

The University Senate of Michigan Technological University

PROPOSAL 10-96

MS DEGREE IN ENVIRONMENTAL POLICY

The requirements to initiate the proposed MS degree program are described below.

I. EXECUTIVE SUMMARY

A wide range of skills is needed for the solution of contemporary environmental problems. These include scientific expertise, understanding of the policy process, and familiarity with public interests in technological change. The Department of Social Sciences, with substantial collaboration from faculty in humanities, forestry, business, and engineering, proposes to establish a master's degree program in Environmental Policy. Graduates of this interdisciplinary, professional program will meet the diverse needs of communities and organizations involved in environmental decision-making.

The program will focus its recruitment efforts on students with undergraduate degrees in engineering or science who wish to develop policy skills, gain knowledge of the regulatory process, and understand the social context of environmental issues. In their first year in the program, these students will be introduced to the fundamentals of public policy decision making, environmental regulation, global systems, and environmental ethics. During the summer before the second year, students will fulfill an internship requirement. With the Great Lakes as their laboratory, they will build a foundation for a thesis or a project. In the second year, students will pursue individually-designed specializations that capitalize on existing MTU strengths in environmental fields and complete a major research project or thesis.

The core faculty for the program is drawn from the Department of Social Sciences, the Department of Humanities, the School of Business and Engineering Administration, the College of Engineering, the Department of Biological Sciences, and the School of Forestry and Wood Products. In addition, the program will draw on the numerous environmental agencies and organizations located in the upper Great Lakes region.

The combination of undergraduate background in science and engineering with graduate training in environmental issues separates this program from most environmental management and policy programs. This "third generation" (see text) approach to education in the area will provide significant employment potential in the industrial sector, as well as in appropriate government agencies and non-profit organizations.

Development of a master's degree in Environmental Policy fits the mission of Michigan Technological University. It diversifies the university's graduate offerings in an appropriate direction. It contributes to Michigan Tech's Initiative for the Environment. And, by providing a social dimension to the university's environmental activities, it will strengthen the competitive advantage of the university in seeking environmental research funding and delivering environmental education.

II. BACKGROUND

Solving environmental problems today requires a broad range of expertise in science, technology, politics, and social interactions. Increasingly, organizations find they need individuals with diverse skills--awareness of local community and citizen concerns, knowledge of political processes in federal and state government, familiarity with social and policy analysis, training in a scientific field, and an understanding of technical solutions and limitations. But such a combination of skills and knowledge is rarely found in

those who work on environmental issues. Traditionally, the specialists who have staffed environmental policy departments in the corporate, government, and non-profit sectors have had either technical training or political/economic training, but not both.

The *first generation* of environmental managers had training that was almost entirely technically oriented. For instance, prior to the 1960s natural resource and engineering programs prepared foresters and sanitation engineers to work in or with public bureaucracies to solve problems of reforestation and water pollution. These largely technically- and scientifically-trained individuals often found themselves faced with citizen groups, competing organizational demands, and economic-political realities without the benefit of appropriate professional training. Although some natural resource programs added some public policy exposure to their curriculum, *first generation* managers remained overwhelmingly technical in orientation and training.

A *second generation* of environmental managers emerged in the 1970s in response to a growing consensus in the U.S. regarding the use of regulatory strategies to remedy environmental problems. The emphasis on legislative remedies created a demand for organizational expertise in regulation itself, leading to degree programs which taught skills in government, risk assessment, technology assessment, and benefit-cost analysis and provided courses in rule-making and public administration. Over the last twenty years, environmental bureaucracies have hired public policy specialists trained to utilize these tools within the public sector. These *second generation* environmental policy programs, however, seldom offered training in the technical aspects of environmental problems. Neither did they provide a full treatment of ethical, historical, and social analytical approaches to environmental problems.

In recent years a few universities have groped towards creating *third generation* training programs for environmental managers and policy makers, programs that would provide a better balance between the technical and the non-technical. The aim of *third generation* programs is to furnish students with credentials and legitimacy in engineering and science accompanied by training in complex organizational, industrial, and democratic issues, or to provide students with credentials in the social sciences with specific exposure to environmental issues, while giving them sufficient science and engineering training to deal effectively with the technical aspects of environmental problems.

The proposed Michigan Tech program is a form of *third generation* environmental policy education.

III. ACADEMIC PRECEDENTS: A UNIQUE OPPORTUNITY

Most existing programs that train students in environmental policy or environmental management are either *first generation* or *second generation* in focus.

Third generation environmental management requires the capability to move comfortably between technical/scientific expertise, the application of policy skills, and an understanding of the historical/societal context of particular environmental problems.

These capabilities are addressed in the proposed master's degree in several manners (for a more complete description of the curriculum, see pp. 9-14). Scientific credentials, for example, are insured by initially focusing recruiting on undergraduate science and engineering majors, by the entry requirements, and by the concentration requirements in the program's second year. Most of the first year, in contrast, focuses on providing these students with a solid knowledge base in the non-technical aspects of environmental management: the human dimensions of environmental problems, policy, politics, policy analysis, economics, and knowledge of the legal and practical aspects of citizen participation.

In addition, the curriculum's required internship will provide students with a means of learning first-hand the political strategies, social concepts, and technical solutions necessary for the new generation of environmental managers in this region and elsewhere.

