NSF Symposium on the Low Carbon Footprint Supply Chain

Keynotes

**Speaker:** Lawrence D. Burns, University of Michigan & Columbia University

**Title:** What is the Question?

**Abstract:** Supply chains are part of a broader value adding network and low carbon footprints are part of a broader sustainability challenge. While reducing the carbon footprint of supply chains is important, this objective should be addressed in terms of the broader objectives of creating consumer value and generating supplier returns in a sustainable economy. This presentation will frame opportunities and challenges related to low carbon footprint supply chains in the context of realizing sustainable economic growth through sustainable system design.

**Bio:** On October 1, 2009, Larry Burns completed a 40-year career with General Motors serving as Corporate Vice President of Research & Development and Strategic Planning. He is currently a Professor of Engineering Practice at University of Michigan and the Director of the Roundtable on Sustainable Mobility at Columbia University. He is also the Vice Chairman of the Midwest Research Institute, a contractor to the National Renewable Energy Laboratory, and an advisor to Hess Corporation, Vantage Point Venture Partners and GreenTech Capital Advisors.

**Speaker:** Gerard Cachon, University of Pennsylvania

**Title:** Supply Chain Structure and the Cost of Carbon

**Abstract:** A considerable amount of research has been done to optimize the efficiency of a given supply chain, but surprisingly little has been done to understand the drivers behind the structure of a supply chain. This paper focuses on the structure of a retail supply chain – the size and location of stores. Both transportation as well as inventory costs are considered. The key findings relate changes in the cost of carbon to the optimal changes in the supply chain configuration.

**Bio:** Professor Cachon is an expert in supply chain management and operation strategy with a focus on how new technologies transform competitive dynamics and enable novel operational strategies. His recent research is centered on sustainable operations and the impact of climate change on supply chains. He is the Editor-in-Chief of Management Science, the premier academic journal for scientific analysis across all business disciplines. He is the Chair of the Operations and Information Management department, a Fellow and former President of the Manufacturing and Service Operations Management Society of INFORMS, and a former Editor-in-Chief of Manufacturing & Service Operations Management. He is the author of Matching Supply with Demand: An Introduction to Operations Management (2ed), which has been used in undergraduate, MBA and executive MBA courses at Wharton as well as at numerous other business schools throughout the world. He has received several teaching awards for effective course delivery. His articles have appeared in Harvard Business Review, Management Science, Manufacturing &
Title: Embodied Carbon Flows and Product Footprinting in an Era of Differential Carbon Pricing

Speaker: Michael Grubb, Cambridge University

Abstract: Carbon footprinting has at least two major functions. One is a broad corporate function, helping companies to understand carbon embodied in their supply chains, for the purposes of CSR & supply chain management and communication of this information to consumers. The other is a wider policy function, providing a new route towards helping countries to reduce CO2 emissions. This presentation argues that the policy dimension has important but different implications for regions that have implemented carbon pricing, and those that are struggling to do so; but that the importance of both increases with the growing scale of ‘embodied carbon’ flows between countries. The scale of global embodied carbon trade has grown rapidly and now probably exceeds 20% of emissions in major regions, flowing predominantly from the developing world (including the major emerging economies) and Russia to the OECD countries. This is also a measure of the gap between production and consumption based accounting of emissions. For the European Union, tracking embodied carbon flows in primary commodities will be crucial to strengthening the EU ETS through border levelling measures. For the US, the difficulties experienced in trying to implement a carbon price puts more emphasis upon the question of whether consumer preference can be a strong enough motivation to help decarbonise supply chains. In either case, there is a clear and useful interface to be established between government tracking & regulation of carbon intensive production and products, and private sector efforts to trace supply chains through to final manufactured and processed goods.

Bio: Professor Michael Grubb is Chair of the international research organization Climate Strategies, headquartered at Cambridge University where he is also a Senior Research Associate at the Faculty of Economics. In Oct 2008 he stepped down from his position as Chief Economist at the UK Carbon Trust to focus on his academic work, and is writing a book, The Carbon Connection, on the lessons from 20 years of efforts to implement climate policies. He was formerly, Professor of Climate Change and Energy Policy at Imperial College London, and head of Energy and Environment at Chatham House, and he continues to be associated with these institutions. In 2008 he was appointed to the UK Climate Change Committee, established under the UK Climate Change Bill to advise the government on future carbon budgets and to report to Parliament on their implementation. Michael Grubb is author of seven books, fifty journal research articles and numerous other publications. He has held numerous advisory positions with governments, companies and international studies on climate change and energy policy, and has been a Lead Author for several reports of the IPCC on mitigation, including the IPCC Fourth Assessment Report. He is editor-in-chief of the journal Climate Policy and is on the editorial board of Energy Policy. His most recent works have been directing Climate Strategies research on competitiveness dimensions of the EU ETS, now extending into analysis of EU ETS design and impacts to 2020; and editing a book A low carbon electricity system for the UK: technology, economics and policy (Cambridge University Press, May 2008).

