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An AIChE Technological Community

Pacific Northwest Regional Conference on Sustainability

University of Washington

Seattle Campus

April 29 to May 1, 2011

PROGRAM BOOK

American Institute of Chemical Engineers

Puget Sound Local Section

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An AIChE Technological Community

Pacific Northwest Regional Conference on Sustainability

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The local Pacific Northwest sections of AIChE have committed to minimizing the environmental impact of the Conference by:

- Decreasing the amount of solid waste produced by the event
- Reducing energy and water consumption at the event
- Minimizing or off-setting harmful emissions resulting from vehicular transportation, other travel and energy consumption associated with the event
- Educating Conference participants in green or sustainable practices employed at the Conference
- Disposing of solid and liquid waste in an environmentally responsible manner and
- Eliminating the use of harmful chemicals at or for the event.

A note about this program book:

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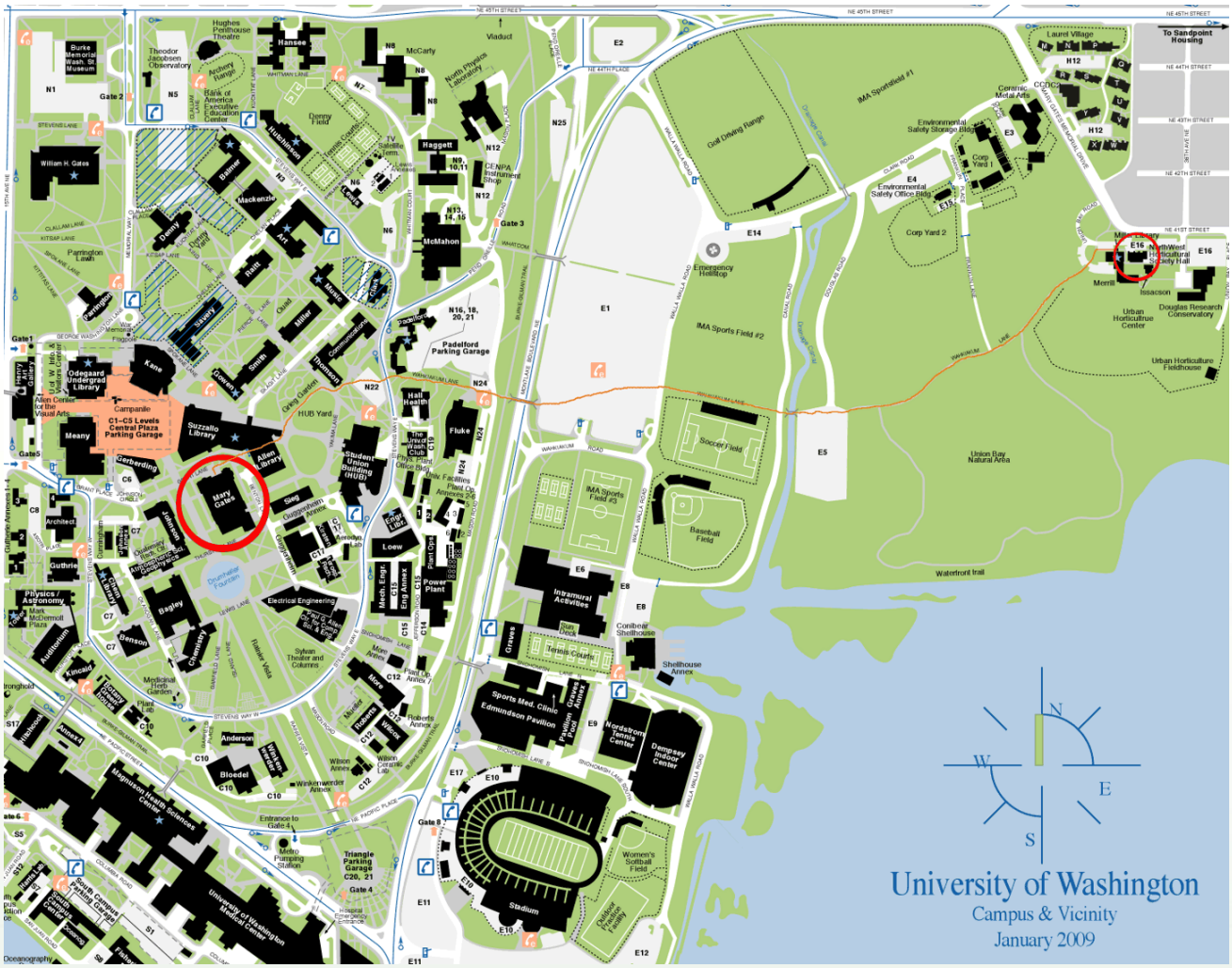
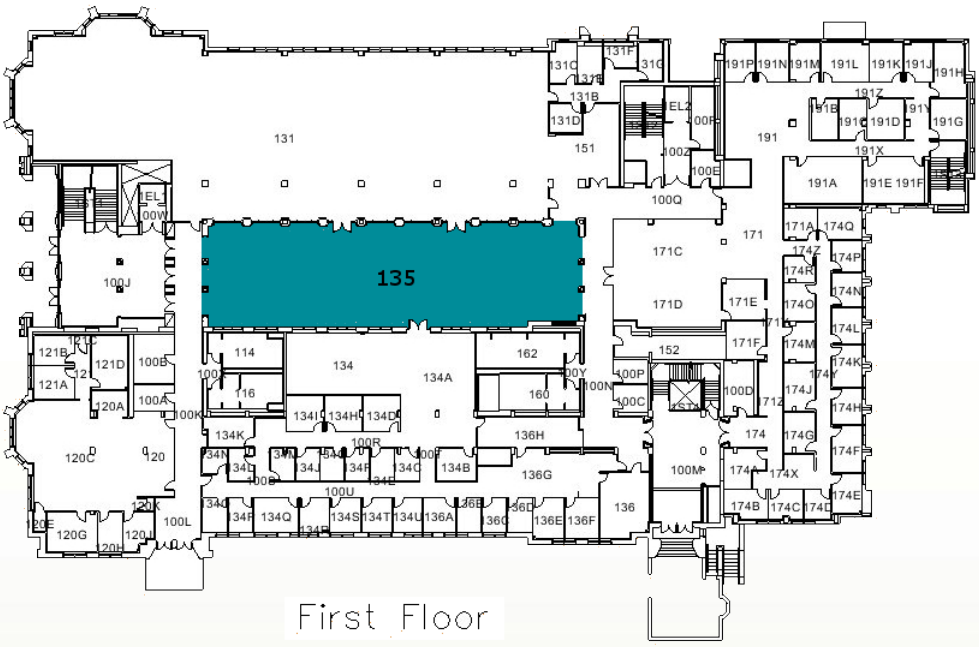


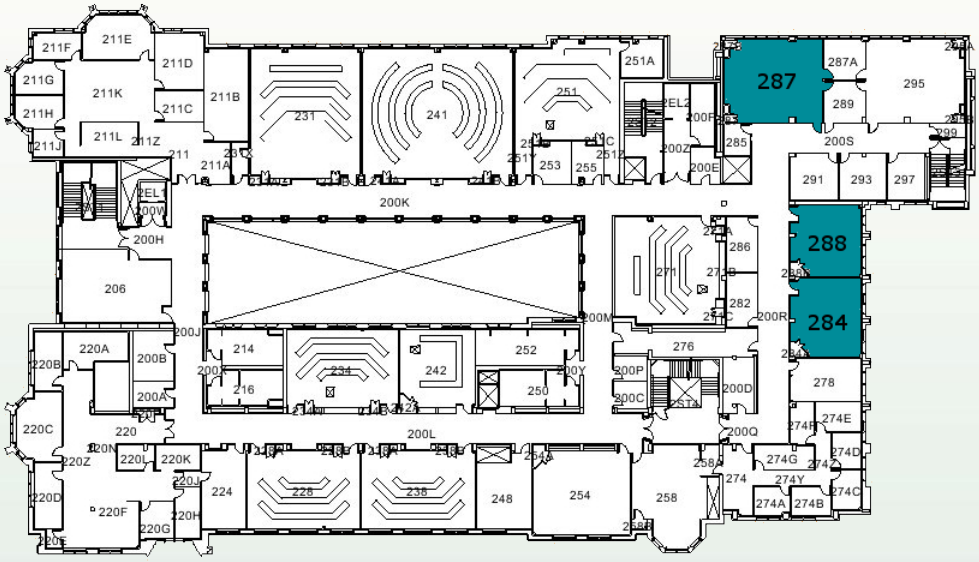
Mary Gates Hall is the University of Washington's center for undergraduate learning—a crossroads and commons for undergraduates. From orientation to graduation and beyond, students find opportunities and academic services within Mary Gates Hall that enhance their education.

