This course is available for student registration only after the approval process has been completed.

SUBJECT  I  S  C  COURSE NO.  1  5  0  0  CREDIT HOURS  3  TERM TO BE ADDED TO THE FILE  Fall 2010

CLASS HOURS 45/semester  LECTURE HOURS  CONTACT HOURS (CEU ONLY)

DEPARTMENT Biological Sciences

SCHEDULE TYPE  Lecture (A)

☐ COLLEGE OF AERONAUTICS – 23  ☐ COLLEGE OF PSYCHOLOGY AND LIBERAL ARTS – 25
☐ NATHAN M. BISK COLLEGE OF BUSINESS – 24  ☐ COLLEGE OF SCIENCE – 26
☐ COLLEGE OF ENGINEERING – 1  ☐ EXTENDED STUDIES DIVISION / NATHAN M. BISK COLLEGE OF BUSINESS – 90

COMPUTER TITLE  Restricted to 25 characters, including spaces  Intro Sustain

CATALOG TITLE  Introduction to Sustainability

CATALOG DESCRIPTION OF COURSE  Restricted to 350 characters, including spaces

Uses lectures, reading and discussions to explore the biological, environmental, economic, technological, humanistic and social-science aspects of sustainable resource use and development.

In addition, please attach a course syllabus and/or more detailed description.

RESTRICTIONS

☐ Prerequisite

 Course Number

☐ Corequisite

 Course Number

☐ Prerequisite

 Course Number

☐ Corequisite

 Course Number

☐ Prerequisite

 Course Number

☐ Corequisite

 Course Number

GRADES TO BE ISSUED

☒ A, B, C, D, F

☐ A, B, C, D, F, CEU

☐ CEU

☐ S, U

☐ P, F

☐ Other

ADDITIONAL RESTRICTION

(e.g., Major, Class Level, Department Head Approval)

If this course replaces a course currently offered in BANNER, please indicate old course information and the date/term the course may be removed from the system.

SUBJECT Alpha Prefix (e.g., CSE)  COURSE NO. (e.g., 1301)

APPROVALS: Upon completion of appropriate department approvals, submit form to Chair, Graduate Council, or Chair, Undergraduate Curriculum Committee for approval below and forward to Catalog Director.

Richard B. Aronson  4/21/10

Originator

Date

Chair, Graduate Council

Date

OR

Department Head/Program Chair

4/21/10

Dean or Associate Dean

Date

Chair, Undergraduate Curriculum Committee

Date

CATALOG DIRECTOR

These changes/additions have been made for the University Catalog/policy management system and entered into the BANNER term named above.

Catalog Director

Date

REGISTRAR’S USE ONLY

SCACRE  SCADETL  SCAPREQ

SCARRES  Operator Init.  Date

Florida Institute of Technology • Office of the Registrar

150 West University Boulevard, Melbourne, FL 32901-6975 • (321) 674-8114 • Fax (321) 674-7827

RRD:108-409
Proposed New Course: ISC 1500

Introduction to Sustainability

Prefix: ISC

Credit Hours: 3

Prerequisites: None

Contact: Richard B. Aronson, Head, Department of Biological Sciences

Course Description: This introductory-level course provides the foundation for students to participate in the interdisciplinary, cross-college, undergraduate Minor in Sustainability, and it is a requirement for the minor. Lectures, readings, and discussions explore the biological, environmental, economic, technological, humanistic, and social-science aspects of sustainable resource use and development.


Evaluation:
Grades are based on a midterm exam, a non-cumulative final exam, a term paper of 10–15 pages, and participation in discussion sessions.

Midterm exam    30%
Final exam      30%
Term paper      30%
Participation   10%

Grading Policy:
University grading policy based on percentage performance.
   A   90% and above
   B   80–89%
   C   70–79%
   D   60–69%
   F   59% and below
### Course Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Earth and Its Resources</td>
</tr>
<tr>
<td>2</td>
<td>History of Ideas on Sustainability</td>
</tr>
<tr>
<td>3</td>
<td>Biodiversity and Evolution</td>
</tr>
<tr>
<td>4</td>
<td>Communities and Ecosystems</td>
</tr>
<tr>
<td>5</td>
<td>Deforestation, Fragmentation and Desertification</td>
</tr>
<tr>
<td>6</td>
<td>Exploitation of the Seas, Fisheries and Marine Reserves</td>
</tr>
<tr>
<td>7</td>
<td>Food Security, Agribusiness and Genetically Modified Crops</td>
</tr>
<tr>
<td>8</td>
<td>Water Supply; MIDTERM EXAM</td>
</tr>
<tr>
<td>9</td>
<td>Sustainable Energy, Smart Grids, and the Nuclear Option</td>
</tr>
<tr>
<td>10</td>
<td>Pollution</td>
</tr>
<tr>
<td>11</td>
<td>Population Growth, Disease, War and Terrorism</td>
</tr>
<tr>
<td>12</td>
<td>Environmental Economics</td>
</tr>
<tr>
<td>13</td>
<td>Sustainability, Culture, Public Perception, and the Media</td>
</tr>
<tr>
<td>14</td>
<td>Legislation and Policy: Fisheries and Forest Management</td>
</tr>
<tr>
<td>15</td>
<td>Global Change and the Future of Sustainability; Term Papers Due</td>
</tr>
<tr>
<td>16</td>
<td>Exam Period: FINAL EXAM</td>
</tr>
</tbody>
</table>
This course is available for student registration only after the approval process has been completed.

Subject: [LCS] (e.g., CSE)
Course No.: 4000
Credit Hours: 3
Term to be added to the file: Fall 2010

Class Hours: 45/semester
Lecture Hours: [ ]
Lab Hours: [ ]
Contact Hours (CEU only): [ ]

Department: Biological Sciences
Schedule Type: Seminar

☐ College of Aeronautics - 23
☐ College of Psychology and Liberal Arts - 25
☐ College of Engineering - 1
☐ Extended Studies Division / Nathan M. Bisk College of Business - 90

Computer Title: Restricted to 25 characters, including spaces
Catalog Title: Applied Sustainability

Catalog Description of Course: Restricted to 350 characters, including spaces

Requires the design, production and presentation of an individual or group project on improving the sustainable operation of some aspect of the Florida Tech main campus or Florida Tech satellite location.

In addition, please attach a course syllabus and/or more detailed description.

Restrictions: ☒ Prerequisite [ISC 1500]
☐ Corequisite [ ]

Grades to be Issued:
☒ A, B, C, D, F
☐ A, B, C, D, F, CEU
☐ CEU
☐ S, U
☐ P, F
☐ Other

Additional Restriction: Completion of other requirements of Sustainability minor or permission of the instructor.

If this course replaces a course currently offered in BANNER, please indicate old course information and the date/term the course may be removed from the system.

Subject: Alpha Prefix (e.g., CSE) [ ]
Course No. (e.g., 1301) [ ]

Approvals: Upon completion of appropriate department approvals, submit form to Chair, Graduate Council, or Chair, Undergraduate Curriculum Committee for approval below and forward to Catalog Director.

Originator: Richard B. Atkinson
Date: 4/26/10

Department Head/Program Chair: [ ]
Date: [ ]

Dean or Associate Dean: [ ]
Date: 4/21/10

Catalog Director: [ ]
Date: [ ]

Registrar's Use Only:
SACRSE: [ ]
SCADETL: [ ]
SCAPREQ: [ ]

SCARRES: [Operator Init.] [Date]

Distribution:
Original – Registrar
Copy – Academic Unit

Florida Institute of Technology • Office of the Registrar
150 West University Boulevard, Melbourne, FL 32901-6975 • (321) 674-8114 • Fax (321) 674-7827

RGR381-109
Proposed New Course: ISC 4000

Applied Sustainability

Prefix: ISC

Credit Hours: 3

Prerequisites: ISC 1500, plus completion of other requirements of the Sustainability Minor or permission of the Instructor.

Contact: Richard B. Aronson, Head, Department of Biological Sciences

Course Description: This seminar-style course provides the opportunity for students to complete the Minor in Sustainability by synthesizing and applying what they have learned in their coursework. It is a requirement for the minor. Students are expected to design, carry out, write up, and publicly present an individual- or group-based project to improve the sustainable operation of some aspect of Florida Tech's Melbourne Campus or a satellite location.

Readings: Primary and review literature to be selected by the instructor.

Evaluation:

Grades are based on successful completion of the components of the project, as well as participation in class discussion.

Project design and prospectus 25%
Project log 20%
Written report on the Project 25%
Presentation on the project 20%
Participation in discussions 10%

Grading Policy:

University grading policy based on percentage performance.

A 90% and above
B 80–89%
C 70–79%
D 60–69%
F 59% and below
Course Schedule

Two or three seminar-style meetings per week and/or individual or group tutorial-style meetings with the Instructor, for a total of 150 minutes per week.