Only one *third generation* program in the U.S. combines environmental science and technology with policy, history, ethics, communications, and STS to the same extent as the proposed program--the recently established Master of Science in Environmental Policy Studies at the New Jersey Institute of Technology (NJIT). Like Michigan Tech, a large majority of NJIT students receive engineering degrees; they provide the recruits for that program. NJIT is also similar to MTU in that their environmental policy faculty are largely social scientists with expertise in the social dimensions of technology.

Other distinguished programs, however, have begun to move toward the *third generation* approach to environmental management, but in a less comprehensive manner. Their programs are, moreover, somewhat different than the proposed environmental policy program at MTU. The "Environmental Management and Policy" program at the University of North Carolina-Chapel Hill, for instance, adds a policy focus to an engineering program, but it does not include much environmental science or broader social analysis. It is housed in the Environmental Engineering program under the School of Public Health. At Duke University, the School of Forestry has recently been renamed the "School of the Environment." Its Master's degree in "Environmental Management" trains students to apply the major policy tools in the environmental sciences, but Duke's program has not viewed engineering students as a recruiting base, and its program largely ignores matters of citizen participation. The School of Public and Environmental Affairs at Indiana University, the "Energy and Environment Studies" program at Boston University and the environmental program of the University of Michigan's School of Natural Resources emphasize policy analysis, environmental modeling, and environmental sciences, but none of these, likewise, has viewed engineering students as their primary recruiting base. The Michigan and Boston University Programs don't give much attention to citizen participation issues; the Indiana program does not offer that approach to all students.

Environmental Education at Michigan Tech

As we enter the next century, environmental management and decision-making will require professionals skilled in very diverse fields. The proposed environmental policy degree at MTU is unique in its training in citizen participation and its requirement that students bring their undergraduate technical training to bear on the policy context of an environmental problem in their thesis or project.

MTU has considerable expertise in environmental sciences and engineering. The program in environmental engineering is highly respected and for its size is one of the strongest in the country. Faculty in environmental science areas such as environmental geology, limnology, ecology, and remote sensing are also held in high regard. These areas form the basis for the MTU Initiative for the Environment, a project to integrate perspectives on the environment provided by a number of diverse academic fields. The first goal of that initiative is

"to integrate throughout our curricula--both graduate and undergraduate--an awareness of the environmental implications of all human activity, and to create new curricula that support environmental education and promote sustainable development. These curricula will encompass not only science, engineering, and technology, but also the social, political, economic and cultural aspects of environmental issues."

The university is currently engaged in the construction of a new environmental sciences and engineering building, development of interdisciplinary, environment-based undergraduate courses, increased levels of environmental research, and a program of campus-wide reading and discussion of sustainable development issues.

In deliberations of Initiative committees it became clear that interdisciplinary approaches to environmental research and teaching are essential. More funding agencies are encouraging or even requiring, a policy component to research proposals. Leaders in business and industry are urging broader conceptualization of environmental issues. As Bill Butz, director of NSF's division of social, behavioral, and economic research, notes, "public, not-for-profit and private organizations regularly make decisions that affect and are affected by the environment. We need to understand better the processes that produce

these decisions, and thus learn how to encourage the desirable ones." Numerous MTU faculty members in engineering and sciences have expressed the belief that a graduate degree in environmental policy would contribute measurably to the university's research and pedagogical capabilities. This program offers an innovative approach to environmental management through the collaboration of the social sciences, humanities, biology, engineering, and forestry faculty.

The Program in Environmental Policy (EP) in the Department of Social Sciences, which will manage the proposed degree with the cooperation of faculty from other academic units, is in a position to undertake this initiative. Social Sciences faculty have a multidisciplinary focus in Science, Technology, & Society (STS) studies and a set of undergraduate courses in environmental and natural resources issues already in place. Departmental faculty are also qualified and prepared to teach additional courses, such as environmental politics, environmental policy analysis, environmental decision-making, and global environmental systems. These courses and existing department faculty provide the necessary core for a Master's degree program housed in the department.

Particularly in the second year of the program, the EP Program in Social Sciences will draw heavily on faculty in other academic units at Michigan Tech. These faculty provide additional expertise in such areas as environmental economics (School of Business), environmental ethics and environmental communication (Department of Humanities), ecology and toxicology (Department of Biological Sciences, School of Forestry) and in other areas of environmental sciences and engineering.

IV. INSTITUTIONAL RESOURCES

A. Faculty

Core faculty, who will be teaching and advising students in the program, will be drawn from the Department of Social Sciences, the School of Business and Engineering Administration, the College of Engineering, the School of Forestry and Wood Products, and the Department of Humanities. They have the expertise and background necessary to support a Master's Degree in Environmental Policy. All are currently members of the graduate faculty and have served on graduate committees for students in other programs.

Core faculty outside the Social Sciences Department will work with the program in a number of ways. All will be available to serve on graduate committees. Several faculty teach 400-level and graduate courses in fields such as environmental engineering, ecology, ethics, risk communication, and forestry in which students from the EP program would be able to participate. Others have indicated an interest in including environmental policy graduate students on grant proposals or in ongoing research efforts where social science and policy perspectives are required. Many of the non-Social Sciences core faculty have volunteered to help place graduate students in internships with state agencies, private firms, or regional environmental institutes and agencies. These faculty, all strongly supportive of such a program on campus, plan to contribute in substantial ways that will enhance the experience and placement of students.