Mary Gates Hall is a place where students from diverse backgrounds come to learn, study, celebrate their accomplishments, and plan their futures. The two-story interior commons is surrounded by technologically-advanced classrooms in which faculty bring students into the excitement of their work, encouraging discovery, community, and life-long learning.

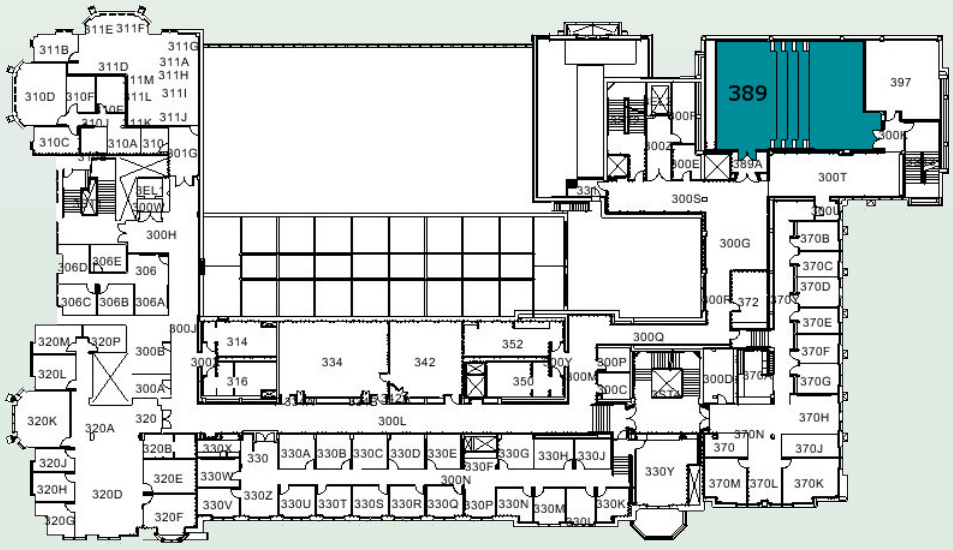
The sustainability conference will be held in the highlighted areas of the map. Please check the program for specific room numbers and times of the talk or event you are interested in attending.



First Floor



Second Floor



Third Floor

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An AIChE Technological Community

Pacific Northwest Regional Conference on Sustainability

DAY 1
Friday, April 29, 2011

	AUDITORIUM	ATRIUM EVENTS
Location:	**MGH 389 (Auditorium)**	**MGH 135 (Commons)**
START TIME		
6:00 PM	Registration	POSTER SESSION and RECEPTION
6:30 PM	Opening Remarks and Keynote Scott Butner, PNNL	
7:15 PM		Networking Event and Reception

DAY 2

Saturday, April 30, 2011

	MAIN	TRACK				ATRIUM EVENTS
		ENERGY	ENVIRONMENT	WATER	AUDITORIUM	
Location:		MGH	MGH	MGH	MGH Auditorium	MGH Commons
START TIME		284	287	288	389	135
8:00 AM						Breakfast and Registration
9:15 AM					Keynote Mary Armstrong, VP Environment, Health and Safety, Boeing	
10:00 AM	15 minute break					
10:15 AM		SESSION 1 William Breneman, HM3 Energy Inc. "Torrefied biomass: A carbon sequestering alternative"	SESSION 1 Liv Haselbach, WSU "Low Impact Development and Pervious Concrete: Environmental Chemistry and Heat Island Impacts"	SESSION 1 Carolina Gonzalez, GE "Water Recovery and Reuse for Coal Steam Gas Operations in Queensland, Australia"	SESSION 1 Fred M. Lightfoot, Robert E. Milligan, William C. Morchin, and Dr. Terry I. Eade "Ocean-Based Wave Energy Conversion, Storage and Transportation to Shore-Based Distribution Centers"	
11:15 AM		SESSION 2 Leslie Snowden-Swan, PNNL "Sustainability Assessment for Biomass Thermochemical Conversion Processes"	SESSION 2 Charles Brandt, PNNL "Ocean Energy: Emerging Technologies to Meet the Challenge of Sustainability"	SESSION 2 Javad Abbasian, Illinois Institute of Technology "Municipal Waste Water Utilization in Power Plant Cooling System"	SESSION 2 Bill Byers, CH2M HILL "Water Risk Assessment: Case Studies and Mitigation Strategies"	
12:15 PM	Lunch					
1:00 PM	Keynote Aaron Johnson, Global Application Leader – Oilfield Water, The Dow Chemical Company					Poster Session and Vendor Booth Exhibit
2:00 PM		SESSION 3 Dr. Teodora Shuman, Seattle University "Low-energy Consumption Method for Settling of Microalgae"	SESSION 3 Dr. Daniel Kirschen, University of Washington "Smart Grids"	SESSION 3 Dr. Mike Marsolek, Seattle University "The impact of thermal pretreatment on biogas yields from anaerobic digestion of algae."	SESSION 3 Dr. Kenneth Williamson, Oregon State University "Sustainable Water and Wastewater Infrastructure as a Function of Societal Development"	
3:00 PM		SESSION 4 Richard Berry, Rembco Geotechnical Engineers and Contractors "The Value of an Absolute Starting Point: Why? Is Most Important"	SESSION 4 Patrick Leonard, Paladino "The Engineer as Change Agent – Redefining 'The Box' for More Sustainable Outcomes"	SESSION 4 Mike Oddo, WasteMinCo "Accelerating Low GHG Technology Development & Implementation"	SESSION 4 John Stasko, Applied Filter Technology "Hydrogen Sulfide Removal: An Important Biogas Challenge"	
4:00 PM		SESSION 5 Karin Holland, Haley & Aldrich "Application of a Framework to Increase the Sustainability of Remediation Projects"	SESSION 5 Eleanor Kirtley, The Glosten Associates "Marine Vessel Environmental Performance Assessment"	SESSION 5 Brian Boyd, PNNL "Every Drop Counts: Water Efficiency in the Federal Sector"	SESSION 5 Jonathan Lemons, 14ft 8in & Runberg Architecture Group "14ft 8in: Our Cities Will Become Ecosystems"	
5:00 PM						
6:00 PM		BANQUET at Center for Urban Horticulture Dinner Keynote Dr. Graham Allan, Professor of Chemical Engineering and Forest Resources, University of Washington				