Sample Readings


Florida Institute of Technology

ADDING A NEW MAJOR OR MINOR TO THE CURRICULUM

Please provide the following information when requesting a new major or minor (program or option) to be added to the curriculum. Only new majors, minors and options are assigned a new code and printed on the diploma. The code will be assigned by the Office of the Registrar and a copy of this form will be sent to the appropriate department.

COLLEGE: Science

DEPARTMENT: Biological Sciences

SITE(S): Melbourne

CAMPUS(ES): ____________________________

PROGRAM TO BE ADDED: ☐ Major or ☐ Minor or ☐ Option for ____________________________ (existing degree program)

NOTE: Only Majors, Minors and Options receive new codes and print on the diploma.

☐ Associate of Arts (A.A.) ☐ Executive Master of Business Administration (E.M.B.A.) ☐ Educational Specialist (Ed.S.)
☐ Associate of Science (A.S.) ☐ Master of Arts (M.A.) ☐ Doctor of Education (Ed.D.)
☐ Bachelor of Arts (B.A.) ☐ Master of Arts in Teaching (M.A.T.) ☐ Doctor of Philosophy (Ph.D.)
☒ Bachelor of Science (B.S.) ☐ Master of Business Administration (M.B.A.) ☐ Doctor of Psychology (Psy.D.)
☐ Master of Education (M.Ed.) ☐ Master of Public Administration (M.P.A.) ☐ Graduate Certificate
☐ Master of Science (M.S.) ☐ Master of Science in Aviation (M.S.A.)
☐ Professional Master of Business Administration (P.M.B.A.)

OTHER ADDITION TO THE CURRICULUM (NOTE: Only Majors, Minors and Options receive new codes and print on the diploma.)

☐ Concentration or ☐ Specialization for ____________________________ (existing degree program)

PROGRAM TITLE: Restricted to 30 characters, including spaces

Minor in Sustainability

TERM TO BE INITIATED: Fall 2010

ADVISER FOR NEW PROGRAM: Richard B. Aronson

ROUTING APPROVALS: 1) Department head/program chair and college dean approve and sign form; 2) Provost approves business plan of the program in terms of financial viability and impact on the university mission, and signs form; 3) Undergraduate Curriculum Committee or Graduate Council approves academics and signs form; 4) Provost gives final approval of program, signs form and forwards to Office of the Registrar.

1) Richard B. Aronson 4/23/10
   Department Head/Program Chair
   Dean or Associate Dean

2) Provost
   Date

3) Chair, Graduate Council
   Date
   OR

4) Chair, Undergraduate Curriculum Committee
   Date

Provost

REGISTRAR'S USE ONLY

FSA ATLAS ________________________ SOAXREF ________________________ SMAPRLE ________________
STVMAIPR ________________________ SOACURR ________________________ Major Code Assigned ________________
SOAXCURR ________________________ CIPC Code ________________________ Operator Initials/Date ________________________

DISTRIBUTION
Original – Registrar
Copy – Academic Unit

Florida Institute of Technology • Office of the Registrar
150 West University Boulevard, Melbourne, FL 32901-6975 • (321) 674-6950 • Fax (321) 674-7827
General Information – ext. 8115, Graduation – ext. 8116, Records and Transcripts – ext. 8117, Registration – ext. 8118
R35-035-309
Proposal for an Interdisciplinary, Cross-College Undergraduate Minor in Sustainability at the Florida Institute of Technology

Prepared by
Richard B. Aronson
Head of Biological Sciences
and
Thomas J. Marcinkowski
Associate Professor of Science/Math Education

Conceived by
Gordon L. Nelson
Dean of the College of Science

April 2010
Proposal for an Interdisciplinary, Cross-College
Undergraduate Minor in Sustainability
at the
Florida Institute of Technology

Executive Summary:
Florida Tech strives to keep up with and surpass competing institutions of higher learning by offering the finest educational opportunities available. The study of sustainability is rapidly becoming a standard instructional program offered at colleges and universities nationwide. The College of Science proposes an interdisciplinary, cross-college Minor in Sustainability. The rationale for adopting the minor derives from multifarious trends:

- the societal urgency of creating a sustainable future;
- the increasing interest in sustainability expressed by university students nationwide;
- the increasing number of programs in sustainability at universities nationwide;
- the increasing availability of research funding in the area of sustainability;
- the expanding availability of jobs in the area of sustainability; and
- the burgeoning of sustainability initiatives at Florida Tech.

This proposal explores the feasibility and advantages of the minor from both programmatic and marketing standpoints.

The minor will consist of six cross-disciplinary courses totaling 18–21 credits. Each student will take two minor-specific courses:

- an introduction to sustainability (3 credits); and
- a project-based synthesis course (3 credits).

For the remaining four courses, the student will select one course of 3–4 credits in each of four general areas of sustainability:

- ecology and environmental science;
- economics;
- technology; and
- social sciences and humanities.

The minor will be open to students in each of Florida Tech’s Colleges. This proposal has been endorsed by a broad spectrum of faculty and administrators within all five Colleges.

The minor will require:

- the establishment of two new courses; and
- the addition of one faculty line for teaching, advising, and extramural fundraising.

As a matter of fiscal pragmatism, the new faculty member could be introduced in the second year of the program. This new faculty member would be tasked with developing the minor into a major in sustainability.

A report on marketing research by University Marketing Director Jennifer Neuhard endorses implementation of the minor and expresses the willingness of Enrollment Management to participate in planning and marketing. Examination of undergraduate degree requirements across a broad spectrum of subjects showed that existing degree programs in all five Colleges can accommodate the minor. Establishment of the minor will open the possibility of developing a major in sustainability.
Proposal for an Interdisciplinary, Cross-College

Undergraduate Minor in Sustainability

at the

Florida Institute of Technology

Rationale:

Sustainability is the managed use of natural resources for the preservation and improvement of human welfare in a manner designed to preserve, renew and enhance those resources for future use. More succinctly, the goal of sustainable development is “...to ensure that [humanity] meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987). Climate change, accelerated by the anthropogenic emission of greenhouse gases, poses the greatest, most immediate threat and the greatest challenge to maintaining a sustainable planet. Changes in temperature, rainfall, oceanic pH, and the dynamics of fire are already altering the geographic ranges of species, patterns of land use, and the epidemiology of infectious diseases. These problems are exacerbated by the synergistic interactions of climate change with other human activities, including pollution and nutrient loading, deforestation and biomass burning, development, overexploitation of living resources, and biological invasions promoted by the globalization of travel and commerce. In the quest for a sustainable future, we have no choice but to adapt to existing climate change while we work toward mitigation and, hopefully, reversal of the effects of greenhouse-gas emissions.

Increasing public alarm about the state of the global environment has aroused intense interest in sustainability among scientists and academics, policymakers and corporate leaders, including many within the Florida Tech community (Nelson and Hronsky, 2009; Zonka 2010). In 2008, Congress passed and President Bush signed into law the Higher Education Sustainability Act (HR 4137), which among other things created the University Sustainability Grants Program at the Department of Education. The National Science Foundation is now devoting $16 million per annum to a cross-cutting, agency-wide grant program on Water Sustainability and Climate (NSF solicitation 10-524).

Unless institutions of higher education increase their offerings of coursework and degree programs in sustainability studies—which many are presently doing (AASHE, 2009)—there will be a dearth of trained professionals equipped to meet these challenges in the coming decades (e.g., U.S. Dept. of Commerce and U.S. Dept. of Education, 2008). A recent article in USA Today indicated that students across the U.S. are increasingly asking for and expressing interest in sustainability offerings in colleges and universities (Berman, 2009; see also Stafford, 2010; and many others). The College of Science, which is already active in the area of sustainability (Appendix 1), herein proposes an interdisciplinary, cross-college Undergraduate Minor in Sustainability.

Objectives:

The Minor in Sustainability will address four primary objectives: (1) students will increase their understanding of concepts and best practices associated with sustainability; (2) students will become more familiar with the relevance of sustainability within their areas of study and to their
career paths; (3) students will become more aware of the complex nature of real-world problems related to society and environment and, through exposure to perspectives on sustainability from other academic and professional fields, recognize the need for interdisciplinary approaches to understand and solve such problems; and (4) students will be provided with opportunities to synthesize and apply their understanding of sustainability through interdisciplinary team projects on campus and in the region.

