Northeastern

Final Presentations
for
Chemical Process Design

Wednesday, April 22, 2015
11:20am – 4:40pm

Spring 2015

Department of Chemical Engineering
313 Snell Engineering Center
Boston, Massachusetts
02115

Chemical Process Design – Spring 2015
Web Streaming and Teleconference

Wednesday, April 22, 2015, 11:20am (EST)

WEB STREAMING URL:

Room 206 Egan Center
packnetwork.com/chemecapstone/room206EC

Room 306 Egan Center
packnetwork.com/chemecapstone/room306EC

Room 333 Curry Student Center
packnetwork.com/chemecapstone/room333CSC

Final Presentations for
Chemical Process Design – Spring 2015

Wednesday, April 22, 11:20am – 4:40pm

Room 206 Egan Center

(Abstracts on following pages)

Group Number 8

11:20am – 12:00pm
Design Project Title: ***"Production of A Cognitive Decline and Anti-Aging Dietary Supplement Consisting of Two Synergistic Agents: Naturally Derived Fisetin and Docosahexaenoic Acid"***
Group Members: Alex Colville, Brian Malloy, Dan Reilly, and Ryan Cart
Industry Mentor: Gretchen Govoni

Group Number 1

12:00pm – 12:40pm
Design Project Title: ***"An Eco-Friendly Conversion of Grape Pomace Waste into New Products"***
Group Members: Abdulrahman Almulla, Samantha Romano, Jennifer Rosa, and Victoria Zeuner
Industry Mentor: Joe Govoni

Group Number 2

12:40pm – 1:20pm
Design Project Title: ***"Treatment of Industrial Wastewater Using Microbial Electrolysis Cells"***
Group Members: Mitch Brun, Chris Caleca, Bowen Huo, and Matt Pontrelli
Industry Mentor: Bob Snell

Group Number 3

1:20pm – 2:00pm
Design Project Title: ***"Optimization and Craft Production of Whiskey Using Green Engineering Techniques"***
Group Members: Margaret Dowst, Lexi Hamsmith, Hayley Hicks, and Laura May
Industry Mentor: Anthony Fusco

Group Number 4

2:00pm – 2:40pm
Design Project Title: "***Cultivation of Algae to Reduce Carbon Emissions in Cogeneration Facilities"***
Group Members: Megan Harless, Dan Ahlstedt, and Adam Shorey
Industry Mentor: Kristen Talbot
Industry Co-Mentor: Kyle Haraldsen

Wednesday, April 22, 11:20am – 4:40pm

Room 206 Egan Center, Cont'd

(Abstracts on following pages)

Group Number 5

2:40pm – 3:20pm

Design Project Title: *"Utilization of a Parabolic Solar Reflector and Steam Power Generation System as Part of a Modular Energy Production Device"*

Group Members: James Berberian, Joseph DePeter, and Emily Fisler

Industry Mentor: Katie Passino

Industry Co-Mentor: John Schoepf

Group Number 21

3:20pm – 4:00pm

Design Project Title: *"Catalyst Aided Coal Gasification to Produce Natural Gas"*

Group Members: Julia Baker, Chia-Hsing Lin, Jocelyn Podyma, and John Vitale

Industry Mentor: Jeff Heil

Group Number 7

4:00pm – 4:40pm

Design Project Title: *"Gluten-Free Beer Production from Sweet Potatoes"*

Group Members: Lia Calise, Alyssa Meizoso, and Jordan Rubio

Industry Mentor: Dean Poillucci

Wednesday, April 22, 11:20am – 4:00pm

Room 306 Egan Center

(Abstracts on following pages)

Group Number 17

11:20am – 12:00pm
Design Project Title: ***"Creation of Sulfur-Lithium Batteries Using Viral-Templated Graphene Oxide Nanowires"***
Group Members: Gloria Singleton, Reem Nassar, and Juan del Hoyo
Industry Mentor: Tom Dusseault
Industry Co-Mentor: Gary Broberg

Group Number 9

12:00pm – 12:40pm
Design Project Title: ***"Polydiacetylene Biosensors for Rapid Detection of the Influenza Virus"***
Group Members: Vincent Couming, James Lawlor, and Ian Powell
Industry Mentor: Laurel Rowse
Industry Co-Mentor: Eric Thorgerson

Group Number 10

12:40pm – 1:20pm
Design Project Title: ***"Recycling and Repurposing of Carbon Dioxide to Reduce Carbon Footprint"***
Group Members: Jacqueline Boivin, Josiah Strawser, and Nauchelle Martinez
Industry Mentor: Rich MacLean