DAY 3

Sunday, May 1, 2011

	MAIN	TRACK			ATRIUM EVENTS
		ENERGY	ENVIRONMENT	AUDITORIUM	
Location:		MGH 284	MGH 288	MGH 389 (Auditorium)	MGH 135 (Commons)
START TIME					
8:00 AM	**SETUP**	**SETUP**	**SETUP**	**SETUP**	Breakfast and Registration
9:15 AM				Keynote David Thompson, PhD, Biochemical Engineer – Renewable Resources, Idaho National Laboratory	Poster Session and Vendor Booth Exhibit
10:00 AM	15 minute break				
10:15 AM		SESSION 1 Bill Wilson, Washington State University Extension Energy Program "Industrial Steam Boiler System Efficiency Improvement Measures, Analysis Tools and Resources"	SESSION 1 Nathan Friend and Devor Barton, Seattle Carbon Coaches "So you want to do climate outreach?"	SESSION 1 Tony Thompson, REC Silicon "Silane Based Silicon Technology for Solar Energy"	
11:15 AM		SESSION 2 Greg Rorrer, PhD, Program Director, Energy for Sustainability, Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET), Engineering Directorate, National Science Foundation	SESSION 2 Sustainability Conference Organizers "Roundtable on Sustainable and Green Event Planning and Our Carbon Offsets"	SESSION 2 Shwetak Patel, University of Washington "Energy and Water Sensing in the Home"	
12:15 PM	Lunch				
12:45 PM	Keynote Linda A. Beltz, PhD, Director, Technology Partnerships, Weyerhaeuser				
1:30 PM	30-Minute Wrap-Up Forum featuring Conference Speakers (Chaired by Dr. Kenneth Williamson)				

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ENERGY TRACK ABSTRACTS

Linda Beltz, PhD, Director Technology Partnerships | Keynote | 5/1 | 12:45 PM
Weyerhaeuser
Implementing Open Innovation to Jumpstart and Expand Innovation
Open Innovation is a powerful practice for accelerating development within an organization. Open Innovation can also comprise a broad range of external reaching practices. Although the returns of Open Innovation can be great, implementing Open Innovation practices within a company can be a complex. This presentation will discuss the discipline of Open Innovation and best practices for implementing and practicing Open Innovation within an organization.

Richard Berry | MGH 284 | 4/30, Session 4 | 3:00 PM
Rembco Geotechnical Engineers and Contractors
The value of an absolute starting point: Why? is most important.
What? When? Where? are cited easily, and even How? by the very inexperienced. Yet answering Why? is required to receive a Nobel Prize in Science. This is true of Albert Einstein, the only man to ever be awarded two Nobel Prizes. This the only way that a a thought process becomes a Theory. I will relate this information to the Energy field.

Charles Brandt | MGH 287 | 4/30, Session 2 | 11:15 AM
Pacific Northwest National Laboratory
Ocean Energy: Emerging Technologies to Meet the Challenge of Sustainability
Energy generated from ocean tides, waves, currents and temperature gradients, as well as offshore winds, has the potential to contribute to a robust and diverse portfolio of renewable energy that can sustain the nation's energy needs into the future. The power available from harnessing ocean energy is carbon-free, predictable, and rivals land-based sources in magnitude.
Specialized technologies are under development to capture energy from the movement of water and wind; early pilot projects in the U.S. are under development, following a small number already deployed in Europe. Pacific Northwest National Laboratory (PNNL) and other US. Department of Energy national laboratories, along with university partners and the emerging ocean energy industry, are exploring ways to responsibility deploy and operate devices in the ocean. The challenge of working in the harsh ocean environment is joined by the need to protect marine life, habitats, and ecosystem services that support marine industries such as fishing, recreation, and shipping, as well as navigation and national security. This paper will introduce the technologies and research tools that PNNL and their partners are using to responsibly accelerate the ocean energy industry in order to create a new sustainable energy source.

William Breneman | MGH 284 | 4/30, Session 1 | 10:15 AM
HM3 Energy, Inc.
Torrefied biomass: A carbon sequestering alternative
Through the process of torrefaction, biomass can be converted to a form suitable for use as a direct replacement for coal in large scale electrical power generation. The absence of sulfur, mercury and other impuriies reduces or eliminates the need for expensive post combustion scrubbers. As the biomass is grown and harvested within a short distance of the user, it essentially becomes a sequetering agent for the CO2 produced by the combustion process. Washington and Oregon have ample supplies of woody biomass suitable for use which further promotes cost effective reductions in atmospheric polution resulting from uncontrolled oxidation of the biomass while promoting healthy forests at the same time.

Catherine Brewer | MGH Commons 135 | Poster
Iowa State University
Selection of Biochars for a Field Study
One factor limiting the understanding and evaluation of biochar for soil amendment and carbon sequestration applications is the scarcity of long-term, large-scale field studies. Limited land, time and material resources require that biochars for field trials be carefully selected. In this study, 17 biochars from the fast pyrolysis, slow pyrolysis and gasification of corn stover, switchgrass and wood were thoroughly characterized and subjected to an 8-week soil incubation as a way to select the most promising biochars for a field trial. The methods used to characterize the biochars included proximate analysis, CHNS elemental analysis, BET surface area, photo-acoustic Fourier transform infrared spectroscopy (FTIR-PAS), and quantitative 13C solid-state nuclear magnetic resonance (NMR) spectroscopy. The soil incubation study was used to relate biochar properties to three responses of a local Iowa soil: pH, cation exchange capacity (CEC), and water leachate electrical conductivity (EC). Characterization results suggest that biochars made in a kiln process where some oxygen was present in the reaction atmosphere have properties intermediate between slow pyrolysis and gasification and therefore, should be grouped separately. A close correlation was also observed between aromaticity determined by NMR and fixed carbon fraction determined by proximate analysis. The four biochars ultimately selected for their potential to positively improve soil properties and provide data to refine the selection scheme were from corn stover low-temperature fast pyrolysis, switchgrass slow pyrolysis, switchgrass O2/steam gasification, and hardwood kiln carbonization. Ultimately, biochar selection will depend on local energy and soil needs, advantageous use of liquid and gaseous co-products, and local availability of feedstock, in addition to biochar properties and soil effects.

Daniel Kirschen | MGH 287 | 4/30, Session 3 | 2:00 PM
University of Washington
Smart Grids
This presentation will explain the motivation for the development of smart grid, explore what smart grid might entail and then describe the part of the Pacific Northwest smart grid demonstration project that is taking place at the University of Washington.

Fred M. Lightfoot, Robert E. Milligan, WilliamC. Morchin, and Dr. Terry I. Eade | Auditorium | 4/30, Session 1 | 10:15 AM
Alternative Energy Engineering Associates, LLP
Ocean-Based Wave Energy Conversion, Storage and Transportation to Shore-Based Distribution Centers
Introduction: There has been a common requirement for the many types of alternative energy systems existing, in development or in the planning phases at this time: national authorities have emphasized the need to become independent from foreign petroleum sources as they become depleted or otherwise are unobtainable. However, other requirements have become manifest as these systems achieve, or approach operational status. To assist in the choice of an alternative energy field of endeavor to pursue, an interpretation of the generally accepted goals for a System-of-Systems development has been performed and adapted for this application. This rapidly evolving field has encountered many constraints in the application of available technology to wave, tidal, thermal and in-stream current extraction methods. One particular application of wave energy conversion (WEC) that has up to now not been addressed in detail is wave energy derived from the more remote sections of our coastal resources, the Continental Outer Shelf (OCS). This region is generally recognized to extend from 3-9 nm offshore (depending on individual state jurisdiction) to the end of Federal jurisdiction (the beginning of the continental slope and the deep ocean). The Federal government retains the jurisdiction over the seabed, subsoil and submerged lands. The problem encountered in the exploitation of this abundant energy is well-known, i.e., the transportation of this energy to shore based users.

The most common means existing or planned at this time is the use of submerged power transmission lines. The current technical limit is about 80 nm while the economic limit is probably much shorter The production, storage and transportation of molecular hydrogen, H2, at the point of energy conversion is sometimes considered. The economics and safety factors have not been considered attractive. This study suggests one approach frequently mentioned, but not in development to our knowledge at the present time as no satisfactory alternative energy collection method has been developed for the remote OCS sites.

