

# Clean Green IGERT Newsletter



<http://cleanenergy.ucla.edu>

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## Highlights from the Clean Energy for Green Industry Traineeship for Graduate Studies at UCLA



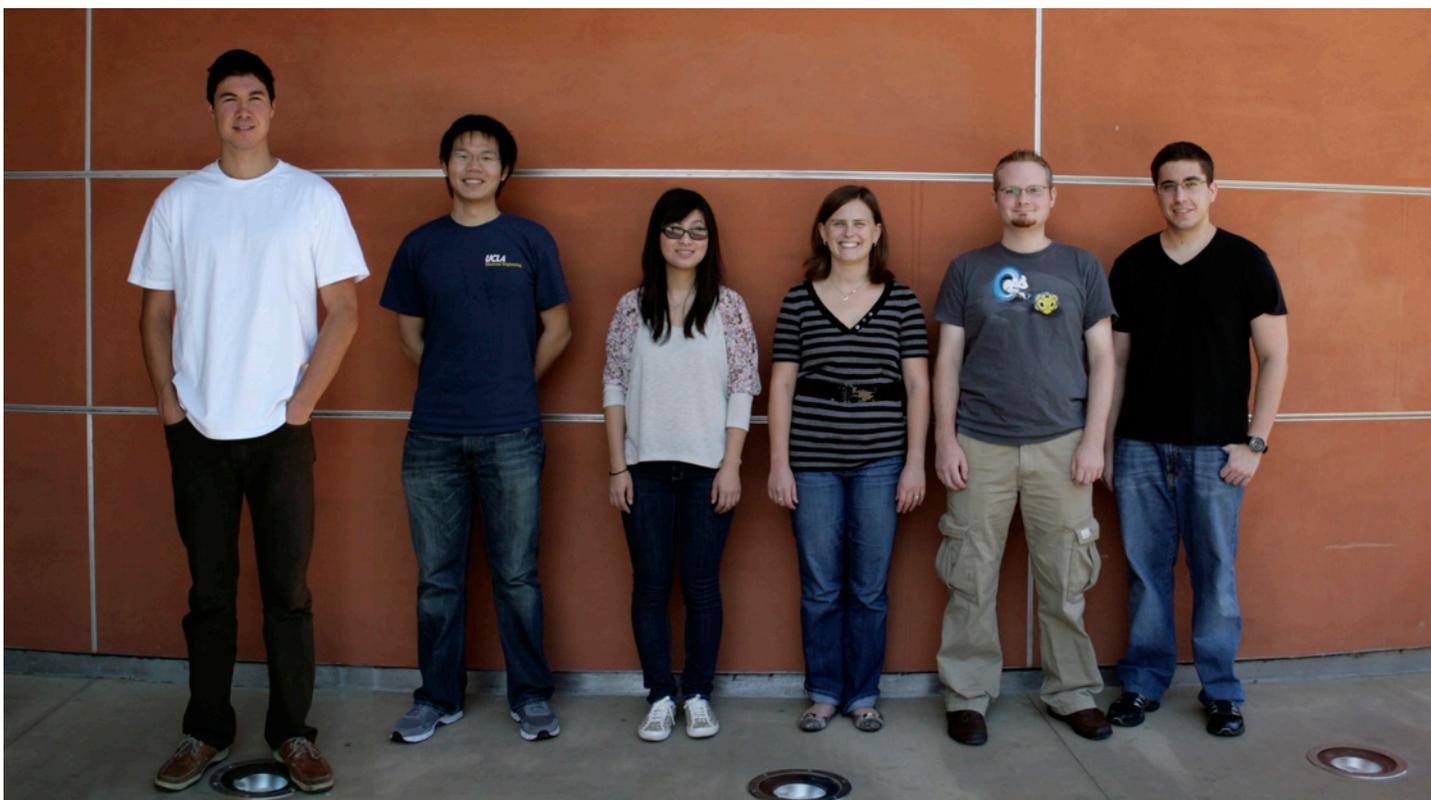
(l-r): Jaime Torres, Brion Bob, Igor Bogorad, David Watts, Leland Smith, Razmig Kandilian

### Outreach: The EnGen Roadshow

Spearheaded by **Igor Bogorad** and **Leland Smith**, the CGI trainees have developed “The EnGen Roadshow” to present at high schools in Los Angeles County. The roadshow consists of several energy related demonstrations designed by the trainees, including a hand-cranked electric generator, hydro power generator, thermoelectrics, solar panels, stirling engine, fuel cells, rudimentary steam engine, and a toy hydrogen car. The goal is to map out for students the basic infrastructure that connects their household electronics to various resource streams that generate electricity. The road show is under continual development and is rotated through all CGI fellows so that everyone has an opportunity to connect to students in our local community.