Group Number 11

1:20pm – 2:00pm
Design Project Title: ***"Production of a Whey Protein Isolate Derived from Acid Whey Using Cation-Exchange Chromatography"***
Group Members: Caleb Chase, Chris Lamb, Devin McAvoy, and Trevor Polidore
Industry Mentor: Jeff Palumbo

Group Number 12

2:00pm – 2:40pm
Design Project Title: ***"Large-Scale Production of ZMapp via Plant Cell Suspension Culture for the Treatment of Ebola Virus Disease"***
Group Members: Melissa Buttimer, John Jamieson, and Emily Wisniewski
Industry Mentor: Larry Seidler

Wednesday, April 22, 11:20am – 4:00pm

Room 306 Egan Center, Cont'd

(Abstracts on following pages)

Group Number 14

2:40pm – 3:20pm

Design Project Title: ***"Process Control Oriented Extraction of Methane and NGLs from Marcellus Shale"***

Group Members: Anthony Silvi, Jared Conte, and Joe Bonneau

Industry Mentor: Chris Tagoe

Group Number 15

3:20pm – 4:00pm

Design Project Title: ***"Floating Modular Water Purification Utilizing Solar Energy"***

Group Members: Laurie Bock, Miranda Lawrence, and Duy Le

Industry Mentor: Michelle Schneider

Wednesday, April 22, 11:20am – 4:00pm

Room 333 Curry Student Center

(Abstracts on following pages)

Group Number 25

11:20am – 12:00pm
Design Project Title: ***"Automated Aeroponic Growing System"***
Group Members: Will Chauvin, Paul Berry and Phaethon Philbrook
Industry Mentor: Paul Galasso

Group Number 18

12:00pm – 12:40pm
Design Project Title: ***"E^3 Fuels"***
Group Members: Anna Del Rosario, Claudia Okonkwo, and Deanna Wong
Industry Mentor: Zeke Johnston

Group Number 19

12:40pm – 1:20pm
Design Project Title: ***"Suspended Cell Culture and Decoction of Lonicera japonica for use as a Natural Antiviral"***
Group Members: Rosalie Philpot, Kris Kennedy, and Hannah Doss
Industry Mentor: Michelle McNeilly

Group Number 20

1:20pm – 2:00pm
Design Project Title: ***"Steering Buddy"***
Group Members: Noah Buff, Jake Fagen, Ahmad Almakhaita, and Matt Teixeira
Industry Mentor: Peter Ries
Industry Co-Mentor: Richard Schoenfeld

Group Number 6

2:00pm – 2:40pm
Design Project Title: ***"Safe Alternatives to the Smoking of Medical Cannabis"***
Group Members: Irene LeBaron, Gregory Krowicki, and Andrew Schult
Industry Mentor: Judith Bodette

Group Number 22

2:40pm – 3:20pm
Design Project Title: ***"Resveratrol Production"***
Group Members: Justin Lanan, Timur Kurjez, and Matthew Cassista
Industry Mentor: Michael Morris

Wednesday, April 22, 11:20am – 4:00pm

Room 333 Curry Student Center, Cont'd

(Abstracts on following pages)

Group Number 23

3:20pm – 4:00pm
Design Project Title: ***"The Hudson River WTE Consortium"***
Group Members: Luke Gauvin, Noah Luszcz, and Chris Oliveira
Industry Mentor: Dick Giberti

Final Presentations for
Chemical Process Design – Spring 2014

ABSTRACTS

Group Number 8

11:20am – 12:00pm, 206 Egan Center

"Production of A Cognitive Decline and Anti-Aging Dietary Supplement Consisting of Two Synergistic Agents: Naturally Derived Fisetin and Docosahexaenoic Acid"

Alex Colville, Brian Malloy, Dan Reilly, and Ryan Cart

Millions of people worldwide suffer from age-related disease and crippling neurodegenerative diseases such as dementia. These neurodegenerative diseases are of particular importance to the agenda of both the United States and China as the countries face rapidly aging populations and trillions of dollars in additional healthcare expenditure. In an industry swamped with mistrust and pseudoscience, there exists a large opportunity for a premium natural dietary supplement based on science. A special formulation of naturally derived fisetin and docosahexaenoic acid (DHA), a flavonoid sirtuin activator and an endogenous omega-3 fatty acid respectively, has been proven to demonstrate a strong synergistic effect in decreasing cognitive decline in pre-clinical models. The manufacturing process involves the conversion of fustin collected from Lacquer trees to fisetin through a gas bubbling separation. Our team's goal is to produce and market non-FDA evaluated tablets containing this formulation to population segments in the United States and China interested in alleviating or limiting cognitive decline.

