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**AC 2012-5213: A NEW COURSE ON DISTRIBUTION OF GREEN TECHNOLOGIES: CONTEMPORARY TOPICS IN ELECTRONICS DISTRIBUTION - GOING GREEN**

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## **A New Course on Distribution of Green Technologies: Contemporary Topics in Electronics Distribution - Going Green**

### **Abstract**

In this paper, we present a senior level electronics distribution course for an Engineering Technology and Industrial Distribution Program. The course is developed as an upper-level undergraduate course for junior and senior students interested in green technologies and electronics industry based on 14 weeks of course schedule. It is expected that a single instructor will deliver the course material but invite several guest speakers to deliver certain topics. The course will cover technical details regarding the selected products such as electric vehicles and charging components, photovoltaic, and energy management systems in addition to discussion adoption of new technologies and market analysis for such products. The course curriculum includes a review of published papers, case studies, group project work, and interaction with these two industries through invited guest speakers.

### **1. Introduction**

There is an increasing interest in developing new green technologies or improving the existing ones. The main motivation behind this interest is to reduce fossil fuels consumption especially due to its environmental and health related effects (Parmesan and Yohe, 2003). In addition, there is growing public interest in green energy due to rising costs and increasing dependence on fossil fuel supply from foreign countries. Lastly, considering the fact that total world energy consumption has increased significantly by 9.8% from 2004 to 2008 (World Energy Council, 2011), adoption of green technologies has become crucial for a sustainable future as there is only a limited supply of fossil fuels. Consequently, reducing fossil fuel consumption has positive impact on sustainable development, which “meets the needs of the present without compromising the ability of future generations to meet their own needs” United Nations (1987).

New green technology products range from harvesting renewable energies (e.g., wind turbines and solar panels) to managing energy consumptions (e.g., building energy management systems). Many electric and electronics distributors have identified distribution of these products as a viable growth opportunity for future. However, there are not many educational programs that support this new industry demand for skilled workforce, especially in the field of logistics and distribution of green technology products. Our conversation with industry (manufacturers and distributors alike) has clearly demonstrated a need for change in curriculum to support the challenges associated with the distribution of green technology.

In this paper, a new senior level electronics distribution course for an Engineering Technology and Industrial Distribution (ETID) program at the YY<sup>1</sup> University is introduced. During the semester, the course will first cover technical details regarding the selected products, such as solar panels and energy management systems. Next, challenges related to adoption of new technologies and market analysis for such products will be introduced. Finally, successful distribution strategies will be discussed from supply chain and distribution perspective to minimize overall cost of products and to facilitate adoption of green technologies. The course curriculum includes a review of published papers, Harvard Business case studies, and interaction with these two industries through invited guest speakers. These class activities will prepare students to take sales, marketing, operations management positions in electric/electronics

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<sup>1</sup> Name of the university is hidden for blind review purpose.

industry targeting distribution of green technologies. Hence, the course will help industry to recruit much needed talent.

The remainder of this paper is organized as follows. In Section 2, we discuss course content together with course objectives and outcomes. In Section 3, we present class activities and instructional methods. Finally, we conclude the paper in Section 6 after presenting the assessment plan in Section 4 and tentative course schedule in Section 5.

## **2. Course Content, Objectives, and Outcomes**

This course was developed as an upper-level undergraduate course for junior and senior students interested in green technologies and electronics industry. Currently 51 students are registered to take the course in Spring 2012 semester. The course aims to help these students to create a foundation to study concepts, issues, and techniques used to plan, and analyze supply chain for new generation of green products. The course will be offered in spring semesters as a three credit course, which meets twice a week for 75 minutes. It is also designed in modules such that the course content can be updated in the future with new technologies as they emerge or as instructor sees a fit.

The broader objective of the course is to expose students to new green technologies and electronics industry through an interdisciplinary approach combining team projects, individual research, case study analysis, and interaction with industry executives. Students taking this course will be able to

- Identify new trends/products in the electronic industry.
- Identify various electronics components regarding new technologies.
- Determine factors affecting the adoption of new technologies
- Analyze the various challenges specific to green electronics products
- Create marketing plans for new product introduction and sales growth
- Analyze and design supply chain processes to distribute green products while increasing market coverage and minimizing the cost of distribution.