Core faculty (Appendix A) in the program include:

Martin T. Auer, Ph.D., University of Michigan
Professor of Civil and Environmental Engineering
Water Quality Modeling; Environmental Impact Assessment

Bradley H. Baltensperger, Ph.D., Clark U.
Professor of Geography
Environmental Perception; Natural Hazards; Environmental History

Stephen H. Bowen, Ph.D., Rhodes, South Africa
Professor of Biological Sciences

Energy and Materials Transfers in Food Chains; Aquatic Habitats

Peck Cho, Ph.D., Northwestern
Associate Professor of Mech. Engineering-Engr. Mechanics
Combustion; Energy and Fuels

Mary H. Durfee, Ph.D., Cornell U.
Assistant Professor of Political Science
Environmental Policy; Technology Policy; Great Lakes Institutions

Kathleen E. Halvorsen, ABD, University of Washington
Instructor of Natural Resource Policy
Environmental and Natural Resource Policy; Environmental Sociology

Josiah M. Heyman, Ph.D., CUNY
Associate Professor of Anthropology
Social Theory, Political Ecology, Anthropology of Industry

Carol A. MacLennan, Ph.D., University of California
Associate Professor of Anthropology
Politics of Technology; Democratic Participation; Anthropology of Industry

Willie Melton, Ph.D., Washington State U.
Associate Professor of Sociology
Collective Behavior; Small Group Behavior; Social Research Methods

Glenn D. Mroz, Ph.D., North Carolina State U.
Professor of Silviculture
Forest Management; Impacts of Forest Management/Disturbance

William C. Sewell, Ph.D., Case Western
Associate Professor of Philosophy
Environmental Philosophy, Philosophy of Science

Barry D. Solomon, Ph.D., Indiana University
Associate Professor of Geography and Environmental Policy
Environmental and Energy Policy; Global Climate Change

Craig R. Waddell, Ph.D., Rensselaer
Associate Professor of Rhetoric
Public Participation; Environmental Communications and Rhetoric

Laurie A. Whitt, Ph.D., University of Western Ontario
Associate Professor of Philosophy
Environmental Ethics; Philosophy of Technology

A number of other faculty have assisted in the development of this proposal. They will be closely associated with the program; most are available to serve on graduate committees. They include:

Dallas K. Bates, Associate Professor of Chemistry
Gary Campbell, Professor of Mineral Economics
Margaret R. Gale, Associate Professor of Forest Management
Carl H. A. Dassbach, Assistant Professor of Sociology
Neil J. Hutzler, Professor of Civil and Environmental Engineering
Ted W. Lockhart, Associate Professor of Philosophy

Susan R. Martin, Assistant Professor of Archaeology
Ann Maclean, Associate Professor of Remote Sensing
Blair B. Orr, Assistant Professor of Forestry
Rolf O. Peterson, Professor of Wildlife Ecology
David Reed, Professor of Biometry
Terry S. Reynolds, Professor of History
Mark Roberts, Associate Professor of Mineral Economics
William I. Rose, Professor of Petrology
David R. Shonnard, Assistant Professor of Chemical Engineering

For many years the Department of Social Sciences, which will administer the program, has focused its faculty hiring in the interdisciplinary area of Science, Technology, and Society (STS). That department, along with many faculty in the Humanities Department, has emphasized undergraduate program development centered on the impact of technologies on human institutions and behavior and on the institutional constraints on technological change. Participating faculty have research programs oriented toward the study of environmental issues in the industrial world, including questions of environmental perception, cultural adaptation, domestic and international regulation, and work, labor and organizations.

The Department of Social Sciences has the requisite experience with graduate programs to administer this degree. The department currently offers a Master's Degree in Industrial History and Archaeology, which was initiated in 1992. University resources and external funding have supported a number of students who have gone on to employment with federal, state, and private organizations that interpret, evaluate, and manage historic and archaeological sites. Most of the other academic units from which core faculty will be drawn support Ph.D. programs (in Environmental Engineering, Mechanical Engineering-Engineering Mechanics, Forest Science, Biological Sciences, and Rhetoric and Technical Communications).

There are several significant areas where the Industrial Archaeology (IA) program and the EP program overlap. Students and faculty in the two fields share interests in environmental history, working with citizens' groups, environmental impact assessment, and land management issues. These common concerns will enhance the education of students in both degree tracks. One of the possible concentrations for EP students is in Cultural Resources Management. This concentration draws on existing faculty expertise to train students in federal and state historic resource policy and the assessment, interpretation, and preservation of historic and archaeological sites, including industrial and industrially-related sites.

Some IA students might also enroll in EP classes. Many Master's level archaeologists work for Federal land management agencies such as the Forest Service and Bureau of Land Management. IA students wishing to take this track could benefit from a broader understanding of environmental policy and natural resource management issues. Possibilities also exist for future appointments of faculty who could contribute to both programs in such areas as hazardous and industrial waste disposal sites.

B. Library Resources

Library materials are housed in the J. R. Van Pelt Library, which contains over 300,000 volumes and currently subscribes to 3,000 print serials and periodicals. The library is also designated as a selective depository for government documents, which are essential for the program. Online computer search services with over 100 databases, interlibrary loan access to over 10,000 libraries worldwide, and public catalog access including the Michigan Library Consortium and Upper Peninsula Region of Library Cooperation systems, are available in the library. The library also has a rapidly growing collection of CD-ROM indices and provides Biosis online, Proquest, Current Contents, and the Wilson Index. The university also has access to Lexis and Nexis databases.