System Overview: The benefits of the system suggested by the AEEA are:
(1) Wave energy density is greater in the more remote OCS locations;
(2) Exploitation and continuing use of existing industrial fuel storage and distribution infrastructure;
(3) Provide for a gradual transition to widespread electric vehicle uses;
(4) Avoid environmental destruction and visual impairment, and minimal impact on commercial fishing and recreation uses;
(5) Foster the development of a new maritime and energy industry;
(6) Avoid the high capital investment in mooring and anchoring, seabed electrical cable installation and seabed restoration; and (7) Fleets of these vessels may be deployed flexibly to supply widely separated market locations using coastal and national waterways.(8)Additional fleets may be added without depletion of primary feed stocks as in nuclear energy systems In summary, the system converts renewable energy from the nearly unlimited resources of the open ocean to a form useful in reducing dependence on petroleum sources, and reduces, or is neutral to the amount of CO2 in the atmosphere. Further, the system uses most of existing common facilities and personnel trained to perform energy conversion, storage, transportation, and distribution.
Concept Description: Fleets of ocean going vessels coupled together in longitudinal rows, and transversal columns operate in unison to convert wave motion to electricity which is then converted into methanol, or other hydrocarbon products. If and when future electrical storage methods are economical, they may be stored directly in an electrical form. The vessels may be detached from the fleet to transport the product to shore for distribution to market centers shown off-loaded in place. Means are provided to optimize the energy conversion process to accommodate changes in wave direction, wavelength, amplitude and phase.
These vessels are self-powered for off shore or inland waterway navigation. Fully articulating stern and bow thrusters are used for dynamic position keeping as an alternative to anchoring, and for propulsion for delivery of the methanol to ports of call. Two or more vessels remaining coupled during transport are capable of recapturing some of the energy expended during the delivery. An extensive system of self-contained fleets of these vessels operating along the outer Continental Shelves adjoining the Atlantic, Gulf and Pacific coasts would be located to serve regional fuel distribution markets. The most practical selection of the type of vessel appeared to the authors to be modified seagoing barges of standard sizes to benefit from previous investments and large scale production in barge design and construction; e.g., typified by a capacity of 2600 tons and dimensions of 200’x 50’x13’. In addition to the distribution hubs there are seventy customer/distributor centers scattered throughout the country. Barges, railcars and tanker trucks are used to move the methanol to market. Nearly 92% of the methanol is moved by barges, about 7% by rail cars and 1% by tanker truck. Cost savings may achieved by using the barges of the fleet in the intercontinental waterways without cargo transfer to existing barge carriers. It is apparent that there are significant existing methanol production and distribution resources capable of being linked by barges, rail, trucks and in the future, pipelines which could be the nucleus of a national transition to a “Methanol Economy” within the U.S. This concept has been suggested by Dr. George Olah, a distinguished Nobel Prize winner, and his colleagues. Most of the issues of this transference of the present economic system to one based on methanol are discussed in the reference.

The methanol production is based on the pioneering work performed by Dr. Meyer Steinberg[i]. On each vessel, three compartment electrolysis cells are used to recover hydrogen and carbon dioxide which are then compressed and heated over a copper catalyst wherein methanol is produced. Either carbon dioxide is recovered from shore sources in sequestered carbonate solution form or from an onboard scrubber in carbonate solution form. Oxygen is vented to the atmosphere from an anode outer section of the electrolyzer.

The carbon dioxide is obtained from the center cell of the electrolyzer, after decomposition by a low voltage high current electrical supply, of the fed in carbonate solution to that cell. Hydrogen is obtained from the cathode outer cell. A hydroxide is also obtained from the cathode outer cell which is either returned to shore for further sequestering of carbon dioxide or is returned to the on board scrubber. Make up water is returned from the catalytic converter to the center cell of the electrolyzer. Sodium or Potassium is used as the basis for the carbonate solution and the hydroxide.

For sodium, the sequence of reactions is[ii]:

Absorption

$2NaOH + CO2 = Na2CO3 + H2O$

Electrolysis

$Na2CO3 + 4H2O = 2NaOH + 3H2 + 3/2O2 + CO2$

Catalytic reaction for Methanol production

$3H2 + CO2 = CH3OH + H2O$

Catalytic reaction for Gasoline

$nCH3OH = (CH2)n + nH2O$

Large heat-exchange loads are avoided because the absorption of carbon dioxide and the electrolysis take place at ambient temperature. The process requires 30.4 kWh to produce one gallon of methanol or 49 kWh to produce one gallon of gasoline. A chemical conversion efficiency of 57 per cent is achieved for the production of methanol if the carbon dioxide is taken from the air. This efficiency increases to about 63 percent if sequestered carbon dioxide is used. The method is based on Steinberg adapts the three compartment electrolyzer of Tirrell et al[iii] for his process by injecting makeup water in the center compartment and taking out carbon dioxide from that compartment. The anode compartment is separated from the center compartment by a diaphragm which allows passage of the electrolyte but restricts flow of gaseous products such as oxygen. The cathode compartment is separated from the center compartment by different diaphragm that is permselective and impervious to water and negative ions but pervious to positive ions.

The whole process of the system is carbon dioxide neutral between its removal from air and subsequent use of methanol or gasoline as a fuel.

Examples of methanol applications include:

Automotive: Conventional Internal combustion engines (ICV) have been successfully tested in national tests in 1978 using vehicles converted to M85 flex-fuel operation.The Open Fuel Standard, H.R. 476, S. 835 would require that 80% of new autos have Flex FuelVehicles (FFV's) that can operate on 85% ethanol, and methanol or gasoline which would open up the market.

Proton Exchange Membrane fuel cell powered fuel cell powered vehicles could use on-board H2 reforming.

Dimethyl ether is an excellent synthetic diesel fuel Combined Cycle Gas

Turbines used in utility power grid, and other stationary applications could use neat methanol with minor conversion.

Jet Fuel:J7/J8 can be synthesized as an alternate to biojet fuel now being tested.

References:

7] Olah, George A.; Goeppert, Alain; Prakash, G.K ,Surya, Beyond Oil and Gas 168-208, Wiley-VCH.

[i] Meyer Steinberg, United States Patent 3,959,094, Electrolytic Synthesis of Methanol from CO2, May 25, 1976.
[ii] Martin M. Halmann, Meyer Steinberg, Greenhouse Gas Carbon Dioxide Mitigation: Science and Technology, CRC Press, 1999.
[iii] Charles E. Tirrell, Nahant, and Edgardo J. Parsi, United States Patent, 3,135,673, Process and Apparatus for Electrolyzing Salt Solutions", June 2, 1964.

Michael D. Marsolek, Elizabeth Kendall, Phillip L. Thompson, and Teodora Rutar Shuman | MGH 288 | 4/30, Session 3 | 2:00 PM
Seattle University
The impact of thermal pretreatment on biogas yields from anaerobic digestion of algae.
Algal based biofuels are an emerging technology for fossil fuel replacement. The algae-to-fuel process becomes more competitive when the raw algal substrate is transformed into as many useful products as possible. The primary products include lipids for use to make green fuel, proteins for use in food and nutritional supplements, and residual hydrocarbons. Converting the residual algal byproduct into valuable methane via anaerobic digestion improves overall process efficiency, however algae digestion typically doesn't yield as much biogas as other conventional biomass sources. Here we investigated the impact of heat-based pretreatments on methane yield from algae-fed anaerobic digesters. We thermally pretreated Nanochloropsis oculata for four-hours at 30°C, 60°C, and 90°C, as well as at a constant temperature of 90°C for 1, 3.5, and 12 hours. Algal COD decreased by 7% at 30°C to 23% at 90°C when heated for four hours. There was little change in volatile solids concentration as a function of pretreatment temperature.
Similarly, COD decreased linearly as a function of heating time, from 3% at 1 hour to 12% at 12 hours, but there was no change in average volatile solids concentration. Batch digester bottles were then fed the pretreated algae, incubated at 37°C for 12 days, and analyzed for cumulative biogas production. Biogas production per unit COD and VS increased with increasing pretreatment temperature, from 0.146 ± 0.016 mL biogas/mg COD for the control (non-pretreated algae) to 0.277 ± 0.016 mL biogas/mg COD when heated at 90°C. Similarly, biogas production increased per unit COD and per unit VS as a function of heating time, from 0.182 ± 0.028 mL biogas/mg COD for the control, to 0.281 ± 0.021 mL biogas/mg COD when heated for 12 hours. These results demonstrate the potential of thermal pretreatment to improve biogas yields from algae.

