



Maine EPSCoR

## NSF EPSCoR RII Strategic Plan for 2009-2014



**Revised working draft as of 9/9/10**

## Maine's Sustainability Solutions Initiative (EPS-0904155)

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*On the cover: Acadia National Park, Mount Desert Island, ME*



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*The research portion of the five-year Maine EPSCoR RII initiative, led by the Senator George J. Mitchell Center at UMaine, will involve core research teams from UMaine and USM, as well as government and industry stakeholders, to improve the science and practice of sustainable development.*

Maine EPSCoR's Sustainability Science Initiative seeks to connect knowledge with action in ways that promote strong economies, vibrant communities, and healthy ecosystems. A strong research and education foundation will be combined with STEM education and workforce development, outreach and communication, and cyberinfrastructure components to increase capacity, competitiveness, and development in a focus area that is vital to Maine's future.

Producing knowledge and linking it to actions that meet human needs while preserving the planet's life-support systems is emerging as one of the most fundamental and difficult challenges for science in the 21st century. There is growing consensus that traditional methods of generating and using knowledge must be fundamentally restructured to confront the breadth, magnitude, and urgency of many problems now facing society. Solving sustainability problems requires unprecedented levels of program integration characterized by a deep commitment to interdisciplinary teamwork, robust university-stakeholder partnerships, and an innovative institutional culture.

Our strategy for strengthening sustainability science and practice has two major components. First, our research teams include experts in the ecological, social, and economic dimensions of sustainability, as well as researchers skilled in understanding and strengthening connections between knowledge and action. Second, these interdisciplinary teams work in close partnership with diverse stakeholders to maximize the relevance and potential value of research for decision-making.

The Sustainability Solutions Initiative (SSI) group uses Maine as a laboratory to study the emerging field of sustainability science. The focus on landscape dynamics reflects a broad consensus that land change science is a critical research frontier and leading societal problem for sustainable development.

## Maine's Sustainability Solutions Initiative

This strategic plan provides a framework around which this NSF EPSCoR RII project will operate and measure progress and performance. The following are the overarching goals that will be addressed:

Goal 1: Investigate the dynamics of social-ecological systems, with particular emphasis on SES resilience.

Goal 2: Examine connections between scientific knowledge regarding SES dynamics and stakeholder actions that potentially affect SES resilience.

Goal (new): Test models from organizational science to understand and improve program effectiveness.

Goal 3: Focus on landscape change as a productive research nexus.

Goal 4: Foster the next generation of sustainability science professionals through K-20 programs that are linked to the diverse challenges and opportunities in the emerging field.

Goal 5: Prepare Maine's current and future STEM workforce through coordinated programs and opportunities, training, and knowledge dissemination.

Goal 6: Engage all aspects of the state's human and institutional resources in the achievement of the RII project goals and objectives.

Goal 7: Implement new cyberinfrastructure to improve communication, collaboration, and visualization capabilities that enable innovation and competitiveness in the sustainability science focus area.

Goal 8: Create and maintain an effective outreach & communication network through strategies that encompass all participants, stakeholders, and the general public.

Goal 9: Implement an effective management plan that will support and ensure the overall success of the Maine EPSCoR RII project.

Goal 10: Manage project to result in a shared vision for- SSI research and integrated education; effective collaboration; and participatory project management.

Goal 11: Utilize multiple formative and summative evaluation processes to improve the project's effectiveness and assess its impact in relation to its goals.

Goal 12: Sustain SSI infrastructure, impacts, and achievements through continued integration of scientific entrepreneurship, institutional and external support, partnerships, education, workforce development, and constituency outreach.



*Portions of southern Maine have experienced rapid sprawl while record sales of private forest lands and mill closures are transforming the social and economic fabric of northern and western Maine.*

# Sustainability Solutions Initiative (SSI) Research Portfolio

The research to be supported by the Sustainability Solutions Initiative (SSI) is designed to address the intersecting ecological, social, and economic dimensions of sustainability science. As described in the project proposal, transforming Maine’s capacity for sustainability science requires unprecedented program integration and interdisciplinarity. The SSI will eventually lead to the creation of the Center for Sustainability Solutions (CSS) at the University of Maine.

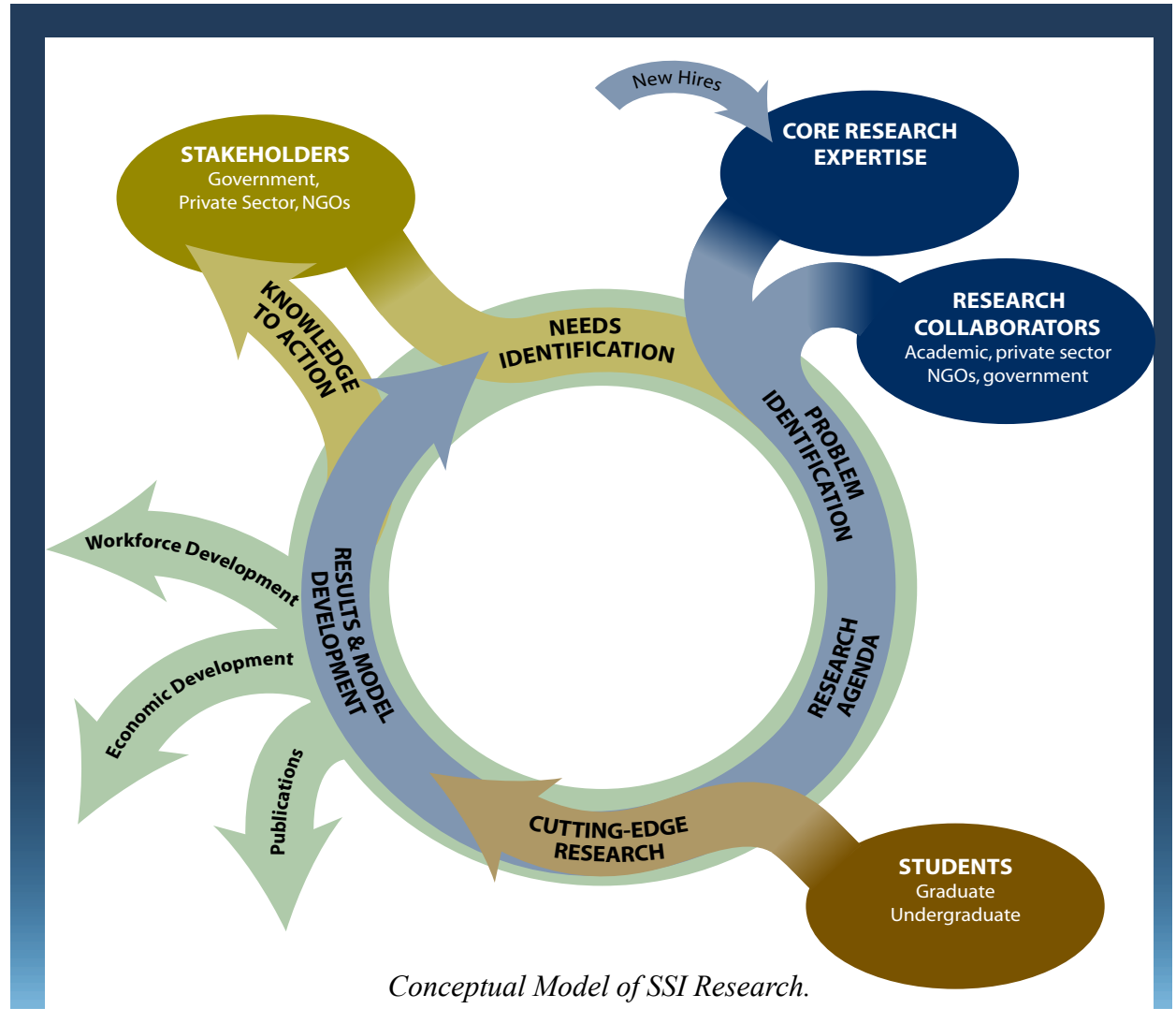
The mission of SSI is to understand the coupled dynamics of social-ecological systems (SES) and connections between knowledge and action (K-A) that enhance individual and institutional decision-making. SSI will use Maine as an R&D “laboratory” for the emerging field of sustainability science. Our focus on landscape dynamics reflects a broad consensus that land change science is a critical research frontier as well as a pressing societal problem for sustainable development.

SSI research employs innovative strategies: 1) model development and testing based on an integrated analysis of interactions among three drivers of landscape change (i.e., urbanization, forest ecosystem management, and climate variability); 2) a quasi-experimental approach to evaluate alternative modeling of SES thresholds, feedbacks, and resilience; and, 3) analysis of university-stakeholder engagement processes to increase the potential value of research for decision-making.

The success of SSI research depends on high levels of interdisciplinary integration and will

enhance research capacity (Figure 1). SSI will apply and test models from organizational science to improve program effectiveness, resulting in a deeper understanding of the theory and practice of sustainable development in the context of landscape change. As a result

of this innovative research cycle, the explicit structures of individual projects are expected to evolve through each iteration. The projects listed in the following table each include extensive integration of SES and KA into the respective research topics.



Conceptual Model of SSI Research.

Figure 1

# Representative SSI Research Projects



Research Project Focus	Primary Stakeholders	Outcomes	Outputs	Links to Economic Development & Capacity Building
Sustainable Water Resources	Public Water Suppliers, Dam Owners, Landowners, Local Government, Lake Associations	Improved lake quality and quantity management, Stakeholder knowledge gain	Decision support tools, Hydrological Models (scenario analysis)	Watershed management, Forest operations
Maine's Landscape: Alternate Futures	State agencies, Forest Management Companies, Conservation Organizations	Increased stakeholder ability to understand changes and plan	GIS models of landscape change (multiple variables)	Land use planning tools, conservation and econ. dev. synergies
Urban Landscape Models	Transportation agencies, Regional Planners, Regional Business Councils, Infrastructure companies	Improved urban planning and growth management	Model of complex coupled systems, Scenario analysis (e.g. re-urbanization vs. sprawl)	Urban planning, climate change adaptation
Spatial Forest Planning	Forest management companies, conservation groups, forest products industry, environmental orgs	Adaptive management for changing forest composition due to pest outbreaks or invasive species	Spatially explicit maps of forest composition and vulnerability analysis. Scenario analysis	Decision support tools for Forest management, habitat management
Small-Scale Forests: Policy & Management	Small woodland owners, state forest service, municipalities, forest industry	Increased knowledge leading to improved small woodland policies and land management	Agent based modeling of small woodlands	Landscape change, Forest operations, urban planning
Urban Streams: Restoring and Sustaining	Regulatory agencies, environmental orgs, engineers, town planners	Acceptance of new decision support tools, increased process-level knowledge, clearer legal landscape	Ecohydrological decision support tools, neutral ground forum (exchange)	Urban planning, climate change
Dam Removal & Stream Restoration	Native communities, state and federal agencies, environmental organizations	Develop a framework to study and conduct dam removals to meet social, economic, and ecological goals	Development of dam removal "best practices" to achieve ecological, social, and economic goals	Hydropower, recreation, community redevelopment
Refining Mercury Fish Consumption Advisory	Native communities, Environmental agencies, fisheries agencies, health departments, fishing public,	Improved public awareness and targeted health advisory information (spatial and market segment)	Detailed spatial mapping of mercury in sport fish, Identification of communication barriers	Recreation, Public health.