Scope and Structure:

The Minor in Sustainability will require undergraduates to complete six cross-disciplinary courses totaling 18–21 credits. Each student will take two minor-specific courses, described below. For the remaining four courses, the student will select one course of 3–4 credits in each of four general areas of sustainability: (1) ecology and environmental science; (2) economics; (3) technology; and (4) social sciences and humanities. A student enrolled in the minor will be required to take an upper-level course in the general area to which her/his major belongs and a lower-level course in each of the three other general areas (Table 1). With only two exceptions, the lower-level courses do not have prerequisites. A maximum of 4 credits will be allowed within a student’s major department, easing the problem of satisfying prerequisites for upper-level courses. Table 2 presents a list of existing, eligible courses in the University’s five Colleges: Science, Business, Engineering, Aeronautics, and Psychology and Liberal Arts. This list includes both 1000- and 2000-level courses in each general area for non-majors, and 3000- to 5000-level courses in each general area for those majoring in that general area. The four courses will address Objectives 2 and 3.

Two new courses will be created to support the unique nature of the minor, both of which will be required of all students.

- **Introduction to Sustainability** (3 credits). Ideally, this course will be taken first and will provide students with an historical, holistic, and interdisciplinary view of the modern concept of sustainability and of problems and issues related to sustainability. This course is designed to address Objective 1.

- **Synthesis Course** (3 credits). Ideally, this course will be taken last, during junior or senior year. It will provide students with the opportunity to synthesize and apply what they have learned to projects that address real-world issues in sustainability. This course is designed to address Objective 4.

Gauging Student Interest:

In Fall 2009, Thomas Marcinkowski of the Department of Science/Math Education and Elvan Sahin, a visiting researcher from Turkey, conducted a sustainability survey among undergraduates in the Colleges of Science, Engineering, Business, and Psychology and Liberal Arts. Of 157 respondents, 24 students (15 %) stated that they were ‘considerably’ or ‘extremely’ interested in a sustainability minor (i.e., they scored their interest as 4 or 5 on a five-point rating scale). Based on this survey and national trends in interest (Berman, 2009), and at the request of Dean of the College of Science Gordon Nelson, Vice Provost for Enrollment Management Gary L. Hamme used the sustainability minor as the first test case for a new initiative in marketing research at Florida Tech. The report, discussed below, includes the results of a survey of current and prospective students, in which 64 % of the 304 respondents expressed interest in a minor in sustainability.
Marketing Research:
The Office of the Vice Provost assessed the feasibility and possible outcomes of a sustainability minor at Florida Tech. Written and compiled by University Marketing Director Jennifer Neuhard, the report endorses the implementation of the minor and expresses the willingness of Enrollment Management to participate in planning and marketing. The recommendation to implement the minor is based on the following considerations:

- the societal urgency of creating a sustainable future;
- the increasing interest in sustainability expressed by university students nationwide;
- the increasing number of programs in sustainability at universities nationwide;
- the increasing availability of research funding in the area of sustainability;
- the expanding availability of jobs in the area of sustainability; and
- the burgeoning of sustainability initiatives at Florida Tech.

The report is appended to this document (Appendix 2).

Fit of the Proposed Minor to Existing Degree Programs:
Table 3 shows a worked example of a degree program from each College that can accommodate the proposed minor. The minor will not fit every undergraduate program that Florida Tech offers, but it will be a viable course of study university-wide.

Implications for the Curriculum and the Faculty:
The selection of existing courses from each College, described under Scope and Structure, will reduce or remove any necessity for new courses to fit the requirement of four subject-area courses. Two new courses—the introductory and synthesis courses—will need to be created, reviewed, and approved by the UGCC. Although the two new courses could be developed by a team of current faculty members, the minor, as proposed herein, will require one new faculty member to serve as coordinator of the minor. The duties of the new faculty member will include but not be limited to: (1) marketing and recruiting for the new minor; (2) academic advising of students who minor in this area; (3) developing and teaching the introductory course; (4) developing, teaching, and advising students on projects carried out in the synthesis course; (5) liaising with administrators and faculty in all five Colleges on the curriculum of the minor; and (6) developing a program of extramurally funded research in the area of sustainability.

Administration:
For administrative purposes, the minor will reside in the College of Science. Richard Aronson, Head of the Department of Biological Sciences, will supervise the coordinator and serve as overall supervisor of the program.

Conclusion:
Florida Tech strives to keep up with and surpass competing institutions of higher learning by offering the finest educational opportunities available. The study of sustainability is rapidly becoming a standard instructional program offered at colleges and universities nationwide. Establishing the proposed Minor in Sustainability will open the possibility of developing a major in sustainability, which could increase undergraduate enrollment.
**Endorsements:**
The following individuals have endorsed this proposal.

**Office of the Provost**
T. Dwayne McKay, Provost  
Gary L. Hamme, Vice Provost for Enrollment Mgt.

**College of Science:**
Gordon L. Nelson, Dean  
Richard B. Aronson, Head of Biological Sciences  
Richard L. Turner, Associate Dept. Head  
Mark B. Bush, Professor  
Robert van Woesik, Professor  
Michael W. Babich, Head of Chemistry  
Mary L. Sohn, Professor  
David E. Cook, Head of Science/Math Education  
Thomas J. Marcinkowski, Associate Professor  
Semen Koksal, Head of Mathematical Sciences  
Terry D. Oswalt, Head of Physics and Space Sciences

**College of Aeronautics:**
Winston E. Scott, Dean  
Ulreen Jones, Instructor for Aviation Management

**College of Business:**
Alexander Vamosi, Associate Dean for Academic Affairs  
Michael A. Slotkin, Associate Professor

**College of Engineering:**
Edward H. Kalajian, Associate Dean  
George A. Maul, Head of DMES  
John G. Windsor, Associate Dept. Head  
Steven M. Lazarus, Associate Professor  
Frank R. Leslie, Adjunct Professor  
Kenyon C. Lindeman, Research Professor

**College of Psychology and Liberal Arts:**
Mary Beth Kenkel, Dean  
G. Susanne Bahr, Program Chair for Undergraduate Psych.  
William K. Gabrenya Jr., Professor
References:


Table 1. Structure of the minor, showing *minimum* course levels for students within each College. A student may enroll in an approved 3000- to 5000-level courses as an alternative to an approved 1000- to 2000-level course if s/he satisfies the prerequisites.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>COS</th>
<th>COE</th>
<th>COB</th>
<th>COP&amp;LA</th>
<th>COA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intro. to Sustainability</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>3000-5000 EDS*</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Synthesis</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

✓ This symbol indicates a required course.

*EDS students are classified in the general area of social sciences, humanities, education and communication.

†DMES students are classified in the general area of ecology and environmental science.
**Table 2.** Existing and likely new courses eligible for the Minor in Sustainability, listed by subject area and level. Number of credit-hours appears in parentheses. Asterisk (*), no prerequisites (or COM 1102 only); lower-level courses have no prerequisites (other than COM 1102), unless denoted by a dagger (†). Italicized course numbers denote planned courses or courses that can be modified to emphasize sustainability.

### A. Ecology and Environmental Science

1. **Lower-Level Courses**
   - BIO 1020 Biological Discovery 2 (4)*
   - **BIO 3410 General Ecology (3)*, would be numbered for 3 cr with no lab**
   - BIO 2801 Biometry (3)†
   - ENS 1001 The Whole Earth Course (3)*
   - OCN 1010 Oceanography (3)*
   - OCN 2602 Environmental Geology (3)*

2. **Upper-Level Courses**
   - BIO 3410 General Ecology (4)
   - BIO 3625 Molluscan Aquaculture (3)
   - BIO 4030 Conservation Biology (3)
   - BIO 4410 Community Ecology (4)
   - BIO 4411 Conservation Genetics (4)
   - BIO 4515 Ecology of Coral Reefs (3)
   - BIO 4517 Introduction to Modeling for Ecology and Biology (3)
   - BIO 4720 Marine Ecology (4)
   - BIO 4620 Fish Aquaculture and Management (3)
   - ENS 3101 Atmospheric Environments (3)
     - ENS 3105 Atmospheric Pollution Lab (1), can be added for 4-cr total
   - ENS 4001 The Earth System: Science, Engineering, Management and Education (3)*
   - ENS 4010 Geographic Information Systems (3)*
   - ENS 4300 Renewable Energy and the Environment (3)
   - ENS 5001 Global Environmental Problems and Solutions (3)*
   - **ENS 5903 Special Topics in Environmental Science: Global Climate Change (3), instructor is applying to list as a regular course**
   - MET 4310 Climatology (3)
   - OCN 4106 Mitigation and Restoration of Coastal Systems (3)
   - OCN 4204 Marine and Environmental Pollution (3)
   - OCN 5903 Special Topics in Oceanography: Marine Protected Areas (3)*

### B. Economics

1. **Lower-Level Courses**
   - BUS 1301 Basic Economics (3)*
   - BUS 1801 Global Business Perspectives (3)*
   - BUS 2602 Environmental Law and Forensic Studies (3)*

2. **Upper-Level Courses**
   - BUS 4425 Environmental and Urban Planning (3)
   - BUS 4426 Environmental and Resource Economics (3)
   - BUS 4504 Special Topics in Management: Sustainable Tourism Management (3)
BUS 4687 Consumer Behavior (3)

