

ENERGY/ENVIRONMENT TRANSITION TRACK:

Sustainable Products for Green Energy Transition(s)

MEMP 590.07

7-9:45 PM on Thursdays – Beginning 9/01/2022

FALL 2022

Professor: [Guerry L. Grune, Ph.D., PA](#) (757) 570-0883 /ggrune@duke.edu and ggrune@epatentmanager.com

Syllabus Updated 7/14/2022

INTRODUCTION

The push for a “Green Sustainable Energy and Environment Policy” throughout the planet is well established and ongoing. This course has been developed to teach student how products can be designed to ensure that energy transitions for existing and new products can be managed properly and effectively while providing sustainability for worldwide consumption. The world’s energy economy and the products and processes used to manufacture them remains driven primarily by fossil fuels. The shift to green, sustainable, alternative processes, products and services requires a multivariable approach which includes both risk assessment and gap analysis. This methodology is useful in order to reach the goals established by the WHO (World Health Organization) and supported by the WTO (World Trade Organization) as well as by most country centric governments.

Students will also be introduced to environmental, social, and governance (ESG) initiatives which are driving the next revolution in products introduced to the retail and wholesale markets. As consumers, regulatory bodies, and governments increase pressure on businesses to demonstrate their commitment to sustainability and ethical labor practices, it’s critical that retailers effectively, profitably, and efficiently integrate ESG into their broader sourcing and supply chain strategies as products are developed.

In order to develop management and engineering skills to acquire the ability to achieve these goals, many tools will be introduced during the course of the semester. These include the use of Life Cycle Assessment (LCA) as it pertains to ISO 14000 (International Standards for Environmental Management Strategy) as well as implementing the ability to understand the importance of intellectual property with regard to prior art using a set of principles and techniques required to maximize product value. These tools include SciFinder, Patbase, EcoChain, LCAPIX, and Clarivate among other proprietary software systems to be utilized during the semester. Many students may have already been exposed to innovation and commercialization as well as green sustainable product models, but rarely provided an understanding regarding the use of valuation techniques to leverage technology driven solutions. This course will provide the student with the **extraordinary ability** to more fully understand all aspects of sustainably focused technologies that can all be brought together for application of these newly introduced skills in order to create products that meet new and existing governmental policies. Teams from the class (and perhaps several teams) **may enter the MEMP GCI EXECUTIVE CHALLENGE March 2023 with a distinct advantage by taking this course.** Additional optional competitions students have competed in and won or placed with similar course material include Licensing Executive Society’s SHALLOWAY GRADUATE STUDENT LICENSING COMPETITION or equivalent outside competitions including the Oak Ridge National Laboratory GLOBAL VENTURE ENERGY COMPETITION as well as the DUKE START-UP CHALLENGE.

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GRADING:

Student participation is required and will make up 20% of the final grade. There will be homework assignments to guide each student within each product group on a weekly and/or bi-weekly basis as needed during the semester. HW assignments will not require greater than 1 hour in length per student and will make up another 20% of the final grade. Project presentation and a final report and exam at the end of the semester will make up 60% of the final grade.

Grading will be proportionate to the effort by each student and group and will be decided at the end of the course based on the preparation and presentation of the product development and valuation exercise

Project progress and review will occur with each group on no less than a tri-weekly basis. Groups are encouraged to reach out to Professor Grune for assistance as needed anytime during the semester. Each student team will present a mock final presentation prior to the actual final presentation that will be judged by professionals within and outside the Duke community.

STUDENT PROJECTS

Students are expected to work in groups to accomplish the final goals of the course – which are group presentations regarding sustainable alternative product needs as well as valuations associated with these selected technologies (mutually chosen by both the students and Professor Grune). **The focus of the course will be to educate each student with both understanding and implementation of new and existing products developed for the clean “green” energy and environment sector. Using tools for making informed decisions along with industrial experts from outside Pratt, students will learn how to search, retrieve, and analyze the ability to provide sustainable green products for different technology spaces. This is a skill set that will be unique as there are very few courses provided anywhere that address leveraging all of these tools to meet global/national energy and environment technology and policy issues with new and existing products.**

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Students will be offered and expected to take advantage of gaining knowledge regarding a set of tools provided by both Professor Grune's contacts and Duke University's resources including LCAPIX, SimaPRO, SciFinder, PatBase, Clarivate, WizDomain, PatSnap, and other "private" databases to accomplish the ability to innovate new and existing products with the emphasis on green, renewable, sustainable energy and environment requirements for the transitioning global economy.