## Representative SSI Projects (continued)



Research Project Focus	Primary Stakeholders	Outcomes	Outputs	Links to Economic Development & Capacity Building
Spatial Landscape Simulations	All stakeholders, including other SSI projects	Increased stakeholder involvement using model visualization	Web-based models for scenario analysis and complex systems experimentation	All SSI projects
Invasive Species and Coupled Human-Natural Systems	Native communities, forestry managers, regulatory agencies, indigenous arts	Develop educated stakeholders to respond to the identification and response to invasive species in the forest	Build a knowledge base, map vulnerable forests, inventory overlapping values systems	Indigenous crafts, Forest management, Climate change adaptation,
Modeling Stakeholder Acceptance of New Knowledge	Sample sub-populations of all stakeholders	Measures of stakeholder response to new information, sociocultural factors affecting attitudes and behaviors	Assessment of stakeholder knowledge, attitudes, and opinions	Improved stakeholder engagement systems for conflict resolution, consensus building
Adaptation to Climate Change in Coastal Communities	Coastal residents, communities, regional planners, and state agencies, local fisheries	Use of adaptive management to respond to changing climate	Opinion surveys and coupled human-natural systems models	Urban planning, Tourism, Climate change adaptation, fisheries management
Estuarine Ecology and Quality of Place	Coastal communities, regional planners, fisheries, natural resource agencies	Increased stakeholder participation in estuarine management	Identification of ecological markers related to community values	Land-use planning, Fisheries, Tourism
Complex Dimensions of River Restoration	River communities, fisheries, natural resource agencies, regional planners	Increased community trust related to riverine restoration	Detailed analysis of ecological and economic evolution of river system	Fisheries restoration, Urban planning, Tourism
Modeling Land Use Effects in Vulnerable Lake Watersheds	Lake watershed communities, natural resources agencies, NGOs	Improved land use management across diverse landscapes	New models of complex interactions between humans and landscapes affecting water quality	Tourism, new BMPs

## SSI Mission, Vision, and Overall Research Goal

### *Mission*

The mission of the Sustainability Solutions Initiative (SSI) is to create a world-class sustainability science research program focused on the coupled dynamics of social-ecological systems (SES) and connections between knowledge and action (K-A) that enhance individual and institutional decision-making.

### *Vision*

SSI will lead to the creation of the Center for Sustainability Solutions (CSS), a national and international center of excellence in sustainability science. Widely recognized for its innovative approaches to interdisciplinary research and deep commitment to collaboration with diverse stakeholders, CSS helps search for, implement, and evaluate policies and practices that promote economic development while protecting ecosystem health and fostering community well-being. CSS also works with a variety of partners (e.g., governments, the private sector, native communities, local-to-global NGOs, academic partners) to educate a STEM-ready workforce and create new technologies, services, and businesses in support of a green innovation economy).

### *Overall Research Goal*

Create a world-class sustainability science research program focused on the dynamics of social-ecological systems (SES), with an explicit goal of understanding and strengthening connections between knowledge and action (K-A).



## **Goal # 1:**

**Investigate the dynamics of social-ecological systems, with particular emphasis on SES resilience.**

### **Targeted Outcomes:**

- ◆ Improved understanding of SES dynamics and resilience.
- ◆ Increased capacity by both SSI and Sustainability Solutions Partners to conduct interdisciplinary research on a wide range of SES problems.
  - ◆ Greater support for, and trust of, STEM-related R&D by stakeholders due to their participation in problem definition and research planning processes.

### **Overall Research Context:**

Sustainability science focuses particular attention on the role of thresholds and feedbacks in affecting SES dynamics. One of the central management objectives of sustainability science is to maintain or increase SES resilience (i.e., “the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks”).

### **Research Objectives:**

- 2.1 Examine how and why SES feedbacks differ for urbanization, forest management, and climate change.**
- 2.2 Determine whether patterns of urbanization, forestry, and climate change offer similar or contrasting insights into the existence and strength of SES thresholds.**
- 2.3 Analyze how the likelihood of encountering and crossing thresholds is affected by interacting, multi-scale system components.**
- 2.4 Investigate how the ability to understand and predict system thresholds depend on the capacity to monitor system feedbacks at multiple spatial and temporal scales.**
- 2.5 Define what indicators best measure change and permit detection of proximity to thresholds.**
- 2.6 Use “Research on the research” to implement and evaluate best practices for promoting interdisciplinary collaboration.**

### **Implementation actions**

- ◆ Involve stakeholders in the problem development and research planning processes.
- ◆ Create and support interdisciplinary teams (including new faculty, postdoctoral fellows, and predoctoral students) focused on SES research.
- ◆ Develop and carry out SES research plans and protocols.
- ◆ Support SES research by Sustainability Solutions Partners.



**Portions of southern Maine have experienced rapid sprawl while record sales of private forest lands and mill closures are transforming the social and economic fabric of northern and western Maine.**

### **Goal #2:**

**Examine connections between scientific knowledge regarding SES dynamics and stakeholder actions that potentially affect SES resilience.**

#### **Targeted Outcomes:**

- ◆ Improved understanding of factors and processes that facilitate and impede K-A efforts focused on landscape dynamics.
  - ◆ Increased capacity to conduct interdisciplinary research on a wide range of K-A problems in sustainability science by both SSI and Sustainability Solutions Partners.
  - ◆ More effective integration of STEM-related knowledge in decision-making processes (e.g., problem definition, options considered, actions taken).
- ◆ Greater recognition of the utility of STEM-related R&D in overcoming K-A barriers and developing improved solutions.



***“Maine’s future depends on the ability to move forward with economic development in a manner that sustains our vital natural resources.”***  
***- Michael Eckardt, UMaine Vice President for Research***

#### **Overall Research Context:**

Maximizing the relevance of sustainability science and its potential to facilitate change requires greater understanding of how flows of information to and from diverse stakeholders affect individual and institutional decision-making processes. Numerous individual and group decisions impact landscape dynamics. Reciprocally, these decisions are influenced by complex feedbacks and thresholds associated with changing landscapes.

#### **Research Objectives:**

- 3.1 Examine processes by which knowledge derived from SES research affects stakeholder actions and the extent to which stakeholders influence the research processes.***
- 3.2 Develop methods for achieving a closer coupling between the societal demand for and supply of science products.***
- 3.3 Determine how information affects collective action processes, including the potential for agents to shape SES resilience and the SES characteristics that facilitate effective governance.***
- 3.4 Create a set of systematic, rigorous, and replicable models to evaluate decision-making processes regarding landscape dynamics, using differences in decision-making environments among the three landscape change arenas as a quasi-experimental system.***
- 3.5 Use “Research on the research” to implement and evaluate best practices for promoting interdisciplinary collaboration.***

#### **Implementation actions**

- ◆ Engage stakeholders in framing key K-A problems and research challenges.
- ◆ Create and support interdisciplinary teams (including new faculty, postdoctoral fellows, and predoctoral students) focused on K-A research.
- ◆ Develop K-A research plans and protocols.
- ◆ Facilitate creation of K-A research by Sustainability Solutions Partners.

### ***Goal #(new):***

**Test models from organizational science to understand and improve program effectiveness.**

### ***Targeted Outcomes:***

◆ (pending)

### ***Overall Research Context:***

◆ (pending)

### ***Research Objectives:***

- ◆ (Examples - remainder pending)
- ◆ Investigate factors facilitating and hindering interdisciplinary collaboration
- ◆ Analyze university-stakeholder engagement processes to increase value of research for decision making

### ***Implementation actions***

◆ (pending)

### **Goal # 3:**

**Focus on landscape change as a productive research nexus.**

#### **Targeted Outcomes:**

- ◆ Development of new conceptual models for creating and managing a portfolio of sustainability science research initiatives.
  - ◆ Establishment of balanced portfolio of sustainability science research focused on landscape dynamics.
- ◆ Expanded capacity for sustainability science research in Maine, including greater collaboration between SSI and Sustainability Solutions Partners.



***Business and communities are being transformed by changes in the global economy, rising energy costs, and a realization that a healthy environment is needed for long-term prosperity.***

#### **Overall Research Context:**

Landscape change has been identified as a “grand challenge” in environmental science and is a central concern in recent reports focusing on Maine’s future. Landscape change also constitutes one of many complex sustainability problems requiring more effective research to generate replicable, solutions-driven models.

#### **Research Objectives**

- 1.1 Use Maine as a “laboratory” for sustainability science research.***
- 1.2 Examine three critical arenas of landscape change - urbanization, forest ecosystem management, and climate variability - including interactions among these landscape arenas.***
- 1.3 Evaluate the intersecting ecological, social, and economic dimensions of landscape dynamics.***
- 1.4 Develop a portfolio of landscape change research projects to determine how the characteristics of different place-based problems influence the potential for generalization and cross-problem integration.***
- 1.5 Include problems that have contrasting biophysical, socioeconomic, and decision-making contexts, span different space, time, and organizational scales, and involve distinct stakeholder constituencies.***

#### **Implementation Actions:**

- ◆ Work with stakeholders to develop a statewide inventory of sustainability problems related to landscape change.
- ◆ Identify candidate problems for inclusion in SSI research portfolio based on the potential for solution, generalization, and cross-problem integration.
- ◆ Seek feedback from SSI Advisory Board on proposed research portfolio.
- ◆ Initiate searches for graduate students, postdoctoral researchers, and new SSI faculty to augment existing sustainability science expertise.