C. Technology

1. Lower-Level Courses
   CHM 1100 Introduction to Chemistry (3)*
   CHM 1101 General Chemistry 1 (4)*
   CHM 1102 General Chemistry 2 (4)†
   CVE 1000 Introduction to Civil Engineering (3)*
   OCE 1001 Introduction to Ocean Engineering (3)*

2. Upper-Level Courses
   AVM 3201 Aviation Planning (3)
   AVM 3202 Airport Design (3)
   AVM 4201 Aviation Advanced Computer Applications (3)
   CHE 3170 Introduction to Environmental Engineering (3)
   CHE 3175 Environmental Engineering Laboratory (1), can be added for 4-cr total
   CHM 4222 Environmental Chemistry (3)
   CHM XXXX Green Chemistry (3) to be introduced Spring 2011
   CVE 3042 Water and Wastewater Systems for Land Development (3)
   CVE 3052 Municipal Water and Wastewater Systems (3)
   CVE 4035 Urban Hydrology (3)
   CVE 4050 Solid and Hazardous Waste (3)
   CVE 4080 Urban Planning (3)
   CVE 5035 Design Concepts in Urban Hydrology (3)
   CVE 5039 Groundwater Hydrology and Contaminant Transport (3)
   CVE 5040 Urban Planning (3)
   CVE 5050 Design of Remediation Systems (3)
   CVE 5052 Solid Waste Management (3)
   MAE 4250 Physical Principles of Nuclear Reactors (3)
   MAE 5240 Solar Energy Analysis (3)
   OCE 4523 Coastal Engineering Processes (3)
   OCE 4525 Coastal Engineering Structures (3)

D. Social Sciences and Humanities

1. Lower-Level Courses
   HUM 1540 Ethics (3)*
   HUM 2080 Principles of Sociology (3)*
   HUM 2480 Introduction to Political Science (3)*
   HUM 2570 Bioethics (3)*
   PSY 1411 Introduction to Psychology (3)*
   PSY 1461 Psychology of Adjustment and Personal Growth (3)*
   PSY 2444 Cross-Cultural and Ethnic Psychology (3)†

2. Upper-Level Courses
   EDS 5430 Methods for Environmental Problems and Issue Investigation (3)*
   EDS 5440 Methods for Citizenship and Environmental Responsibility (3)*
   HUM 3085 Special Topics in Humanities (3)
   HUM 3351 History of Science and Technology: Ancient and Medieval (3)
HUM 3352 History of Science and Technology: Renaissance to Present (3)
HUM 3385 Special Topics in History (3)
HUM 3485 Special Topics in Social Science (3)
HUM 3521 World Religions
PSY 3441 Social Psychology (3)
PSY 3542 Survey of Industrial/Organizational Psychology (3)
PSY 4541 Culture and Psychology (3)
**Table 3.** Fit of requirements for the proposed Minor in Sustainability to a selected degree program within each College at the Florida Institute of Technology.

<table>
<thead>
<tr>
<th>COLLEGE</th>
<th>AERONAUTICS</th>
<th>BUSINESS</th>
<th>ENGINEERING</th>
<th>PSYCHOLOGY &amp; LIBERAL ARTS</th>
<th>SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree Program</td>
<td>Aviation Meteorol</td>
<td>Bus/Env Studies</td>
<td>Civil Engineering</td>
<td>Psychology</td>
<td>Cons Biol/Ecol</td>
</tr>
<tr>
<td></td>
<td>(7106)</td>
<td>(7167)</td>
<td>(7043)</td>
<td>(7144)</td>
<td>(7029)</td>
</tr>
</tbody>
</table>

**Minor Requirements**

1) Introductory Course  
- **TBA***

2) Ecol./Env. Course  
- Req.: MET 4310
- Req.: ENS 4010

3) Economics Course  
- Req., Soc. Sci. Elect.: Req.: BUS 4426
- “B. Economics”

4) Technology Course  
- Req., Restr. Elective: Req.: CHM 1101
- AVM 3201 or 3202
- Req.: CVE 3042

5) Social Sci./Hum. Course  
- Req.: Hum. Elective

6) Synthesis Course  
- **TBA ***

* *TBA* indicates that while there is at least one additional elective that could possibly be used to meet this requirement, it is currently designated as another type of elective (a Restricted or Technical Elective). If these electives and other degree requirements cannot be altered, students in this degree program seeking this minor will need to enroll in these as additional courses.
APPENDIX 1

GREEN ENERGY PROGRAMS AND PROJECTS AT FLORIDA TECH
PREPARED BY GORDON NELSON, DEAN OF THE COLLEGE OF SCIENCE

SUSTAINABILITY CONFERENCES
Sustainability 2009 – The Next Horizon was held on the Florida Tech Campus on March 3-4, 2009 (http://411.fit.edu/sustainability/index.php). Conference Sessions included timely topics such as: Sustainable Tourism, Coastal Economics, Climate Change & Adaptation, Climate Risks: Hurricanes & Lightning, Sustainable & Resilient Communities, Renewable Energy, Recycling and Reclamation, and Managing Emerging Technologies. Conference presenters included faculty from Florida Institute of Technology as well as other leading academic institutions, representatives from NGOs and research centers, regional planners and political figures. Participants were from 7 countries.

The seventh forum, hosted by ITAS, Research Center Karlsruhe (Germany), is set for June 2010 in Berlin. The theme is "The Cultural Aspects of Sustainability". The eighth Forum will be held on the campus of Florida Tech in Melbourne, Florida, March 2011. For More Information, Contact Linda Ward at lward@fit.edu or (321) 674-7573.

SUSTAINABILITY BOOKS
Sustainability 2009: The Next Horizon
Forum 1 - Rationality in an Uncertain World
Forum 2 - 2005 Environmental Studies: Implications for Sustainability
Forum 3 - Assessing Societal Implications of Converging Technological Development
Forum 4 - 2007 International Forum on Sustainability
Forum 5 - 2008 - Issues of Forecasting and Roadmapping
2003 - How Science Can Support Environmental Protection
2004 - Science Supporting Environmental Protection
Links to some books available here: http://411.fit.edu/sustainability/index.php

MASTERS PROGRAM IN CONSERVATION BIOLOGY AND ECOLOGY
Dr. Richard Aronson

The Department of Biological Sciences is developing is a professional (non-thesis) masters program in Conservation Biology and Ecology. The Department also boasts undergraduate, graduate, and post-doctoral programs of instruction and research in aquaculture, fisheries, and marine and terrestrial ecology and conservation.

GREEN CHEMISTRY: EDUCATION AND RESEARCH
Dr. Andrew Knight

Education: The Chemistry Department at Florida Tech is currently reviewing its upper division and graduate level course offerings with a view to introducing a Green Chemistry course by Spring, 2011. Green Chemistry will be an advanced course in inorganic/organic chemistry that emphasizes chemistry for a sustainable environment, current clean chemical technology and
minimization of waste. The course will cover essential concepts in green chemistry including: Principles of Green Chemistry; Chemical Waste Reduction; Catalysis and Green Chemistry; Solvent Alternatives; Renewable Resources; Green Process Design; Emerging Technologies; Industrial Case Studies. The course will be team taught by Drs. Knight (inorganic), Wehmschulte (inorganic), Nesnas (organic) and Sharma (analytical).

**Research:** The Knight group has a number of active projects in the field of green chemistry research including: (a) the use of unusual solvent media e.g. ionic liquids for organic transformations (b) development of new water-soluble catalysts for aqueous phase homogeneous catalysis and (c) new reactions involving C1 feedstocks for increased atom efficiency.

**GREEN CHEMISTRY USING ENVIRONMENTALLY BENIGN IRON COMPOUND**
Dr. Virender Sharma

Iron in the +6 oxidation state, commonly called ferrate(VI) has been of great interest because of its role as an oxidant and hydroxylating agent in industrial and water treatment processes, such as the development of a “super iron” battery, green chemistry synthesis, and non-chlorine oxidation/disinfection of aqueous effluents for pollutant remediation. In our laboratory, studies are being conducted to oxidize emerging contaminants such as nitrogen-containing compounds, and pharmaceuticals in water using ferrate(VI). The contaminants present in water are of great concern because they generate disinfection by-products as well as toxic by-products in treatments using conventional techniques such as chlorination and ozonation. The results have demonstrated that ferrate(VI) can treat most of the contaminants in seconds to minutes with no-toxic by-products. Additionally, ferrate(VI) is also a strong disinfectant to detoxify a wide range of microorganisms including spores, a chlorine resistant species. Tests are also being performed to test ferrate(VI) technology to apply in real-world environmental problems.

