

## MIT and Masdar Institute Cooperative Program

MIT works with the Masdar Institute of Science and Technology to facilitate the development of human capacity in science and technology in Abu Dhabi. Now in its second phase, the Masdar Institute is helping develop a high-caliber workforce focused on research and development that can address grand challenges and underpin economic development in alternative energy and sustainable advanced technologies.

### Objectives

Over the period July 1, 2014, to June 30, 2015, MIT and the Masdar Institute continued to focus on:

- Developing a robust Masdar Institute research ecosystem for industry/government engagement by implementing joint researcher-to-researcher projects
- Leveraging the Masdar Institute's signature emphasis on advanced energy and sustainability to build educational links to industry and assist in the selection of new degrees and tracks within existing programs
- Seeding an innovation and entrepreneurship environment in terms of developing research mechanisms to engage industry and developing educational elements to amplify research impact
- Deepening the relationship between the Masdar Institute and MIT by engaging in co-advising of PhD students, student exchanges, and summer programs for institute students at MIT

### Academic Programs

The educational mission of the Masdar Institute follows directly from the university's vision and mission. This mission is to provide students with the knowledge, skills, and experience necessary for successful careers in industrial or academic roles in their chosen fields and with domain expertise and broad awareness in advanced energy and sustainable technologies and policies.

The structure of the academic programs is designed to encourage students and faculty to study and research across program boundaries. This is important to enable researchers to tackle complex problems in energy and sustainability that cannot be confined to single disciplines. The nine master of science degree programs currently offered at the Masdar Institute were developed with assistance from MIT. In addition, MIT is providing assistance to the institute in establishing a chemical engineering practice option.

MIT continued to advise on the curricula and structure of the Masdar Institute's accredited doctor of philosophy in interdisciplinary engineering. MIT faculty members are currently serving on more than 50 of the institute's PhD student doctoral committees.

MIT has provided scholarly assessment for the hiring of 93 faculty, including 46 at the assistant level, 31 at the associate level, 10 at the full professor level, and six professors of the practice.

## Students

The Masdar Institute's enrollment reached 456 students in May 2015, with students coming from over 22 different countries. The institute graduated more than 100 master's degree students and its first two PhD students in May.

## Research Activities

The program is committed to building a thriving collaborative research environment and focuses on two distinct processes that contribute to and support the development of focused research centers at the Masdar Institute.

### Masdar Institute and MIT One-to-One Joint Collaborative Research

One-to-one research builds upon the strong relationship between the Masdar Institute and MIT and involves one MIT principal investigator (PI) and one Masdar Institute PI. Fifty-four one-to-one projects have been undertaken jointly by the institute and MIT. Three new projects were awarded in 2014–2015:

- Development of a Non-Aqueous Vanadium Redox Flow Battery with Improved Electrolytes and Electrodes (November 1, 2014–October 31, 2016; Professor Yang Shao-Horn of MIT and Professor Saif Saeed Al Mheiri of the Masdar Institute)
- A Multilayered Approach to Assessing the Vulnerability of Critical Infrastructure Against Cyber Attacks (December 1, 2014–November 30, 2016; Professor Nazli Choucri of MIT and Professor Sameh El Khatib of the Masdar Institute)
- Fabrication of an Abrasion Resistant Coating with Anti-Reflection, Anti-Soiling, Anti-Static and Self-Healing Properties (February 1, 2015–January 31, 2017; Professor Michael Rubner of MIT and Professor Khalid A. Askar of the Masdar Institute)

### Masdar Institute and MIT Flagship Research Projects

The flagship research projects are a mechanism for broader collaborative research between the Masdar Institute and MIT. They are designed to bring together teams of faculty from the institute and MIT to address key strategic research areas with the intent of building critical mass, making a sizeable research impact, and fostering the strategic growth of Masdar Institute research centers. A total of nine flagship projects have been awarded to date.

### Masdar Institute and MIT Innovation Program

The Masdar Institute and MIT Innovation Program (MMIP) helps MIT and Masdar Institute faculty and students in their joint efforts to commercialize breakthrough technologies and inventions by transforming promising ideas into innovative products and cutting-edge spinout companies. MMIP makes modest but pivotal investments in research that is being done by some of the most talented scientists and engineers at MIT and the Masdar Institute. The following ignition grants were awarded for the period September 1, 2014, to August 31, 2015:

- Low Cost Rapid Algal Bloom Sensing Device (Dr. Anuradha Agarwal of MIT and Professor Prashanth Reddy Marpu of the Masdar Institute)
- Wastewater Treatment Using Novel Integrated Technology Based on Bio-Electrochemical and Nanowire Filtration (Professor Jing Kong of MIT and Professor Shadi Hasan of the Masdar Institute)
- Novel Module Configuration for High Efficiency Membrane Distillation (Professor John Lienhard of MIT and Professor Hassan Arafat of the Masdar Institute)
- GaN High Efficiency Transmitters for Wireless Communication (Professor Tomas Palacios of MIT and Professor Mihai Sanduleanu of the Masdar Institute)

These ignition grants of \$50,000 were awarded to MIT and Masdar Institute researchers doing promising yet still unproven work on inventions with a potentially large impact. By funding positions for graduate students and postdoctoral researchers, the grants allowed teams to conduct exploratory experiments, validate a concept, and/or develop a working prototype.