# SSI Research Benchmarks

<b>Objectives:</b>	<b>Actions:</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
1) Increase research capabilities through an inter-disciplinary, multi-institutional collaborative project	a) Create the Center for Sustainability Solutions	Develop org. structure to coord. research under EPSCoR project & other ext. funded research (31 core faculty). (June 2010)	Fully integrate students (GK-12) and Sustainability Science Partners (SSP). (June 2011)	Develop Intent to Plan for formal Research Center status; secure post-award funding. Establish K-A resource base. (June 2012)	File for formal Research Center status; secure post-award funding. (June 2013)	Achieve formal Research Center status; secure post-award funding & base operating budget. (June 2014)
	b) Examine three landscape change research arenas: urbanization, forest ecosystem management, climate change; utilize two cross-focus research themes: social-ecological systems (SES), & knowledge to action (K-A)	Establish working teams & leadership; refine research agendas; provide core funding; recruit 1st cohort of PhD students for fall 2010; award 1st round SSP funding; provide planning grants. (June 2010)	Complete first phase to test overall methodologies, recruit 2nd cohort of PhD students for fall 2011; award 2nd round SSP funding. (June 2011)	Projects in 3 arenas have actively engaged stakeholders. 1st cohort of PhD students present research plans. Initiate community & industry internships; 3rd round SSP funding. (June 2012)	PhD student projects fully integrated into core research; 2nd cohort of PhD students present research. Plan 2nd round of community & industry internships; professional partnerships initiated. (June 2013)	Complete EPSCoR research agenda; 3rd round of student internships; 2nd round of professional partnerships. (June 2014)
	c) Increase program visibility in state and nation	Establish connections with state government, communities, NGO's, concerned citizens & other stakeholders. (June 2010)	Team members serve on state panels and boards (10); produce & disseminate one research summary/month. (June 2011)	Team members serve on appropriate national panels & boards (10); 2 research summaries/month scholarly output; regional sustainability meeting. (June 2012)	Continue previous; co-sponsor national sustainability meeting. (June 2013)	Plan for continued accessibility for new researchers, students, agencies, and communities. (June 2014)
	d) Create opportunities for research to support sustainable policies	Establish advisory group for input on needs and expectations; establish partners network. (June 2010)	Establish K-A network (using cyber-infrastructure); forge partnerships with commerce and industry in the state (20 new). (June 2011)	Use research findings to test K-A systems (new policies and procedures); help businesses incorporate sustainability science. (June 2012)	Transfer knowledge gained from model systems to help stakeholders formulate sustainable policies. (June 2013)	Complete organizational infrastructure for continued research and development. (June 2014)
	e) Maximize the efficient and wise use of resources in the state through a holistic & inclusive process that is transparent and synchronous.	Identify, through stakeholder processes, resource management challenges in the state. (June 2010)	Align research goals with stakeholder goals; establish methods to collect, store, and share relevant information. (June 2011)	Develop models to test different resource mgt. policies; collect information to gauge how well information flows between interest groups. (June 2012)	Re-address priorities to test how new information has affected policy (6 examples). (June 2013)	Highlight 24 case studies of project success in transforming agency and business policies. (June 2014)

# SSI Research Benchmarks

<b>Objectives:</b>	<b>Actions:</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
2) Increase Maine's competitiveness & funding in this focus area	a) Grant submissions	4 \$400,000 (June 2010)	15 \$1,800,000 (June 2011)	25 \$2,100,000 (June 2012)	25 \$3,750,000 (June 2013)	30 \$4,860,000 (June 2014)
	b) Publications	Submit 3-5 major journal manuscripts & 8 other journal publications. (June 2010)	5-10 major journal publications & 20 other journal publications. (June 2011)	5-10 major journal publications & 20 other journal publications. (June 2012)	10-15 major journal publications & 25 other journal publications. (June 2013)	10-15 major journal publications & 30 other journal publications. (June 2014)
	c) Technical presentations	10-15 technical presentations. (June 2010)	20-30 technical presentations. (June 2011)	25-35 technical presentations. (June 2012)	30-40 technical presentations. (June 2013)	30-40 technical presentations. (June 2014)
	d) Funding Opportunities database	5% increase in listings; provide training to participants. (June 2010)	5% increase in listings. (June 2011)	5% increase in listings. (June 2012)	5% increase in listings. (June 2013)	5% increase in listings. (June 2014)
3) Create linkages throughout the state, region, nation, and world	a) Support state PUI involvement	10 institutional collaborations supported. (June 2010)	12 institutional collaborations supported. (June 2011)	14 institutional collaborations supported. (June 2012)	16 institutional collaborations supported. (June 2013)	17 institutional collaborations supported. (June 2014)
	b) National & international R&D collaborations	2 additional collaborations. (June 2010)	6 additional collaborations. (June 2011)	10 additional collaborations. (June 2012)	20 additional collaborations. (June 2013)	20 additional collaborations. (June 2014)
	c) Support visiting scientists	Support 1 visiting scientist (June 2010)	Support 3 visiting scientists (June 2011)	Support 3 visiting scientists. (June 2012)	Support 3 visiting scientists. (June 2013)	Support 3 visiting scientists. (June 2014)
4) Understand Socio-Ecological Dynamics	a) Socio-economic Research	Develop research methods and protocols; identify stakeholders. (June 2010)	Complete initial surveys; collect external data; perform data analysis (5-6 projects). (June 2011)	Conduct stakeholder researcher analyses; continue SES data collection and analysis; begin model development. (June 2012)	Conduct stakeholder K-A measurements; continue SES data collection and analysis; test models in specific applications. (June 2013)	Complete stakeholder research analyses; continue SES data collection & analysis; continue model development. (June 2014)
	b) Biophysical Research	Develop research methods and protocols; identify stakeholders. (June 2010)	Initiate field and laboratory-based data collection (5-6 projects). (June 2011)	Conduct mid-project research rev.; catalog field studies & formalize data repository. (June 2012)	Continue field-based studies; test applications of modeled systems; validate info. flow. (June 2013)	Complete work on original research questions; catalog intellectual output. (June 2014)
	c) Knowledge to Action	Develop research methods and protocols; identify stakeholders. (June 2010)	Test information sharing methods using learning laboratory and focus groups (3-4 projects). (June 2011)	Institute project-scale experiments using biophysical researchers and stakeholders. (June 2012)	Conduct stakeholder K-A meas.; cont. SES data coll. & analysis; test models in spec. app.; affect informed decision-making on local to state scale (6 issues). (June 2013)	Continued interactive refinement of formalized methods affecting communities (6 ex.). (June 2014)
	d) Research on the Research	Develop research methods, perform baseline assessments (2-3 projects). (June 2010)	Assessment of attitudes & expectations affect SSI org. behaviors and grad. education. (June 2011)	Assessment of how attitudes and expectations affect SSI organizational behaviors & grad. education. (June 2012)	Evaluation of how interdisciplinary research has affected attitudes and expectations. (June 2013)	Develop best management practices for collaborative interdisciplinary research. (June 2014)

## SSI-Related STEM Education and Workforce Development

### **Goal # 4:**

**Foster the next generation of sustainability science professionals through K-20 programs that are linked to the diverse challenges and opportunities in this emerging field.**

### **Targeted Outcomes:**

- ◆ Enhanced training promotes collaborative, interdisciplinary approaches to problem-solving, fosters innovation, and allows for the successful integration of the production of knowledge with solutions.
- ◆ Participants achieve a greater understanding of, and comfort with, the interdisciplinary nature of sustainability science.
- ◆ Students and professionals gain the ability and knowledge to work with diverse communities and stakeholders beyond their field.

### **SSI STEM Education & Workforce Development Context:**

Problems involving the intersecting ecological, social, and economic dimensions of sustainable development offer rich opportunities for relevant, place-based education and hands-on research linked to real-life needs and concerns.

### **Objectives and Implementation Actions:**

#### **4.1 Increase Maine's overall capacity for producing sustainability science professionals.**

- ◆ Support statewide graduate, undergraduate, and high school research internships with SSI & SSP faculty.
- ◆ Develop new interdisciplinary courses and curricula focused on sustainability science, and integrate sustainability concepts into courses in all of UMaine's colleges.
- ◆ Through the SSP program, support the participation of PUI faculty and students in place-based interdisciplinary research and education.
- ◆ Increase awareness of, and skills in solving, multi-faceted societal problems that require effective teamwork and integration of diverse sources of expertise and experience.
- ◆ Integrate sustainability science concepts into workforce development programs to enhance STEM training, promote collaborative approaches to problem solving, and foster innovation for the development of new technologies, services, and businesses in support of a green innovation economy.

#### **4.2 Support SSI & SSP faculty & postdoc development and mentoring activities.**

- ◆ Four new faculty hires enhance new project research capabilities and synergies.
- ◆ Senior faculty mentors foster integration, training, and retention.
- ◆ Support for travel to conferences and other related activities.
- ◆ Assistance in project planning, grant-writing, and collaborative research methods.
- ◆ Implement team-building activities.
- ◆ Create a Curriculum and Culture Committee that will engage with stakeholders to assist faculty in identifying key problems regarding landscape change.



**Maine's educational partners are in a very strong position to have a significant impact on STEM education for the state, with a coordinated strategy that will develop students' STEM skills, interest, and career paths for all levels of K-20 education.**

## General STEM Education and Workforce Development

### **Goal # 5:**

**Prepare Maine's current and future STEM workforce through coordinated programs and opportunities, training, and knowledge dissemination.**

### **Targeted Outcomes:**

- ◆ A strong, coherent, consistent, and integrated statewide STEM education system utilizes discovery-based learning activities, partnerships, and innovative programs to achieve goals.
- ◆ Statewide P-20 student STEM participation is increased by 10% by 2014.
- ◆ Improved workforce preparedness in STEM through teacher and student opportunities.

### **Overall STEM Education & Workforce Development Context:**

The economy and workforce of Maine increasingly depends on innovation and global competitiveness, which will require a strong educational background in science, technology, engineering and mathematics (STEM). The Maine Department of Labor projects that 40 % of industry job gains from 2004-2014 will be in STEM-related fields, yet Maine's STEM workforce is 30-40% below the national average.

In response to this need for an expanded STEM workforce, the Maine STEM Collaborative has been formed as a statewide partnership of businesses, government, research, education and non-profit sectors striving to improve STEM education in the state. Maine EPSCoR plays a leadership role in this group, and coordinates the RII STEM education and workforce development efforts with those of the collaborative.

