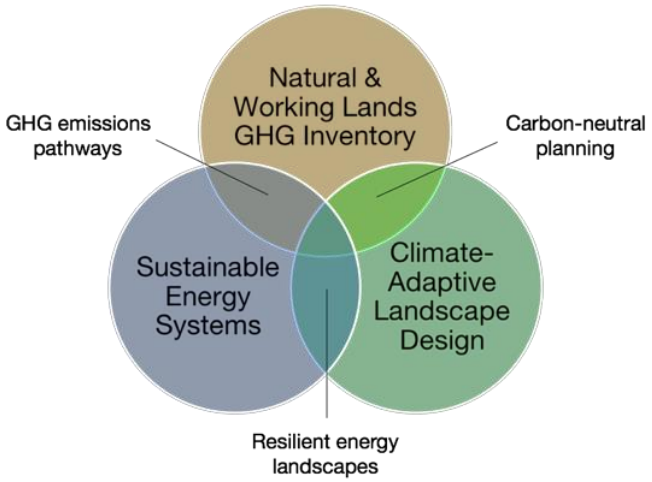
Pathways to a Net-Zero Carbon Future: Landscape Design for Sustainable Energy and Climate Change Mitigation



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Opportunity Description

Achieving a sustainable balance between society's energy demands and the greenhouse gas (GHG) reductions needed to stabilize Earth's climate poses a complex and dynamic challenge for scientists, practitioners, and policy-makers. Using resource inventories, simulation models, life-cycle and techno-economic analyses, among other tools, we can assess how our current land use practices and energy systems contribute to net GHG balance, and to quantify potential pathways to achieving policy and regulatory targets for net GHG emissions.

Yet these approaches, while powerful, do not fundamentally enable us to *design* or *create* landscapes that can follow such pathways, be resilient to change, and achieve our goals. Creating a *net-zero carbon future* requires we employ *landscape design* to identify optimal configurations of natural and built environments for their multiple benefits and values over time and space. Also, because some climate change is assured over the next century, *a truly sustainable landscape design must be adaptive to forthcoming but uncertain shifts in climate.* For instance, the potential to reduce net GHG emissions via improved stewardship of forests, farms, and wetlands will be shaped by feedbacks between climate and ecosystem functions. Moreover, most supply and demand aspects of renewable energy systems, such as wind, solar, hydropower and biomass, are sensitive to shifts in weather patterns and disturbance regimes.

Our ESF Discovery opportunity addresses the globally critical challenge of the *climate-energy-land use nexus* by integrating ESF's strengths in resource stewardship, sustainable energy, and landscape architecture, to establish the College as a 21st century leader in sustainability science. The intersections of these strengths and our commitment to engaging with stakeholders will foster transdisciplinary scholarship and service that can identify and advance practical solutions needed by planners, landowners, communities and policy-makers, from local to global scales.

● ***Natural & Working Lands GHG Inventory*** – Human land use practices shape GHG fluxes from land to atmosphere, and therefore can mitigate or amplify the primary drivers of global climate change. Forests, farms, and wetlands can serve as resilient GHG sinks while providing multiple co-benefits, but careful stewardship and changes in 'business-as-usual' practices are needed to realize this opportunity. New York State recently established the Climate & Applied Forest Research Institute (CAFRI) and has funded ESF to lead its initial efforts focused on state-wide forest carbon sequestration. Over the next 3 years, ESF and CAFRI will: 1) improve inventory and modeling methods for forest-based carbon flux, 2) identify best management practices to reduce GHG emissions and establish resilient C sinks; and 3) recommend policy, programs, and

incentives to achieve forest-based pathways to GHG emissions targets. We will leverage this work and its broader impacts in this Discovery opportunity, to provide faculty and student real-world research opportunities that have a direct conduit to state agencies and policy-makers.