Greg Rorrer | MGH 284 | 5/1, Session 2 | 11:15 AM
National Science Foundation
Support of Sustainable Energy Research by the National Science Foundation
Abstract
Achieving sustainable production of energy is one of the grand challenges of the 21st century. The national needs of energy security, reduction of carbon footprint, and creation of green jobs, as described in recent reports by the National Science Board and the U.S. Department of Energy, as well as the President's energy policy priorities, drive the response to this grand challenge. This presentation will highlight sustainable energy research currently supported by the National Science Foundation (NSF), particularly in the areas of next-generation solar photovoltaics, biofuels, and wind energy.
Bio Sketch
Dr. Greg Rorrer is currently serving as a rotating Program Director of theEnergy for Sustainability program at the National Science Foundation (NSF). Dr. Rorrer holds a BS degree in Chemical Engineering from the University of Michigan and a PhD degree in Chemical Engineering from Michigan State University. His academic home is Oregon State University, where he is a full professor of chemical engineering.

Dr. Teodora Rutar Shuman | MGH 284 | 4/30, Session 3 | 2:00 PM
Seattle University
Low-energy Consumption Method for Settling of Microalgae

This presentation will describe the potential for electroporation as means for economically and environmentally sustainable way of harvesting and pre-treatment of algae. Seattle University undergraduate students and faculty recently designed a novel batch electroporator and demonstrated under sponsorship of SRS Energy of Dexter, MI that electroporation significantly increases the settling rates of algae without the need for flocculants and other chemicals. The electroporation was applied to Nannochloropsis oculata and, separately, to Chlorella minutissima, while the strains were suspended in their respective growth mediums. Both liquids had very high conductivity, circa 35000μS/cm. The electroporation device was powered with a DC power supply, and the custom circuit was outputting square pulses. Energy input to the algae medium was controlled by the three independent variables: voltage, pulse duration, and number of pulses. Applied voltage was less or equal than 15V, the total pulsing time was less or equal to 5 s. Maximum energy density recorded was 4.5 kWh/m3 of algae medium. Experimental data included recording energy input to system, algae settling rate and turbidity after electroporation, and fluorometry. The statistical evaluation of the results shows that voltage was the primary parameter influencing the effectiveness of electroporation, which is expected since the energy input is a linear function of time duration of the pulses and number of pulses, and a squared power function of voltage. The results show that energy density of as low as 0.5 kWh/m3 of algae medium, or 0.8 kWh/kg of dry algal biomass, is enough to completely settle the algae in 30 minutes. Turbidity measurement show that the liquid clears within a minute after electroporation at those conditions.

Lesley Snowden-Swan | MGH 284 | 4/30, Session 2 | 11:15 AM
Pacific Northwest National Laboratory
Sustainability Assessment for Biomass Thermochemical Conversion Processes

As interest in biofuels has increased, the necessity of producing these fuels in an economically, socially, and environmentally sustainable manner has also become a priority. Recent research has focused on ensuring that the growth of biomass resources can be achieved sustainably. Meanwhile, research efforts on conversion processes have been guided by technoeconomic evaluations of minimum fuel selling prices, using economic sensitivities to identify technological and operational improvements that can affect the greatest impact. However, limited research has been done on the sustainability of biomass conversion processes and as a result, baseline sustainability indicators and the effects of improved processing technologies on these indicators are poorly understood.

The purpose of this study is to address environmental sustainability issues related to the thermochemical conversion technologies likely to be used for producing advanced biofuels. This work is funded by the DOE EERE Biomass Program and supports its primary goal of developing efficient, sustainable, and cost-competitive technologies for biobased fuels, products and energy.

The goals of this study are to determine the priority environmental metrics for thermal conversion processes, the key drivers affecting these metrics, and the economic tradeoffs associated with improving these metrics, so that advanced biofuel options can be compared, contrasted, and designed in the most sustainable manner possible. This will facilitate targeted research and development of fuels that are not only renewable and economic, but sustainable with regard to all natural resources consumed and ecological systems affected.

Sustainable design is a holistic way of analyzing and engineering the impact of a process, product or service. Three pillars of sustainable design have emerged: economic, social and environmental. These pillars are highly interdependent in many cases, for example, replacing hazardous chemicals at a facility would not only reduce potential environmental impact (i.e., emissions to water, land and air), but also may improve economic and social risks by reducing liability. At the same time, the capital and operating costs of implementing less hazardous chemicals must also be evaluated. By considering multiple aspects of a product's effect, as well as specific regional

characteristics of its application, one can effectively optimize for all parameters to ultimately achieve a sustainably balanced design.
A useful and widely accepted tool for sustainable design is life cycle analysis (LCA). While the Biomass Program is supporting extensive biofuels LCA work for several technology platforms, a complete LCA is not conducted for the beginning phase of this work, but rather life cycle thinking is used to provide an initial analysis and inventory estimate of several important environmental metrics for biomass thermal conversion processes. Mass and energy balances from the Pacific Northwest National Laboratory's library of process simulation models were used to establish baseline ranges for the metrics, from which key design parameters affecting environmental performance were identified. Design parameters were then varied to provide examples of cost tradeoffs associated with water reduction strategies. The outcome of this project will feed into the Biomass Program's technology development and technoeconomic analysis efforts, to enable sustainable biofuel designs for the future.

David N. Thompson | Keynote | 5/1 | 9:15 AM
Biological Systems Department, Idaho National Laboratory
Sustainability of Cellulosic Biofuels: The Role of Co-Products
Billions of tons of utilizable non-food lignocellulosic residues are potentially available worldwide for conversion to fuels, chemicals and materials each year. This represents a significant, valuable and potentially sustainable renewable biomass resource. The current concept for conversion of lignocellulosic biomass into fuels and chemicals consists of a "biorefinery" that accepts biomass feedstocks and "refines" them into varied product streams that have added value. When oil is refined, it is decomposed into product fractions that then serve as fuels or products, or as feedstocks for other chemical syntheses. Similarly, the biorefinery concept focuses on the production of biofuels from renewable biomass, with the overall economics driven by the production of higher value ancillary products using a portion of the biomass carbon input. This presentation will overview cellulosic biofuel technologies and sustainability issues, and then discuss INL's work on a sustainable co-product, natural fiber-reinforced thermoplastic composites.
The general technology pathways by which biomass can be converted to liquid fuels and chemicals include biochemical and thermochemical routes. Biochemical routes generally focus on conversion of the polysaccharides in the biomass to fermentable sugars, which are then converted using a variety of organisms to fuels and chemicals including alcohols and, more recently, hydrocarbons. Non-fermentable organic fractions of the biomass, such as lignin, generally serve as a combustible energy source for the conversion. Thermochemical processes for the conversion of biomass to fuels and chemicals include combustion, gasification/reduction, and various degrees of pyrolysis, all of which offer the advantage that they utilize the whole of the organic biomass fraction. Combustion is currently practiced in many countries for heat and electricity production. Gasification/reduction involves oxidizing carbonaceous matter to synthesis gas and then reducing the mixture to hydrocarbons and alcohols (with added hydrogen) using inorganic or biological catalysts. Although gasification/reduction is reasonably well-developed as applied to coal, application to biomass can be difficult because of mineral contaminants and gas cleanup challenges. Pyrolysis produces char and a partially oxidized "biocrude" oil that is in some respects similar to crude oil and can be processed in a similar manner to fuels and chemicals. Each route has its benefits and detractions, but all suffer from poor economic competitiveness with fuels and chemicals produced from oil.
When one traditionally considers sustainability from a technological sense, the factors most often considered first include sustainable resource utilization (e.g. efficiency of water and energy use), wastewater treatment and reuse, and greenhouse gas emissions. However, there are additional economic, environmental, and social factors that are also important to consider. Economic sustainability may depend on such factors as current and future product values, availability and cost of feedstocks, availability and cost of energy, product mix, net income, job creation, and others. Besides greenhouse gas impacts, environmental sustainability may depend on factors such as the net energy balance, other environmental impacts, effects on wildlife habitats, and competition for resources and land. Social

sustainability may depend on health impacts, impacts related to industrial development, and the development of a workforce skilled in the operation of the needed technologies.