### **Objectives & Implementation Actions:**

#### **5.1 Take a leadership role in building, integrating, and coordinating STEM efforts in Maine for greater effectiveness and impact.**

- ◆ Support the Maine STEM Collaborative through leadership, programming, strategic planning, and financial support.
- ◆ Identify existing programs and activities, develop avenues to generate awareness and foster partnerships.

#### **5.2 Promote educator professional and leadership development in STEM, and foster STEM approaches and activities that value prior learning across subjects.**

- ◆ Support teacher professional development, curriculum development, and accompanying programs and activities.

#### **5.3 Promote STEM careers and their pathways.**

- ◆ Introduce Career Pathways concepts, programs, and materials to teachers, students, guidance counselors, school administrators, parents, and STEM network partners.
- ◆ Integrate real-world applications and Maine's STEM workforce needs into teaching, programs, and activities.

#### **5.4 Demonstrate the link between investments in STEM and Maine's economic vitality.**

- ◆ Target all STEM stakeholders, general public, legislators, etc. with information on STEM needs for Maine's emerging technologies and workforce.

#### **5.5 Promote measurement systems to monitor and evaluate STEM.**

- ◆ Conduct statewide surveys on STEM education in Maine to establish baselines.
- ◆ Work with STEM partner networks to develop on-going measurement, assessment, and reporting systems.

#### **5.6 Implement and support special STEM programs and opportunities that directly engage students and teachers.**

- ◆ Initiate STEM Schools and STEM Partnership programs; support training and implementation.
- ◆ Provide research assistantships for graduate, undergraduate, and high school students
- ◆ Support special STEM programs for women and underrepresented groups.

**The U.S. Bureau of Labor (2000-2006) reported that Maine's workforce levels in computer/math and engineer/technician occupations were only 60% of the national level.**

### **Goal # 6:**

**Engage all aspects of the state's human and institutional resources in the achievement of the RII project goals and objectives.**

#### **Targeted Outcomes:**

- ◆ Increased awareness and actions lead to greater diversity in SSI participants.
- ◆ Broadened participation in state STEM education programs and activities.
- ◆ Increased Native American community involvement in STEM research and education.
- ◆ Expanded opportunities in STEM research and education for women and girls.
- ◆ Greater inclusion of persons with disabilities in STEM research and education.

#### **Overall Diversity Context:**

While Maine is faced with a few particular challenges in the area of diversity (it is the second least diverse state in the nation), this represents a very viable opportunity for effecting positive action and change. This RII project will utilize diversity as a cross-cutting goal that spans all project components.

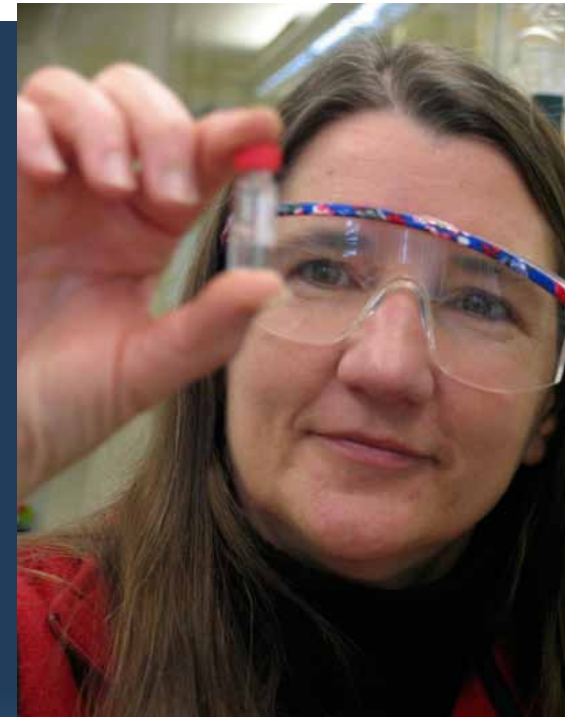
#### **Objectives & Implementation Actions:**

##### **6.1 Expand institutional diversity in this project (academic level, geographic, disciplinary).**

- ◆ Begin the SSP program with 8 PUIs participating, add 1-2 annually, and add 1 community college annually.
- ◆ Multi-disciplinary research and education efforts involve 13 primary STEM disciplines and 15 corollary disciplines.

##### **6.2 Broaden participation through increased individual diversity.**

- ◆ Utilize local, regional, and national networking resources to broaden participation.
- ◆ Women: collaborative programs with UMaine's Women's Resource Center, Maine's National Girls Collaborative Project, Expanding Your Horizons STEM conference, NSF ADVANCE, etc.
- ◆ Native Americans: work with the Wabanaki Center and tribal communities to create STEM-related education and research opportunities for native students and professionals that reflect indigenous values, traditions, and concerns.
- ◆ Persons with Disabilities: promote participation of individuals with disabilities in STEM programs and careers in collaboration with USM's Eastern Alliance in STEM (EAST) program and UMaine's Center for Community Inclusion.
- ◆ First generation/low income: collaborate with existing state programs such as Upward Bound, and support grant proposals to i.e. the McNair Scholars Program.



**Between 2004 and 2005, even though total job growth in Maine for all industries decreased by 0.4%, high technology employment grew by 3.5% and exceeded the U.S. rate of 2.8% and the New England rate of 2.4%.**

# Human Resource Infrastructure Benchmarks

<b>Objectives:</b>	<b>Actions:</b>	<b>Year 1:</b>	<b>Year 2:</b>	<b>Year 3:</b>	<b>Year 4:</b>	<b>Year 5:</b>
1) Directly supported project personnel	a) New faculty hired	Begin search process. (June 2010)	3 UM/1 USM new hires done. (June 2011)	Retained & supported. (June 2012)	Retained & supported. (June 2013)	Retained & supported. (June 2014)
	b) SSI core faculty supported	30 faculty supported. (June 2010)	35 faculty supported. (June 2011)	40 faculty supported. (June 2012)	45 faculty supported. (June 2013)	50 faculty supported. (June 2014)
	c) SSP faculty supported	32 faculty supported. (June 2010)	36 faculty supported. (June 2011)	40 faculty supported. (June 2012)	44 faculty supported. (June 2013)	48 faculty supported. (June 2014)
	d) Postdoctoral associates hired (2-3 yr. appointments)	4 new hires completed. (June 2010)	Retained & supported. (June 2011)	Retained & supported. (June 2012)	New hire replacements completed. (June 2013)	Retained & supported. (June 2014)
	e) Provide graduate students research assistantships	8-10 graduate students supported. (June 2010)	22 graduate students supported. (June 2011)	28 graduate students supported. (June 2012)	30 graduate students supported. (June 2013)	30 graduate students supported. (June 2014)
	f) Provide undergraduate student research assistantships	Begin recruiting undergrad. students (15-20) (June 2010)	90 undergrad. students supported. (June 2011)	110 undergrad. students supported. (June 2012)	120 undergrad. students supported. (June 2013)	130 undergrad. students supported. (June 2014)
	g) Provide high school student research assistantships	Design selection process for summer student researchers. (June 2010)	20 high school students supported. (June 2011)	30 high school students supported. (June 2012)	30 high school students supported. (June 2013)	30 high school students supported. (June 2014)
	h) Professional/ technical/ administrative staff hired/supported	2 new hires completed & 8 others supported. (June 2010)	10 positions supported. (June 2011)	10 positions supported. (June 2012)	10 positions supported. (June 2013)	10 positions supported. (June 2014)
2) Provide technical assistance & research support for project participants	a) Sponsor research-related seminars and workshops	2 seminars/ workshops for 50 participants. (June 2010)	3 seminars/ workshops for 75 participants. (June 2011)	4 seminars/ workshops for 100 participants. (June 2012)	4 seminars/ workshops for 100 participants. (June 2013)	4 seminars/ workshops for 100 participants. (June 2014)
	b) Sponsor technical assistance workshops	2 workshops for 40 participants. (June 2010)	3 workshops for 60 participants. (June 2011)	3 workshops for 60 participants. (June 2012)	3 workshops for 60 participants. (June 2013)	3 workshops for 60 participants. (June 2014)
	c) Sponsor annual statewide EPSCoR conference	Fall 2009 for 150 participants. (June 2010)	Fall 2010 for 150 participants. (June 2011)	Fall 2011 for 150 participants. (June 2012)	Fall 2012 for 150 participants. (June 2013)	Fall 2013 for 150 participants. (June 2014)
	d) Provide travel support for core project participants to conferences/ workshops	Travel for 25 participants. (June 2010)	Travel for 30 participants. (June 2011)	Travel for 30 participants. (June 2012)	Travel for 30 participants. (June 2013)	Travel for 30 participants. (June 2014)
	e) Provide travel scholarships for statewide participants	17 scholarships awarded. (June 2010)	10 scholarships awarded. (June 2011)	10 scholarships awarded. (June 2012)	10 scholarships awarded. (June 2013)	10 scholarships awarded. (June 2014)

## Human Resource Infrastructure Benchmarks

Objectives:	Actions:	Year 1:	Year 2:	Year 3:	Year 4:	Year 5:
3) Provide support for participant and workforce development activities	a) Develop/ implement new graduate & undergrad. courses & curriculum including innovation courses for business & entrepreneurial skills	Form curriculum development team; initial planning for interdisciplinary grad core courses, undergrad. sustainability science intro. courses, innovation courses. (June 2010)	Develop 2 interdisciplinary grad. courses; 1 undergrad. intro. course; 1 innovation course; planning for modeling courses. (June 2011)	Provide 2 interdisciplinary grad. courses; 2 undergrad. intro. course; 2 innovation courses; 2 modeling courses. (June 2012)	Submission of CSS curriculum for approval; 2 interdisciplinary grad. courses; 2 undergrad. intro. courses; 2 innovation courses & 4 modeling courses. (June 2013)	CSS curriculum approval; 2 interdisciplinary grad. courses; 2 undergrad. intro. courses; 2 innovation courses & 4 modeling courses – 1 team-taught. (June 2014)
	b) Develop/ implement service learning opportunities	Develop course with service-learning components; develop summer service-learning internships at partner NGOs. (June 2010)	Offer course. Offer minimum of 2 summer internships at partners NGOs. (June 2011)	Offer course. Offer minimum of 3 summer internships at partners NGOs. (June 2012)	Offer course. Offer minimum of 4 summer internships at partners NGOs. (June 2013)	Offer course. Offer minimum of 4 summer internships at partners NGOs. (June 2014)
	c) Provide related STEM opportunities for K-6 students	100 participants. (June 2010)	150 participants. (June 2011)	200 participants. (June 2012)	250 participants. (June 2013)	250 participants. (June 2014)
	d) Provide related STEM opportunities for middle school students	1,000 participants. (June 2010)	1,200 participants. (June 2011)	1,400 participants. (June 2012)	1,500 participants. (June 2013)	1,500 participants. (June 2014)
	e) Provide related STEM opportunities for high school students	150 participants. (June 2010)	175 participants. (June 2011)	200 participants. (June 2012)	250 participants. (June 2013)	250 participants. (June 2014)
	f) Provide related STEM opportunities for K-12 & pre-service teachers	50 participants. (June 2010)	70 participants. (June 2011)	80 participants. (June 2012)	90 participants. (June 2013)	100 participants. (June 2014)
	g) Provide learning opportunities for stakeholders/partner org.	Develop professional exchange program. (June 2010)	Provide 1 research opportunity for visiting fellow. (June 2011)	Provide 2 research opportunities for visiting fellows. (June 2012)	Provide 2 research opportunities for visiting fellows. (June 2013)	Provide 3 research opportunities for visiting fellows. (June 2014)
	h) Provide professional internships for students	Develop professional internship program. (June 2010)	Provide 2 prof. internships at partner organizations. (June 2011)	Provide 4 prof. internships at partner organizations. (June 2012)	Provide 6 prof. internships at partner organizations. (June 2013)	Provide 6 prof. internships at partner organizations. (June 2014)