The library's resources relating to the environment are substantial, given existing strong graduate programs in forestry, chemistry, biological sciences, chemical engineering, environmental engineering, geology, geological engineering, and mining engineering. At present there are more than 20,000 volumes

under the search term "environment." The collection is particularly strong in environmental sciences and resource management, and technology studies. There is also an excellent map collection available, including topographic, hydrologic, geologic, geophysical topographic, and geologic maps for all of the United States and Canada and most of the world. Basic journals in the humanities and social sciences are also available in the library. Specialty journals in environmental policy will need to be added to the collection.

C. Other Resources

MTU has a long and distinguished record of education and research in environmental sciences and engineering. High quality programs in forestry, geology, biological sciences, geological engineering, mining engineering, and environmental engineering serve sizable numbers of undergraduate and graduate students. New directions include environmentally conscious manufacturing, demanufacturing, environmental education, and environmental communication, which draw upon several additional disciplines. A number of environment-related research institutes and initiatives draw upon the faculty and extensive laboratory facilities at the university. These include the Institute of Wood Research (IWR), the EPA Center for Clean Industrial and Treatment Technology (CenCITT), the Regional Groundwater Education in Michigan Center (GEM), the Modeling Group for Lake Superior (MoGLS), and the Lake Superior Ecosystems Research Center (LaSER).

MTU has recently established a university-wide Environmental Initiative to coordinate these elements and to emphasize and strengthen interdisciplinary research and teaching, particularly as they focus on Great Lakes resources and strategies for sustainable development. The Environmental Policy program will draw upon this extraordinary pool of expertise. The program will also take advantage of a plethora of environmental agencies located in and focused upon the Great Lakes region. These include the EPA's Great Lakes National Program Office, the Council of Great Lakes Governors, the Bi-National Program for Lake Superior, the Michigan Great Lakes Protection Fund, the Great Lakes Commission, the U. S. Forest Service, and the Michigan Department of Natural Resources. The university also cooperates with environment programs at other universities in the Lake Superior region, including Lakehead University (Thunder Bay, Ontario), University of Minnesota-Duluth, the Sigurd Olsson Institute at Northland College (Ashland, Wisconsin), and Northern Michigan University.

V. ANTICIPATED AUDIENCE OF ENVIRONMENTAL POLICY DEGREE

This degree should appeal to several audiences. The primary audience consists of individuals completing an undergraduate degree who wish to continue their education and pursue a professional degree. Other potential students include practicing engineers or scientists in the public and private sectors who are seeking advanced professional degrees; individuals in the local community who wish to acquire advanced degrees; and secondary school educators who desire additional expertise and/or certification.

A. Continued Professional Education for Undergraduates

The primary audience for the Environmental Policy Master's degree will be undergraduates in engineering, science, and forestry programs, either from MTU or other institutions. Students with degrees from Michigan Tech in business, the humanities and social sciences will also be an audience for this degree because of the strong science and math general education requirements at this university. For engineering and science students, this degree adds a policy dimension which complements their technical expertise. Courses of study for humanities and social sciences graduates are considered pre-professional; this degree offers a terminal professional degree to students in those fields. Courses in this program will also be of interest to graduate students in other environment-based programs at MTU.

B. Advanced Training for Practicing Environmental Professionals

For those individuals already working as environmental managers in the public and private sectors, this degree program provides an additional professional dimension to their training and experience. For

instance, it could attract engineers or resource managers who work for local governments, Indian tribes, or private firms who must deal daily with the social and political aspects of regulation and enforcement of environmental laws. Courses in ethics, policy, citizen participation, and additional scientific-technical study would greatly enhance the job performance of this group of professionals.

C. Graduate Degree Program for the Region

Individuals in this region with undergraduate degrees from MTU or other institutions are another important audience for this degree. The Environmental Policy Master's Degree will be of interest for regional residents interested in the Great Lakes ecosystem and the environmental initiatives regarding Lake Superior, in particular.

D. Advanced Degrees for Secondary School Educators

Secondary school teachers, especially in the sciences and social sciences, who seek advanced certification provide a fourth audience for the Environmental Policy Master's program. Science teachers, for instance, would gain expertise in application of science to environmental problems in complex socio-political situations. This would greatly benefit their students who are just beginning to develop career interests, exposing them to the idea of interdisciplinary, problem-solving professions.

VI. EMPLOYMENT POTENTIAL FOR GRADUATES

Only recently have firms, governments, and non-profit organizations recognized the need for a professional who combines technical with socio-political expertise. Employment potential exists in three sectors: (1) industry and private firms; (2) all levels of government: federal, state, local; and (3) non-profit organizations.

Private sector employment for a graduate of the Environmental Policy Master's program will be found in the policy offices of manufacturing corporations and large engineering firms. Industry has perhaps been the slowest sector to recognize the need for policy staff with interdisciplinary training. Generally, policy offices of manufacturing firms employ both public relations specialists and engineers. Typically, neither has graduate experience with regulatory science and law or with social-political analysis. Within, the last few years, however, industrial firms have begun to recruit graduates with such expertise from other policy programs. Recently, the Industrial Advisory Committee for MTU's Department of Mechanical Engineering heard an oral presentation on the preliminary concept of a master's degree in environmental policy. Representatives from the larger manufacturing firms (who were primarily engineers) responded positively to the idea. They had witnessed first-hand the difficulty experienced by technically-trained engineers required to work in regulatory arenas, and by publicists who attempted to explain technical matters in regulatory hearings and conferences. National business leaders likewise report greatly increased need for their managers to combine technical proficiency with understanding of policy development, decision-making, and the interests of outside stakeholders. Furthermore, environmental programs in industry will be required, as is the case with Great Lakes international agreements, to work more closely with citizens in their planning and implementation. The third generation manager will be trained to navigate these new legal and political demands.