Speaker: David Simchi Levi, MIT

Title: The Green (and Lean) Supply Chain

Abstract: There is growing interest in understanding the impact of various supply chain decisions on the firm’s carbon emission footprint. This is in particular true in Europe, which in 2005 imposed the world’s
first cap-and-trade regulation on carbon dioxide, resulting in financial incentives to reduce firms' carbon emission footprints. It has also started taking root in the US where large retailers, such as Walmart, are requiring suppliers to reduce their carbon footprint through, for example, better packaging. In general, the motivation in North America for reducing carbon emission is driven by the recognition that high carbon emission is a sign of inefficiency in the supply chain and in particular it may be a sign that transportation cost is higher than necessary. Unfortunately, reducing carbon emission may not necessarily be consistent with lean supply chain strategies. Thus, in this talk we will review strategies that allow the firm to stay "lean" while becoming more "green."

**Bio:** Professor David Simchi-Levi of MIT holds a Ph.D. from Tel Aviv University. His research currently focuses on developing and implementing robust and efficient techniques for logistics and manufacturing systems. He has published widely in professional journals on both practical and theoretical aspects of logistics and supply chain management. Simchi-Levi has been the principal investigator for more than seven million dollars in funded academic research. He is the editor-in-chief of Operations Research, the flagship journal of Informs, the Institute for Operations Research and the Management Sciences. He was the founder of LogicTools which developed supply chain optimization software and was acquired by ILOG in April 2007 and is now part of IBM where he served as ILOG Chief Scientist. Simchi-Levi is co-author of several books: ‘Designing and Managing the Supply Chain’ (Mcgraw Hill, 1999, 2003, 2007), ‘The Logic of Logistics’ (Springer, 1997, 2004), ‘Managing the Supply Chain’ (Mcgraw Hill, 2003) and the author of the new ‘Operations Rules: Delivering customer value through flexible operations’ (MIT Press, 2010).
Invited Talks

**Speaker:** Mondher Ben Hamida, E2open, Inc

**Title:** Is a Greener Supply Chain a Leaner Supply Chain? Thoughts on Carbon as the New Muda

**Abstract:** Various studies show that Supply Chain related activities (i.e. industrial and transportation) account for close to half of the world’s energy consumption. Modeling and optimizing GHG emissions in manufacturing and logistics operations is therefore of paramount importance if the global community is to seriously tackle the environmental issues facing the planet. However, and despite the rather urgent nature of this global challenge, the momentum behind the green movement lost some strength because of the economic slowdown. Most of the business world continues to perceive the sustainability dimension as a rather costly undertaking with no clear ROI and hence to be tackled only when times are good. Our talk will aim to prove that embracing greener practices is good business and making the shift starts with a surprisingly simple move: approach GHG emissions as just another operational decision variable. Considering CO2 as the new Muda (the Japanese term for ‘waste’ in lean practices) and optimizing its amount within the extended supply chain in line with current practices that aim to reduce cost and inventory is key to taking sustainability mainstream within the OM community.

**Bio:** Mondher Ben Hamida is a Vice President with E2open, Inc a leading provider of supply chain collaboration and integration solutions. His practice is responsible for providing strategic and operational guidance to senior executives of Global 1000 companies. Mondher is a supply chain practitioner, thought leader and educator with 13 years of consulting and operational experience spanning several industries. His focus has been on designing and implementing innovative supply chain models that resulted in significant operational efficiencies and differentiated customer fulfillment models. Mondher has published several articles on various topics ranging from supply chain strategy to reducing the environmental impact of logistics operations. He is also a co-inventor of a supply chain carbon modeling tool. Mondher is a citizen of the world and his passion for solving global supply chain problems along with his fluency in 4 languages has led him to operate in five continents.