# Human Resource Infrastructure Benchmarks

Objectives:	Actions:	Year 1:	Year 2:	Year 3:	Year 4:	Year 5:
4) Provide programs and activities to engage all aspects of the state's human and institutional resources	a) Diversity in new hires (% of total)	Women: 33% Diverse: 5% (June 2010)	Women: 34% Diverse: 6% (June 2011)	Women: 35% Diverse: 7% (June 2012)	Women: 36% Diverse: 8% (June 2013)	Women: 37% Diverse: 9% (June 2014)
	b) Diversity in existing personnel	Women: 33% Diverse: 5% (June 2010)	Women: 34% Diverse: 6% (June 2011)	Women: 35% Diverse: 7% (June 2012)	Women: 36% Diverse: 8% (June 2013)	Women: 37% Diverse: 9% (June 2014)
	c) Diversity in other participants	Women: 33% Diverse: 5% (June 2010)	Women: 34% Diverse: 6% (June 2011)	Women: 35% Diverse: 7% (June 2012)	Women: 36% Diverse: 8% (June 2013)	Women: 37% Diverse: 9% (June 2014)
	d) Native Scholars Program	40 participants. (June 2010)	60 participants. (June 2011)	70 participants. (June 2012)	80 participants. (June 2013)	100 participants. (June 2014)
	e) STEM Disability program	5 participants. (June 2010)	10 participants. (June 2011)	14 participants. (June 2012)	16 participants. (June 2013)	18 participants. (June 2014)



*The University of Maine System provides all state schools and libraries with broadband Internet and Internet2 access, and the Maine Department of Education has equipped each 7th and 8th grade student and teacher with wireless notebook computers. In addition, over 60 high schools in the state have also recently been equipped with laptops for their students, making Maine a leader in the world in technology-enhanced education.*

### **Goal # 7:**

**Implement new cyberinfrastructure to improve communication, collaboration, and visualization capabilities that enable innovation and competitiveness in the sustainability science focus area.**

### **Targeted Outcomes:**

- ◆ Cyberinfrastructure tools that are critical to advancing R&D in the state help overcome the challenges of Maine's remote, rural locations and large geographic size.
  - ◆ Expanded communication tools allow for greater research, education, and innovation opportunities between partners.
  - ◆ Upgraded hardware facilitates collaborative efforts for project participants.
- ◆ Visualization tools allow for greater resolution and understanding in research and education.

### **Overall Cyberinfrastructure Context:**

Maine EPSCoR engaged key stakeholders to develop a statewide cyberinfrastructure strategy that supports the state's Science & Technology Plan and addresses the needs of its EPSCoR & NIH IDeA community, K-12 and higher education system, libraries, industry, and non-profit research institutions. This CI plan is also aligned with a broader Northeast Region plan to address connectivity, high performance computing, virtual organizations, and scientific collaborations. Collaborators also include CIOs from the region's leading research institutions, Northeast Cyberinfrastructure Consortium (NECC), NE Research and Education Networks (NEREN), and the national Research and Education Networks (CANARIE and Internet2). NSF EPSCoR RII Track 2 and NIH INBRE funding has also been received to complement this regional plan.

Maine's remote location and large geographic size makes distance collaboration critical to advancing R&D. Recent state investment has installed multi-wavelength optical fiber connecting key research partners in the state and extended connectivity down to Portsmouth, NH. UMaine's cluster supercomputer (512 CPU), 120-terabyte data storage backbone, and real-time graphic rendering server provides valuable capacity.

The state's CI plan has the following priorities: 1) establish connectivity through all parts of the state; 2) provide regional interconnectivity and access to national grids; 3) upgrade UMaine's data center to the multi-TeraFLOP range; 4) expand the state's CI human resource infrastructure; 5) upgrade statewide communication and visualization tools. This NSF EPSCoR RII project concentrates on addressing the last priority above for the state.

*The northeast region of the U.S. has been identified as a "black hole" lacking advanced networking connectivity and other basic cyberinfrastructure, putting Maine researchers at a significant disadvantage by lack of access to national resources.*

# Cyberinfrastructure for Communication, Collaboration, & Visualization

## Objectives & Implementation Actions:

### 7.1 Expand statewide videoconferencing capabilities and upgrade high bandwidth fiber interconnections:

- ◆ Install a 30 port multipoint Media Control Unit to supplement the over 40 existing videoconferencing units in the state, allowing multiway distance communication for larger numbers of SSI participants and for remote SSI partners to videoconference via webcams.
- ◆ Provide webcams, training, and access for faculty participation in videoconferencing.
- ◆ Outfit a large lecture hall at UMaine with video streaming equipment enabling long-distance participation (conferences, classes) and asynchronous viewing of archived video material (facility updates, video equipment, CODECs for high definition television quality video)
- ◆ Install 12 high bandwidth switchgears/modules in SSI researcher buildings, bringing higher bandwidth connectivity to their desktops and facilitating virtual organization collaborations.

### 7.2 Make new new communication and visualization tools available through:

- ◆ Phase I deployment of two prototype visualization and communication portals at UMaine's Mitchell Center and Target Technology Center (supercomputer), facilitating collaborations between SSI faculty and also enabling a study of their effectiveness as real-time communication tools.
- ◆ Phase II deployment of two more portals at SSP partners.

### 7.3 Develop plans and systems for data handling across research projects and institutions



## Cyberinfrastructure Benchmarks

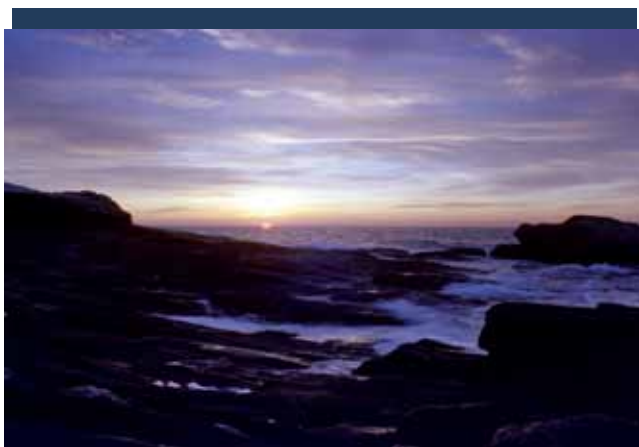
Objectives:	Actions:	Year 1:	Year 2:	Year 3:	Year 4:	Year 5:
1) Statewide videoconferencing capabilities	Install Media Control Unit (MCU) & videoconferencing equipment at SSI partner locations	30 port multipoint MCU installed at UM (by May 2010)	Provide webcams, training, & access for 30-40 SSI faculty (by March 2011)			Replace videoconferencing equipment at 10 partner locations (by March 2014)
2) Operating bandwidth available	Install bandwidth switchgears/modules in CSS researcher buildings	12 switchgears/modules installed (by May 2010)		6 switchgears/modules installed (by May 2012)	6 switchgears/modules installed (by May 2013)	
3) New communication and visualization tools	Deploy prototype visualization & communication portals		Deploy portals at UM's Mitchell Center & Target Tech Center (by May 2011)		Deploy portals at UMM and USM (by June 2013)	
4) Large audience participation capabilities	Install video streaming equipment			Outfit a large lecture hall at UM for video streaming (by June 2012)		

### **Goal # 8:**

**Create and maintain an effective outreach & communication network through strategies that encompass all participants, stakeholders, and the general public.**

### **Targeted Outcomes:**

- ◆ Effective communication networks enable collaboration and sharing of ideas and data.
- ◆ Outreach programs and partnerships expand institutional participation, knowledge, and engagement.
- ◆ Maine's citizenry achieve a greater understanding of sustainability science issues.



*The magnitude, urgency, and complexity of the many problems now facing society means that new and innovative research approaches are needed. This is especially true for Maine, where the State's remarkable "quality of place" is an integral component of its social and economic fabric.*

### **Outreach & Communication Context:**

Due to the nature of the sustainability science theme, outreach and communication is a fully integrated component of the goals and objectives detailed in previous sections. Activities will 1) expand institutional participation through the SSP program; 2) offer greater STEM student career options; 3) engage the private sector in research and workforce development; 4) create communication networks for data and information sharing; 5) engage all participants, stakeholders, the scientific community, state and federal agencies, K-20 community, private sector, general public, EPSCoR jurisdictions, and NSF EPSCoR.

Maine EPSCoR is outfitted with state-of-the-art capabilities and staff for media production, including video, photography, website design, and graphic design. Outreach and Communication positions are embedded in both the Maine EPSCoR and SSI offices and work in tandem to achieve objectives.

### **Objectives & Implementation Actions:**

#### **8.1 Create and maintain an effective communication network that enables information sharing among partners and fosters collaborative work.**

- ◆ Monthly SSI team meetings, listserves, videoconferences, on-line reporting systems, etc.
- ◆ Expanded institutional participation through the SSP program.
- ◆ Explore institutional barriers to data sharing networks & find solutions.
- ◆ Maximize use of cyberinfrastructure improvements for communication & collaboration.