The public sector has recognized for some time the need for environmental managers with a broad interdisciplinary training in policy, social analysis, engineering, and sciences. Federal regulatory agencies, such as EPA, often train their economists and scientists in-house to enhance their analytical skills so that regulatory analyses for specific rules encompass a broader perspective. Staffers in regional offices (e.g. EPA's Chicago offices) have more direct contact with community-based citizen groups and are often faced with citizen needs that go well beyond what can be addressed through the mandated, formal hearing process on any given environmental issue.

State agencies, such as Michigan's Department of Natural Resources (DNR), are also active in local communities. Placed between the demands of national policies and the needs of local communities and

businesses, state environmental offices are in a unique position to mediate the socio-political demands of many stakeholders in disputes. Graduates of the Environmental Policy Master's program who have specialized in Great Lakes environmental problems will find opportunities in the state governments of the Upper Midwest and in Canadian provincial governments.

County, city, and tribal governments in the Great Lakes region must respond to new environmental programs and policies. Local governments often hire engineers or contract with small engineering firms to deal with problems pertaining to groundwater, wastewater, landfills, and toxic wastes. These make up some of the more pressing problem-areas in rural and urban communities. Graduates with undergraduate degrees in engineering or science combined with a professional degree in Environmental Policy will be very attractive candidates for local positions. Because rural governments often contract with regional engineering firms for services on environmental problems, these firms will also find engineering undergraduates who have professional degrees in environmental policy particularly attractive. Finally, tribal governments have already begun to employ environmental specialists because of the great demand on their forests, waters, and minerals. In these positions, knowledge of environmental law and sovereignty rights, coupled with technical and scientific expertise, is critical. We have already had expressions of interest from the Keweenaw Bay Indian Community regarding a program to provide such training.

Non-profit organizations and consulting firms have also expressed a need for technically-trained policy and environmental specialists. They are one of the principal sources of employment for graduates of other environmental policy programs. As lobbyists and public education organizations, non-profits often mediate between large questions of public policy and the environmental concerns of everyday citizens. Professionals skilled in environmental science, policy, regulatory science, and citizen participation would fill a void. Non-profits and consulting firms, in particular, might find individuals combining the technical and policy analysis skills of other professionals to be attractive candidates for their limited budgets. More likely to be working with local communities and businesses, these non-profits are often on the front lines of environmental issues. Professionals who can understand both the science and the citizen in any given dispute will be valuable staff members.

The leading programs in environmental policy have a near 100% placement rate for their graduates. Boston University, Duke, and North Carolina-Chapel Hill, for example, report that most of their graduates moved into government or consulting firms. However, directors of these programs noted that a virtually untapped employment potential lay with industry. This is confirmed by our conversations with industrial advisory boards at MTU. Programs that emphasize environmental studies (without a technical or policy specialization) have lower placement rates.

VII. PROPOSED CURRICULUM

A. Pedagogical Assumptions

Several general assumptions underlie the curriculum of this program. First, this is a professional degree. Therefore, students must be given ample opportunity to apply concepts, strategies, and techniques to contemporary problems. Second, a professional degree need not create technocrats. Thus, the curriculum will provide students with a range of analytical skills and conceptual understanding of environmental issues and their social dimensions. Finally, the faculty must model the attitudes of cooperation, responsibility, and curiosity that we wish to instill in our students. Thus, interdisciplinary research and teaching are emphasized, as is careful attention to the development of students as competent professionals.

B. Degree Requirements

Consistent with graduate school policy, the Master of Science Degree in Environmental Policy requires a minimum of 48 quarter hours of study. At least 30 credits, including the thesis/project, must be taken in courses at or above the 500-level. No more than 18 credits at the 300-400 level may be counted toward

degree requirements. Typically, the program will involve two years in residence. During the intervening summer, students will be expected to participate in an internship with a public or private organization or to conduct an independent project under faculty supervision. A number of policy-related research activities centered on Lake Superior will provide one important avenue for internship opportunities.

First year students will study the fundamentals of environmental policy analysis and the social context of environmental issues. Summer internships and projects provide students with a setting in which they can apply those fundamentals in "real-world" situations in which environmental policies are being developed or implemented. This summer experience will typically form the basis for each student's project or thesis. Most of the second year will be devoted to specialization and to the project or thesis, although there will be an opportunity to take elective courses either within or outside the social sciences.

C. The Core Program

Environmental Policy Courses (14 credits). All students are required to take the following courses.

SS551-3 Environmental Decision Making I, II, III (8 credits)

Group practicum where students apply information and perspectives from courses in first year program of the Masters in Environmental Policy to the typical policy making activities a professional may encounter. A single topic, generally, but not necessarily, related to the Great Lakes will be pursued for the entire year. When possible, the year's topic will be provided by the International Joint Commission, which oversees U.S.-Canada boundary waters, or by other agencies with Great Lakes responsibilities. Examples of such topics include toxic reduction programs, Great Lakes climate change, mercury, and impacts of shipping on aquatic habitats. Public group presentations on findings will be held at the end of each quarter. Members of the core faculty from across the campus will, on occasion, be asked to join the discussions to lend their expertise to the week's topic.

