Meteorology and Atmospheric Science, Energy and Mineral Engineering, or Geosciences) and will also be an EESI associate.

Key performance indicators

- Hire a specialist in environment and human well-being

Action items

- Create a committee to write a description.
- Run a search and hire a candidate.
- Give the candidate resources needed for a successful start to their career at Penn State.