#### **8.2 Communicate research progress and results to the scientific community and establish communication networks with stakeholders.**

- ◆ Peer-reviewed publications, presentations, national conference participation, etc.
- ◆ Maine EPSCoR & SSI websites, newsletters, publications, etc.
- ◆ National sustainability science conference in 2011.
- ◆ Engage in research on communication networks to foster improved interactions with stakeholders.

## Creating Networks

### 8.4 Build scientific literacy in sustainability science for the general public and K-12 community.

- ◆ Maine EPSCoR & SSI websites, newsletters, publications, press conferences, media releases, podcasts, videocasts, social networking sites, and highlights in “Maine Today” and other magazines.
- ◆ Presentations to NGO’s, community organizations, government agencies, and legislative representatives.
- ◆ Partner with Maine Public Broadcasting Network to involve students and faculty in web-based and broadcast communication.
- ◆ Multi-media activities for public, schools, museums, and NGOs such as interactive exhibits, kiosks, web-based interactive programs, exploratory activities, community-based journalism, etc.

### 8.5 Maintain outreach and communications with the NSF EPSCoR office and other EPSCoR jurisdictions.

- ◆ NSF EPSCoR Office program officer communications, site visits, highlight articles, and NSF outreach visits.
- ◆ Keep informed of other EPSCoR jurisdiction activities through newsletters, websites, listserves, and expand collaborations with northeast region EPSCoR jurisdictions.

### Outreach and Communication Benchmarks:

Objectives:	Actions:	Year 1	Year 2	Year 3	Year 4	Year 5
1) Implement multiple tools, processes, and pathways for general public communication & outreach	a) SSI: website, brochures, annual conference, MPBN partnership activities, MMSN	Hire web manager, science writer. Develop communications strategy. Plan 1st conference. (June 2010)	Initial web and print materials completed; 1st conf. held; complete 2 MPBN productions; develop MMSN. (June 2011)	Develop interactive web components; additional print materials. 2nd annual conf. held. Completion of 3 MPBN productions. New features on MMSN. (June 2012)	Website completed & updated weekly; print materials updated; 3rd annual conf held. Completion of 4 MPBN productions. Active content mgt. of MMSN. (June 2013)	Weekly web updates. Print materials updated. 4th annual conf. held. Completion of 5 MPBN productions. Active content mgt. of MMSN. (June 2014)
	b) Maine EPSCoR office: website, newsletter, annual state conference, videos, podcasts, social networking sites, etc.	Hire outreach & comm. staff; develop website; fall conference; 2 videos, 3 podcasts; 1 soc. network site (June 2010)	Expand website; bi-annual newsletter; fall conference; 3 videos, 4 podcasts; 2 soc. network sites (June 2011)	Expand website; bi-annual newsletter; fall conference; 3 videos, 4 podcasts; 3 soc. network sites. (June 2012)	Expand website; bi-annual newsletter; fall conference; 3 videos, 4 podcasts; 4 soc. network sites. (June 2013)	Expand website; bi-annual newsletter; fall conference; 3 videos, 4 podcasts; 4 soc. network sites. (June 2014)
	c) Integration with cyberinfrastructure	Establish connections with state gov., communities, NGO’s, concerned citizens & other stakeholders. (on-going)	Team members serve on state panels & boards (10 commitments); produce & disseminate 1 research summary/month. (June 2011)	Team members serve on appropriate national panels & boards (10); 2 research summaries/month; regional sustainability meeting. (June 2012)	Continue previous; co-sponsor national sustainability meeting. (June 2013)	Plan for cont. accessibility for new researchers, students, agencies & communities. (June 2014)
2) Develop an internal communication network to allow for the effective sharing of information between participants	a) SSI regular meetings, workshops, training sessions, etc.	Monthly SSI core res. team meetings; 1 summer SSP workshop; 4 seminars. (June 2010)	Continue monthly meetings; 2 SSP summer workshops; annual SSI conf.; annual business conf.; 6 seminars. (June 2011)	Continue monthly meetings; 2 SSP summer workshops; annual SSI conf.; annual business conf.; 6 seminars. (June 2012)	Continue monthly meetings; 2 SSP summer workshops; annual SSI conf.; annual business conf.; 6 seminars. (June 2013)	Continue monthly meetings; 2 SSP summer workshops; annual SSI conf.; annual business conf.; 6 seminars. (June 2014)

## Outreach and Communication Benchmarks (continued)

Objectives:	Actions:	Year 1	Year 2	Year 3	Year 4	Year 5
	b) Management & organization	Monthly EPSCoR team mgt. meeting; Bi-weekly SSI mgt. team meetings. (on-going)	Monthly EPSCoR team mgt. meeting; bi-weekly SSI mgt. team meetings. (on-going)	Monthly EPSCoR team mgt. meeting; bi-weekly SSI mgt. team meetings. (on-going)	Monthly EPSCoR team mgt. meeting; bi-weekly SSI mgt. team meetings. (on-going)	Monthly EPSCoR team mgt. meeting; bi-weekly SSI mgt. team meetings. (on-going)
3) External dissemination of research information	a) To the scientific community	2 major publications, 5 technical presentations. (June 2010)	3 major publications, 10 technical presentations, 1 award. (June 2011)	4 major publications, 15 technical presentations, 1 award, host 1 visiting scientist. (June 2012)	5 major publications, 15 technical presentations, 2 awards, host 2 visiting scientists. (June 2013)	6 major publications, 20 technical presentations, 2 awards, host 2 visiting scientists. (June 2014)
	b) SSI stakeholders	Stakeholder collaboration on all research. Projects, progress, results summarized on website. Seminars and workshops for stakeholder participation. (June 2010)	Stakeholder collaboration on all research. Projects, progress, results summarized on website. Workshops for stakeholder participation. Annual conf. (June 2011)	Stakeholder collaboration on all research. Projects, progress, results summarized on website. Workshops for stakeholder participation. Annual conf. (June 2012)	Stakeholder collaboration on all research. Projects, progress, results summarized on website. Workshops for stakeholder participation. Annual conf. (June 2013)	Stakeholder collaboration on all research. Projects, progress, results summarized on website. Workshops for stakeholder participation. Annual conf. (June 2014)
4) General communication & outreach	a) K-12 STEM partners	Maine STEM Collaborative activities; Maine STEM Summit. (June 2010)	Maine STEM Collaborative activities; Maine STEM Summit. (June 2011)	Maine STEM Collaborative activities; Maine STEM Summit. (June 2012)	Maine STEM Collaborative activities; Maine STEM Summit. (June 2013)	Maine STEM Collaborative activities; Maine STEM Summit. (June 2014)
	b) State colleges & universities	SSP program; workshops, conferences, presentations. (June 2010)	SSP program; workshops, conferences, presentations. (June 2011)	SSP program; workshops, conferences, presentations. (June 2012)	SSP program; workshops, conferences, presentations. (June 2013)	SSP program; workshops, conferences, presentations. (June 2014)
	c) NSF EPSCoR community	Newsletters, press releases, highlights, site visits, reports, evaluations, outreach visits. (June 2010)	Newsletters, press releases, highlights, site visits, reports, evaluations, outreach visits, reverse site visit. (June 2011)	Newsletters, press releases, highlights, site visits, reports, evaluations, outreach visits. (June 2012)	Newsletters, press releases, highlights, site visits, reports, evaluations, outreach visits; reverse site visit. (June 2013)	Newsletters, press releases, highlights, site visits, reports, evaluations, outreach visits. (June 2014)
	d) General public, legislators, key sectors, etc.	Project progress, results summarized on website. Press releases for all major activities/ successes. Bi-annual newsletter. (June 2010)	Project progress, results summarized on website. Press releases for all major activities/ successes. Quarterly newsletter. MPBN/MMSM features & activities. (June 2011)	Project progress, results summarized on website. Press releases for all major activities/ successes. Quarterly newsletter. MPBN/MMSM features & activities. (June 2012)	Project progress, results summarized on website. Press releases for all major activities/ successes. Quarterly newsletter. MPBN/MMSM features & activities. (June 2013)	Project progress, results summarized on website. Press releases for all major activities/ successes. Quarterly newsletter. MPBN/MMSM features & activities. (June 2014)

# Overall Maine EPSCoR RII Project Management

## Goal # 9:

**Implement an effective management plan that will support and ensure the overall success of the Maine EPSCoR RII project.**

### Targeted Outcomes:

- ◆ Effective management of all program components and activities ensures programmatic and fiscal integrity.
  - ◆ Timely achievement of project benchmarks allows for demonstrated outputs and outcomes.
- ◆ Effective coordination between all components of the Maine EPSCoR RII project results in a fully integrated and successful project.

### Overall Management Context:

The Maine Innovation Economy Advisory Board (MIEAB) serves as the Maine EPSCoR state committee and is responsible for oversight and coordination of the state's EPSCoR portfolio to ensure synergy with the Science & Technology Action Plan. The Chair of the MIEAB and the Executive Director of the Maine Office of Innovation play key roles in working directly with Maine EPSCoR in project oversight.

Maine EPSCoR at the University of Maine was formally established under a Memorandum of Understanding with the Maine Office of Innovation, and is responsible for the implementation, administration, and evaluation of funded NSF EPSCoR projects. The Maine EPSCoR Director is responsible for day-to-day program oversight and administration, and reports to the NSF EPSCoR RII Project Director (the Vice President for Research at UMaine). The Maine EPSCoR Director oversees the following staff in implementing all non-research program components and administration: Outreach and Program Manager, Communications and Program Coordinator, Financial Administrator, Program Assistant and Diversity Specialist, and several graduate and undergraduate student interns.

### Objectives and Implementation Actions:

#### 9.1 Management systems are in place to allow for effective coordination, communication, and integration of all program components at all institutions.

- ◆ Maintain established channels of communication for oversight and coordination by MIEAB, Maine Office of Innovation, Maine STEM Collaborative, and SSI Advisory Board.
- ◆ Utilize a tandem, but coordinated, organizational structure (Maine EPSCoR & SSI).
- ◆ SSP program institutions have designated leadership and guidelines to follow.

#### 9.2 Ensure administrative, programmatic, and fiscal integrity for all project components and institutions.

- ◆ Meet with SSI core faculty and SSP institutions to outline project requirements and ensure understanding.



***“This is when Maine is at its best, when we work together to pool our expertise and share our resources while working toward a common goal.”***  
**- UMaine President Robert Kennedy**



*This project will provide direct support for 200 to 300 people annually, with the ultimate goal of building capacity for generating solutions to a range of challenging problems.*

- ◆ Utilize NSF EPSCoR outreach visits as appropriate to educate about grants management.
- ◆ Maine EPSCoR staff attend relevant regional and national conferences and workshops to keep abreast of federal requirements and policies.
- ◆ Work with offices of sponsored research, equal opportunity, compliance, etc. at all institutions.