● ***Sustainable Energy Systems*** – Dramatic and widespread changes to the US and global fossil fuels-based energy systems are needed to address climate change. New York has set targets to have 50% of all electricity come from renewables, reduce GHG emissions by 40%, and dramatically increase energy efficiency by 2030. To reach these goals, a systems approach with strong analytical tools are needed to ensure that investments have the largest impact and to avoid unintended consequences. We will build on recent success at integrating techno-economic analysis and life cycle analysis to provide assessments of individual sustainable energy pathways and different mixes of pathways needed to reach targets. Uncertainty and sensitivity analysis of these complex systems will be included to account for known and unknown future variability in energy markets and weather/climate, among other factors. Our expertise in energy markets and policy will be leveraged to design pathways for implementing solutions, to expand our already strong undergraduate energy programs, and integrate these existing programs with other undergraduate, graduate and online programs across campus.

● ***Climate-Adaptive Landscape Design*** – As climate change becomes an increasingly common aspect of planning and design of urban spaces, landscape architects face challenges of greater technical complexity than previously encountered in the design profession. Landscape architects have always designed for change and uncertainty -- these considerations are built into any design that incorporates living systems. However, this reality is becoming more urgent, asking landscape architects to react with design solutions informed by deep scientific, cultural, and economic information, and to provide alternatives which may repair or redirect the damage caused by climate change-related occurrences. A key aspect of this initiative will be to enable landscape architects to engage in collaboration with other faculty and students at ESF to develop scientifically-driven digital workflows for simulating and visualizing climate change mitigation strategies, and to use these workflows to engage new pathways for research across the college. By creating these linkages between scientific study and spatial design, these mitigation strategies can be most fully explored as parametric processes: those which enable definitions and rules to dynamically shape the design strategy through data.

Undergraduate and graduate degree programs

We will create transdisciplinary thesis, capstone, and studio/lab experiences for students in different majors; initial discussions have occurred among faculty in FNRM, LA, ERE, GPES and FCH. We will create a transdisciplinary seminar series and an annual conference addressing the energy-climate-land use nexus. Select classes will be converted into online forms to reach a broader audience and contribute to the sustainability management major. A new graduate program in Sustainable Energy with a focus on transdisciplinary research will be launched.

Agencies, partners, and funding entities

NYS DEC, NYSERDA, NYS Environmental Protection Fund, NYS DOS, NYS DOT, DOD-SERDP, DOE, USDA-NIFA, US Forest Service, RGGI, NSF, EPA, The Nature Conservancy, US Climate Allliance

Expanding and creating new partnerships
ESF can expand and forge new partnerships with state agencies, including DEC, NYSERDA, Cornell CALS / CCE, DOS and DOT, by providing much-needed technical expertise, collaboration, and stakeholder facilitation in energy, land use, and climate policy and planning. Similar expertise is sought by national policy consortiums such as the US Climate Alliance (USCA) of 17 US states, which recently committed to pursue Paris Accord GHG reductions by fostering resilient carbon sinks on 'natural and working lands'. Partnership with the NYS Independent System Operator (NYISO) that operates electricity markets across NY will prove access to very large data sets that are needed for market and policy analysis. We will work with companies such as National Grid that are implementing smart grid and micro-grid systems to understand their impact and how to improve them. There are numerous NGOs focused on land-energy-climate challenges, such as The Nature Conservancy, that will be key partners in this effort.

Use of ESF assets and properties
The College's satellite campuses and Forest Properties are essential research laboratories and experiential learning sites that can support this opportunity in unique ways. In particular, the CAFRI-funded research on forest GHG sequestration and management practices will closely interface with ongoing teaching and applied research efforts at Heiberg, Huntington, Dubar and Pack Forests. Collectively, our campuses span many landscape settings, from urban and exurban to rural and remote, that provide immersive opportunities for students and faculty.

Policy, reputation, and global impact
Policy: ESF can serve as the lead academic institution working with state agencies and policy-makers committed to NY's Reforming the Energy Vision (REV) goals. We are now in that role for forest GHG sequestration with NYS DEC (via CAFRI). Our expertise in energy policy, markets, and systems analysis is highly valued by NYSERDA, who is responsible for modeling statewide pathways to meeting REV goals and related policy targets. Our LA faculty and graduates are highly sought-after leaders and facilitators in community planning efforts funded by NYS DOS.
Reputation: We have the opportunity to bolster ESF's reputation as innovative problem-solvers in a complex and rapidly changing world. Guiding New York State to a sustainable carbon-neutral future will pay great dividends for our regional, national, and global visibility and image.
Global Impact: NY is a global economic and cultural trend-setter, but has lagged far behind CA in climate, environment, and sustainability policy. In short, ESF can help NY 'catch up' and do more to shift one of the world's largest economies and trade centers towards sustainability.