**Speaker:** Saif Benjaafar (with Yanzhi Li and Mark Daskin)

**Title:** Carbon Footprint and the Management of Supply Chains

**Abstract:** Using relatively simple and widely used models, we illustrate how carbon emission concerns could be integrated into operational decision-making with regard to procurement, production, and inventory management. We show how, by associating carbon footprint parameters with various decision variables, traditional models can be modified to support decision-making that accounts for both cost and carbon footprint. We examine how the values of these parameters as well as the parameters of regulatory emission control policies, such as a tax on carbon emissions or a cap-and-trade system, affect cost and emissions. We use the models to study the extent to which carbon reduction requirements can be addressed by operational adjustments alone, as an alternative to costly investments in carbon-reducing technologies. We also use the models to investigate the impact of collaboration among firms within the same supply chain on their costs and carbon emissions and study the incentives firms might have in seeking such cooperation. We provide a series of insights that highlight the impact of operational decisions on carbon emissions and the importance of operational models in evaluating the impact of different regulatory policies and in assessing the benefits of investments in more carbon efficient technologies.
Bio: Saif Benjaafar is a Professor of Industrial & Systems Engineering at the University of Minnesota where he is also Director of the Industrial & Systems Engineering Program, Director of the Center for Supply Chain Research, and a Faculty Scholar with the Center for Transportation Studies. He was a Distinguished Senior Visiting Scientist at Honeywell Laboratories and a Visiting Professor at universities in France, Belgium, Hong Kong, China and Singapore. He Holds PhD and MS degrees from Purdue University and a BS degree from the University of Texas at Austin. His research is in the areas of supply chain management, service and manufacturing operations, and production and inventory systems, with a current focus on sustainability and environmental modeling. He is on the editorial board of several journals including MSOM, POM, NRL, and IIE. His papers have been published in various journals including Management Science, Operations Research, and MSOM. His research has been funded by several US government agencies, including NSF, DOT, DHS, and DARPA. He has consulted widely with leading companies such as Honeywell, General Mills, 3M, and Intel among many others. He is a Fellow of the Institute of Industrial Engineers (IIE). More information can be found on his website: http://www.ie.umn.edu/faculty/faculty/Benjaafar.shtml.

Speaker: Edgar Blanco, MIT

Title: Carbon Footprint in Supply Chains in Practice

Abstract: With growing global concern over the effects of climate change the role of the supply chain in greenhouse gas emissions has increased in attention. One popular measure of a product’s contribution to climate change is its carbon footprint. While this measure is commonly associated with the product is also serves as a measure of the carbon efficiency of the product’s supply chain. Product carbon footprints are traditionally measured using a method known as Life-Cycle Assessment (LCA), which provides a quantitative measure of the environmental burdens associated with a product. Though LCA is conceptually well suited for measuring carbon footprints it suffers from several issues in practice. The issues with current methods for measuring a product’s carbon footprint are explored and a framework for measuring the carbon efficiency of a supply chain through carbon labels is presented, including variability and asymmetric information between supply chain partners.

Bio: Edgar Blanco is a Research Director at the MIT Center for Transportation & Logistics and is the Executive Director of the MIT SCALE Network in Latin America. His current research focus is the design of environmentally efficient supply chains. He also leads research initiatives on supply chain innovations in emerging markets, disruptive mobile technologies in value chains and optimization of humanitarian operations. He has over thirteen years of experience in designing and improving logistics and supply chain systems, including the application of operations research techniques, statistical methods, GIS technologies and software solutions to deliver significant savings in business operations. Prior to joining MIT, he was leading the Inventory Optimization practice at Retek (now Oracle Retail). He received his Ph.D. from the School of Industrial and Systems Engineering at the Georgia Institute of Technology. His educational background includes a B.S. and M.S. in Industrial Engineering from Universidad de los Andes (Bogotá, Colombia) and a M.S. in Operations Research from the Georgia Institute of Technology.

Speaker: Charles Corbett, University of California at Los Angeles

Title: Carbon-Optimal Supply Chains (with Felipe Caro, Tarkan Tan, Rob Zuidwijk)
Abstract: In this paper we explore the differences between making a supply chain carbon-neutral by offsetting all emissions vs. making it carbon-optimal by inducing all parties to invest appropriately in reducing GHG emissions. We examine conditions under which first-best can and cannot be achieved, and examine various decentralized outcomes.