After defining course objective and outcomes, the first step was to determine technologies to be included in the course content. We contacted various electronics distributors and identified electric vehicle charging stations, solar panels, wind turbines, and building energy management systems as new technologies. In addition the following list of topics will be covered to achieve course objectives

- Sustainability
- Introduction to electronics distribution
- New technology adoption
- Developing marketing strategies for new products and market research
- Market segmentation
- Product positioning
- 4Ps of Marketing: price, promotion, product, and placement
- Demand forecasting for new products
- Distribution channel design strategies for green products
- Return and reverse logistics issues for electronics components

Due to its interdisciplinary nature, unfortunately, there is no single text book that covers all these topics. Therefore, the course is created using various resources. For example, the course will start with discussion of concept of the sustainability and the topic will be supported by Graedel and Allenby's

(2010) book. Electronics distribution is covered very well by the book titled “Connecting Resources – A Primer for Electronics Distribution” by Kane-Sellers et al. (2004); hence, the related chapters from the book will be used to introduce the electronics industry to students. Marketing and technology adoption related topics will be supported by recent articles published in academic journals. Finally distribution and logistics related topics will be supported articles and book chapters from Ballou (2004).

### **3. Class Activities and Instructional Methods**

The course is designed based on 14 weeks of course schedule. It is expected that a single instructor will deliver the course material but invite several guest speakers to deliver certain topics. For Spring 2012 semester, four class periods are allocated to guest speakers. While one of these guest speakers is an academician who is expert in the areas of solar panels and electric vehicles, industry guests are going to cover topics such as building energy management systems, wind turbines, and distribution channel design for green products. The industry guests are invited from the leading industrial distribution companies which are already dealing with these products and expressed interest in recruiting students with such talent. Hence, this course will also give students a chance to interact with some prospective employers and better understand expectations.

As hinted above, most of the class periods will be used for regular face-to-face lectures. The instructor will also show videos about manufacturing of these products and application of these product ideas to small gadgets. For example, there are photovoltaic products to charge smart phones and tablets. These videos will help to learn concepts much quicker and remember in the long term. In addition, there will be power point slides posted on the course website. Although these slides will be helpful to keep up with the course, students are expected to take additional notes during lectures.

There will be articles posted on the course website. Students are expected to read these articles before coming to the classroom for discussion. Topic of these articles ranges from discussion of impact of green technologies in general to a very specific topic such as what are the barriers in front of large-scale adoption of electric vehicles (e.g., Romm, 2006). Reading these articles will help student to learn better and also creates a more interactive classroom environment due to students’ participation in discussion. For some articles, there will be in-class assignments that are similar to pop-up quizzes with a slight difference. During some of these in-class assignments students will be allowed to work as a group of two or three together. Working in groups will help them to enhance their learning also improves their communication skills as they need to convince their peers to agree on a team answer.

There will be also Harvard Business case studies related to each specific green technology. Students will work as a group on these case studies. Groups can have no more than five students and each group can choose to work on a case study or on a research topic that is an interest to them. These research topics could be a product that is not discussed in the class such as LED technology or benefits of integrating these technologies. The instructor will approve research topics based on their relevancy and scope. At the end of the semester, each group will submit a report and make a presentation on their case study or research project.

### **4. Course Assessment**

The classroom assessment techniques defined by Angelo and Cross (1993) and Palomba and Banta (1999) including but not limited to by quizzes, in-class and homework assignments, research/case study report and presentation, and exams will be utilized throughout the semester. Quizzes are usually takes less than 15 minutes and may have true/false, multiple choices, or a short essay type questions. In-class assignments are usually essay type questions related to topic covered and students are allowed to

create teams with their peers sitting close to them. Homework assignments will be based on additional reading and research to better understand these technologies and identify challenges associated with them. Students will have a week to work on each homework assignment. There will be also topics posted online on course management system and students are expected to respond those discussion topics within one week time frame.

For case studies (or research project), each team will prepare a two-page report discussing what are the areas of importance in their case study, what are some issues faced by the company discussed in the case, and how they plan to approach these problem to solve. The two-page report will be due mid-semester and students will get some feedback and guidance from instructor about their approach. Teams will submit their final report at the end of semester before presentations starts. Each group delivers a 20 minute presentation about the case study or research project. Presentation will be assessed by students in the audience and the instructor. Moreover, each student is expected to evaluate himself/herself and his/her team mates at the end of the semester based on their contributions to the case study (research project).