Policy is what we do; environmental policy is what we do about the environment. This simple pair of ideas, however, has complex consequences for those who would be active in making environmental policy. The professional skills needed for success in environmental policy can usefully be outlined relative to four "actor" categories and to typical stages in policymaking. The actors are one's self, the public, other experts, and other governmental bodies. The typical stages of policy are problem identification and definition, problem analysis, political choice, implementation and evaluation. Would-be analysts need to be able to collect and sift through a wide array of sources of information and then present the results of that collation to others. They then must, in concert with others, define a particular problem in need of solution and identify possible solutions to it. Constraints on the solutions, be they technical, economic, or political, must be addressed, as must any timeframes for action. Then analysts need to move to specific recommendations, rules, procedures and the like. This entails who, how, and when actions will be taken. Often ways to evaluate the strengths and weaknesses of the solution must be included.

The environmental decision making sequence connects the actors and policy stages to specific skills. What do analysts need to do in identifying problems and defining them? They need to collect information and turn the mound of information into a concise format like a brief. What might analysts do at this stage relative to the public? They may need to build awareness and seek ways of encouraging citizen participation, thus they might offer a press release or explain a scientific or technical idea in terms the layperson can understand or they might organize a public event. Relative to other experts, they may have to show that their assessment of a problem is sound from legal, scientific, or technical perspectives. They would likely engage other experts and representatives from government bodies through a technical report. Each of the Decision Making courses emphasizes different stages of the policy process, thus students gain important knowledge about their future profession and specific skills that will serve them well whether they take positions in the government, non-profits, or industry.

Although a number of faculty will participate in the practicum, one faculty member will manage the sequence in order to maintain continuity. The course addresses three pedagogical goals: integration of

abstract and concrete information, enhancement of problem identification and analysis competencies, and development of professional skills of group leadership and public presentation.

SS551 Environmental Decision Making I (2 credits)

Students will use "large-scale" concepts from geography, history, and the environmental sciences to address an environmental problem. Written projects will include problem definitions, executive summaries, and short news articles appropriate for popular consumption. The final group project will be a technical report.

SS552 Environmental Decision Making II (3 credits)

Students will employ concepts from public policy and citizen participation to explore an environmental problem. Written work may include assessments of different community interests and concerns, as well as further problem analysis. The final group project will be the preparation of a briefing appropriate for a legislative committee.

SS553 Environmental Decision Making III (3 credits)

Students will propose model legislation, regulations, corporate guidelines, or participation guidelines to cope with an environmental problem. Attention to risk, regulatory, economic, and political issues in crafting such documents will be emphasized.

SS577 U.S. Environmental Policy (3 credits)

An introduction to environmental policymaking in the U.S.. The course covers the major environmental laws, regulations, and programs, as well as their administration in the following areas: air pollution, water pollution, toxic and hazardous substances, and monitoring and enforcement. The traditional approaches focus on "command-and-control" or end-of-the-pipe solutions, while innovative approaches include emissions trading, pollution taxes and fees, and pollution prevention. In addition, the pros and cons of regulating individual environmental pollutants or media vs. a comprehensive risk assessment approach to environmental pollution will be discussed and critically debated.

SS578 Environmental Policy Analysis (3 credits)

A review of the major tools used in environmental policy analysis, including standard setting, risk assessment, benefit-cost analysis, environmental externality analysis, pollution taxes, emissions trading, technology assessment, and environmental impact assessment. Students will become familiar with how these tools are utilized in policy analyses for environmental regulations in the U.S. at the federal and state levels. Students will also be introduced to the origins of these tools, the policies surrounding their use, and the primary critiques and revisions of these assessment techniques.

Environment and Society Courses (10 credits). All first-year students will take the Human Dimensions course and the Global Environmental Systems course. They will select one course from among Environmental Ethics, Environmental Politics, Environmental Economics, and Resource Economics.

SS547 Global Environmental Systems (4 credits)

A course designed to connect global biological and physical processes with human adaptations, interventions, and social systems. Study of human systems for living in and with the environment, placing human activities in a global environmental perspective. Topics will include energy balance and transfer in the earth environment, ecosystems and energy flow, climate change, soils and food resources, human population dynamics, and land use change and impacts. Emphasis will be placed on anthropogenic effects on ecosystem process and function and on the interconnectedness of earth systems.

SS548 Human Dimensions of Environment (3 credits)

An examination of the social scientific dimensions of environmental problems and constructions. The political, cultural, and structural aspects of environment are analytically linked through a set of current public policy issues. The primary objective of the course is the development of student abilities to analyze the social dimensions of environmental problems using a conceptual framework which integrates traditionally disparate social scientific disciplines. Fulfillment of this objective will not require that

students become experts in any particular discipline, but rather that they will develop the ability to draw linkages between the disciplines and defined problems in the natural environment. This seminar-style course will combine in-class discussion and analysis of case studies with quarter-long individual student work on the analysis of particular environmental problems. Students will develop research papers which approach their problems from an integrated social scientific perspective. Students will then present their analysis to the class at the end of the term.

SS478 Environmental Politics (3 credits)

This course will use the case study approach to understanding the dynamics of environmental politics and the resolution of environmental problems at the U.S. and global levels. The roles and functions of government environmental agencies and officials will be reviewed. Different strategies will be discussed for gaining power and influence on environmental issues by private corporations, non-governmental organizations, special interest groups, and the public. The interactions and clashes of all these groups, and their cooperation, negotiation or blockage of solutions to various environmental problems will be critically examined.