Bio: Charles Corbett, Ph.D., is professor of Operations Management and Environmental Management at the UCLA Anderson School of Management, where he currently also serves as Chairman and Deputy Dean of Academic Affairs. He was an AT&T Faculty Fellow in Industrial Ecology, and served as Associate Dean of the MBA program from 2003-2006. He was named Joseph J. Jacobs Term Chair in Entrepreneurial Studies for the period July 2008-2011. His areas of teaching include operations of entrepreneurs and small business, environmental issues in management, operations management, and supply chain management. His 2006 study on sustainability in the motion picture industry was featured in media outlets worldwide, including CNN, the Los Angeles Times, the New York Times, The Guardian, La Opinion, and various radio and TV stations.

Speaker: Cynthia Cummis, WRI

Title: Reducing Corporate GHG Emissions through GHG Protocol’s Scope 3 and Product Life Cycle Accounting and Reporting Standards

Abstract: To address the growing need to accurately and consistently measure corporate value chain emissions, the GHG Protocol launched an effort to develop the Scope 3 Accounting and Reporting Standard and the Product Life Cycle Accounting and Reporting Standard. The new GHG Protocol standards will provide a standardized method to inventory the emissions associated with individual products across their full life cycles and of corporate value chains, taking into account impacts both upstream and downstream of the company’s operations. By taking a comprehensive approach to GHG measurement and management, businesses and policymakers can focus attention on the greatest opportunities to reduce emissions within the full value chain, leading to more sustainable decisions about the products we buy, sell, and produce. To develop the new standards, the GHG Protocol is following the same broad, multi-stakeholder process used to develop our previous standards, with participation from businesses, policymakers, NGOs, academics and other experts and stakeholders from around the world. The first drafts of the standards were released for public comment in November 2009 and road testing of the standards was recently completed by more than 60 companies. Based on the feedback received, the standards are being revised and the second drafts will be available in October 2010.

Bio: Cynthia Cummis is a Senior Associate with the GHG Protocol team at WRI and currently manages the development of the GHG Protocol Scope 3 and Product Standards. She brings more than 10 years of experience in GHG accounting. Cynthia comes from Clear Carbon Consulting where she was Director of Carbon Management, managing carbon quantification and GHG management projects for multiple Fortune 500 clients. Cynthia was the founding Director of U.S. EPA’s Climate Leaders program, where for more than 5 years she led the design and implementation of the program and oversaw its’ growth to more than 90 corporate partners. In this position, she managed the development of the Climate Leaders inventory protocols and advised dozens of companies on completion of a corporate GHG inventory. While at EPA, Ms. Cummis was closely involved in the development of the GHG Protocol Corporate Standard as a representative on the Editorial Committee for the first version and a member of the Revision Working Group for the revised edition. She is currently also a faculty member of the Greenhouse Gas Management Institute instructing a course on the basics of GHG accounting.
**Speaker:** Kaan Katircioglu, IBM  

**Title:** Measuring and Managing Carbon Emissions in Supply Chains: Solutions & Lessons Learned from Implementations

**Abstract:** At least half the global carbon emission can be attributed to supply chain activities. Accurate measurement of the carbon associated with these activities and identification of cost-effective ways to reduce it are challenging. IBM Research developed a framework for modeling carbon in supply chains and conducted three pilot implementations. The software solutions created in these implementations are designed to calculate carbon emissions and analyze the trade-offs between carbon and other metrics in supply chains such as warehousing and transportation costs, inventory, and service levels. The solutions also provide extensive scenario analysis capabilities to evaluate the impacts of various supply chain actions on operational, financial, and environmental metrics. We will present details of our framework and the solutions we developed. We will share our findings, describe the most effective levers for carbon reduction that we found in our projects, and show some win-win scenarios that can reduce both carbon emissions and costs. We will also articulate the lessons learned and make recommendations for those considering similar initiatives.

**Bio:** Kaan Katircioglu is a senior research scientist at IBM Research’s Business Analytics & Mathematical Sciences Department. He has fifteen years of industry experience in Operations Research, Management Science & Logistics. He received his B.Sc. in Industrial Engineering M.Sc. in Statistics, and Ph.D. in Management Science / Transportation & Logistics. He joined IBM’s T.J. Watson Research Center in 1996 as a research staff member. Since then, he has worked on over 30 projects for various divisions of IBM and its clients. He performed as IBM representative at SEMATECH Logistics Forum in 1997-2000, and as the IBM Research Relationship Manager for Travel & Transportation Industry in 2007-2009. Currently, he is the IBM Research lead for supply chain sustainability management. He has over 35 scientific publications, book chapters, working papers, and numerous conference presentations. He appeared in many events as an invited speaker or panelist. He has patents and pending patent applications for his work. He is the lead inventor of IBM’s Carbon Trade-off Modeler announced by IBM in May, 2008. He is a member of INFORMS, DAS and IEEE.