**COLLEGE OF BUSINESS OFFERS A B.S. DEGREE IN BUSINESS & ENVIRONMENTAL STUDIES**
Dr. Mike Slotkin

The Florida Tech College of Business offers a B.S. degree in Business & Environmental Studies, a relatively new major which combines a traditional business core with 40+ hours of environmental studies courses. In addition, Florida Tech College of Business faculty participate yearly in assessing the economic impact of the nation's most renowned birding and wildlife festival, the Space Coast Birding & Wildlife Festival, held every January in Titusville, Florida. On a biannual basis, Florida Tech's College of Business and College of Science co-hosts an International, Interdisciplinary Sustainability Forum with a sister school in Hungary.
APPENDIX 2

SUSTAINABILITY: MINOR FEASIBILITY
AT FLORIDA INSTITUTE OF TECHNOLOGY

Following is a report on the results of a feasibility study from University Marketing Director Jennifer Neuhard.
Florida Institute of Technology
Office of the Vice Provost
Enrollment Management

To: Richard Aronson, Ph.D.
   Department Head, Biological Sciences

From: Gary L. Hamme

Date: March 3, 2010

Re: Proposal to introduce a minor in Sustainability

Initially, let me express appreciation for your patience in allowing the Enrollment Management and Marketing teams to collaborate in this first-time review of a proposed academic program. As you will see from the report, we have the capabilities to support academic departments in evaluating the feasibility and outcomes of a proposed program.

In summary, we endorse the implementation of a minor in Sustainability.

Your request to project new enrollments that may result from implementing a minor in sustainability was noted. Historically, minors in and of themselves are not a primary point of interest to prospective students. However, when the minor is linked in admission literature to specific majors it does have an impact by depicting the depth of opportunities available to a prospective student.

In addition to a review of the survey data conducted on current students by interested faculty, Enrollment Management took the opportunity to test the sustainability minor concept on engineering prospects being recruited for fall, 2010. The results are noted on page 16 of the report. The amount of interest is gratifying, however to maximize participation of engineering students there must be a modified program (less total credits than required for a minor) because the engineering curriculum is very structured not allowing enough elective credits to complete a full minor.

Should you have any questions, feel free to contact me.
Sustainability: Minor Feasibility at Florida Institute of Technology

A deeper look into the feasibility and possible outcomes for sustainability as a minor at Florida Tech

Jennifer Neuhard
University Marketing Director
Submitted: March 3, 2010
The following is a suggested outline to determine the competitive landscape, evaluate intelligence and draw reasonable analysis to make strategic decisions regarding the addition of “Sustainability” as a minor at Florida Institute of Technology. This outline was created in part by reviewing documents on the Web with regards to what other universities release upon notice of said action, scholarly research as well as a business-wide model of feasibility analysis.

Addition of a Sustainability Major or Minor Research and Task Outline

1. Industry Overview
   a. Facts
      i. We have more than 6.6 billion people on the earth today and are adding 80 million each year (Izaak Walton League of America).
      ii. Today, over 1 billion people lack access to safe drinking water. Some estimates report that will double by 2050 (Izaak Walton League of America).
      iii. Human activity has cleared about half of the world’s original forest cover and we lose an additional 18 million acres of forests per year (Izaak Walton League of America).
      iv. Cleantech Corporate Group predicted that between the years of 2006-2009, 3.4 billion would be set forth in capital to fund green technologies (McCarthy, 2006).
      v. Each year, KLD Research and Analytics lists the stocks of the 20 most sustainable publicly traded businesses for investor’s reference (KLD Research Analytics).
      vi. Americans discard 2.5 million plastic bottles every hour. That’s enough bottles to reach all the way to the moon every three weeks (Sustainability Dharma).
      vii. Americans use four million plastic bottles every hour, yet only one out of four are recycled (UCLA Bruins for Recycling).
   b. Characteristics and challenges

      Over the last 40 years, specifically in the last decade, sustainability has become a buzzword within just about every discipline, from tourism, to building to restaurants, from campus initiatives to agriculture. It is a topic for just about every industry, and many organizations. With this focus come multiple definitions and combinations of terminology. Careful review of many definitions seem to point to a cohesive set that is defined by the EPA,
which defines it through of both a private and public sector lens. The public sector uses the term as “the satisfaction of basic economic, social and security needs now and in the future without undermining the natural resource base and environmental quality on which life depends.” Privately, the business sector sees the opportunity “…to increase long-term shareholder and social value, while decreasing industry’s use of materials and reducing negative impacts on the environment” (epa.org).

The EPA notes that most importantly, it is not the parallels between the two definitions, but rather the synergy that must exist and be sought after in order to manage the risk of not using sustainable practices, as well as earning a profit. This cross discipline or inter-disciplinary approach seems most effective for a university approach. The three-legged stool reference needs all three legs in order to achieve balance, with resources coming from both business and science. The government and private sector have both come to realize the importance of sustainability, realizing that protecting the world we live in makes sense for people and business. Through the use of in-house and private research initiatives and grants, the EPA is a driving force behind a sustainable future for the planet. For the EPA and so many of these other organizations who carry this issue forward, advances in science and technology most assuredly are the drivers behind sustainability practices, as well as government regulation and practices. Long-term environmental solutions are constantly being considered by the EPA, in the Office of Research and Development (ORD) to provide technical and scientific support to many state and local agencies, governments and even private sector businesses.

Businesses, organizations, governments and people alike are considering the fact that our planet is unsustainable at our current consumption rate. The challenges that face mankind today are some of the most trying and most critical. Indeed, they are so challenging and obtuse that solutions simply cannot arise from narrowly focused initiatives. The multi-dimensionality that is present in sustainability includes three pillars: economic, environmental and social concerns. Distilled further into their multi-dimensional avenues, the list includes: climate change, eco-efficiency, green and sustainable chemistry, sustainable, green engineering; design for the environment; sustainable manufacturing, sustainable architecture; sustainable mobility; sustainable agriculture, forestry and fisheries, ecologically sustainable resource management; cleaner production and sustainable consumption; renewable energy and energy efficiency; pollution
prevention and integrated product policy; the polluter pays principle; ethics; ethical investment; ethical employment; corporate social responsibility; and human population control (Lozano-Garcia et. al., 2008). Additionally, thought and solutions must be offered to consumption and waste patterns, water quality and availability, deforestation and the ensuing habitat destruction, CO₂ emissions and a myriad of other environmental concerns in order to sustain our planet.

The biggest challenge is clearly defined by Ashford (2004): multi-disciplinary approach is critical and governments must make commitments to hire young graduates in these fields, as well as give incentives to hire these grads in the private sector. Given the economic climate today, it is easily surmised that this is not happening. In fact, President Obama recently signed legislation to give incentives to firms in the private sector who hire those who are unemployed.

It is the integration of these challenges and characteristics of sustainability elements that is critical to the education of students interested in sustainability. Addressing these challenges head-on will create the futures of tomorrow.

Consequently, consideration of the interdisciplinary aspects of science, historic trends, philosophic theories and cultural forces with regard to sustainability is mass-critical. In order to move forward in answering sustainability’s feasibility question, we must briefly review the history of the subject matter. What follows in this section is a very brief summarization of key events that have transpired to give us the concept of sustainability as it is today.

**History of Sustainability as a movement**
Following WWII, the National Academy of Sciences studied and identified four key values that emerged in the collective wisdom of the world: peace, freedom, development and the environment. What followed that identification is five decades of commissions, declarations, symposia, papers, conferences and hundreds of documents that have made the case for a continual “moral and pragmatic” dive into the depths of these interrelated wisdoms (Leiserowitz et. al., 2004). The Academy went on to further define sustainability and sustainable development. They determined that what was to be sustained were as follows: nature, life support systems and community. This is similar to the three-pillar approach—also known as the three legged
stool, comprised of economic, environmental and social concerns (Ashford, 2004; Izaak Walton League of America).

Developmentally, the Academy determined that people, economy and our society as a whole should be further rationalized into a cohesive plan for our future. This three-pronged approach is pervasive throughout the literature and documentation of the sustainability movement.

According to the Izaak Walton League of America, which believes that sustainability forms the foundation of our work, claims the term was “widely used” after a 1972 United Nations (UN) meeting about the human environment. Later, in 1987 the UN World Commission on Environment and Development issued the first report on “sustainable development.” This report focused on the governmental needs of an expanding population. It is from here that the world has evolved to think of sustainability as this so-called three legged stool comprised of economic, environmental and social (human) capital, and all three must be considered in order to maintain or achieve balance. A holistic approach to people, the economy (consumption and waste patterns) and our society will enable us to delve into these very complex issues.

Conversely, the Izaak Walton League deems each leg of the stool from a business perspective rather than a science or environmental perspective: each leg represents a function of capital resources so as to consider the ramifications of increasing or decreasing each leg, to build up and/or out, and how we choose to act upon these decisions. Furthermore, spreading up, out, forward, down, or any direction will create more of any one capital resource(s). This business perspective pushes the intersection of business and science to its deepest foundations and to its broadest expansion towards impacting change.