Group Number 1

12:00pm – 12:40pm, 206 Egan Center

"An Eco-Friendly Conversion of Grape Pomace Waste into New Products"

Abdulrahman Almulla, Samantha Romano, Jennifer Rosa, and Victoria Zeuner

In the United States, the wine-making industry uses approximately 4.24 million tons of grapes to produce over 8 million gallons of wine each year. This also produces 1.24 million tons of pomace waste every year. Pomace waste consists of the grape seed, skin, stem, and remnant juices and it is disposed of by three main methods: paying a third party to remove it, using a portion as fertilizer for the vineyard, or as cattle feed. Our company, Waste Watchers, aims to turn these compounds into two profitable products, eco-friendly corks and grape seed oil. The systems will be individually designed for wineries based on their size and waste production amounts and incorporated into their current manufacturing processes. This system will save the wineries money and increase profit margins as they sell the two new products and reduce the expenses associated with purchasing natural cork.

Group Number 2

12:40pm – 1:20pm, 206 Egan Center

"Treatment of Industrial Wastewater Using Microbial Electrolysis Cells"

Mitch Brun, Chris Caleca, Bowen Huo, and Matt Pontrelli

Industries such as breweries and pulp and paper mills generate a vast amount of wastewater that must be treated for organics before it can be discharged to navigable waters or the sewer system, in accordance with guidelines set forth by the Clean Water Act, state laws, and local ordinances. In the United States, over 40 billion gallons of wastewater is generated per day, and 3 percent of the country's energy is spent treating this water. Microbial Electrolysis Cells (MECs) are a newly emerging technology capable of transforming this otherwise energy intensive process into an energy positive process, by utilizing the energy contained in wastewater organics. Exoelectrogenic microbes break down the organics, and by applying a small electric current, the breakdown products can be used to make biogas such as methane or hydrogen. MECs are more favorable compared to aerobic digesters, which require large amounts of energy for aeration pumps, and anaerobic digesters, which are more often used for very concentrated effluent and produce impure biomethane through a complex series of biological stages. To date, only one company, Cambrian Innovation, has successfully commercialized MECs for simultaneous wastewater treatment and biomethane production at wineries. The goal of this project will be the design of a system that utilizes MECs for production of hydrogen, a cleaner and higher-energy gas compared to methane, that can be implemented into a broader range of industries, including pulp and paper mills as well as breweries.

Group Number 3

1:20pm – 2:00pm, 206 Egan Center

"Optimization and Craft Production of Whiskey Using Green Engineering Techniques"

Margaret Dowst, Lexi Hamsmith, Hayley Hicks, and Laura May

Green Whiskey is an up and coming craft distiller that will revolutionize the whiskey industry. Our team is proposing a variety of changes to the traditional, outdated process of whiskey production that will increase efficiency, decrease cost, and lead to a higher profit. This innovation coupled with a recent market shortage and an increase in demand offers an ideal opportunity to break into the market. Many industry analysts have been calling this time a whiskey renaissance in with whiskey sales greater than ever and continuing to climb, which will ultimately allow for Green Whiskey to get name recognition but more importantly taste recognition.

Green Whiskey is proposing to introduce changes to starting material, fermentation, and the maturing process, while still producing a whiskey of the highest quality. These process changes in addition to the innovative ideas our team is utilizing to make it a "green" production facility promise a secure and successful future in the whiskey industry. Our team's goal is to produce 150 barrels of whiskey every year: 60 will be designated for immediate sale as white whiskey, 60 will be designated as straight whiskey after 2 years of aging, and the final 30 barrels will become the reserve collection of whiskey that is aged for over 5 years. With three different products Green Whiskey will be able to start selling and making profit as soon as the facility is

ready as well as increasing that profit over the years as more batches of the straight and reserve whiskey are ready for sale.

Green Whiskey is a company dedicated not only to making a quality product but also to making whiskey with a smaller carbon footprint and less waste. Our team's main goals lie in helping the environment and making it cleaner for the many generations to come. Additionally, with these goals in mind, Green Whiskey will make safety a top priority, believing that a quality product can only be made when safety is assured. Green Whiskey is dedicated to their product and to improving the future of whiskey production.