Finally, there will be two exams to assess students' learning. These exams will combine true/false, multiple choices, and short essay type of questions. Detailed breakdown of course assessment is provided in Table 1.

Table 1. Assessment of Learning

Midterm Exam	200 Points
Final Exam	200 Points
Case Study / Research Project	200 Points
Homework Assignments and Quizzes	250 Points
In-Class Assignments	100 Points
Discussion Board	50 Points
Total	1000 Points

## 5. Tentative Course Schedule

This course will be offered during the Spring 2012 semester first time and the tentative schedule presented in Table 2 will be followed.

Table 2. Tentative Schedule

Week	Topic
1	Introduction, Course Overview and Project Description
1	Sustainability
2	Introduction to Electronics Distribution
2	Supply Chain Management for Electronic Products / Quiz 1
3	GUEST SPEAKER
3	Green Electronic Components: EV charging stations / solar panels
4	Green Electronic Components: Wind turbines
4	Green Electronic Components: Building energy management systems

Table 2. Tentative Schedule (Cont.)

Week	Topic
5	Technology Adoption
5	Developing Marketing Strategies and Market Segmentation / Quiz 2
6	Product Positioning
6	GUEST SPEAKER
7	4Ps of Marketing: Price and Promotion
7	4Ps of Marketing: Product and Placement / Quiz 3
8	Market Research
8	Midterm Exam
9	Spring Break
9	Spring Break
10	Demand forecasting for new products
10	Distribution channel design strategies / Quiz 4
11	Distribution channel design strategies
11	GUEST SPEAKER
12	Distribution channel design strategies
12	Return and reverse logistics issues for electronics components
13	GUEST SPEAKER
13	Case Presentations
14	Case Presentations
14	Case Presentations

## 6. Additional Discussion on Selected Course Materials

Considering that this is a new course in this field, two course units are selected to provide more details on the course. The first unit is the energy management and the other one is the case study titled "EnerNOC: Turning Energy Savings into Sales" by Rice et al. (2009).

The energy management chapter is built on Taylor's (2011) supplemental material for introductory operations management courses. The energy management course unit aims to explain why energy is important for humanity, what are the factors impacting energy consumption and conservation, and presents the relationship between energy resources and the environmental effects of consuming these resources. The course specifically covers topics such as fundamental concepts in energy management, why energy management is important, energy consumption in the US and world, fossil and renewable energy resources, and energy efficiency and reduction strategies (see sample slides in the Appendix). At the end of the unit, students are expected to explain why energy concepts are important for green technologies.

The EnerNOC: Turning Energy Savings into Sales case study is about " *a clean energy company -- sells energy-monitoring, management and efficiency services to utility customers, who agree to reduce consumption during peak-period emergencies in exchange for payments throughout the year. Utilities*

*sign long term contracts with EnerNOC for delivery of "negawatts", i.e. the reduced consumption of electricity during peak periods, as a way to avoid adding power generating capacity. EnerNOC is undergoing explosive growth and must manage the build out of its energy management system, as well as the growth and evolution of its sales force."* The case study introduces concepts such as how building energy management systems work and what could be different business models for companies to operate in the green technology arena. The detailed discussion on the case study will focus on questions such as will there be a fossil fuel shortage in the near future, how does energy conservation will help, why should companies invest in green technology products (e.g., cost saving, environmental reasons, increased revenue through innovation, enhanced brand reputation), and what could be some threat for companies planning to create a business model around green technology products?

These two units together show how energy management issue discussed early in the semester tied to a topic covered toward to very end of semester. The case study also related to several other topics discussed in the class throughout the semester.

## **7. Conclusions**

There is an increasing interest in green technologies, which creates a new growth opportunity for many industrial distribution firm related electronics industry. However, our interviews with these companies shows that there is a lack of talent whom understand these new technologies, have a good grasp of supply chain management and logistics concepts as well as marketing of these products. To address this industry need, starting Spring 2012, a new course in an ETID program at YYY University will be offered. The course has an interdisciplinary approach combining team projects, individual research, case study analysis, and interaction with industry executives. These class activities will prepare students to take sales, marketing, operations management positions in electric/electronics industry targeting distribution of green technologies.

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