The first EnGen Roadshow was presented at Bell Gardens High School on May 20. The show has also been presented to students in UCLA’s Art|Sci Center program on June 22, Alexander Hamilton High School on September 28, and Redondo Union High School on November 17.

Bell Gardens High School teacher **Mr. Mitchell Paik** noted that the demonstrations and flash cards on energy were great tools to engage the students as they seem to know the terms for alternative energy but do not understand the science behind how it actually works. Hamilton High School teacher **Ms. Dina Kraemer** commented that the roadshow was a huge success for students to see the connections between the information presented and participating in the demonstrations.



(l-r): Brian McVerry, Hao-Yuan Chang, Tiana Huang, Megan Accordino, Brian Keck, Michael Haddad

## Clean Green IGERT Trainees 2011-2012

This year 6 new trainees joined the CGI program for a program total of 22. Additionally, 2 faculty advisors also joined CGI: **Prof. Rajit Gadh** (Mechanical & Aerospace Engineering; CGI focus: energy conservation) and **Assoc. Prof. Deepak Rajagopal** (Institute of the Environment & Sustainability; CGI focus: policy and economics).

**Megan Accordino** (Economics, advisor Prof. Deepak Rajagopal) studies the economic effects of electricity storage into the grid, specifically the investment in and usage of storage and its relation to the market power of firms.

**Hao-Yuan Chang** (Electrical Engineering, advisor Prof. Kang Wang) is developing a novel computing architecture that not only consumes less energy but also efficiently solves problems involving multidimensional data sets.

**Michael Haddad** (Electrical Engineering, advisor Prof. Diana Huffaker) fabricates III-IV solar cells based on patterned catalyst-free nanopillars using both organic and non-organic approaches. He also studies the morphology of nanopillars grown by MOCVD as it relates to the doping of these structures.

**Tiana Huang** (Electrical Engineering, advisor Prof. Rajit Gadh) researches smart energy profiles as applied to smart products, demonstrating energy efficiency aspects of smart buildings such as smart HVAC, smart switch panel, and smart sensors.

**Brian Keck** (Chemistry & Biochemistry, advisor Prof. Sarah Tolbert) conducts research on materials for chemical and electrochemical energy storage using self-assembled mesoporous structures.

**Brian McVerry** (Chemistry & Biochemistry, advisor Prof. Richard Kaner) develops new materials for more efficient water filtration including desalination, ultrafiltration, and microfiltration.



Seminar speaker Professor Eli Yablonovitch with trainees Joshua Shapiro, Amy Ferreira, and Jaime Torres

## Fall Symposium & Seminar

This year the CGI trainees created the Clean Energy and Sustainability Lecture Series, featuring one high-impact researcher each quarter. As a leading scientist in photovoltaics, **Prof. Eli Yablonovitch** (UC Berkeley) gave the inaugural seminar to a packed house at the California NanoSystems Institute on December 7. A former UCLA faculty member, Yablonovitch co-founded Alta Devices and their research has broken the solar cell efficiency record and attracted over \$70 million for commercialization. A symposium was held in conjunction with the seminar, consisting of a poster session of the fellows' research on the analysis of corporate carbon footprints and financial performance, plasmonic organic

tandem solar cells, waste heat energy harvesting, applications for III-V nanopillars, self-assembly of semiconducting polymers, high performance lithium ion batteries, salinity-gradient energy, and a real-time energy monitoring study at UCLA student housing. Demonstrations from the EnGen Roadshow were also presented along with demonstrations from the "Earth's Energy: Diminishing Fossil Resources and Prospects for a Sustainable Future" course taught by **Prof. David Paige** (Earth and Space Sciences).

## Research Highlights

**Benjamin Feinberg** (advisor Prof. Eric Hoek) co-authored a paper published in *Energy & Environmental Science*. The paper, entitled "Membrane-based production of salinity-gradient power", outlines the fundamental

principles and state-of-the-art of membrane-based conversion of salinity-gradient energy, a renewable and environmentally benign energy source receiving increased attention in recent years. In particular, an attempt is made to identify the most important and promising directions for future research and technological innovation.