Group Number 4

2:00pm – 2:40pm, 206 Egan Center

"Cultivation of Algae to Reduce Carbon Emissions in Cogeneration Facilities"

Megan Harless, Dan Ahlstedt, and Adam Shorey

In recent years, society has become increasingly aware of the impact greenhouse gas emissions (GHG) have had on the global climate. Politicians, private companies, and even the government all currently are in a movement to become more 'green' and reduce our environmental footprint. World leaders have acknowledged that climate change is a tangible problem and countries must act now to reverse the damages that have already been incurred. Utilizing algae has been a recent advance in reducing these GHG emissions. Algae growth is rapid and relatively simple and one of its main nutrients is carbon dioxide, the largest contributor to these emissions. Algae consume the carbon dioxide through the natural process of photosynthesis and biomass is produced. Typically, the algae are cultivated in large ponds that span acres in the Midwest of the United States. However, research is focused on the development of photobioreactors (PBR) that isolate the photosynthesis in a closed system instead of using large algae ponds. We have designed a system of PBRs and recycle streams to be implemented right at the source of GHGs: cogeneration plants in urban environments. We plan to cultivate algae and directly reduce flue gas emissions before they hit the atmosphere and use the biomass produced to fuel the turbines in the power plant. This system provides new revenue streams for businesses, reduces emissions through the cultivation of algae, and provides a major incentive for gaining carbon credits. By implementing this design, an energy intensive facility is making strides to becoming net zero with an associated progressive image of becoming 'green.'

Group Number 5

2:40pm – 3:20pm, 206 Egan Center

"Utilization of a Parabolic Solar Reflector and Steam Power Generation System as Part of a Modular Energy Production Device"

James Berberian, Joseph DePeter, and Emily Fisler

The two main home energy generation solutions utilized in the United States are gasoline generators and solar panels. Gasoline generators suffer from the necessity of a consumable fuel while solar panels do not immediately provide an energy storage system; our team aims to design a device that provides a robust power output and high capacity energy storage system

that is modular and simple for the consumer to setup, use and maintain. By use of a parabolic reflective surface focusing the sun's radiation onto a closed system of liquid water, steam is produced and provides shaft work to a turbine, generating an electrical current which is stored in a battery array. One of the main goals to be achieved is to design a device that has a comparable energy output and consumer cost of many solar panels on the market today.

Group Number 21

3:20pm – 4:00pm, 206 Egan Center

"Catalyst Aided Coal Gasification to Produce Natural Gas"

Julia Baker, Chia-Hsing Lin, Jocelyn Podyma, and John Vitale

Increasing concern over the environmental impacts of fracking combined with the reality that natural gas produces cleaner energy than coal has created a demand for alternative sources of natural gas. Coal gasification is a process that converts coal into hydrogen and carbon monoxide, these in turn are combined to create natural gas and carbon dioxide. Our project scales up a novel coal gasification process utilizing microwave radiation and a catalyst as the heat source. This novel heat source allows for more precise temperature control than traditional systems, allowing the process to be more energy and economically efficient. The process can be easily adapted to utilize alternative carbon sources, such as wood chips or biomass, which makes the process applicable even after coal resources are depleted. In addition, the carbon dioxide byproduct can be separated and sold for profit as well as recycled as an alternative carbon source. Initially the process will use low-grade coal which is ideal for this application because of its high moisture content and low market price. Our use of low-grade will be more environmentally friendly than when used in traditional power generation systems. The objective of this project is to create a sustainable source of natural gas that can be adapted according to market needs and carbon source availability.

Group Number 7

4:00pm – 4:40pm, 206 Egan Center

"Gluten-Free Beer Production from Sweet Potatoes"

Lia Calise, Alyssa Meizoso, and Jordan Rubio

According to a recent study, the gluten-free market, which includes both food products and beverages, is projected to grow by double-digit figures by 2017. This growth is fueled by a broader demographic of consumers avoiding gluten due to health reasons, such as Celiac disease, weight management, or simply because a gluten-free diet has been bolstered to be "natural". Breweries are not missing out on the gluten-free fad, with more and more breweries producing gluten-free ales made without the traditional barley or wheat. Starting materials such as rice, buckwheat, sorghum, and corn have been utilized by various breweries to achieve a gluten-free product. Craft breweries have also experimented with various gluten-free ingredients such as chestnuts, lentils, and quinoa, although various other starting materials could be utilized.

Our group proposes a novel gluten-free beer produced solely from sweet potatoes while utilizing green engineering practices. Sweet potatoes have the appropriate starch content to allow for yeast-aided fermentation of the resulting sugars and are therefore great candidates for a gluten-free beer production process. Sweet potatoes are also currently used in the beer industry as a flavoring aid, so a beer produced solely from sweet potatoes is expected to have a pleasant, sweet flavor. Currently there are no gluten free beers with sweet potato as the main ingredient on the market, therefore this is the novelty in our proposal.