### ***9.3 Foster effective communication and coordination between all project components and institutions.***

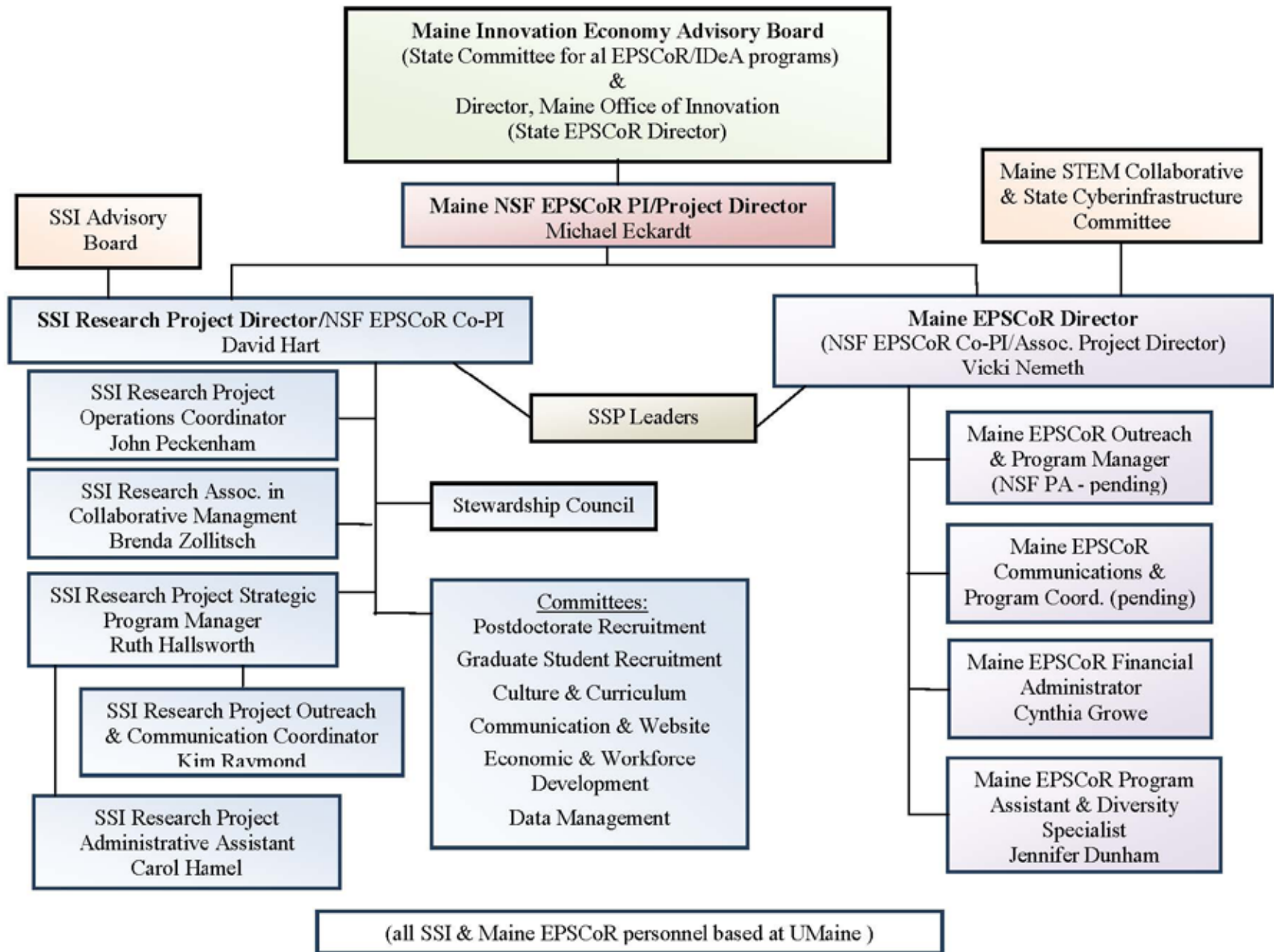
- ◆ Appoint SSI and SSP team leaders to act as point person for projects and accompanying budgets, with SSI Stewardship Council oversight.
- ◆ Sponsor project meetings and training for all SSI participants through videoconferencing and at state conferences.

### ***9.4 Implement a comprehensive technical assistance plan that includes:***

- ◆ Workshops on grant-writing, funding opportunities, evaluation, outreach, broadening participation, etc.
- ◆ Outreach visits and assistance by NSF EPSCoR and other federal agencies.
- ◆ Annual Maine EPSCoR state conference.
- ◆ Travel support for national EPSCoR conferences and workshops.
- ◆ Training workshops for SSP collaborators.
- ◆ Technical grant-writing assistance for collaborative and/or multi-disciplinary proposals.
- ◆ Web-based, searchable Funding Opportunities Database to assist researchers throughout the state in finding new sources of funding for sustainability of research.



# Maine EPSCoR RII Project Management Chart



### **Goal # 10:**

**Broad coordination of management and decision-making results in a shared vision for SSI research and integrated education, effective interdisciplinary outcomes, and participatory project management.**



*The initiative will create lasting partnerships with most of Maine's colleges and universities for research and education efforts designed to advance economic and community development while protecting the environment.*

### **Targeted Outcomes:**

- ◆ Commitment to organizational learning becomes a core value of SSI.
- ◆ Greater shared governance affords increased involvement of individual faculty and stronger commitment to the long-term success of SSI.
  - ◆ Increased organizational resilience and capacity to respond to internal and external challenges.
  - ◆ Participants show greater willingness and ability to take on the task of solving complex SES problems.
- ◆ Collective commitment to identifying and solving organizational management problems.
  - ◆ Continuous improvement in project management.
- ◆ SSI becomes a model system for development and testing of organizational learning processes in sustainability science.

### **Overall Research Project Management Context:**

The SSI Research Project Director is also the Director of UMaine's Senator George J. Mitchell Center, and is responsible for day-to-day oversight of the SSI research and integrated education. This position also directly reports to the NSF EPSCoR RII Project Director (the Vice President for Research at UMaine). The SSI Research Project Director oversees the following staff in implementing all research program components: Strategic Program Manager, Operations Coordinator, Outreach and Communications Coordinator, and Administrative Assistant. The SSI office works in tandem with the Maine EPSCoR office for coordinated management and implementation, and this parallel structure of technical and administrative oversight allows the effective application of the appropriate expertise.

A distributed management approach will embed interdisciplinary and collaborative perspectives in all activities. Under this system team members share managerial duties within the Stewardship Council, other SSI Committees, and as Project Team Leaders. SSP Leaders and faculty will also have active roles within specific areas.

An SSI Advisory Board will be formed and meet in person during the first 6 months of the project to assess the scientific development and management of the project and provide recommendations and guidance. Thereafter, the Advisory Board will either in person or by phone/videoconference every 12-18 months. The Founding Chair of the board will be Dr. Robert Kates, who is a member of the National Academy of Sciences and helped found the field of sustainability science.



*Maine has fully recognized that in order to implement the state's Science & Technology Action Plan and further develop an innovation economy based on R&D investment, an adequate STEM-educated workforce is critically needed.*

### *Objectives and Implementation Actions:*

- 10.1 Establish a new organizational structure and processes that allow for effective communication, coordination, and exchange among SSI research teams and SSI management committees.**
- ◆ Create an SSI Stewardship Council to oversee all aspects of SSI governance.
  - ◆ Create SSI committees to help develop and implement key policies regarding graduate student recruitment, postdoctoral fellow recruitment, faculty recruitment, development of graduate curricula, etc.
  - ◆ Explore structures for incorporating research project team leaders into management.
  - ◆ Establish an SSI Advisory Board to provide guidance to the SSI Management team.
- 10.2 Establish communication and feedback loops for modifying management systems and practices in ways that lead to more effective organizational processes.**
- ◆ Hold SSI all-team meetings at least once per month.
  - ◆ Create a dedicated SSI website and update at least weekly.
  - ◆ Create and distribute an SSI e-newsletter at least monthly.
- 10.3 Engage in activities to advance understanding of challenges and opportunities related to interdisciplinary collaboration and effective teamwork in large-scale projects.**
- ◆ Use internal “research on the research” to conduct qualitative and quantitative research on faculty attitudes and perceptions related to costs and benefits of SSI participation, challenges of interdisciplinary collaboration, graduate education, etc.
  - ◆ Identify and utilize recommended “best management practices” for promoting open communication, mutual respect, shared governance, and organizational learning.
- 10.4 Establish a system for managing the interdisciplinary research projects.**
- ◆ Create a formal RFP process to solicit SSI & SSP research proposals.
  - ◆ Create a formal peer-review process to make funding decisions regarding SSI projects.
  - ◆ Review SSI and SSP projects on a regular basis through presentations and discussions at SSI meetings, project symposia, and external conferences.
  - ◆ Require formal project progress reports on an annual basis. The report will include an assessment of research, educational, and budgetary objectives.

### **Goal # 11:**

**Utilize multiple formative and summative evaluation processes to improve the project's effectiveness and assess its impact in relation to its goals.**

#### **Targeted Outcomes:**

- ◆ The appropriateness of the investment relative to accomplishments is firmly established.
- ◆ The investment strategy yields substantial improvement in research and competitiveness.
- ◆ Linkages between the project's research, education, and innovation efforts are effective.
  - ◆ Strategies increase participation in sustainability science research and education.
- ◆ Findings enhance efficacy, identify obstacles, assist in developing corrective action plans as needed, and help plan improvements.

#### **Overall Evaluation & Assessment Context:**

The Management Team will utilize a five-pronged approach to project evaluation and assessment that includes 1) independent external evaluation; 2) assessment by the American Association for the Advancement of Science (AAAS) Research Competitiveness Service; 3) SSI Advisory Board; 4) NSF EPSCoR Reverse Site and Site visits; and 5) internal project management evaluation and assessment. The evaluation design will use a multi-method approach based on extensive quantitative and qualitative data to develop a rigorous, longitudinal appraisal of Maine EPSCoR research and related activities. A co-developed logic model will serve as the feedback tool for Maine EPSCoR management and evaluators.