**Speaker:** Diego Klabjan, Northwestern University  

**Title:** Low Carbon Supply Chain Design where Green Really Matters (with Yue Geng)

**Abstract:** Nowhere are low emission operations more important than in logistics to remote pristine locations such as within the Arctic Circle. Logistics to remote locations posts traditional challenges including highly seasonal variability, limited options resulting in high transportation costs, and the much more contemporary aspect of low carbon footprint requirements. Low emission requirements are of particular importance to agencies such as the NSF responsible for conducting atmosphere related research activities that must not be influenced by manmade pollution from logistics activities. Such pollution would easily skew research findings and thus the trade-off between cost and emissions needs to be carefully assessed. This study focuses on the long term economic assessment of a large research site in Greenland operated by NSF with outsourced logistics operations. To this end, we study the strategic supply chain design problem as a bi-objective optimization problem, where cost and carbon footprint must be controlled. The overall model is based on the time-spaced network and a multi-commodity mathematical programming formulation. Capturing emissions at the actual point of delivery requires an explicit inclusion of energy consumption, which depends on the activities that are in turn part of decisions. An interesting option is the use of renewable electricity sources at the site, which would have an immediate direct impact on the fuel delivered and with consequences on the entire logistics operations. Alternative modes of transportation, which are not necessarily most cost efficient, but have low carbon...
footprint are included in the study. By using goal programming techniques of first minimizing cost and then emissions subject to a tolerable cost increase, we show how to design a cost and environmentally effective logistics network and provide guidance to future feasibility of operating the site.

**Bio:** Diego Klabjan is an associate professor at Northwestern University, Department of Industrial Engineering and Management Sciences. Professor Klabjan obtained his doctorate from the School of Industrial and Systems Engineering of the Georgia Institute of Technology in 1999. In the same year he joined the University of Illinois at Urbana-Champaign, and in 2007 became an associate professor at Northwestern. His research is focused on business intelligence and analytics in the areas of electric vehicles, smart grid, renewable energy, and sustainable transportation and supply chain management.

**Speaker:** Sujeeesh Krishnan, Carbon Trust

**Title:** Product Carbon Footprinting: Assessment, Standard Development and Application

**Abstract:** The presentation will discuss the evolving product carbon footprinting space from the perspective of what it is, why it is important, what the emerging methodologies are, and what the Carbon Trust is doing in this space. The BSI PAS 2050:2008 – a world-recognized methodology for conducting product carbon footprinting will be introduced along with a discussion of the process by which it was written and the supporting documentation that the Carbon Trust developed in order to support businesses to implement the methodology in an efficient manner. The presentation will also describe Carbon Trust’s tools – Footprint Expert™ and service offerings to enable companies to measure, reduce, and communicate product carbon footprints. A few case studies of the results our work with companies will be discussed to provide some insight into how different companies are using product carbon footprinting to reduce carbon emissions, make their operations more efficient, and communicate all of their work with their external stakeholders.

**Bio:** Sujeeesh Krishnan is Head of Carbon Footprinting with the Carbon Trust LLC. He is responsible for the Carbon Trust’s product carbon footprinting and labeling initiatives in the Americas. He is coordinating work with leading manufacturers and retailers and is working with key government bodies, NGOs, and think tanks around the development of standards. Sujeeesh has worked at Ernst Young, GetConnected Inc. a digital services aggregator, and i2 Technologies Inc., a supply chain solutions provider. Sujeeesh holds a B.E. (Honors) in Mechanical Engineering from the Birla Institute of Technology & Science, a M.S. in Manufacturing Systems Engineering from the University of Wisconsin and a MBA from the MIT-Sloan.

**Speaker:** Steve Leffin, UPS

**Title:** Carbon Footprint Management through Strategic Supply Chain Logistics

**Abstract:** Steve will show how UPS manages its network to drive carbon efficiencies through its operational strategies, network planning, and supply chain logistics capabilities. Specific areas to be addressed will be: network structure and planning benefits, intermodal, the relative impact of efficiency strategies, supply chain optimization capabilities, a responsible carbon neutral service, and a legacy of asset and network efficiencies.