HU454 Environmental Ethics (3 credits)

Examination of ethical and philosophical issues concerning human relations to the environment. Topics may include the moral standing of future generations, animals and non human entities, natural resource depletion, energy use, and pollution and its control.

BA491 Environmental Economics (4 credits)

Study of the relations between economics and the environment, particularly the residuals of production and consumption and the role of economic incentives in the environmental arena. Discussion of market failures, efficiency, the role of markets and government failures, as well as sustainability and sustainable development. Emphasis on the economics of environmental quality and the measurement and analysis of benefits and costs.

BA569 Natural Resource Economics (4 credits)

An introduction to the economic theory of the use of renewable and depletable natural resources for society's needs. Topics include recycling, depletion, property rights, and efficient management of resources.

Methods (6 credits). Students will select one methods course (typically from among SS401 (Social Research Methods), SS402 (Quantitative Social Analysis), FW454 (Remote Sensing and Geographic Information Systems for Renewable Resource Management) and BA417 (Econometrics), depending upon their background and interests. They will also take one approved advanced communications course, generally HU425 (Risk Communication).

Internship. During the summer between the first and second years, each student will undertake an internship, working with either a public agency, non-governmental organization, or private firm. Internships may be either paid or unpaid, but should form the basis for the master's project or thesis. During the first year of study, in consultation with the guidance committee, the student will develop an internship plan and a plan for study for the second year which links internship activities with elective courses and the project or thesis.

Students will receive assistance and guidance in identifying internship opportunities. Faculty will work with organizations which specialize in environmental internships, such as the Environmental Careers Organization's Great Lakes Regional Office in Cleveland, to develop internships for students. ECO is dedicated to providing students with both paid and unpaid internships nationwide. They have a particularly successful track record in placing students with strong technical skills, which students in the environmental policy program are likely to possess. Most internships will last between 1-3 months, but some could last longer. Some students may also be placed through the Student Conservation Association, which provides internship positions in resource management agencies, or with state or federal internship programs (Appendix B).

Concentration (9-12 credits). Numerous courses in the Department of Social Sciences and elsewhere at MTU are closely related to the goals of the Environmental Policy program and may contribute to either a more complete understanding of environmental issues and policy, or to the development of skills and techniques which will enhance graduates' employment opportunities. In the second year, students, in consultation with their guidance committee, will identify up to four courses which provide further depth in some aspect of environmental policy, and which are most appropriate for their needs. These electives will be chosen to build upon students' core curriculum in environmental policy and link their more applied internship experiences with the thesis/project.

The concentrations developed in the second year will often relate specifically to the students' undergraduate background. For instance, a student with an undergraduate degree in environmental engineering might select courses in solid waste management, industrial and hazardous waste management, and soil and hazardous waste containment in preparation for a project or thesis on policy development for siting of waste facilities. Other students might use the concentration to make connections between several areas or disciplines. For example, a student seeking to explore factors underlying public attitudes toward environmental decisions or policies might elect courses in organizational communication, small group behavior, and natural resource administration and policy.

The concentration requirement enables students to draw upon MTU's environmental expertise in many disciplines. Concentrations selected will depend upon student interest and background, and may be limited by the courses prerequisite to advanced study in certain fields. Concentrations might include, but are not limited to, resource management, policy and regulation, environmental technologies, industrial archaeology, ecosystems, pollution, philosophy, organizations, communication, and STS. Sample courses currently available in each of these areas are listed in Appendix C.

Project or Thesis (6 to 9 credits). Much of the second year is devoted to a project or thesis. Each student will conduct research under the supervision of his/her advisor. By October 15 of the second year of enrollment, students must submit a written proposal describing the project or thesis for approval by the student's graduate committee. Each student will give a brief presentation on the project to faculty and graduate students in the program. The completed project or thesis will be examined by a committee of four faculty. There is no coursework option available in this degree program.

The master's project (typically 6 credits) identifies and represents the student's major area of interest and concentration, and demonstrates the student's competence in that area. The objective is to provide a framework for gaining experience in problem-solving in a field of environmental policy and to integrate course work, analytical skills, writing ability and career interests. The product of the project will be an in-depth study and report. Acceptable projects might include a case study, a management plan, analysis of an existing or proposed policy, or solution of an applied environmental management problem.

The traditional thesis (typically 9 credits) is designed to demonstrate the student's grasp of a complex problem in environmental management or policy through original research on a resource or environmental topic.

D Sample Curriculum Plan

Year 1: 27 credits

Fall Winter Spring

Env Decisions I-2 Env Decisions II-3 Env Decisions III-3

Env Policy-3 Human Dim of Env.-3 Env Policy Analysis-3

Global Env Systems-4 Env Ethics-3 or Conc Elective-3

Res/Env Econ-3 or

Env Politics-3

Summer: Internship

Year 2: 21 credits

Fall Winter Spring

Methods Elective-3 Env or Risk Comm-3 Conc Elective/Thesis-3

Conc Elective-3 Project or Thesis-3 Project or Thesis-3

Conc Elective-3

VIII. STUDENTS

Because of the interdisciplinary nature of the field and the intensity of the curriculum plan, the admission process will be highly selective. Students accepted into the program must have strong undergraduate credentials, should be well-versed in basic environmental issues and problems, and should have proven facility with written and oral communication. Entering students will be expected to have a solid background in mathematics, and in undergraduate biology, chemistry, or geology. They should also have preparatory work in the social sciences, particularly political science and economics. Specifically, students will be expected to have taken (as undergraduates) at least one statistics course, one course in micro-economics, and a course emphasizing basic principles of ecology (which may include fundamentals of environmental engineering, environmental geology, or ecology). Students without this background will be expected to make up their deficiencies during their first year of graduate study.