Other organizations that have included sustainability in their vision include, but are not limited to the Global Scenario Group, the United Nations, and as stated, the EPA. Although no clear reigning organization exists in terms of measuring these sustainable targets and outcomes, the United Nations is a leader on sustainability and the interrelations of countries working towards its positive outcomes. It has developed a monitoring system that includes 8 goals, with 18 targets and 48 indicators to measure progress by which experts from the UN Secretariat and IMF, OECD and the World Bank continuously use as a yard stick (EPA).
Clearly, from the 1940’s onward to the 1990’s, issues continued to evolve in many industries. Specifically issues in higher education have come to the forefront as having the ability to collectively train future leaders, business (private sector), as well as in government.

**Higher education**

The first intergovernmental conference on higher education and sustainable, environmental concerns occurred in 1977. Known as the Tbilisi Declaration, it addressed education at all levels, including public school. Being early in the movement, the inter-relatedness of all that sustainability involved at the time and for the foreseeable future was addressed. The challenges that were addressed in this document sadly are still true today—progress is slow (Svanstrom et. al., 2008).

Composed in 1990, the Talloires Declaration (TD) was then created by the association of University Leaders for Sustainable Future (ULSF). The TD is a ten-point action plan for incorporating sustainability and environmental literacy in teaching, research, operations, and outreach. It is the first official statement made by university administrators of a commitment to environmental sustainability in higher education, and to date has been signed by over 414 presidents and chancellors in over 50 countries. The ULSF is committed to bringing sustainable education to the university level in teaching, research, operations, and outreach.

The Barcelona Declaration was written in 2004 during the Engineering Education for Sustainable Development Conference. It deals specifically with engineers and the educational opportunities for that profession (Svanstrom et. al., 2008).

**Business**

In 1999, the Dow Jones created the Dow Jones Sustainability Indices (DJSI) which looks at 5 elements of companies stocks and creates reports based on these elements. Additionally, each year, SustainableBusiness.com announces the World’s Most Sustainable Stocks and is presented in the Progressive Investor newsletter. These stocks for the last three years are listed in Appendix B. The importance here is that the Dow Jones is telling stakeholders to be responsible for the outputs (Lozano-Garcia et. al, 2008).
Government

According to the ULSF, in December 2002, the United Nations General Assembly adopted a resolution declaring a "Decade of Education for Sustainable Development" to begin on January 1, 2005. It will end in 2014, a scant 4 years from now. The UN Educational, Scientific, and Cultural Organization (UNESCO) is serving as the lead agency of this named decade, and nations are being encouraged to establish their own decade-oriented initiatives. The US formed their own partnership in 2004 to support this declaration and currently there are over 300 organizations in the U.S. endeavoring to participate. Internationally, strategies are less unified; UNESCO is heavily involved, as well as several other countries including the Czech Republic and Japan.

The World Values Survey (WVS) was introduced in 2004, having evolved from a study in 1981. It is a worldwide network of social scientists studying changing values and their impact on social and political life. One section specifically questioned nation’s residents about their attitudes and behaviors towards sustainability. In it, 52% of respondents worldwide cited that “protecting the environment should be given priority” over “economic growth and creating jobs.” The WVS is given about every 10 years and is based with social scientists in Sweden. The most recent version was completed in 2005-6. No information could be extrapolated from the most recent survey regarding sustainability. The recent economic downturns of 2008-2009 will have affected these statements and results (from the 2006 survey), but it is too early to tell by how much.

Conclusively, sustainability initiatives are pervasive, broad, and often ambiguous as the different groups work to create rules, laws, visions, and order, although not consistently. Without a governing body worldwide to dictate its outcomes, each country, person, and business can interpret at their will. It is without a doubt, an area in need of greater specificity to interpret the many levels of value laden visions. Institutions of higher learning can make an impact by educating the future minds in business, science and technology areas that will ultimately be leading the companies that can affect this change.

c. Trends and Drivers in the university setting

Generally

The biggest drivers of sustainability are the issues that comprise the stool, collectively. For example, creating affordable housing is a positive, but when that housing is too far away from where people work, it creates more
pollution, and an increase in traffic. By solving one problem in a vacuum, a whole new set of problems arise. When government makes its decisions about the economy, the environmentalists become agitated and vice versa. For example, when considered by itself, DDT, a common pesticide used in the 1950’s, seemed like a viable solution for the agriculture industry. The long-term effects were devastating. Sustainability, in order to be effective, must take a collective i.e., inter-disciplinary view of the capital involved: economic, environment and social or human capital (Sustainable Measures).

Furthermore, an excellent way to appreciate the “triple bottom line” of environmental, economic, and social concerns is to connect course content to unmet needs in the community (Timpson, et al. 2006). These interrelations will be the driving force of sustainability in the decades to come and any university would be well-advised to institute sustainable practices and education in an inter-disciplinary approach.

Indeed, hundreds of colleges and universities have campus-wide initiatives that pertain to sustainability initiatives and major/minors/certifications. Some of the initiatives may or may not have anything to do with a major or minor. In fact, the type of student who is concerned about sustainability may or may not be involved with it an educational matter, but it may just be a personal choice which should be integrated into their campus extracurricular activities. For example, many campuses have clubs and groups whose missions deal with recycling, greening, and reduction efforts for waste and consumption.

According to Academic Impressions, 100 colleges and universities added a major or minor last year in sustainability, although they do have concern there may not be jobs in this field available as the economy continues to shrink. Appendix B details many of the programs found within institutions of higher learning.

**Science**

Secondly, as research dollars have continued to climb, faculty members have seen their research opportunities increase and the trend has been met with great success to integrate business and the natural environment (Walck, 2009). Should Florida Tech decide to add this minor, there may be new funding avenues that appear in research. President Obama has supported new research efforts and his agenda calls for research in alternative energies and the environment. This alone is creating a cultural shift in the sustainability paradigm and will ultimately drive the greening of education systems. Additionally, any university must consider its mission and goals, and must integrate sustainability into its goals and directives, which will further support the faculty ownership of curricula and programs (Walck, 2009). Moreover, Walck goes on to point out that engineering educators “could learn from business educators, who were well ahead of the curve on sustainability.” One of the covenants of running a profitable business over
the long run is the reduction of negative impacts on the environment, and business leaders have known this for some time. It is only recently that science has begun to catch up in terms of funding opportunities.

**Engineering**

Engineering institutions of higher learning are considering the fact that they teach the future “problem solvers” of the world. If change needs to occur and problems must be solved, engineers will likely be involved. Engineering resources often drive the industrial state, which ultimately drive the state of science which is “generally rooted in engineering (Ashford, 2004). This interdisciplinary approach could only function to better serve our students in their quest for sustainable measures.

Additionally, a spring 2010 survey of engineering students conducted by Florida Tech’s enrollment division ascertained that over 60% (n=304) of the respondents said they would be interested in sustainability as a minor (See Appendix D for the entire survey and results).

**Business**

From the business perspective, Florida Tech may consider adding a minor in business that includes sustainable development or perhaps even an MBA in sustainability. Each year the Aspen Institute and the World Resources Institute publish the list of 100 full-time MBA programs that implement social and environment concerns into their curriculum ([http://www.beyongoaheadygreenstripes.org/rankings/top30cfm](http://www.beyongoaheadygreenstripes.org/rankings/top30cfm)). The Association to Advance Collegiate Schools of Business (AACSB) accreditation assures quality and promotes excellence and continuous improvement in undergraduate and graduate education for business administration and accounting. It does not directly reference sustainability. It is “subsumed under ethical understanding and responsibility” (Walck, 2009). In Florida Tech’s case, the AACSB accreditation is at a tipping point and accreditation will not occur simply because we add a minor. However, in terms of educating students to be the leaders of tomorrow, sustainable development is a critical need in communities of business and social endeavors. In fact, the AACSB has renamed their annual Ethics and Governance Conference to the Sustainability Conference (2008), and has continued that until at least 2010. Considering ethics in the business world has become one of the hottest topics to hit business-schools in the world, sustainability certainly falls into its scope. In a national survey, it was reported that in-bound college students have stronger concerns about the environment than their parents ([Environment, 2007](http://example.com)). This report does not differentiate between majors, or career aspirations. It is a rather general sentiment but one which must be considered.
Florida Tech sustainability measures currently
Florida Tech in particular has many initiatives in its arsenal of campus wide sustainability projects that could be more fully integrated into its collateral materials to further attract this type of student: the Siemens project, recent LEEDS certified buildings, as well as waste and water consumption reductions by replacing many plumbing fixtures that are outdated.

Architecturally
LEEDS certifications that have been pursued in the Scott Center for Autism Treatment include: sustainable sites, water efficiencies, energy and atmosphere improvements, and materials and resources, including recycling. It will be important to incorporate these initiatives into the collateral materials describing this minor to give credibility to our program.