At the INL, we are working with partners in the Pacific Northwest and across the United States to develop sustainable co-products and enable more positive forest biorefinery economics. The forestry, wood and paper industries in the United States provide thousands of productive well-paying jobs; however, in the face of the recent financial downturn it faces significant challenges in remaining economically viable and competitive. To compete successfully on a global market that is increasingly driven by the need for sustainable products and practices, the industry must improve margins and diversify product lines while continuing to produce the staple products. One approach that can help to accomplish this goal sustainably is the forest biorefinery. In the forest biorefinery, traditional waste streams are utilized singly or in combination to manufacture additional products in a profitable and environmentally sustainable manner.

In this work, we produced wood fiber reinforced thermoplastic composites (WFRTCs) using microbial thermoplastic polyesters in place of petroleum-derived plastic. Renewable microbial polyesters are not used in WFRTCs primarily because their production costs are several times higher than those of conventional petrochemical-derived plastics, limiting their use to small specialty markets. For purified product, production costs are roughly distributed 40% to feedstock, 20% to fermentation, and 40% to purification. Our strategy included reducing or eliminating the most costly steps in the bio-plastic production by producing the bioplastics in and from waste effluents from the forest products sector, and by eliminating the costly purification steps. After production the plastic-laden biosolids were dried and used directly to replace petroleum-derived plastics in WFRTCs.

We demonstrated that the biopolymers can be successfully produced from wood pulping waste streams and that viable wood fiber reinforced thermoplastic composite products can be produced from these materials. The results showed that microbial polyester (PHB in this study) can be extruded together with wastewater-derived cell mass and wood flour into deck products having performance properties comparable to existing commercial HDPE/WF composite products. This study proved our underlying concept that microbial polyesters produced from waste effluents can be used to make cost-effective and energy-efficient wood-plastic composites. The cost of purified microbial polyesters is about 5-20 times that of HDPE depending on the cost of crude oil, hence, the ability to produce competitive and functional composites with unpurified PHA-biomass mixtures from waste carbon sources in unsterile systems—without cell debris removal—is a significant step forward in producing competitive value-added structural composites from forest products residuals using a biorefinery approach.

Tony Thompson | MGH 389 | 5/1, Session 1 | 10:15 AM
REC Silicon
Silane Based Silicon Technology for Solar Energy

REC silicon in Moses Lake, WA is a leading producer of solar grade polysilicon used in photovoltaic cells. Quartz is reduced and crushed offside to create metallurgical grade silicon at about 98% Si to feed the process. The Si is reacted to form chemical intermediates which can be purified with standard engineering unit operations. Silane has a number of advantages as a chemical intermediate. Impurities are removed through distillation and adsorption, and then the silane is deposited as pure Si in the standard Siemens style bell-jar reactors or the recently developed fluid bed reactor (FBR). The state of the art FBR deposition of silane lowers the energy usage while improving product handling for the end user with its advantageous shape factor. The polysilicon produced goes on to be made into wafers and finally modules to become part of a solar power installation. The Moses Lake site has been producing high purity silicon in Washington for over 20 years; continually lowering the product cost to make solar energy more affordable while also expanding to meet current demand for material.

William H. (Bill) Wilson | MGH 284 | 5/1, Session 1 | 10:15 AM
Washington State University Extension Energy Program

Industrial Steam Boiler System Efficiency Improvement Measures, Analysis Tools and Resources

The presentation will explore a number of conventional and non-conventional improvement measures appropriate for industrial boiler systems for increasing “fuel-to-steam” efficiency and reducing energy consumption. Several no-cost predictive software analysis tools and other resources that can be used for gaining additional knowledge, insight into specific systems, and quantification of energy and cost savings will be introduced. Energy savings ranges one can expect from improvement measures outlined will be examined. Improvement ideas explored will range from combustion efficiency improvement measures, control system improvements, operational improvements and various waste heat recovery opportunities, including flue gas combustion moisture latent heat recovery. While there are many similarities between all industrial steam systems, variabilities in fuels used, steam production volume rates, steam pressure, steam temperature, returned condensate temperature and relative volume with respect to steam production, etc. have a profound effect on the economics of implementing modifications. We will explore aspects of how these variabilities can make implemention of measures in one steam system economically viable while in another steam system the same measures may not be economically viable.

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WATER TRACK ABSTRACTS

Javad Abbasian | MGH 288 | 4/30, Session 2 | 11:15 AM
Illinois Institute of Technology
Municipal Waste Water Utilization in Power Plant Cooling System
The thermoelectric power industry in the US uses a large amount of freshwater. As the availability of freshwater becomes increasingly limited, alternative sources of water for power plant cooling are of interest for both existing and future power plants. Utilization of impaired water requires evaluation of the deleterious effects on the cooling system and necessary treatments with consideration of quality and abundance of the impaired water source. Treated municipal waste water is one the most suitable non-traditional water sources for use in thermoelectric power production because of its abundance and geographic distribution.
This paper addresses the development of a software module to identify and evaluate the water management and treatment processes required and potential freshwater reduction possible when utilizing treated municipal waste water for makeup water in the cooling system of thermoelectric power plant. A framework is presented for modeling and simulation of the circulating cooling system, treatment processes, water chemistry, and condenser performance. The effect of water properties on the selection and configuration of the treatment processes, the rate of scale formation in the main condenser as well as the overall performance of the cooling water cycle will be discussed. A costing analysis for both secondary- and a tertiary-treated water will also be presented.

Brian Boyd | MGH 288 | 4/30, Session 5 | 4:00 PM
Pacific Northwest National Laboratory
Every Drop Counts: Water Efficiency in the Federal Sector
In the past few years water conservation and water sustainability efforts have gained momentum in the Federal sector. Legislation for measuring and reducing water use includes Executive Order 13423, Executive Order 13514, and the Energy Independence and Security Act of 2007 (EISA). This presentation will provide an overview of recent activities the water efficiency team at Pacific Northwest National Laboratory (PNNL) has worked on in support of the Federal Energy Management Program (FEMP), the Federal Water Working Group, and the Department of Defense (DoD).

Bill Byers | MGH 389 | 4/30, Session 2 | 11:15 AM
CH2M HILL
Water Risk Assessment: Case Studies and Mitigation Strategies
Water-intensive industries have historically viewed water as a nearly free commodity, used as a medium for receiving rejected chemicals and for transferring heat within processing plants. Water collected from these operations has usually been sent offsite for treatment, if required, and then to surface water disposal. Water conservation and water reuse were considered justifiable only if they represented economic savings, either through material recovery or through the avoidance of treatment costs.
More recently, many companies have come to recognize that water-related risks represent strategic business risks. Shareholders owning these companies have begun to require disclosure of water-related risks along with other strategic risks facing the companies.
Global companies are assessing risks on three levels:
- Global water risks are risks that affect a company's going concern value based on the regional locations of the company's businesses throughout the world. Aligning water needs with water availability in the global areas within which the company operates helps to determine a company's global exposure to water-induced business interruption.
- Regional water risks are more specific risks related to sharing of water needs among stakeholders within a specific country, watershed, or other geographic area.