**Joshua Shapiro** (advisor Prof. Diana Huffaker) co-authored 4 papers published in *Nano Letters* this year: "Bottom-up Photonic Crystal Cavities Formed by Patterned III-V Nanopillars", "Patterned Radial GaAs Nanopillar Solar Cells", "Surface Plasmon-Enhanced Nanopillar Photodetectors", and "Bottom-up Photonic Crystal Lasers".

**Johnny Chen** (advisor Prof. Yang Yang) co-authored 2 papers published in *ACS Nano* this year: "Plasmonic Polymer Tandem Solar Cell" and "Polymers for Highly Transparent Conductors". A third paper on "Fused Silver Nanowires with Metal Oxide nanoparticles and Organic Polymers for Highly Transparent Conductors" has been accepted for publication.

**Brion Bob** (advisor Prof. Yang Yang) co-authored a paper published in *Chemistry of Materials*. The paper is entitled "Identification of the Molecular Precursors for Hydrazine Solution Processed  $\text{CuIn}(\text{Se},\text{S})_2$  Films and Their Interactions".

Another paper, “Mechanism of Sulfur Incorporation into Solution Processed  $\text{CuIn}(\text{Se,S})_2$  Films”, has also been accepted for publication.

**Razmig Kandilian** (advisor Prof. Lauren Pilon) co-authored a paper published in *Smart Materials and Structures*. The paper is entitled “The pyroelectric energy harvesting capabilities of PMN–PT near the morphotropic phase boundary” and reports on direct thermal to electric energy conversion by performing the Olsen cycle on pyroelectric materials.

**Ian McKinley** (advisor Prof. Lauren Pilon) co-authored a paper that has been accepted to *Smart Materials and Structures*. The paper is entitled “Pyroelectric Waste Heat Energy Harvesting Using Relaxor Ferroelectric 8/65/35 PLZT and the Olsen Cycle”. Ian is also preparing a paper with Razmig Kandilian on waste heat energy harvesting.

## Internships

**Rita Blaik** (advisor Prof. Bruce Dunn) is currently serving 2 internships over Fall and Winter Quarters. First, she is serving as the outreach and networking coordinator for the UCLA Art|Sci program to help develop another center in New York City with Parsons and Columbia University. Second, she is serving on the proposal



Intellectual property negotiation exercise led by Cynthia Cannady (left)

evaluation team with the Buckminster Fuller institute, a non-profit organization that fosters collaborative projects between scientists and artists to develop projects that focus on issues of sustainability.

Over the summer, **Nicholas Nairn-Birch** (advisor Prof. Magali Delmas) interned at the New Chemicals Management Branch in Washington, DC. The Branch is responsible for regulating all new chemicals introduced into the market place and is part of the Environmental Protection Agency’s Office of Pollution Prevention and Toxics.

## Donation from Intel

CGI has received a \$10,000 donation from Intel Corporation. We are grateful for this gift and thank Salvador Rivas (HSSEAS Office of External Affairs) for

securing the donation.

## Intellectual Property Negotiation Exercise

On September 8, Cynthia Cannady, (attorney, founder of IPSEVA) and Shahin Farshchi, (Lux Capital Management) led a four hour intellectual property negotiation exercise. Teams of trainees role-played the interested parties in a mock negotiation between the university inventors and the corporation licensing the technology. This negotiation exercise built upon a workshop with Cannady earlier in the year where the trainees learned about patents and how to make the best use of them.

## Conferences

The CGI travel allowance enabled two trainees to attend



(left) Omar Asensio leading a workshop at the Southwest Regional ACS Meeting  
 (right) Jaime Torres at the Los Angeles Port Tech Expo with Avid Boustani (Mayor's Office)



workshops in Europe this year. In November, **Joshua Shapiro** attended “DFT and Beyond”, an intensive 10 day hands-on workshop on density functional theory held at the Fritz-Haber Institute in Berlin, Germany.

In June, **Omar Asensio** (advisor Prof. Magali Delmas) was one of 15 Ph.D. students selected in a globally competitive process from 11 countries to attend the Oikos Young Scholars Entrepreneurship Academy in Filzbach, Switzerland. Omar’s submitted paper was entitled “The effect of R&D capital on stock market returns in the clean tech industry: The dynamic structure of policy-induced innovation”. Omar also led a 4-hour innovation workshop entitled “Fostering Innovation: Styles and Process” at the 67th Southwest Regional American Chemical Society (ACS) Meeting in Austin, Texas on November 12.