COURSE DESCRIPTION:

The nature and importance of green sustainable technologies relating to product development is an area that is evolving and becoming increasingly recognized as required skills by business leaders, educators, politicians, and individual members of society as a driver to ensure sustainable economic development and wealth creation in organizations. These organizations range in size from small (sometime start-up) companies to entire nations. Most investors will not seriously consider new product technologies and entrepreneurs in the energy and environment space unless new products are also accompanied by intellectual property (IP) ownership. Technology-based inventorship is particularly important to economic development due to its impact on productivity and potential for exponential growth. To create something new and of value to both the organization and the market requires an individual with technical and management skills who is willing to assume the social, psychological, and financial risks involved. Achieving resulting rewards for which monetary value is known is difficult and depending on the circumstances may be impossible. However, personal satisfaction, independence, and other non-financial rewards are also important for those seeking solutions and recognition. The process usually occurs while starting an enterprise (i.e., entrepreneurship) or while driving innovation within an existing organization (intrapreneurship).

This course also provides students with a formal education involving the various technologies associated with green sustainable products from energy resources that co-exist with and maintain sustainable clean environments. The course provides an in depth understanding of product development along with the use of practice of prior art searching analysis. By using these tools it will provide students with a keener insight into how to tackle difficult technology and public policy changes required for product development. Issues related to enhancing innovation in the context of a technology-based organization are discussed in each class. Sustainable energy and environmental concerns along with ESG (environmental social and governance policies) will be emphasized in this course using detailed product design case studies. Carbon credits and the value of these credits as they pertain to product development will also be included during the semester. Expertise acquired using these techniques pertaining to managing new product introductions can be very complex as sustainable energy transitions are still in their relative infancy. Students will learn that seldom is there an exact solution and/or valuation based on the analysis, but there are numerous best practices and benchmarks that can assist the organization

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or individual obtain energy transition solutions for new products. In most cases the use of a valuation matrix of products and their patent portfolios helps provide a more complete understanding for decision making during the transition phase for the internal and external economies of both businesses and governments.

The ultimate goal of this course is to provide the student with the ability to utilize the proper understanding for developing new products that utilize energy transition and sustainable environment tools available to leverage emerging strategies. The use of these tools will allow for successful endeavors in any future engineering management career.

The goals of this FULL semester course are;

- Provide information and education involving development of new products using sustainable energy and environmental solutions for transforming economies
- Understanding the use of ESG as it relates to New Product Development and relationships to the Energy Star and closely associated programs
- Understanding and use of Life Cycle Assessment (LCA) and Activity Based Costing (ABC) for New Product Development plus the use of carbon credits to complete valuations
- Understanding and use of ISO 14000 for practices in developing new products
- Enable the participants to understand all aspects of product initiation, substantiation, and introduction into an accepting marketplace.
- Defining sustainability and green energy and environment Product ideation, creation, and public policy initiatives
- Prior Art Searching and Conceptualizing Innovation for Products that Meet New and Existing Market Demands

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- It will also be shown how green, sustainable, ESG policy based products can be leveraged for energy and environment transitions when applied in a technology-based organizational setting. This learning allows for the ability to make decisions that will allow for benchmarking the multiple opportunities that an organization must consider before embarking on an energy transition program.

More specifically, learning outcomes from this course include an understanding of:

Products developed from sustainable transitions, needs, and energy requirements needed for each possible undertaking

Global, Regional, and Domestic Energy Practices and Policies that influence Product Development

Global, Regional, and Domestic Sustainable Environmental Practices and Policies that influence Product Development

Understanding regarding ISO 14000 (Environmental Management System) and implementation within any corporate or business entity

Carbon credits and their influence on manufacturing and profitability

How to protect innovation of new and existing products regarding energy transition within any organization

How to promote idea generation and the creative process for new products that meet energy and environment transition needs

How to use technology and intellectual property as a competitive advantage

How to value and extend alliances and partnering for enhanced innovation of new and existing products

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Forming and forging a logical business and licensing scenario from all of the above