- Inside-the-fence risks are risks that can affect the operation of a specific process plant due to quantity and quality of water available to the plant as well as restrictions on water discharge from the plant.

Thinking strategically about water's impact on a company's business operations requires addressing and mitigating risks at all three levels.

Tools for assessing water risk and cases of companies developing strategies for water risk mitigation will be discussed.

Carolina Gonzalez | MGH 288 | 4/30, Session 1 | 10:15 AM
GE Water
Water Recovery and Reuse for Coal Seam Gas Operations in Queensland, Australia

Coal Seam Gas (CSG) is mostly methane trapped in the natural coal structure.

The extraction of CSG requires the removal of the associated water with surface pumping or a well. GE has developed a zero liquid discharge (ZLD) treatment scheme to specifically treat the associated produced water from coal seams in Queensland, Australia. The treatment scheme maximizes the water recovery for reuse, and produces mix salt solids for disposal. The result of the implementation of this treatment scheme is the reduction of pond areas, elimination of discharges, and production of water that can be reused in adjacent fields. This paper focuses on the ZLD treatment design, and evaporator and crystallizer technologies for water reuse.

Shwetak Patel | Auditorium | 5/1, Session 2 | 11:15 AM
University of Washington
Energy and Water Sensing in the Home

Professor Patel will describe work on a new generation of electricity, water, and natural gas measurement systems that are low-cost, easy-to-install, and, most importantly, capable of providing disaggregated data on consumption down to the individual appliance or device from single sensing points. The vision is to provide high granularity resource sensing systems for homes and businesses that will fundamentally transform how end uses of electricity, water, and natural gas are understood, studied and, ultimately, consumed. All three systems share a common approach: they monitor side-effects of resource usage that manifest throughout a home's internal electricity, plumbing, or gas infrastructure.

http://shwetak.com
http://ubicomplab.cs.washington.edu

Kenneth Williamson | Auditorium | 4/30, Session 3 | 2:00 PM
Oregon State University
Sustainable Water and Wastewater Infrastructure as a Function of Societal Development

The progression of water and wastewater infrastructures in societies can be correlated closed to per capita income and follows a consistent pattern. This pattern of development may represent significant inefficiencies and may result in post-modern societies such as the US with unsustainable costs in large metropolitan areas. Estimates of infrastructure costs provide estimates of the time necessary for development of such infrastructure systems.

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ENVIRONMENT TRACK ABSTRACTS

Nathan Friend & Devor Barton | MGH 288 | 5/1, Session 1 | 10:15 AM
Seattle Carbon Coaches
So you want to do climate outreach?
This session aims to give you practical, hands-on tips for doing personal outreach on climate change issues. Learn how to speak with your friends, family, co-workers, and others about climate change in a meaningful way and with positive outcomes. Session speakers Devor Barton and Nathan Friend are certified Carbon Coaches for the City of Seattle. They'll discuss the goals and strategies of the Carbon Coach program and give you the knowledge and skills to apply these strategies in your own community.

Liv Haselbach | MGH 287 | 4/30, Session 1 | 10:15 AM
Washington State University
Low Impact Development and Pervious Concrete: Environmental Chemistry and Heat Island Impacts
Low impact development (LID) represents a growing compilation of best management practices (BMPs) for dealing with stormwater runoff that strive to mimic more fully the natural hydrologic processes on a site and alleviate many downstream runoff quantity and quality problems. This presentation introduces LID and some related metrics, and then focuses on one of the prominent LID technologies, pervious concrete. Research has been underway into the unique and varying material properties of pervious concrete systems in order to understand their performance and additional benefits or associated challenges of implementation. Topics discussed include multi-media issues such as urban heat island mitigation, pH and metal adsorption as related to receiving water quality and carbon sequestration.

Karin Holland | MGH 284 | 4/30, Session 5 | 4:00 PM
Haley & Aldrich
2011 Pacific NW Regional Conference on Sustainability
Framework for Integrating Sustainability into Environmental Remediation Projects
Significant breakthroughs have occurred in the sustainable remediation field during the last few years, permitting more and more remediation practitioners to effectively incorporate sustainable practices into their projects. However, the methodologies employed for the integration of sustainable practices have generally been inconsistent, caused in part by the lack of a broad ranging, widely applicable sustainable remediation framework. This has made it difficult for practitioners to evaluate sustainability during their projects and to compare sustainable practices across a range of remediation sites. Additionally, regulatory agency personnel have not been provided a consistent approach to include, validate, and incorporate sustainability into their decision making. The Sustainable Remediation Forum (SURF), a national sustainable remediation professional organization, has therefore developed a framework that provides a consistent process to consider and balance sustainability parameters throughout the remediation life cycle (and beyond) while continuing to provide long-term protection of human health and the environment, and achieving public and regulatory acceptance.
The framework is the combined contribution of environmental and engineering professionals representing site owners (including organizations from the chemical, petrochemical and aerospace sectors), the Department of Defense, and regulatory agencies. The framework is scheduled to be released in spring 2011. The framework has been designed to ensure that users with varying sustainability experience can easily, cost-effectively and efficiently incorporate the framework into remediation projects. Intended users include all stakeholders involved with, or affected by a remediation project. The framework provides step-by-step guidance to assist practitioners in identifying the data sources required for different sustainability analyses, selecting the most appropriate type and level of analysis, documenting sustainability results, and integrating sustainability into the decision-making process. By using the framework, site-specific parameters, stakeholder concerns, and preferred end-use(s) and future use(s) can be evaluated throughout the remediation life cycle and balanced with sustainability considerations.

The application of the framework will be described during the presentation. Real life case studies will be provided to illustrate how the integration of sustainability can generate high value to remediation projects. Recommendations will be discussed so that the audience will be able to immediately apply the framework to their own projects.

Eleanor Kirtley | MGH 287 | 4/30, Session 5 | 4:00 PM
The Glosten Associates

Marine Vessel environmental Performance Assessment

Maritime shipping carries 90% of all commerce through at least part of its journey. It is the most efficient transportation mode. Per cargo ton-mile carried, shipping emits roughly 0.09 lb CO_2 while rail, truck, and aviation emit 0.23, 0.37, and 1.78 pounds, respectively. However, with the large volume of cargo carried, ocean going vessels are still a significant contributor.

"As noted in the 2nd International Maritime Organization Greenhouse Gas Study, transportation produces roughly 27.7% of the world's CO_2 emissions. Roughly 21.3% of those emissions are from road transportation (trucks and cars), 2.6 % from aviation, .5% from rail, and 3.3% from all marine transportation (2.7% comes from international maritime shipping and .6% from domestic shipping and fishing)."[1]

While CO_2 is a primary focus in the current climate, ships also impact the environment in a number of other ways from air quality issues in port areas to the transport of invasive marine organisms. Today's heightened attention to minimizing environmental impact and the rising cost of fuel has fostered many initiatives to rate and reward performance and innovations to deliver it. Governments, international regulatory bodies, classification societies, philanthropists, and industry partnerships are all making strides.

This presentation will give an overview of these initiatives and focus on one by the Society of Naval Architects and Marine Engineers. The Marine Vessel environmental Performance Assessment (MVeP) is being developed to provide vessel designers, owners, operators, and other governing bodies with a standard methodology to assess the relative merits of several different environmental practices. Based on objective technical information, standard performance criteria will be provided to quantify the environmental impact of a vessel's life cycle. The Phase 1 Pilot Project compiled a checklist of impacts categorized into energy efficiency, air emissions, emissions to water, and general measures. Each impact is assessed on its own merit and the compilation of all assessments makes clear the trade-offs of various measures giving a holistic view of the ship's performance.