#### **Objectives & Implementation Actions:**

**11.1 Contract with experienced external evaluators to annually assess the project's performance, with a particular focus on the evolution and outcomes of collaborative relationships, student integration in the research process, and external stakeholder interaction.**

- ◆ Utilize qualitative investigations such as interviews, document analysis, and case studies.
- ◆ Utilize quantitative analysis of attitudinal, network, productivity, and other behavioral data collected in annual surveys.

**11.2 Utilize AAAS to provide a scientific peer review that ensures high quality program delivery.**

- ◆ Experienced S&T professionals with relevant expertise will meet biennially in Maine for project review, including one-on-one interactions with the management team, key administrators, project personnel, outreach participants, industry and small business, and stakeholders.
- ◆ Examine and report on focal questions on the project objectives to help ensure success.

**11.3 An SSI Advisory Board will provide on-going assessment and guidance to the research project team.**

- ◆ Recruit 12-15 members with regional, national, and international expertise.
- ◆ Advisory board engages in a site visit every 18 months and holds more frequent phone or videoconference meetings.

**11.4 Participate in NSF EPSCoR reverse site visits, site visits, and host NSF EPSCoR program officers and directors in visits to the Maine EPSCoR project sites.**

**11.5 Maine EPSCoR Management Team engages in on-going evaluation and assessment to ensure that the project achieves goals, objectives, and benchmarks.**

- ◆ Meet monthly to plan and oversee activities, review financial and programmatic progress, and recommend needed changes and solutions as applicable.
- ◆ Utilize a web-based data-collection system.
- ◆ Utilize the state's EPSCoR Committee for guidance and monitoring.

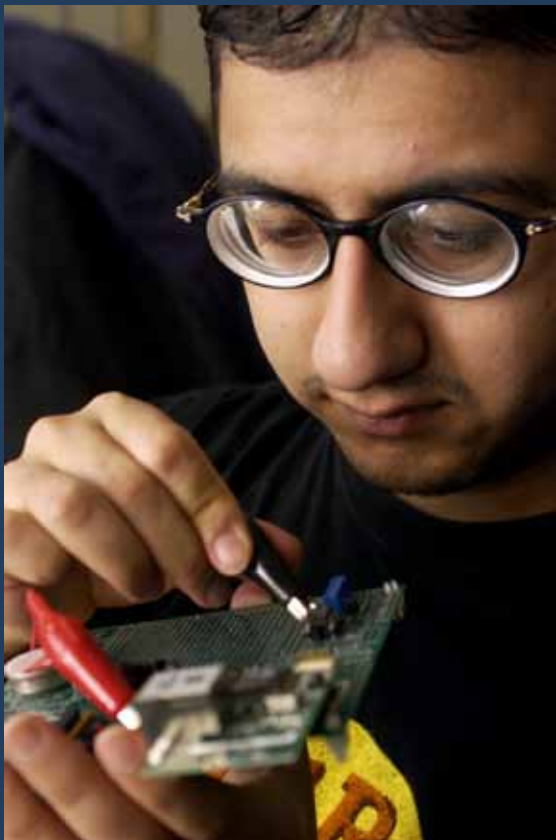


# Management & Evaluation Benchmarks



Management & Evaluation

<b>Objectives:</b>	<b>Actions:</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
1) Implement evaluation and assessment activities	a) External evaluation by independent reviewers	Sept 2009 initial planning & evaluation development. (Sept. 2009)	Year-round review & Nov. 2010 site visit. (on-going)	Year-round review & Fall 2011 site visit.	Year-round review & Fall 2012 site visit.	Year-round review & July Fall 2013 site visit & June 2014 site visit.
	b) AAAS assessment	NA	March 2011 review.	NA	March 2013 review.	NA
	c) SSI Advisory Board	Establish board with 10 members - December 2009 first site visit.	1-3 phone or videoconference meetings; site visit June 2011.	1-3 phone or videoconference meetings.	1-3 phone or videoconference meetings; site visit December 2012 .	1-3 phone or videoconference meetings; site visit May 2014.
	d) NSF EPSCoR Reverse Site visit		September 2010		September 2012	
	e) NSF EPSCoR staff site visit	September 2009	March 2011	Fall 2012	Fall 2013	Spring 2014
	f) MIEAB reporting		September 2010	September 2011	September 2012	September 2013
	g) NSF EPSCoR reporting	Annual report filed on time. (April 2010)	Annual report filed on time. (April 2011)	Annual report filed on time. (April 2012)	Annual report filed on time. (April 2013)	Final report filed on time. (April 2014)
2) Effective management & communication	a) Maine EPSCoR Management Team	Monthly meetings. (June 2010)	Monthly meetings. (June 2011)	Monthly meetings. (June 2012)	Monthly meetings. (June 2013)	Monthly meetings. (June 2014)
	b) CSS Core Management Team	Weekly meetings. (June 2010)	Bi-weekly meetings. (June 2011)	Bi-weekly meetings. (June 2012)	Bi-weekly meetings. (June 2013)	Bi-weekly meetings. (June 2014)
	c) SSI Stewardship Council	Bi-weekly meetings. (June 2010)	Bi-weekly meetings. (June 2011)	Bi-weekly meetings. (June 2012)	Bi-weekly meetings. (June 2013)	Bi-weekly meetings. (June 2014)
	d) SSI Team	Monthly meetings. (June 2010)	Monthly meetings. (June 2011)	Monthly meetings. (June 2012)	Monthly meetings. (June 2013)	Monthly meetings. (June 2014)
	e) Fiscal responsibility	NSF unexpended funds <10%. (June 2010)	NSF unexpended funds <10%. (June 2011)	NSF unexpended funds <10%. (June 2012)	NSF unexpended funds <10%. (June 2013)	All NSF funds expended. (June 2014)
		Corresponding % of matching funds expended. (June 2010)	Corresponding % of matching funds expended. (June 2011)	Corresponding % of matching funds expended. (June 2012)	Corresponding % of matching funds expended. (June 2013)	All corresponding match expended. (June 2014)



*“Maine’s Sustainability Solutions Initiative will play a pivotal role in creating a brighter economic, social, and environmental future for the people of Maine.”*  
- Senator George J. Mitchell

### **Goal # 12:**

**Sustain the SSI infrastructure, impacts, and achievements through the continued integration of scientific entrepreneurship, institutional and external support, partnerships, education, workforce development, and constituency outreach.**

### **Targeted Outcomes:**

- ◆ The Center for Sustainability Solutions (CSS) is an established UMaine research unit with a base operating budget, and is an internationally acclaimed center of research excellence in the field of sustainability science.
- ◆ CSS is viewed as a valued partner by federal, state, and local government, tribal communities, business and industry, NGOs, fostering statewide opportunities for sustainable development.
- ◆ CSS has a large and diverse portfolio of external funding, including grants and contracts from federal and state agencies, private sector contracts, private foundation grants, and philanthropic gifts from individual donors.
- ◆ On-going support is obtained for current and additional CSS faculty, postdoctoral fellows, graduate students, and undergraduate interns, ensuring a critical mass of expertise for sustainability science research in the state.
- ◆ SSP institutions will have a stronger research and education base that will increase their research competitiveness, support STEM students, and foster increased academic and stakeholder partnerships.

### **Overall Sustainability Context:**

Because most sustainability-related problems do not have simple causes or solutions, the development of durable solutions will necessarily require long-term R&D efforts and partnerships. Thus, the ultimate value of sustainability science to society cannot be realized unless we develop long-lasting research institutions and partnerships that are committed to social learning.

Long-term financial support for CSS’s research and education efforts post-RII will come about through a combination of institutional support and extramural funding. In particular, after Year 5, UMaine will support their three new faculty hires and provide institutional support services for the new CSS research unit that includes a base operating budget. USM will support their one new faculty hire. Specific extramural funding opportunities have been targeted to provide on-going research and education support past Year 5, and will take advantage of new collaborations formed with SSP and other partners to include interdisciplinary, multi-institutional proposals.

## Sustaining Infrastructure & Achievements Beyond the RII

### *Sustainability Objectives:*

- 12.1 Use SSI as a catalyst for within- and among-institution synergy in solving sustainability-related problems.*
- 12.2 Brand Maine as a leader in sustainability science and the creation of clean technology and a green economy.*
- 12.3 Build interconnected, state-wide network of university-stakeholder partnerships.*
- 12.4 Seek external grants and contracts from government, foundations, and private sector.*
- 12.5 Cultivate relationships with potential future donors for CSS endowment .*

### *Implementation actions:*

- ◆ Harness critical mass of CSS faculty, postdoctoral fellows, and students to develop new R&D strategies.
- ◆ Expand and strengthen university-stakeholder partnerships in and beyond Maine.
- ◆ Market the value of CSS for solving a wide range of sustainability-related problems.
- ◆ Collaborate with business and industry initiatives in sustainable development and engage in patent & licensing activity as applicable.

### SSI Project Sustainability Benchmarks:

<u>Objectives:</u>	<u>Actions:</u>	<u>Year 1:</u>	<u>Year 2:</u>	<u>Year 3:</u>	<u>Year 4:</u>	<u>Year 5:</u>
1) Provide physical infrastructure to support R&D agenda	a) Provide capital equipment & renovation support	Planning for new social science research lab. (June 2010)	Creation of new social science research lab. (June 2011)			
	b) Provide support for materials & supplies	Social science research lab, research team; SSP. (June 2010)	SSI Team; SSP; new faculty; grad students. (June 2011)	SSI Team; SSP; new faculty; grad students. (June 2012)	SSI Team; SSP; new faculty; grad students. (June 2013)	SSI Team; SSP; new faculty; grad students. (June 2014)
2) Show a positive economic contribution to the state by providing a solid platform for knowledge to action	Support small business & industry initiatives	Initiate planning process for new partnerships. (June 2010)	Initiate 5 new business & industry partners. (June 2011)	Add 5 new partners & initiate special small business outreach. (June 2012)	Integrate researchers with business partners to utilize new methods developed in project (5 new partnerships). (June 2013)	Formalize business and industry support with new internship programs (+5); professional exchanges (+5); and technology transfers (+5). (June 2014)
	Intellectual property, patent & licensing activity	Begin to identify potential intellectual property, patentable research. (June 2010)	Identify intellectual property, patentable research & prepare applications (1-2). (June 2011)	Identify intellectual property, patentable research & prepare applications (1-2), license technology. (June 2012)	Identify intellectual property, patentable research & prepare applications (1-2), license technology. (June 2013)	Identify intellectual property, patentable research & prepare applications (1-2), license technology. (June 2014)



**COLLABORATING PARTNERS**





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