In July, Omar volunteered behind-the-scenes at the Governor’s Conference on Local Renewable Energy Resources, held jointly with Governor Jerry Brown’s Office and the UCLA Luskin Center. Additionally, just before the start of the new school year, Omar and new trainee **Megan Accordino** attended the UCE<sup>3</sup> Summer School at the Center for Energy and Environmental Economics, UC Berkeley.

**Razmig Kandilian** and **Ian McKinley**, along with their advisor Prof. Laurent Pilon presented their research at the International Workshop on Piezoelectric Materials and Applications (IWPM), 6th Annual Energy Harvesting Workshop, and 1st Annual Center for Energy Harvesting Materials and Systems (CEHMS) Conference in Roanoke, Virginia on August 10. Razmig presented his research on “Pyroelectric Energy Conversion

using PMN-32PT Single Crystals” and Ian presented his research on “Waste Heat Energy Harvesting Using Olsen Cycle on PZN-5.5PT Single Crystals”.

In September, **Leland Smith** (advisor Prof. Bruce Dunn) attended the 5th Annual Energy & Sustainability Conference held by the Solar Hydrogen IGERT at the University of Delaware. For 3 days, IGERT fellows from across the country gathered to foster conversations what will lead to a more sustainable future. Government officials, faculty, and industry representatives were amongst the invited speakers.

**Amy Ferreira** (advisor Prof. Sarah Tolbert) represented the CNSI High School Nanoscience Program at the 8th Gold Coast Science Network Conference for K-12+ Science Educators on November 5 in Oxnard, CA and demonstrated the program’s superhydrophobic experiment.

**Jaime Torres** (advisor Prof. Richard Kaner) volunteered at the 2nd Annual Port Tech Expo 2011 on September 14 in San Pedro, CA. Jaime served with a delegate from the Los Angeles Mayor’s Office to generate interest in Clean Tech LA and the role of academia (specifically UCLA) to commercialize lab research in renewable and sustainable technology. The expo attracted government officials as well as investors and technology entrepreneurs with clean and green

maritime solutions.

## Faculty and Staff News

**Prof. James C. Liao** has been named the holder of the Ralph M. Parsons Foundation Chair in Chemical Engineering. The endowed chair is intended to educate a brand of engineers who can design new technological products and systems while anticipating and preventing adverse social and environmental impact. Much of Liao's research focuses on creating new ways to produce environmentally friendly biofuels and chemicals. Earlier this year, Gevo Incorporated, who has licensed a biofuels production method co-developed by Liao, completed a \$107 million initial public offering.

**Prof. Yang Yang** has been named the holder of the Carol and Lawrence E. Tannas Jr. Endowed Chair in Engineering. This chair is the first in the world dedicated to the area of electronic information displays. Yang's research focuses on conjugated polymers and organics, polymer LEDs, and related polymer electronic, photonic and bio-devices. Yang has recently attracted attention for his novel concept for harvesting and recycling energy for electronic devices by equipping LCD screens with built-in photovoltaic polarizers, allowing them to convert ambient light, sunlight, and their own backlight into electricity.

**Prof. Rajit Gadh** has been elected a Fellow of the American Society of Mechanical Engineers (ASME). Gadh's contributions are in the area of information-based design and manufacturing. Gadh also showcased his research on wireless monitoring of electric vehicle smart grid at the UCLA Electric Vehicle-Smart Grid (EV-SG) Living Lab Demo and EV-SG Consortium on August 3.

**Prof. Chang-Jin Kim** was selected as one of Dong-A Newspaper's "100 People Who Will Light Up Korea in Year 2020". Kim was selected for his outstanding research in the field of micro electro-mechanical systems (MEMS) as well as his ability to communicate and network.

**Prof. Diana Huffaker** has been awarded nearly \$1.4 million from the National Science Foundation to study fundamental issues related to organic/inorganic hybrid solar cells.

Program Coordinator **Mariko Walton** has accepted to serve on the IGERT Resource Center (IGERT.org) 2011-2012 Program Coordinator Advisory Board.

## Save the Date: ReSET 2012

CGI trainees are currently organizing the Renewable and Sustainable Energy Technology (ReSET) Workshop—Technology and Policy Efforts to ReSET our economy to renewables: a cross-

disciplinary IGERT workshop. The workshop will take place at UCLA's California NanoSystems Institute (CNSI) on April 12-13, 2012. Preliminary invitations and a call for abstracts have been sent to IGERT programs around the country. A web site with further details will be available in January 2012. Registration is free.



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