Dining Services
Florida Tech’s dining services sustainable practices include the following: Usage of Ecolab’s environmentally friendly “Apex” line of ware washing chemicals and a “green” floor stripper which allows the effluent to flow into the sanitary sewer instead of barrels to be hauled off as hazardous waste; currently testing a green stainless steel cleaner/polish; participate in recycling pre-consumer waste from all of the campus kitchens; and post consumer recycling cans in all of our “retail” operations that generate that type of waste; cardboard recycling from all of our operations. Evans Dining Hall will begin to push the “Be Green Don’t Use a Tray” initiative, and hopes to partner with an environmentally active student group to help foster it.

d. Competitive Landscape in the university setting
An important function of the United Nations Decade, the Education for Sustainable Development (ESD) group provides a voice for the public at large to partake in the change afoot, and help the world to sustain itself. Additionally, the ESD “strives to measure the improvements to their quality of life and they seek to help people to develop the attitudes, skills and knowledge to make informed decisions for the benefit of themselves and others” (Cusick, 2008).

Furthermore, the United Nations Conference on Environment and Development was a wake-up call for institutions of higher education, particularly those entrenched in science and technology to focus their efforts to the “highest priority goals of a sustainability transition” (Cusick, 2008).
As institutions of higher learning are evolving, it is critical to meet the needs of the students as well as the workforce demands. As the evidence shows, many business schools and others also are creating programs around this paradigm.

Currently, a minor in sustainability is ripe for exploration and most certainly can be considered a facet of program diversification in science, engineering and even business.

2. Competitor Analysis
   a. Competitors (major players & where, volume)
      i. Where is this already in the marketplace servicing those in need in B-schools
         All green MBA programs have begun within the last 5-7 years
         (Beyond Grey Pinstripes, 2008).
      ii. Listing (see attached spreadsheet)
         Web site with list:
         http://www.aiche.org/IFS/Youth/Ycosst/SustainableMajorsandCurriculumUndergradProg/Index.aspx
b. Local, regional, national (Glavic, 2006).

The following tables offer great insight to the European countries and the programs which are offered. Additionally, the tables also depict some larger US universities which have many programs that pertain to sustainability.

| Table 5 Number of courses in different subject groups at US universities |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Groups of subjects | University | Sum |
| | | Stanford | Caltech | MIT | Princeton | Wisconsin | Illinois | Texas |
| Pollution control | 0 | 0 | 2 | 0 | 2 | 2 | 1 | 7 |
| Pollution prevention | 8 | 0 | 1 | 2 | 6 | 3 | 0 | 20 |
| Resource minimization | 13 | 0 | 15 | 14 | 14 | 9 | 1 | 66 |
| Green manufacturing | 20 | 9 | 57 | 27 | 39 | 29 | 11 | 192 |
| Ecodesign | 0 | 0 | 1 | 0 | 1 | 0 | 3 | 5 |
| Environmental economics & management | 8 | 0 | 2 | 4 | 13 | 9 | 3 | 38 |
| Social topics | 10 | 0 | 6 | 3 | 12 | 1 | 1 | 34 |
| Total | 59 | 9 | 84 | 50 | 87 | 53 | 20 | 362 |

| Table 6 Fraction of subject groups at US universities (in %) |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Groups of subjects | University | Stanford | Caltech | MIT | Princeton | Wisconsin | Illinois | Texas | Average |
| Pollution control | 0 | 0 | 2 | 0 | 2 | 4 | 5 | 2 |
| Pollution prevention | 14 | 0 | 1 | 4 | 7 | 6 | 0 | 6 |
| Resource minimization | 22 | 0 | 18 | 28 | 16 | 17 | 5 | 19 |
| Green manufacturing | 33 | 100 | 68 | 54 | 45 | 54 | 55 | 53 |
| Ecodesign | 0 | 0 | 1 | 0 | 1 | 0 | 15 | 1 |
| Environmental economics & management | 14 | 0 | 2 | 8 | 15 | 17 | 15 | 10 |
| Social topics | 17 | 0 | 8 | 6 | 14 | 2 | 5 | 9 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

| Table 7 Fraction of EU universities offering courses in Green manufacturing—small European countries (in %) |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Green manufacturing | Small European countries | Average |
| | AT | CH | DK | FI | IE | NL | NO | SE | SI |
| Green science | 64 | 53 | 56 | 33 | 76 | 66 | 40 | 49 | 55 | 23 |
| Green technology | 12 | 21 | 22 | 17 | 8 | 17 | 20 | 17 | 18 | 7 |
| Green engineering | 12 | 5 | 11 | 33 | 8 | 17 | 30 | 17 | 9 | 7 |
| Green systems | 12 | 21 | 11 | 17 | 8 | 0 | 10 | 17 | 18 | 6 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 43 |
c. Organizing Cooperative Information

The following is a brief outline of major organizations that Florida Tech may or may not work with in terms of standards, educational opportunities, and faculty involvement measures, which have sustainability in their directives. It is by no means exhaustive; it is simply to be used as a measuring stick to prove that it is top of mind for many organizing and collective groups to which we subscribe.

i. ASCE (American Society of Civil Engineers) Task Committee on Sustainable Design

Having created the Sustainability Action Plan, the ASCE is focusing on the following key areas: Sustainability certification of civil engineering projects and professionals; creating an ASCE Sustainability website; development and implementation of said action plan and others. According to their current website, the ASCE reports “With the continual shrinking of our planet and the collision of population growth, ambitious economic development and
finite natural resources (including fresh water and fertile, open land), including a sustainability component within infrastructure development plans is inevitable....The civil engineers voice and point of view is essential and vital to forming these multidisciplinary, sustainable solutions.”

ii. AIChe (American Institute of Chemical Engineers)

The Institute for Sustainability Center for Sustainable Technology Practices (CSTP) Center for Sustainable Technology Practices (CSTP) focuses on sustainability issues of importance to industry.

The Institute for Sustainability Sustainable Engineering Forum enables individuals to participate in cutting edge discussions and information sharing on Sustainability Issues.

The AIChe Sustainability Index was developed by engineering and scientific experts for both engineering and scientific experts and enterprise managers. Unlike other indices, the AIChe Sustainability Index benchmarks well-defined performance metrics and indicators, including SH&E performance, innovation, and societal measures. The metrics are based on over 30 sources of public data and allow companies to measure their efforts at the company and sector level.

The Youth Council for Sustainable Science and Technology enables sharing of best practices to incorporate sustainability into undergraduate research in all disciplines.

iii. Association for the Advancement of Sustainability in Higher Education (AASHE) [http://www.aashe.org/; http://stars.aashe.org/]

The ASSHE is an association of colleges and universities that are working to create a sustainable future. Their mission is to empower higher education to lead the sustainability transformation. They do this by providing resources, professional development, and a network of support to enable institutions of higher education to model and advance sustainability in everything they do, from governance and operations to education and research.

AASHE defines sustainability in an inclusive way which encompasses human and ecological health, social justice, secures livelihoods and a better world for all generations. Additionally, their activities are focused on making sustainable practices the norm within higher education. Additionally, AASHE provides many resources for
campuses that are looking to go green, become green, newsletters, resources, award opportunities, event listings, tradeshows and many papers.

In mid-2009, AASHE published a guide for universities to use a litmus test type tool to green their campuses, as well as implementation of sustainability into their educational requirements, across all disciplines (http://stars.aashe.org/). This group is primarily concerned with “walking the walk,” so to speak.

iv. Engineers Without Borders (EWB) http://www.ewb-usa.org/

Founded in the 1980’s, this group works to achieve international prominence by conducting service projects that often have an environmental component (Walck, 2009). With over 12,000 members worldwide, 300 chapters worldwide and over 180 on US university campuses, they have more than 350 projects currently underway in developing countries in water, renewable energy, sanitation and more.

v. National Collegiate Inventors and Innovators Alliance (NCIIA) http://nciia.org/

The NCIIA supports technological innovation and entrepreneurship in higher education to create experiential learning opportunities for students and successful, socially beneficial businesses.

Because science, innovation and business all go hand in hand, the NCIIA strives to implement elements of this intersection within their entrepreneurial projects. The NCIIA awards approximately 2 million dollars in grants annually to U.S. colleges and universities in support of technology innovation and entrepreneurship with a positive social impact (http://nciia.org/grants). This again demonstrates the intersection of science and business within sustainable development.