Group Number 17

11:20am – 12:00pm, 306 Egan Center

"Creation of Sulfur-Lithium Batteries Using Viral-Templated Graphene Oxide Nanowires"

Gloria Singleton, Reem Nassar, and Juan del Hoyo

One of the most important technological developments of the 20th century is the battery. Batteries enable constant energy storage to power emerging technologies, but they have become the bottleneck of innovation. Currently, lithium-ion batteries possess the highest energy density available for commercial applications; however, in order to meet the energy storage needs of the world, it is necessary to advance battery technology beyond lithium-ion. The most promising option is the sulfur-lithium battery. This design replaces the lithium cobalt cathode with sulfur, while the anode becomes elemental lithium. This design has the capacity to achieve energy densities up to 4 times higher than today's lithium batteries. The challenge of this battery is that side polysulfide reactions shorten the battery's life cycle. In this project our team proposes an efficient and scalable process which combines nanotechnology, biology, and engineering to eliminate side reactions in sulfur-lithium batteries, improving power density and life cycle. This facile process exploits the M13 bacteriophage to assemble a nanoporous graphene oxide wire mesh, the wire mesh is then doped with nitrogen, and infused with sulfur to create the cathode. The doped wire mesh creates both a chemical and physical barrier around the sulfur, while allowing li ions to react freely with sulfur. This design will allow our team to generate profits through the introduction of a significantly improved battery to the small electronics market.

Group Number 9

12:00pm – 12:40pm, 306 Egan Center

"Polydiacetylene Biosensors for Rapid Detection of the Influenza Virus"

Vincent Couming, James Lawlor, and Ian Powell

Influenza is one of the most prolific diseases in the world, affecting 5-10% of the global population and claiming almost 500,000 deaths annually. One essential reason for influenza's widespread proliferation is its extended contagion period and uncanny imitation of the common cold in the initial stages. Victims are often unaware that they have indeed contracted influenza, and continue to shed active viral mucus droplets in public, which can live on common surfaces for up to 48 hours. In the absence of effective agents to cure influenza, we propose a health culture based on prevention of transmission of the virus through an effective

colorimetric influenza sensor for home use. The easy to use liquid solution would respond rapidly with a color change from blue to red upon contact with a positive nasopharyngeal mucus sample from the user. Compared to conventional influenza detection methods which require extensive sample preparation and trained technicians, this sensor would be easily operated by the average individual. Available at prices comparable to or lower than symptom relief products, the proposed polydiacetylene sensor would allow parents to test their children prior to sending them to school, restaurant owners to ensure that their facilities are clean, and doctors to quickly diagnose influenza during an office visit. The availability of the product would allow people to inexpensively test themselves for the virus without the need to visit the doctor's office, which may discourage some individuals due to time commitment or financial burden. Our product stands to add unprecedented value to society through immediate medical feedback to infected persons, allowing them to make informed decisions and minimize transmission.

Group Number 10

12:40pm – 1:20pm, 306 Egan Center

"Recycling and Repurposing of Carbon Dioxide to Reduce Carbon Footprint"

Jacqueline Boivin, Josiah Strawser, and Nauchelle Martinez

Industrialized countries around the world are increasing rules and regulations surrounding carbon emissions in an attempt to reduce global warming. Carbon dioxide gas emissions add heat to the environment resulting in major ecological changes. Carbon dioxide emissions from power plants account for about 30-40% of total national carbon dioxide emissions in some industrialized nations. Carbon dioxide emissions can be reduced by the production of algae, resulting in valuable biomass to be used as an alternative fuel source. Our consulting team works to design novel systems to reduce carbon dioxide emissions from powerplants and simultaneously grow and harvest biomass. The systems utilize carbon capture technology for high algae growth rates in photobioreactors and algae flocculants for environmental friendliness in harvesting. These systems will increase profits for powerplants through tax breaks and the sale of biomass, and provide a positive lasting effect on the environment.