We anticipate that students will be drawn primarily from engineering, forestry, and the physical and biological sciences. Well-qualified students with undergraduate degrees in the social sciences, business, and humanities will also be welcome. Initially, the primary pool of potential applicants will be Michigan Technological University students, but regional and national advertising will be conducted to broaden and deepen the pool. The first-year entering class will be 4 to 6, with a total of 12 to 16 students anticipated by 1999 (contingent on student support). Faculty in the MTU School of Forestry and Wood Products and the Department of Biological Sciences have indicated an interest in encouraging their graduate students to take several of the courses offered and, perhaps, even to develop a specialty in the area.

A student panel has been advising faculty on the content and nature of the proposed program. Many of these are undergraduates majoring in environmental engineering or one of the environmental sciences. Highly capable in their fields, they are particularly interested in bringing their technical and scientific backgrounds to bear on larger social and political decision-making processes. Several of these students have already expressed a desire to matriculate in the proposed program. Others have recently enrolled in policy programs at other institutions, but expressed an interest in this program, had it already been in operation. Based on these discussions, it is clear the program will appeal to MTU students.

IX. ORGANIZATION

The MS in Environmental Policy will be housed in the Department of Social Sciences. General oversight will be provided by an Environmental Policy (EP) Program graduate committee, consisting of five graduate faculty selected from among the program's core faculty. The chair and at least two other members of this committee will be from the Department of Social Sciences.

The EP Program graduate committee will provide overall guidance, set policies on admissions and degree requirements, and approve new courses for the program. Day-to-day oversight of the degree will be the

responsibility of the Department of Social Sciences. Faculty in other academic units who wish to play a more active role in advising will be encouraged to do so.

Applications for graduate study will be reviewed by the Environmental Policy Program graduate committee, which will recommend acceptance or rejection to the Dean of the Graduate School. Applicants will be judged on the basis of past academic performance, recommendations from faculty members, GRE scores, and demonstrated scholarly potential.

Upon admission, each student will be assigned a temporary academic advisor. By the end of the second quarter in residence the student will select a permanent advisor. The advisor and two additional faculty members serve as the student's guidance committee, which will assist in designing an individualized course of study for the student and supervise the student's research and internship activities. The guidance committee, with one additional faculty member, forms the examining committee for the student's thesis or project.

X. RESOURCES NEEDED

The Department of Social Sciences already has a number of faculty members with expertise in the areas covered by the proposed program. In addition, it will be searching for one additional faculty member to support this initiative. Hence, the new institutional resources needed to initiate this program will be relatively modest.

A. Faculty

As noted, the Department of Social Sciences is currently conducting a search for a new faculty member in support of the program.

B. Student Support

Many environmental programs in the U.S., including Wisconsin, Boston University, University of North Carolina, and SUNY-Environmental Science and Forestry, support only a small proportion of their graduate students. Others provide stipends to most or all of their students (Appendix D). At MTU, every effort will be made to support environmental policy graduate students through external research funding generated by core faculty or by projects of other faculty which require a policy component. Important potential funding sources include government agencies such as NSF, Michigan DNR, Michigan Seagrant, U.S. EPA, and the newly-established National Center for Environmental Decision-Making Research. Numerous environmental grantmaking foundations and non-governmental organizations such as Earthwatch and Public Citizen are other potential sources of support. Several faculty have proposals in preparation or under review by many of these organizations and agencies. However, not all students will require university support and not all students will necessarily be supported. At least two graduate teaching assistantships will be needed to initiate the program and attract an initial cohort of top-quality students. These TAs will initially be assigned to assist the faculty involved in directing the program, since faculty will be taking on many of the additional responsibilities on an overload basis. Later, TAs will be used to provide assistance to departmental faculty who teach large sections.

C. Library Resources

Michigan Tech's library has an abundance of resources in environmental matters. In order to bring Tech's library up-to-date in environmental policy and management, however, we request \$10,000 to supplement the Department's book budget for 1995-96 or 1996-97. Current periodicals are adequate to support the program, however, an increase in the department's annual periodical budget of \$2000 would enable us to acquire valuable journal titles (Appendix E).

We also request that the Library be provided with sufficient additional funds in its base budget to set up one or more LEXIS/NEXIS terminals on a permanent basis. The estimated cost of such a facility would

be \$10,000-20,000 annually. LEXIS/NEXIS, currently housed in the School of Business and Engineering Administration, is an automated information retrieval service which makes available the full-text of most federal and state codes and regulations, a full-text patent listing, court decisions (both domestic and foreign), and a variety of other services. This capability would provide faculty and students involved in the program with access to a huge, modern electronic data base relating to legislative and regulatory information in the environmental area. NEXIS/LEXIS has other capabilities which would contribute to other programs on campus. It is, for example, able to conduct patent searches and provides the world's most comprehensive news and business information resource.

Adopted by Senate: January 10, 1996

Approved by President: February 16, 1996

Approved by Board of Control: July 30, 1996