Specific Topics to be covered in detail:

1. Development of new products that allow pivoting from fossil fuels to sustainable green energy policies
2. Products that utilize technologies required to make these pivots
3. Assessment and proper decision-making regarding implementation of green product choices
4. Understanding how to develop products that meet local regional and global energy transition regulations and compliance
5. Understanding and implementation of regional and global Intellectual property laws and regulations
6. Search, retrieve, analyze and map IP for the products meeting energy transition sector(s)
7. Product licensing and licensing opportunities for products in the sustainable green energy and environment sector

RESOURCES:

There are 3 *suggested* textbooks for this course;

“ Design for Environment: A Guide to Sustainable Product Development, 2nd Edition, Joseph Fiksel – 2009 – ISBN 9780071605564

“Energy Demand and Climate Change”, Franklin Hadley Cocks, Wiley, VHC – Duke University, 2019, ISBN 978-3-527-32446-0

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“The Singularity is Near” Ray Kurzweil - 2005 – Viking Publishing, Co., ISBN 978-0-670-03384-3

Additional References:

Coley, D. Energy and Climate Change Creating a Sustainable Future 2008 ISBN: 978-0-470-85312-2

Paul, B. Future Energy How the New Oil Industry Will Change People, Politics and Portfolios 2007 ISBN: 978-0-470-09642-0

Kruger, P. Alternative Energy Resources The Quest for Sustainable Energy 2006 ISBN: 978-0-471-77208-8

Olah, G. A., Goeppert, A., Prakash, G. K. S. Beyond Oil and Gas: The Methanol Economy 2006 ISBN: 978-3-527-31275-7

Synwoldt, C. Mehr als Sonne, Wind und Wasser Energie für eine neue Ära 2008 ISBN: 978-3-527-40829-0

Romm, J. J. Der Wasserstoff-Boom Wunsch und Wirklichkeit beim Wettlauf um den Klimaschutz 2006 ISBN: 978-3-527-31570-

“Introduction to Intellectual Property and IAM”, G.L. Grune course notes

“Who Owns the Sun ?” by Daniel Berman and John O’Connor, Chelsea Green Publishing Co., White River Junction, Vermont, ISBN 0-930031-86-5, 1996

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WEEKLY SYLLABUS TOPICS AND ASSIGNMENTS

Week 1: -

Design of New and Existing Products

Week 1 - Defining DFE

Required Reading: – Discuss Energy and Environment Transitions and what to review

– **Design for Environment: A Guide to Sustainable Product Development, 2nd Edition – first 2 chapters**

Lecture Content:

Different definitions of DFE

The value of creativity in a technology related firm

Initial Review of Projects and Project Considerations:

Discussion:

How does policy driven energy and environmental concerns affect product value?

What risks are involved ?

What constitutes DFE ?

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Week 2; -

DFE and GSE – As It Applies to Energy Transitions

Week 2 – Understanding DFE and GSE

Complete project assignment discussion (assign teams)

Required Readings:

– Chapters 4-6 of **Design for Environment: A Guide to Sustainable Product Development, 2nd Edition**

Lecture Content:

Relating DFE to policy matters

Understanding the past

Discussion:

How to begin DFE

Determination of projects for DFE/GSE consideration

Initial DFE methodology

Search engines and search tools available to begin project work

Week 3;

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Innovation in the Energy and Environment Transition Space

Week 3 – Merging DFE and GSE Strategies for New Products

Required Readings:

Chapters 7-10 of **Design for Environment: A Guide to Sustainable Product Development, 2nd Edition**

Chapters 1-5 of Who Owns the Sun ?

Assign projects to student participants – after drop/add date is complete -might extend to week 4

Lecture Content:

Selecting the best technical projects and assigning students to each group

The portfolio approach

Tools to utilize

Discussion:

Discuss all issues and expectations for each project

Exercise on Technology Assessment

Exercise on Valuation

Optional Readings (in order of priority):

“Implementing a Stage Gate Process: A Multi-Company Perspective,” by P. O’Conner, J. Prod. Innov. Manag., Volume 11, 1994

“A Few Things Every Manager Ought to Know about Risk,” Harvard Management Update, Reprint no. U9703D

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Week 4;

DESIGN CAPABILITIES AND TECHNIQUES

Week 4 - Systematic product design

Required Reading:

Chapters 10-13 Design for Environment: A Guide to Sustainable Product Development, 2nd Edition

Finish Who Owns the Sun ?