**Bio:** Steve Leffin serves as Director of Global Sustainability for UPS, the world’s largest package delivery company and a global leader in supply chain services. He is responsible for managing all sustainability initiatives and strategies. Leading a cross-functional team from various business units
throughout the company, Steve has worked to implement numerous sustainability initiatives at UPS. Steve joined UPS 28 years ago and has held various region and district assignments throughout the country. As a graduate engineer with a postgraduate masters, he was promoted through several levels of management and has served as a mechanic, supervisor, project engineer, facilities engineer, district plant engineering manager, operations division manager, region plant engineering manager and regional engineering manager. Steve’s previous assignments leading up to his current position include corporate telematics manager and corporate environmental affairs manager.

Speaker: H. Scott Matthews, Carnegie Mellon University

Title: Using Public Data to Estimate Corporate and Product Carbon Footprints

Abstract: In this talk we summarize how input-output analysis has been used over the past 15 years to estimate life cycle energy and environmental impacts of companies and products. Using economic data from the Department of Commerce, and energy/emissions data from the Department of Energy and US EPA, we show examples from our published papers on how companies can quickly estimate their scope 1, 2, and 3 emissions in support of GHG Protocols. In short for most companies Scope 1 and 2 GHG emissions represent a small part of their overall footprint, with scope 3 dominating. This is part of the reason why standards agencies are so focused on Scope 3 emissions at this point in time. We also show how our work has been used to help California gauge the degree to which low-carbon policies (such as low carbon fuels and low-carbon electricity) can be limited by the focus of control within the state given the global and complex supply chains of today's products. To achieve truly low-carbon products, substantial investments will be needed.

Bio: H. Scott Matthews is the Research Director of the Green Design Institute and a faculty member in the Departments of Civil and Environmental Engineering and Engineering & Public Policy at Carnegie Mellon University. The Green Design Institute is an interdisciplinary research consortium at Carnegie Mellon focused on identifying and assessing the environmental impacts of systems and helping businesses manage their use of resources and toxic materials. His research and consulting interests are in the area of valuing the socio-economic implications of environmental systems and infrastructure and industrial ecology. Of particular interest are using the Internet to facilitate environmental life cycle assessment of products and processes, estimating and tracking carbon emissions across the supply chain, and the sustainability of infrastructure. At Carnegie Mellon, he has taught graduate and undergraduate courses in the Departments of Economics, Civil and Environmental Engineering, Engineering and Public Policy, and Computer Science

Speaker: Jong-Shi Pang, University of Illinois at Urbana-Champaign

Title: Emissions Allowance Allocation in Competitive Electricity Markets

Abstract: We present non-cooperative game models for competitive electricity markets in a pollutant cap-and-trade system wherein emissions permit are allocated according to certain rules, such as by auction, by giving away fixed amounts, or by allocating based on present or recent output, investment, or other decisions. Nonlinear complementarity formulations are derived for investigating the long-run equilibria in such emission constrained power markets characterized additionally by time-varying demands, multiple technology types, and capacity trading. Solutions for simple systems show that certain allocation rules can yield large distortions in capacity investment, invert the operating order of power plants, and inflate consumer costs.
Bio: Jong-Shi Pang joined the University of Illinois at Urbana-Champaign as the Caterpillar Professor and Head of the Department of Industrial and Enterprise Systems Engineering in August 2007. Prior to this, he held the position of the Margaret A. Darrin Distinguished Professor in Applied Mathematics in the Department of Mathematical Sciences and was a Professor of Decision Sciences and Engineering Systems at Rensselaer Polytechnic Institute from 2003 to 2007. He was a Professor in the Department of Mathematical Sciences at the Johns Hopkins University from 1987 to 2003, an Associate Professor and then Professor in the School of Management from 1982 to 1987 at the University of Texas at Dallas, and an Assistant and then an Associate Professor in the Graduate School of Industrial Administration at Carnegie-Mellon University from 1977 to 1982. Professor Pang was a winner of the 2003 George B. Dantzig Prize awarded jointly by the Mathematical Programming Society and the Society for Industrial and Applied Mathematics for his work on finite-dimensional variational inequalities, and a co-winner of the 1994 Frederick W. Lanchester Prize awarded by the Institute for Operations Research and Management Science. Two of his publications have received best paper awards. He is an ISI Highly Cited Researcher in the Mathematics Category between 1980-1999; he has published 3 widely cited monographs and more than 100 scholarly journals in top peer reviewed journals. Dr. Pang is a member in the inaugural 2009 class of Fellows of the Society for Industrial and Applied Mathematics.