Group Number 11

1:20pm –2:00pm, 306 Egan Center

"Production of a Whey Protein Isolate Derived from Acid Whey Using Cation-Exchange Chromatography"

Caleb Chase, Chris Lamb, Devin McAvoy, and Trevor Polidore

With the recent boom of Greek yogurt within the yogurt market, acid whey, a byproduct of Greek yogurt production, has become a large issue for Greek yogurt companies. For every one gallon of Greek yogurt produced, two gallons of toxic acid whey are produced. Today, the majority of Greek yogurt manufacturers pay farmers to take the acid whey off of their hands and incorporate it into livestock feed, or concentrate the byproduct and dispose of it. Whey+ Exchange, LLP provides a process that will extract valuable whey protein isolate (WPI) from the

currently underutilized acid whey. Whey protein isolate is a widely used dietary supplement with 90% or higher protein content, and is a potential additional revenue stream for companies that make Greek yogurt. Using our novel cation-exchange chromatography system, we provide the means for these companies to tap into this potential revenue. Our system has been proven to work on the lab-scale, and we will be the first to make this commercially viable on large scales.

Group Number 12

2:00pm –2:40pm, 306 Egan Center

"Large-Scale Production of ZMapp via Plant Cell Suspension Culture for the Treatment of Ebola Virus Disease"

Melissa Buttimer, John Jamieson, and Emily Wisniewski

Ebola virus disease (EVD) is a rare and deadly disease with no current approved treatment. The fatality rate of EVD ranges from 50 to 90 percent. Small outbreaks of this disease affecting a few hundred people occur almost annually in Africa. However, since December 2013, the worst Ebola outbreak in history has plagued West Africa. As of February 2015, 9,268 people have died from this epidemic. This outbreak has focused the world's attention on finding an Ebola treatment. ZMapp, developed by Mapp BioPharmaceuticals, is a cocktail of three monoclonal antibodies that has been proven to treat EVD in non-human primates and has shown promise during compassionate use in humans. Current production of ZMapp in transgenic whole tobacco plants only produces dozens of doses per month, which is not enough to meet the demands of an epidemic. Creating a production process for ZMapp in a tobacco cell suspension culture has many advantages over the transgenic plant method, including scalability, improved control over process parameters and product purity, and amenability to cGMP requirements. This project both creates this tobacco cell suspension culture production platform and details the logistics of ZMapp's production and distribution to combat future Ebola outbreaks.

Group Number 14

2:40pm – 3:20pm, 306 Egan Center

"Process Control Oriented Extraction of Methane and NGLs from Marcellus Shale"

Anthony Silvi, Jared Conte, and Joe Bonneau

In 2008, geologists estimated that the Marcellus Shale deposit located in the northeastern U.S. contains one of the largest natural gas deposits in the world. This deposit has estimated reserves of 500 trillion cubic feet of natural gas which has an estimated monetary value of about $1 trillion dollars and enough gas to supply the entire U.S. for two years. Our team hopes to extract and process the super-rich wet gas located in the southwestern corner of Pennsylvania in Washington county. We aim to separate and process the Natural Gas Liquids (NGLs) in addition to other profitable gases such as helium and sell them through the proper natural gas channels. By utilizing the portability and versatility of skid-mounted plants and remotely operated process control systems we hope to enter the lucrative natural gas industry.

The portable nature of our plant design will allow us to move well locations to ensure the highest quality and production rates can be achieved to maximize profitability.

Group Number 15

3:20pm –4:00pm, 306 Egan Center

"Floating Modular Water Purification Utilizing Solar Energy"

Laurie Bock, Miranda Lawrence, and Duy Le

Water scarcity is a widespread issue that affects hundreds of millions of people worldwide resulting in water related diseases, high mortality rates, and a number of additional social and economic problems. Our team proposes a technology that can address these water shortages, particularly in developing nations lacking the infrastructure to utilize available water sources. The system features floating modular solar stills that employ simple evaporation and condensation to purify water. The phase change involved in the distillation process removes all impurities, making this system viable for use with virtually any water source. The solar stills will be coupled with photovoltaic driven pumps to deliver water from the source to the inlet of the still, transforming conventional batch distillation into an efficient continuous process. By removing the human labor from the distillation process, these modules have the potential to recover millions of dollars lost as a result of countless hours spent on water collection. This system will be marketed to water aid organizations seeking low cost, sustainable solutions with minimal set up and maintenance.