Discussion:

What limits creativity?

Is "creative organization" an oxymoron?

What is the role of creativity in an existing firm?

How do large firms utilize creativity?

Lecture Content:

Aspects and methods for doing industry analysis

Aspects and methods for doing competitive analysis

Importance of competitive and industry analysis

Discussion:

What is the importance of competitive analysis?

What are the methods that are useful for analyzing competitive products (services) and companies?

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What is the role of competitive analysis in the business plan?

Week 5; GREEN SUSTAINABLE AND RENEWABLE BENCHMARKING – Life Cycle Assessment and Activity Based Costing

Week 5 – will present a comprehensive review

Required Reading:

Design for Environment: A Guide to Sustainable Product Development, 2nd Edition

Lecture Content:

What is LCA ?

What is ISO 14000 ?

What is Activity Based Costing ?

Discussion:

What are the basic requirements to develop a usable product ?

How to develop a useful global product ?

Distinguishing pretenders from saleable offers ?

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Week 6;

- Product Examples

Week 6 – Wind Turbines, Biofuels, Solar Alternatives -Contrast with existing Petroleum Technologies

Required Reading:

Chapters 14-17 Design for Environment: A Guide to Sustainable Product Development, 2nd Edition

Lecture Content:

Defining wind, biofuels, geothermal, hydroelectric (Schneider Electric) and solar technologies

The prior art search

Using prior art to your advantage

Discussion:

What's been done before – what constitutes prior art ?

Using the past to create the future

What works and what does not work

Week 7;

– Product Innovation for DFE

Week 7 – How to Create the Future Product(s)

Required Reading:

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Finish **Design for Environment: A Guide to Sustainable Product Development, 2nd Edition**\

Begin - “**The Singularity is Near**” by Ray Kurzweil

Lecture Content:

Guest Lecturer – David Bradin/ Marty Trivette – Biofuels

Also invite Greg Twiss

Discussion:

Implementing the Energy Equation and LCA to define the outcome

Using ISO 14000 to achieve the results

Begin Group Product design in earnest

Week 8;

Week 8 – Group Reviews of Product Design and Development

Required Reading:

Continue “The Singularity is Near” by Ray Kurzweil

Lecture Content:

Defining product innovation

Differences between innovation, imitation, and implementation

Licensing activities contemplated

Discussion:

What constitutes product innovation ?

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Where, how and when do you design the next best DFE product ?

Real-life examples of DFEs that works

Week 9; – Break

Work on projects – DFE product design review with each group week after break

Week 10;

Week 10 – Implementing DFE with Tools Provided

Required Reading:

Continue with “**The Singularity is Near**” by Ray Kurzweil

Lecture Content:

Review of each project with each group

Drafting the DFE product

Explaining how the new product design meets the energy transition requirements

Quantifying the basics

Discussion:

What constitutes a real DFE ?

Quantifying the energy and environment loads ?

Why the new product will be successful or not ?

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Week 11;

FINALIZE PRODUCT/PROJECT ISSUES

Working with Groups to Finalize New DFE Projects/Products

Week 11 – Ensuring Success – Multi-variable factor analysis

Further Review of the Projects

Provide Roadmaps to Success

Required Reading:

Continue with “**The Singularity is Near**” by **Ray Kurzweil**

Lecture Content:

Product design differentiation

Product/Process Comparisons with Older Petro Based Technologies

Discussion:

Is the product/process novel and useful ?

Can this unique approach reach marketplace acceptance and success?

Is it workable, marketable, and protectable ?

Are LCA/DFE/GSE tools utilized to achieve benchmarking needs ?

Provide key features that address all of the above

Week 12;

Mock Presentations of Product/Process by Groups

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Week 12 – Mock Final Presentations

Plus other project/product issues

International Perspectives

Required Reading:

Finish “**The Singularity is Near**” by Ray Kurzweil

COMPLETE REVIEW

Week 13; Product/Project Presentations

Final Reports and Presentations Due

Week 13 – Review of Group Efforts

Final Exam date (Tentative); TBD during the class with student input