

AT A GLANCE

Founded: 2014

Program Director: Edward H. Sargent, University of Toronto

Fellows and advisors: 16

Institutions represented: 15, in 7 countries

Fields and subfields: nanotechnology, including nanomaterials; physical and inorganic chemistry; polymer science; biophysics; chemical, molecular and quantum physics; optics; environmental engineering

Interaction meetings: 2; in San Francisco, USA, and Vancouver, Canada

Relevant knowledge users: cleantech and biotech industrial sectors; economists; policy-makers

Partner: Fonds de recherche du Québec — Nature et technologies

Supporters: The Arthur J.E. Child Foundation, Chisholm Thomson Family Foundation, Charles Hantho, Jerry and Geraldine Heffernan, Max Bell Foundation, Metcalf Foundation

BIO-INSPIRED SOLAR ENERGY

Aims to improve our ability to use solar energy by learning lessons from the remarkable effectiveness of photosynthesis in plants, algae and photosynthetic bacteria.

The program in Bio-inspired Solar Energy completed the first year of its initial five-year term in 2015/2016. Aiming to make sustainable energy sources, such as solar and wind, cost-effective and ubiquitous, the program's scientific strategy involves studying how nature's photosynthetic organisms already achieve this goal, and seeking inspiration for new materials, chemistries, devices and systems from these compelling biological precedents.

During the year, the program held two successful program meetings, which helped to further refine the intellectual agenda of the program and expand the program's membership. Resulting from these interactions, the

program grew to include 11 appointed fellows and five advisory committee members.

With newly designed support from CIFAR, the program ran a competitive process to identify, recruit and support three postdoctoral fellows and six graduate students, each of whom are being jointly supervised by two or more program fellows. These two-year positions will support specific, high-risk collaborative projects designed to advance the program's research thematics and strengthen the intellectual synergy among program members.

The program also held preliminary discussions with relevant industrial stakeholders by inviting three industrial representatives to participate in the program meeting held in Vancouver. The program has identified the energy sector as a highly relevant intellectual input to the program's research direction and is aiming to embed industrial influence by bringing key individual researchers from industry into the program to serve as links between advanced research and future commercial applications.

Research

- Fellows **Alán Aspuru-Guzik** (Harvard University), **Greg Scholes** (Princeton University) and CIFAR Advisor **Robert Blankenship** (Washington University in St. Louis) have formed a new collaboration to study the evolution of the Fenna-Matthews-Olson complex, a notable pigment-protein complex found in bacteria that mediates the conversion of light into energy. Probing the underlying mechanisms in this system may enable new understanding of natural and artificial photosynthetic systems and brings together experts in computational modeling, biochemistry and photophysics.
- In a recent collaboration, fellows **Chris Chang** and **Peidong Yang** (both University of California, Berkeley) successfully combined catalytic molecules and nanomaterials on a single platform to enhance the catalyst efficiency for the reduction of carbon dioxide to syngas, a valuable intermediate in the production of synthetic fuels.
 - > Kornienko N, Zhao Y, Kley CS, Zhu C, Kim D, Lin S, **Chang CJ**, Yaghi OM, **Yang P**. 2015. Metal-organic frameworks for electrocatalytic reduction of carbon dioxide. *J Am Chem Soc.* 137: 14129-14135.
- The group of Heffernan Director and Senior Fellow **Edward Sargent** (University of Toronto) designed the most efficient catalyst for storing energy in chemical form by splitting water into hydrogen and oxygen (similar to photosynthesis). A key element of success was the use of a catalyst made of tungsten, iron and cobalt that was found to be over three times more efficient than the current state of the art.
 - > Zhang B, Zheng X, Voznyy O, Comin R, Bajdich M, García-Melchor M, Han L, Xu J, Liu M, Zheng L, García de Arquer FP, Dinh CT, Fan F, Yuan M, Yassitepe E, Chen N, Regier T, Liu P, Li Y, De Luna P, Janmohamed A, Xin HL, Yang H, Vojvodic A, **Sargent EH**. 2016. Homogeneously dispersed, multimetal oxygen-evolving catalysts. *Science.* 352(6283): 333-337.

Other notable publications

- Mirkovica T, Ostroumovb EE, Annac JM, **van Grondelle R**, Govindjee, **Scholes GD**. 2016. Light absorption and energy transfer in the antenna complexes of photosynthetic organisms. *Chem Rev.* In press.

IdeasExchange

- In October 2015, Senior Fellow **Jillian Buriak** (University of Alberta) participated in a technical engagement session focused on innovation and technology as part of the Climate Leadership Discussions of the Government of Alberta's Climate Change Advisory Panel. She presented the goals and research directions of CIFAR's program in Bio-inspired Solar Energy, as well as insights from her own research. Approximately 30 participants attended the session, representing research funders, industry, government and innovation support agencies.
- Senior Fellow **Alán Aspuru-Guzik** (Harvard University) helped to facilitate an invitation to give a plenary lecture in Mexico City on **Global Networks: the Future of Energy**, together with CIFAR President and CEO **Alan Bernstein** in April 2016. Hosted by the Energy Sustainability Fund of Mexico's Ministry of Energy, and held at the National Autonomous University of Mexico, the event attracted nearly 200 participants, including stakeholders from academia and the public and private sectors.

Global Academy

- The program has begun training the next generation of research leaders by inviting students and postdoctoral fellows to participate in program meetings. The program also recently decided to use newly allocated support from CIFAR to recruit graduate students and postdoctoral fellows to be jointly supervised between program fellows in an effort to expose burgeoning researchers to multidisciplinary approaches and ideas.

To learn more: <https://www.cifar.ca/research/bio-inspired-solar-energy/>

Heffernan Director and Senior Fellow Edward Sargent speaks at the December 2015 meeting of CIFAR's program in Bio-inspired Solar Energy.