Group Number 25

11:20am – 12:00pm, 333 Curry Student Center

"Automated Aeroponic Growing System"

Will Chauvin, Paul Berry, and Phaethon Philbrook

The global urban population is projected to increase by more than 2.5 billion people by 2050. Resulting developmental challenges and demand for food require sustainable solutions. Expanding conventional agricultural practices will exhaust natural resources, increase emissions and destroy ecosystems. Furthermore, growing disconnect between producers and consumers has resulted in decreased efficiency and accessibility. In the U.S., fruits and vegetables travel thousands of miles before sale, yet only 1% of adults meet combined consumption recommendations. Consumers value nutrition and taste while producers optimize for transportability and profit. Presented is an automated, enclosed system that enables consumers to grow their own high quality produce within the constraints of an urban environment with minimal oversight or expertise. An innovative design and prototype with functional software have been developed. Plants are grown aeroponically by spraying roots suspended in air with a nutrient solution. This reduces water consumption by 98%, minimizes nutrient use and eliminates need for pesticides, herbicides or soil management. A microcontroller and series of sensors and actuators regulate lighting, temperature, humidity, nutrient delivery and CO_2 enrichment. Controlling these variables can accelerate growth rate by 200%. A mobile application provides remote control, monitoring and notifications. An

integrated system offers growers optimal preset parameters. Results can be shared through this network to create a continuously improving community. This system empowers individuals to grow fresh food year-round, and has a modular design that allows for scaled up commercial purposes. Underutilized urban spaces can become assets, making affordable produce accessible to local communities while creating jobs. Safe, controlled, high quality production has various applications including for distributors, restaurants and research institutions.

Group Number 18

12:00pm – 12:40pm, 333 Curry Student Center

"E^3 Fuels"

Anna Del Rosario, Claudia Okonkwo, and Deanna Wong

Climate change is a real and critical issue that affects the entire planet. There is a rising demand for more sustainable alternative energy sources. The tradition extraction and use of petroleum fuels results in the depositing of carbon into the atmosphere. These petroleum sources are becoming increasingly scarce with biofuels becoming the trend in alternative energies. Biofuels are fuels that are derived from biological material derived from living, or recently living organisms. Some sources of biofuels include sugarcane, corn, and algae. However, using algae rather than sugarcane or corn, prevents the use of a food source biomass. Cultivation of algae also operates as a means of carbon sequestering. Our team intends to create a process that is commercially viable and is optimized to produce biocrude that can be used to produce high quality biofuels such as jet fuel, biodiesel and fuel oil. The utilization of hydrothermal liquefaction, allows for conversion of the entire algae biomass, including carbohydrates, lipids and proteins, into biocrude. This process reduces the number of steps and performs the reaction more efficiently. Our target market is alternative energy industries and traditional industries looking to expand into greener fuel practices. By creating a process that is sustainable and ethically green, this team hopes to move the fuel industry one step closer to a more Earth friendly future.

Group Number 19

12:40pm – 1:20pm, 333 Curry Student Center

"Suspended Cell Culture and Decoction of Lonicera japonica for use as a Natural Antiviral"

Rosalie Philpot, Kris Kennedy, and Hannah Doss

The flu is a disease that develops as a result of infection by the influenza virus. Symptoms of infection include cough, runny nose, high fever, malaise, body aches, sore throat, and headache. 5-10% of adults and 20-30% of children are affected by the flu globally each year, and 250,000-500,000 people die. Currently, there is no cure for the flu, though there are several therapies available on the market. A new annual vaccine is developed every year, though is it not always effective, and not everyone is able to be immunized. Antivirals, such as Tamiflu and Relenza are commercially available, though they are not very effective and have the potential for serious side effects. Another alternative is palliative care, bed rest, and waiting for the body's natural immune response to fight the disease.

Japanese Honeysuckle (*Lonicera japonica*) has long been believed to provide an effective treatment to the flu. New research, originating from the University of Nanjing in China, points to MIR2911 as the compound responsible for this effect. We propose a large-scale, suspended cell culture of *Lonicera japonica* root cells, followed by tangential flow filtration, diafiltration, several wash steps, and decoction. The final product is a highly pure, highly concentrated serum that can be taken orally as a treatment to the flu.

Group Number 20

1:20pm – 2:00pm, 333 Curry Student Center

"Steering Buddy"

Noah Buff, Jake Fagen, Ahmad Almakhaita, and Matt Teixeira

The Steering Buddy is an innovative design that revolves around a multi-functioning steering wheel. Resistance heating is used to heat four metal contacts embedded in the polyethylene terephthalate (PET) plastic steering wheel rim, strategically placed for comfortable hand positions while driving. The majority of the hollow steering wheel rim will allow for unimpeded air flow, when the cooling function is activated, from the vehicle's main ventilation fan through a supplementary ventilation branch directed into the steering column. Utilizing a sliding air duct alignment between the steering column and the steering wheel, the air flow will continue through the hollow steering wheel rim and back down the steering column to rejoin the main ventilation ducts without hindering the rotation of the steering wheel. The health monitoring systems will provide drivers with a comfortable and reliable single-lead ECG for improved personal health management. These leads will be embedded inside the steering wheel, providing ECG information when the driver is contacting at least two of the four metal contacts. This ECG data will be saved to a portable memory device that can be removed from the car for personal use at any time. The Steering Buddy will be a patented idea to be licensed to an independent automotive manufacturer(s) due to the need for certain design aspects to be installed during the manufacturing process.