Speaker: Erica Plambeck, Stanford University

Title: Allocating Emissions from Process to Co-Products (joint with Nur Sunar)

Abstract: To implement a GHG emissions tax on imports or to evaluate the carbon footprint of a supply chain, one must specify how to allocate the emissions from a process among its co-products. For example, emissions could be allocated in proportion to the economic value or in proportion to the mass of co-products. We investigate the implications of the allocation rule (and flexibility therein) for investment in energy efficiency, production quantities, GHG emissions, and firms’ profits.

Bio: Erica Plambeck is the Kilpatrick Professor of Operations, Information and Technology at the Graduate School of Business and a Senior Fellow in the Woods Institute for Environment at Stanford University. Her research addresses sustainability in operations and supply chain management, and she teaches ‘Environmental Entrepreneurship’ and ‘Environmental Science for Managers’.

Speaker: Buddy Polovick, U.S. Environmental Protection Agency

Title: The SmartWay Transport Partnership: Enhanced Supply Chain Carbon Accounting for the Freight Sector

Abstract: Business leaders are looking closely at their supply chains to address more urgent concerns for energy security, economic vitality and climate change. As marketplace conditions change, sustainability minded companies have demonstrated that they can address these issues by reducing fuel use in goods movement. The SmartWay Transport Partnership is a government industry Partnership which has been shown to help the domestic trucking and rail sectors to save fuel and money. EPA is now enhancing the first-generation Partnership to include other modes of transportation in the global supply chain such as air cargo and maritime. SmartWay next-generation tools will give freight shippers and carriers the ability to better address their goods movement supply chain carbon footprints. This discussion will highlight how a market based public private partnership helps freight shippers and carriers to save fuel and money by benchmarking their transportation supply chain carbon efficiency and optimizing both modal and provider choices. Partners are demonstrating to customers, clients, and investors that they are taking responsibility
for freight emissions throughout their supply chain. EPA shows how SmartWay Transport shipper and carrier Partners use new technologies and management practices to improve their supply chain efficiency and reduce fuel use and emissions. EPA will also showcase the next generation SmartWay tools EPA provides to quantify the efficiency of ground freight operations. Freight shippers and carriers benefit from fuel savings, cost savings, improved information and resources, competitive advantages gained, and enhanced public relations. SmartWay Partners who demonstrate their commitment to improving fuel efficiency qualify to use the SmartWay logo to enhance their visibility as a responsible corporate citizen and fuel efficient business partner.

**Bio:** Buddy has worked for the US Environmental Protection Agency for fifteen years as part of the Office of Transportation and Air Quality, which is part of EPA's Office of Air and Radiation. Based in Ann Arbor, Michigan at the National Vehicle and Fuel Emissions Laboratory, Buddy is the International Team Leader for the SmartWay Transport Partnership. Buddy is part of the EPA team who worked with industry leaders to develop and implement this innovative Partnership in 2004. Prior to SmartWay, Buddy worked to implement vehicle emission testing programs throughout the US. Before joining the EPA, Buddy served in the US Peace Corps as a Community Development Specialist in Mali, West Africa. His education background includes a B.A. in International Relations from The Ohio State University and graduate studies in Environmental and Natural Resource Policy at Michigan State University.

**Speaker:** Steven Skerlos, University of Michigan

**Title:** Predictive Life Cycle Assessments for Technology, Policy, and Supply Chain Design

**Abstract:** This presentation explores a specific type of consequential life cycle inventory that incorporates incentives for consumer demand, producer profit, and producer competition within a life cycle inventory (LCI) framework. The purpose of developing this predictive market system LCI (pLCI) is to permit endogenous calculation of economic and behavioral effects that are important when evaluating the environmental consequences that might arise from different product and policy design options. The presentation will: 1) demonstrate how pLCI has been initially utilized in technology and policy design applications, 2) address some of the data and computational challenges of pLCI, and 3) offer thoughts regarding how pLCI can be utilized to aid in minimizing the expected carbon footprint of the supply chains emanating new product and regulatory systems.