New investments
A dedicated space for collaborative scholarship and transdisciplinary integration is needed to support sustainable landscape design training and practice. This may be a new or remodeled studio / computing facility for faculty, students, practitioners and partners engaging in design efforts that include 'big data' visualization and analysis. We envision establishing at least one such space on the main campus, and one at a remote campus in the Adirondacks (likely in Newcomb given available facilities). We also expect that faculty hires in applied climate change science (impacts/adaptation/mitigation), land use change/land owner decision-making (agent-based modeling), and 'big data' science (algorithms/machine learning) might be recommended.

PATHWAYS TO A NET-ZERO CARBON FUTURE

STARTUP PLAN: ***Year 1*** – ESF faculty, alumni, collaborators, and partners define Center's tripartite mission in sustainable landscape design: research/innovation, training/service-learning, and consultation/practice. Efforts to renovate a space for Center's state of art computing lab/design studio will begin immediately, with completion by Fall 2020. Series of interactive workshops to draft a near-term strategic plan including objectives, funding sponsors, curriculum revisions, partners, recruiting, obstacles, benchmarks, etc. Create unofficial hybrid 'MS-MLA' prototype in GPES CNHS, begin recruiting students, explore links with 'feeder programs' such as new ESF online (OA) B.Sc. in Sustainable Management. ***Year 2*** – Complete lab/studio renovation and tech installation in time for first cohort of 'MS-MLA' students (Fall 2020), to be supported by SUNY Discovery fellowships. Organize a public seminar series around Center expertise and practice, such as life-cycle analysis, data visualization, community-based design, etc., and convert seminars into short courses and/or online modules. Center fellows and faculty identify research-design-consultation opportunities with municipalities, industry, and NGOs (e.g., TNC). Work with ESF COO, agency partners, NYS legislators and Governor's Office to cultivate regular funding support via State budget items (by Year 4). Recruit second cohort of 'MS-MLA' fellows. Grant-writing workshops and retreats. ***Year 3*** – Second cohort of Center fellows arrives; first cohort moves into active research-design-consultation phase. Grow sophisticated web presence and digital outreach to raise awareness of Center activities, share success stories, provide public service (e.g., online 'climate futures' visualization tools) and support fundraising and recruiting efforts. Center fellows and faculty will host '*Sustainable Landscapes Summit*' with local planning boards, State decision-makers, energy industry, and landowners, to create conduits for future consulting opportunities. Decide whether to establish a true dual 'MS-MLA' degree with SUNY.

FISCAL SUSTAINABILITY: Multiple funding streams via NY State (e.g., DEC, NYSERDA, DOT, DOS), federal (e.g., DOE, NSF, USDA, EPA) and philanthropic sponsors (e.g., Pew, Doris Duke) will be targeted during startup. We have strong relationships to build upon with many of these sponsors, especially NYS agencies tasked with achieving policy goals for net GHG emissions, renewable energy (REV), and 'climate-smart' communities. By year 4, should have first cohort of Center-sponsored MS graduates and new funding streams in place. **TEAM EXPERTISE:** Systems ecology, land and resource management, energy systems, community-based design, landscape simulation and visualization, life-cycle / techno-economic analysis, participatory research, etc.

TRANSFORMATIVE POTENTIAL: *At the nexus of natural climate solutions, renewable energy systems, and landscape design, is the* ***knowledge and practice to foster a more sustainable way of life****.* With this Center, we will simulate, visualize, and assess potential pathways to carbon neutrality by integrating land use and energy systems models under various social-ecological scenarios. We will introduce community-based design principles into this systems modeling space to 'create' hypothetical landscapes that can operate within sustainable boundaries. We will engage with communities, decision-makers, NGOs and industry to take practical steps to translate those models into reality. And because land use and energy vitally intersect with food and water systems, we can also engage those big sustainability challenges, and draw scholars and students to ESF who seek innovative training and solutions. Our focus on consultation and practice will ensure our work is highly impactful and visible well beyond ESF's campus. In doing so, we will not only transform ESF, but also all of the places (landscapes) where we do our work.