Group Number 6

2:00pm – 2:40pm, 333 Curry Student Center

"Safe Alternatives to the Smoking of Medical Cannabis"

Irene LeBaron, Gregory Krowicki, and Andrew Schult

The United States is the largest consumer of prescription pain relievers in the world using 200 million prescriptions per year, including nearly 100% of the world's supply of hydrocodone/acetominophen. Using opiods can be problematic for patients since they are highly addictive, and there currently do not exist any non-addictive, potent prescription analgesics alternatives. Our project goal is to gain a competitive foothold in the U.S. analgesic market through an innovative, non-addictive, and highly potent pharmaceutical compound classified as a 'cannabilactone' Positive Allosteric Modulator (PAM). This cannabilactone amplifies the agonizing effects relating to CB2 receptors found in the body (more commonly known for agonizing with THC in cannabis) to take advantage of pain-relieving effects without

inducing a "high", addictive effect. We propose a production process adapted from a laboratory experimental produced by Dr. Makriyannis who synthesized this cannabilactone.

Group Number 22

2:40pm – 3:20pm, 333 Curry Student Center

"Resveratrol Production"

Justin Lanan, Timur Kurjez, and Matthew Cassista

Resveratrol or 3,5,4'-trihydroxy-*trans*-stilbene is a chemical found in the skins of muscadine grapes and in other plants as well. Its presence in red wine makes it a suspect for the French paradox in which the French people have low rates of heart disease despite their relatively high fat diet. Although the effects of resveratrol on the human body are still under study, there are laboratory studies showing that resveratrol may have significant cardioprotective and anticarcinogenic benefits. Word of the possible health benefits of resveratrol has led to an established market for it in the US supplements industry valued at $45 million annually. The market continues to grow and is not dominated by any one particular supplier; however most of the resveratrol supplements on the market today come from the Japanese knotweed, an invasive and environmentally harmful species. Grape skins contain less resveratrol, but the US has an established grape supply in California due to the high concentration of wineries. JMT Manufacturing aims to tap into the resveratrol supplements market by extracting resveratrol from grape skins and operating locally to the grape supply. With the potential for clear profit, JMT manufacturing has developed a solvent extraction process to obtain the resveratrol. An ultrasonication technique is utilized to significantly boost the yield, giving a competitive advantage. With an estimated market share of 5% and an annual capacity of 3,000 kg per year, the project has the potential to turn profits of over $5 million after 20 years.

Group Number 23

3:20pm – 4:00pm, 333 Curry Student Center

"The Hudson River WTE Consortium"

Luke Gauvin, Noah Luszcz, and Chris Oliveira

The Hudson River Waste to Energy Consortium seeks to solve the challenges associated with municipal solid waste handling in New York City. Current system inefficiencies force the city to invest $300 million annually in order to transport municipal solid waste out of state for disposal. The municipal government currently funds public and private contractors for these tasks using significant tax-sourced capital. In doing so the state loses an opportunity to reduce transportation costs and generate valuable products.

An alternative solution presented herein involves a waste-to-energy conversion technology facility that readily integrates with the current infrastructure. This project will offer the value proposition of cost-effective, clean, and localized waste disposal for New York City. The system is designed to be mounted on a mobile floating unit the size of a shipping barge, thus allowing direct loading at municipal solid waste transfer stations. The firm seeks to gasify approximately 3% of the total annual city-wide output for each barge implemented. The waste-to-energy

plant is a manifestation of New York City's ambitions to reduce reliance on landfills in other states while producing significant revenues.

Furthermore the waste-to-energy conversion technology will produce valuable syngas fuel, which is a marketable environmentally friendly energy source. As envisioned, the gasification barge will produce 121 thousand tons of syngas each year and displace 470 thousand barrels of oil consumed by the United States. Gasification technology will reduce the carbon footprint of municipal solid waste disposal by eliminating greenhouse gas emissions associated with landfilling and transportation. Implementation of non-traditional waste disposal facilities aligns with the alternative energy objectives of the United States EPA. The Hudson River Waste to Energy Consortium is dedicated to providing a sustainable and cost-effective technology to an iconic United States city in order to demonstrate the nation's continued leadership in economical environmentalism.