**Bio:** Steven J. Skerlos, PhD, is Associate Professor and Associate Chair of Mechanical Engineering at the University of Michigan, Ann Arbor. He also holds a faculty appointment in Civil and Environmental Engineering. He earned a Ph.D. in Industrial Engineering and a B.S. in Electrical Engineering with Highest Honors from the University of Illinois. Professor Skerlos is a researcher in the fields of sustainable design, sustainable manufacturing, sustainable water systems, and technology policy. He has co-authored over 80 publications in refereed journals and conference proceedings and has co-founded two start-up companies. He has served as Associate and Guest Editor for four different journals in design, manufacturing, and environmental science. He was awarded the National Science Foundation CAREER award in 2000 and the College of Engineering Education Excellence Award in 2006. He has received awards for research scholarship and education excellence from the Society of Manufacturing Engineers and the Society of Automotive Engineers.

**Speaker:** Valerie M. Thomas, Georgia Institute of Technology

**Talk:** Co-product Allocation and Indirect Effects in Lifecycle Greenhouse Gas Calculations
Abstract: Regulatory requirements for renewable fuels with low lifecycle greenhouse gas emissions, and the development of markets for low greenhouse gas electricity are driving the development of improved methods of environmental lifecycle assessment (LCA). Analysis of potential large-scale changes in product systems are driving the LCA methodological basis from an attributional to a consequential framework. Key challenges are co-product allocation – with agricultural by-products and electricity exports the leading examples – and indirect effects, with land use change the leading example. We show how indirect effects can be calculated, and that they can be the dominant factor, using an example of large-scale US bioenergy development. We also use the biofuel example to show how coproduct allocation methods can dominate the calculation of lifecycle greenhouse gas emissions. For different bioenergy systems, different approaches to coproduct allocation have been used, including mass, energy content, economic value, displacement and systems expansion. While system expansion is the preferred approach in ISO LCA standards, system expansion presents challenges for regulatory interpretation and for markets. For the well-studied case of corn-derived ethanol, we show how co-product allocation through displacement calculations introduces parameters that are not measurable or verifiable at the micro-economic scale. We introduce a statistical approach for compositional distributions at the macroeconomic scale to validate some aspects of coproduct allocation and indirect land use effects.

Bio: Valerie Thomas is the Anderson Associate Professor in Industrial and Systems Engineering at Georgia Tech, with a joint appointment in the School of Public Policy. Her research addresses energy, greenhouse gas emissions, and environmental impact analysis, including lifecycle assessment of biofuels and bioenergy, as well as studies of urban systems, and information technology and markets for recycling, reuse, and product lifecycle management. Before coming to Georgia Tech, she worked at Princeton University and Carnegie Mellon University and was a Congressional Science Fellow sponsored by the American Physical Society. She has a PhD in theoretical physics from Cornell University, and a BA from Swarthmore College.

Speaker: Tarkan Tan, Eindhoven University of Technology, The Netherlands

Title: Measuring and Regulating Carbon Emissions in Transportation

Abstract: Carbon emissions are increasingly being regulated yet little understanding is available about the proper measurement of these emissions in transportation and the potential impact of regulations on transportation. Using a double case study, we investigate the measurement process of carbon emissions in a European transport network of two primarily bulk shippers. We provide insights into the actual emissions and identify emission reduction possibilities. Next, we investigate the effect of regulation mechanisms on the transport mode selection decision. A faster transport mode typically results in lower inventory or higher service at the cost of higher emissions and transport costs. We use an accurate calculation method to determine the carbon emissions. Our results show that introducing an emission cost for freight transport, e.g. via a market mechanism such as cap-and-trade, will not result in large emission reductions, since significant changes in transport modes are not likely to take place for plausible carbon prices.

Bio: Tarkan Tan is an Assistant Professor in the School of Industrial Engineering at Eindhoven University of Technology, The Netherlands, and he has recently spent an academic term at the University of California, Los Angeles, as a visiting scholar. Dr. Tan received his Ph.D in Industrial Engineering from the Middle East Technical University, Ankara, Turkey, in 2002. He pursued one year of his studies towards his Ph.D. degree at Columbia University, Graduate School of Business, Management Science / Operations Research division, New York, as a Fulbright scholar. He joined Eindhoven University of Technology as a post-doc researcher in 2003 and started working as an assistant professor the same year in the Operations, Planning, Accounting, and Control group. Dr. Tan is an executive board member of the
European Supply Chain Forum. His research interests include inventory theory, capacity management, spare parts management, and supply chain management with a particular focus on the effects of carbon emissions.