The Standard Assessment Methodology will be reviewed with examples of prescriptive measures and quantitative metrics for energy efficiency gains by hull & propeller maintenance, reductions of SOx emissions, and treatments for the spread of non-indigenous, invasive species in ballast water. MVeP Performance Assessment Guides address both the most advanced technologies reaching for a zero impact ship and the most cost-effective, well vetted, and easily retrofitted technological or operational measures for improved performance.

In its next phase, MVeP implementation will define "what is green?" and a rating for "how green?" Adoption would likely be market driven. In addition, potential performance incentives and penalties will also be discussed. Anticipated fee increases and stricter operating limits are driving some owners and operators to green their fleet sooner rather than later. In the near future, sustainable operation may not just be the difference between lower and higher fees, but sustainability will mean port, government, regulatory, and class compliance rather than business obsolescence.

http://www.sname.org/SNAME/AHP19/Home

[1]http://www.worldshipping.org/industry-issues/environment/air-emissions/WSC_Emissions_Policy_Paper_to_IMO.pdf

Jonathan Lemons | MGH 389 | 4/30, Session 5 | 4:00 PM
14ft 8in & Runberg Architecture Group
14ft 8in: Our Cities Will Become Ecosystems

I'm very passionate about architecture and feel it in my soul. At the beginning of 2010 I created 14ft 8in (facebook.com/14ft8in), an interdisciplinary gateway for international architecture collaboration and exploration. 4,000+ people now subscribe and 5.1 million visits are projected for 2011. Architecture teams are morally culpable for the environments we create and we cannot neglect this inherent responsibility.

Cities and buildings hemorrhage energy and precious resources. Our cities will become ecosystems, living buildings will become the status quo, and I'm rigorously working to pursue these ideas and more with colleagues.

Currently working at Runberg Architecture Group on a pioneering project in South Lake Union for Vulcan and taking my Architect Registration Exams, I've worked on architecture teams in Seattle at HyBrid Architecture + Assembly, Pb Elemental Architecture, Kable Design Build, & LMN Architects. I've also worked in Portland for GBD Architects, in Ukraine designing a new university, and in Budapest for Erick van Egeraat Associated Architects redesigning St. Petersburg's Vosstaniya Square. At the end of 2009 I was selected as Architect in Residence for Harvard GSD's Butaro Hospital in Rwanda with PIH, but was unable to attend due to regional conflicts and family reasons.

In 2011 and 2012 I will physically connect, work, and learn from top projects and pioneers in Malaysia, Singapore, Hong Kong, Italy, France, England, Brazil, Sweden, Denmark, Poland, Germany, Netherlands, B.C., and our own country. The outcome will be producing a Seattle pavilion, discussions and exhibitions of the research, a film and streaming online media of this worldwide expedition, and a free book people can download/print of the findings.

In my heart I truly believe that working together as a city, country, and globe we will realize this emerging future together and continue building upon innovative research. We will explore in teams, stretch our imaginations, make creative solutions affordable, and pioneer construction methods to truly catalyze this renaissance. We are teammates standing at the precipice of a radically new global consciousness. We must utilize these opportunities to work together in this new world without borders. Thanks so much for your support.

Patrick Leonard | MGH 287 | 4/30, Session 4 | 3:00 PM
Paladino
The Engineer as Change Agent – Redefining 'The Box' for More Sustainable Outcomes

As systems thinkers, engineers often unknowingly hold key roles of influence as those that establish the boundary conditions driving sustainable outcomes. To succeed as sustainability change agents, engineers must challenge conventional assumptions and often, question practices that have helped them in the past. Embracing the role of change agent pushes the engineer into new terrain, and boundaries are redefined based on emerging concepts about what belongs in, or out, of the box. Illustrated through actual building projects, this session will explore the expanding role of the engineer as a change agent, the need for boundary redefinition through the concept of 'the box', and how more sustainable outcomes are a natural consequence of having drawn the boundary correctly.

Speaker Bio: Patrick Leonard is an engineer and green building consultant with Paladino and Company and specializes in helping owners transform building portfolios into high performance assets that improve human, financial and environmental performance. An engineer with a background in renewable energy, Patrick leads the company's Existing Buildings Practice. His clients include Lamb Weston/ConAgra, Verizon Wireless, GSA and the US Department of State.

Mike Oddo | MGH 288 | 4/30, Session 4 | 3:00 PM
WasteMinCo (AKA Waste Minimization Company)
Accelerating Low GHG Technology Development & Implementation

Tax structure modification is the most effective way to accelerate the development and implementation of low-GHG (greenhouse gas) technology. This presentation highlights the relationship between labor, taxes and GHG emissions. It touches on some of the obstacles to tax structure modification and how to overcome these obstacles and illustrates the benefits of the proposals.

GHG-intensive practices are often used to save time and labor. As the cost of labor increases, GHG-intensive technologies become more cost-effective. Wage-based, income taxes increase the cost of labor, and therefore, increase the economic viability of GHG-intensive practices. This is compounded when this tax revenue is used to subsidize hydrocarbon oxidation (e.g. build highways and airports).

GHG emissions will be reduced if the current tax basis is shifted from wage-based income taxes to taxes on GHG emissions. Gradually shifting the tax basis from wages to a tax on CO2-Equivalent (CO2E) emitted would make low GHG technology more cost-effective—thereby, dramatically accelerating development and implementation. To prevent environmental risk (and jobs) from simply being outsourced to other countries, a tax on products could be applied unilaterally at the point of consumption (like a sales tax) regardless of the product's origin. It would tax the total CO2E emitted during the production and distribution of a product. Alternatively, the tax basis could be shifted from wage-based taxes to a uniform, global tax on hydrocarbons slated for oxidation (with the revenue going to the nation hosting the oxidation). By tying a country's trading status to inclusion of such a pact, developed nations with their enormous markets (i.e. the US) could easily persuade developing countries to join them in implementing a uniform tax on hydrocarbons.

Either of these alternatives would be far more effective than the inherently contentious, burdensome and ineffectual "Cap-and-Trade" taxes currently being proposed. Nimble and creative organizations (and their communities) that accelerate low-GHG technology would enjoy a tremendous technological and market advantage over those that continue to cling to the past and use powerful lobbyists to delay the inevitable. The shift into green, low-GHG technology would stimulate local economies while creating meaningful, sustainable jobs and industrial capacity. Furthermore, traffic congestion, non-GHG pollution, infrastructure needs, trade deficits and real energy costs will all decrease. And, most importantly, many of the problems and much of the true costs of climate change may be avoided.

In 1988 Mike Oddo founded WasteMinCo, a Seattle-based consulting firm that uses Chemical Engineers to focus exclusively on Pollution Prevention and Sustainability. He has helped private and public clients to identify, evaluate, and implement projects that increase sustainability and saving them money. He has performed hundreds of detailed cost/benefit and life-cycle analyses on sustainability projects that have already been implemented – allowing him to understand what works and why. The above insights and proposals stem from over 100,000 billable hours of this relatively unique experience. He is hoping to expand on these ideas and is actively seeking collaboration in areas where his expertise may be enhanced and efforts augmented.

John Stasko | MGH 389 | 4/30, Session 4 | 3:00 PM
Applied Filter Technology
Hydrogen Sulfide Removal: an Important Biogas Challenge

The efficient use of biogas is hindered by a number of factors, not the least of which is contaminants. Low level contaminants, such as siloxanes, are readily removed using adsorbent media. However, hydrogen sulfide, present in much larger concentrations, presents the challenge of high costs for removal while threatening the environment and equipment if removal is poor. Several technologies are examined such as water stripping, swing adsorption, aqueous chelants and biological remediation, along with suggested niches for each application.

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