Net Impact is a non-profit hat was founded in 1993 as Students for Responsible Business and has over 80 chapters at business schools world-wide with 7,000 students, alumni and professional members. Their aim is to make a better world using the resources we currently have and may have in the future. They seek to bring values back to
the boardroom and their personal communities for a better planet (Kaemerle, 2003). Again, we can see the intersection of science and business.

d. Flaws in others programs
   Flaws in other programs have not been determined at this time.

e. Screen shots, collateral materials
   Not available at this time, although we have created a spreadsheet of all the programs we have found up to this point, both in Florida and nationwide. See Appendix C for the spreadsheet. Should Florida Tech wish to see screen shots and/or collateral materials from any of these programs, we can easily request them.

3. Assessment of benefits to offer proposed major/minor
   a. Benefits to adding/changing proposed major/minor
      i. Add new or different student base
         In the spring of 2010, Florida Tech’s Enrollment Management division conducted a survey that questioned respondents (current and prospective students) about engineering topics. When asked about a minor in sustainability, 64.1% responded that they would be interested in it (n=304) (Appendix D). Given this fact, it is entirely feasible that this would attract a certain number of new students and/or help retain current students, at least in engineering. Because of the difficulty in adding a minor for engineering students, it could be extrapolated that the College of Science could also benefit from adding this as a major.

      ii. Will students require any kind of different experience from what is already required for admission?
         Students for this program will not need to supply any additional resources or documents other than those already required by admissions standards. If other colleges/students other than those in science, engineering or business were to pursue this as a major, it would be up those respective Deans to allow.
b. Weaknesses to adding/changing proposed major/minor

There are no foreseeable weaknesses to adding this as a minor to the curriculum at Florida Tech. More in-depth research can be fulfilled in terms of job availability, but it was considered only necessary if a major would be added. As the lists of schools show (Appendix B), Florida Tech would have to work hard to overcome a lack of market share, however it can easily be overcome with full incorporation of collateral materials. If this minor were to be changed to a major at Florida Tech, further research should be conducted as to its viability, cost/benefit analysis, market demand, and labor/capital requirements.

4. Perspective on the field developments

a. Prepares students to do what?

On a technical level, environmental change would be implemented by trained students of sustainability practices. This education would also be incorporated with policies that affect competitiveness, environment and obviously employment. In fact, there are few employers who would be averse to streamlining the bottom line while reducing the impact on the environment.

According to U.S. News & World Report, the following is a list of great jobs in the field of sustainability. It is important to note that this was published in 2008, before the economic downturn, and perhaps in time when money was of no object to employ these types of jobs. There is some evidence to suggest that perhaps some of these job opportunities have disappeared.

10 Hot Sustainability Jobs

- Agriculture of forestry supervisors
- Architects
- Construction managers
- Consultants
- Social responsibility officers
- Engineers
- Electricians
- Scientific researchers
- Transportation supervisors and dispatchers
- Environmental design
- Environmental engineering
- Environmental science
- Geothermal development
- Green interior design
b. Any special emphasis in particular area where students may focus?
Students can potentially focus the minor in Science, Engineering and even Business within the undergrad and MBA concentration areas. The university would certainly need to look at cross-discipline capabilities in order to include these colleges and not just Science. Moreover, the needed research for sustainability across all disciplines should be “protected and incubated and with a long-term focus” (Ashford, 2004). It is important to note that for engineering, if will up to the department to research its feasibility in terms of electives available for engineering students. Other departments and students, if creative enough, could also anticipate the opportunity to use this to supplement their department.

c. Does the change/addition create any changes in any previously held major/minor programs
The addition of Sustainability as a minor does not affect course work in any of the other programs in the College of Science. The selection of this minor would not create any additional course work for a student other than a typical minor would create. It is however a possible first-step in bringing sustainability ideas, issues and concerns into all aspects of collaborative learning, much like the theme of Ethics has pervaded much coursework in all disciplines and therefore is applicable in many of the disciplines offered at Florida Tech.

d. Does this streamline any other program offerings for students?
This does not streamline any of the current minors or majors currently available at Florida Tech.
5. Marketing Strategy
   a. Entry Strategy
      Viewbook, News Releases that incorporate current sustainable practices as the foundation for the major; Earth Day promotions on campus and otherwise.
   b. Critical Success factors
      Curriculum committee must set forth the learning outcomes and objectives for sustainability education as a minor. Enrollment management will work collaborating with university marketing and each college to ensure its appropriate propagation throughout the university’s collateral materials and appropriate placements. Additionally, appropriate alignment with certain directives, declarations and organization could potentially open unforeseen doors within the research world.
   c. Competitive Advantage
      - Create a program that “goes beyond the low-hanging fruit of reduce, reuse and recycle” (Cusick, 2008).
      - Create visible sustainable projects on campus that can be woven into the tapestry of the entire university.
      - Create a palate of experiential learning opportunities around the world for our students to apply and learn even more, as well as our faculty.
      - According to some benchmarks, the US lags behind in greening of technology. Companies in Europe and elsewhere have to comply with very strict environmental standards. “MBA graduates who are well versed in sustainability from …product design…to recycling …can use it as a competitive advantage” (Kaemerle, 2003).
   d. Unique selling points
      Create a list of things that Florida Tech is doing to accompany sustainability marketing. While this may not be critical for a minor, it is critical to announce efforts at every opportunity. Many universities are doing this on Web sites and collateral materials. It speaks to a well-rounded, concerned individual, even those who cannot or will not pursue this minor.
   e. Target numbers (1-5 years)
      It is extremely difficult to project enrollment numbers based on the lack of research within our own College of Science. However, given
the engineering research conducted, it can be estimated that a large percentage of our student base would be interested.

f. Facilitation in any areas from more non-descript areas
   i. Faculty, student buy-in activities

   See section 1.c. for details of sustainable practice measures Florida Tech is currently involved.
FEASIBILITY DIRECTION:

Today’s and tomorrow’s businesses, governments and professionals – architects, engineers, attorneys, business leaders, scientists, urban planners, policy analysts, cultural and spiritual leaders, teachers, journalists, advocates, activists, voting citizens, and politicians – will need new knowledge and skills that only higher education can provide on a broad scale to create change and develop a more sustainable world.

Higher education institutions are particularly poised to create a society of analytical thinkers whom can easily apply the theory of knowledge, and push beyond the boundaries of the low-hanging fruit. It is incumbent upon us in fact to build a more permanent environment, without the law of diminishment, and eager to solve the problems of an unsustainable world.

For this reason, Florida Tech should pursue the addition of sustainability minor to its College of Science, possibly Engineering, as well as seriously consider making it an opportunity within the Nathan M. Bisk College of Business.
REFERENCES:


Page, Robert A., Kirsten A Collins. The Green MBA: A Competing Values matrix. Indiana: Vol. 6, Iss. 2; pg 384, 7 pgs.


WEBSITES FOR REFERENCE:

Academic Impressions, retrieved on 2/17/10  
 http://www.academicimpressions.com/web_conferences/0410-green-jobs.php

AICHE Institute for Sustainability, retrieved on 2/15/10  
 http://www.aiche.org/IFS/index.aspx,  
 http://www.aiche.org/IFS/Youth/Ycosst/SustainableMajorsandCurriculumUndergradProg/Index.aspx

ASCE, retrieved on 2/5/10  
 http://content.asce.org/sustainability/committeesummary.html

AASHE, retrieved on 2/16/10  
 http://stars.aashe.org/

EPA Sustainability webpage:  

 http://www.epa.gov/sustainability

Engineers without Borders, Retrieved in 2/15/10:  
 http://www.ewb-usa.org/

Izaak Walton League of America, retrieved 2/5/10  
 www.iwla.org/sustainabilityeducation

Net Impact, Retrieved on 2/16/10  
 http://www.netimpact.org/

Sustainable Business, retrieved on 2/11/10  
 http://www.sustainablebusiness.com/index.cfm/go/progressiveinvestor.sb20p2

Sustainable measures, retrieved on 2/5/10  
 http://www.sustainablemeasures.com/Sustainability/index.html

Sustainability Dharma, retrieved on 2/15/10  
 http://signature103.wordpress.com/

UCLA Bruins for Recycling, retrieved on 2/15/10  
 http://www.studentgroups.ucla.edu/recycle/fun.htm

U.S. News and World Report, October 2008, Retrieved 2/10/10  
 http://news.ufl.edu/2008/11/18/green-careers-are-red-hot-new-degree-helps-students-prepare-for-sustainability
APPENDICES:

Appendix A: Education for Climate Neutrality and Sustainability: Guidance for ACUPCC Institutions

Appendix B: Sustainable Index Reports: Last 3 years of Stocks

Appendix C: Universities with Sustainable Majors/Minors/Certificates

Appendix D: Enrollment Management Survey, 2007, Florida Tech

TASKS, in addition to research above:

To Be Completed Upon Request

A. Define a set of keywords to describe the proposed addition and search the Web using at least 10 different search engines
B. Conduct focus groups asking local and regional students (prospective and otherwise) their opinions. (Conduct with alumni on road, as well if possible and where applicable)
C. Collect collateral materials of other universities programs, where possible.