Up to three of the four projects listed above will be chosen for one year of additional funding in July 2015 that will lead to a proof of concept toward potential commercialization. These projects, after year one, will have exhibited sufficiently developed results and will have high potential for further support to refine and enhance an innovation, systematically explore potential markets, and assess the commercial viability of specific applications. The ultimate goal upon completion of MMIP funding is to attract sufficient investment to commercialize a product and launch a spinout company and/or to license the technology to an existing company.

### **Accomplishments**

During this reporting period, an additional four MIT faculty participated in the program (for a total of 119), along with 54 additional research scientists or postdocs (for a total of 116); these researchers are from 24 different centers, labs, and departments at MIT. No posting to Abu Dhabi is required.

An additional 75 MIT students were supported by the program, raising the total number to 302; these students, from 19 different departments, labs, and centers, have had funded interactions with Masdar Institute faculty, students, and staff.

MIT students traveling abroad under the program participated in over 60 conferences and workshops.

The program has helped build experience and capacity at MIT for collaborative institution building and research.

An additional 24 visits to Abu Dhabi by MIT faculty and staff took place during this reporting period, bringing the total number of visits to 184; an additional 19 visits to MIT by Masdar faculty and staff took place, bringing that total to 180.

Masdar Institute and MIT participants authored 15 peer-reviewed journal articles, for a total of 81 to date. In addition, Masdar Institute faculty independently authored more than 50 papers during this reporting period.

Five additional Masdar Institute faculty members spent time at MIT over the reporting period, bringing the total number to 60.

MIT interviews all faculty and senior-level Masdar Institute administrators. The current number of Masdar faculty is 93. Also, MIT reviewed and provided scholarly assessments of an additional 10 suggested elective courses at the institute, raising that count to 117 elective courses.

The Masdar Institute has filed over 120 utility patents, invention disclosures, and provisional patents.

Professor Erik Brynjolfsson, Dr. Frank MacCrory, and Dr. George Westerman from MIT and Professor Yousef Al Hammadi from the Masdar Institute won the 2014 International Conference on Information Systems Award for Best Conference Paper.

The Masdar Institute topped *U.S. News & World Report's* rankings in the area of research in the magazine's inaugural Best Arab Region Universities listing.

### **Impact of Social and Cultural Policies and Events**

The success of the Masdar Institute is highly dependent on the government's acceptance of the notion of a private, not-for-profit, research-based university operating in Abu Dhabi. The Masdar Institute is an agent of change for the diversification of the Abu Dhabi economy, but change is never easy, and long-term commitment is crucial in terms of human capital development, institutional independence and flexibility, and financial support. This applies to all aspects of building a research-based university.

Over the last year, several events have been organized to foster connections with government and industry stakeholders and to further build strong connections between the Masdar Institute and MIT. A particularly important effort is to foster the building of an ecosystem supporting entrepreneurship and innovation that can help bring about the economic transformation desired in Abu Dhabi and the United Arab Emirates.

New technologies are needed to solve the world's problems—whether disease, malnutrition, pollution, or climate change—and it takes a team of dedicated and motivated individuals working together to get their inventions into the hands of those who need them most. On April 13, 2015, Dr. Vladimir Bulovic, MIT professor of electrical engineering, spoke at a joint MIT/Masdar Institute research conference on emerging nanotechnologies; over 30 MIT faculty and staff participated in this conference in Abu Dhabi. MIT's efforts to develop strategies to help accelerate all of the steps from discovery to invention, production, and profitability as part of its innovation mission tie into the innovation focus at the Masdar Institute.

## Program Governance

### Cooperative Program Steering Committee

The Cooperative Program Steering Committee oversees the program's intellectual and strategic goals. The committee also reviews the recommendations of the joint Research Advisory Committee.

MIT steering committee members are Dr. Duane Boning (program director), Dr. Charles Cooney (MIT faculty director, Deshpande Center for Technological Innovation), Dr. Claude Canizares (vice president), and Patricia Vargas (program executive director). Masdar Institute members are Dr. Sultan Al Jaber (United Arab Emirates minister of state and chairman, Abu Dhabi Future Energy Company), Dr. Fred Moavenzadeh (president, Masdar Institute), Dr. Mohammed Sassi (interim dean of faculty, Masdar Institute), and Hamza Kazim (vice president of operations and facilities, Masdar Institute).

### Research Advisory Committee

The Research Advisory Committee reviews all research proposals, monitors progress on research projects, and makes recommendations to the Cooperative Program Steering Committee.

Committee members from MIT are Robert Armstrong (professor of chemical engineering and director of the MIT Energy Initiative), Professor Munther Dahleh (interim director of the Laboratory for Information and Decision Systems), John Lienhard (professor of mechanical engineering and director of the Abdul Latif Jameel World Water and Food Security Lab), Eugene A. Fitzgerald (professor of materials science and engineering), and program director Boning. Masdar Institute members are Hassan Arafat (associate professor of water and environmental engineering), Ibrahim Elfadel (professor of microsystems engineering and head of the Institute Center for Microsystems), Bruce Ferguson (professor of the practice, engineering systems and management, and head of the Institute Center for Innovation and Entrepreneurship), Taha Ouarda (professor of water and environmental engineering and head of the Institute Center for Water and Environment), and Jens Ejbye Schmidt (professor of chemical engineering and head of the Institute Center for Energy).

## Organization

The director of the MIT and Masdar Institute Cooperative Program is Dr. Duane Boning. Patricia Vargas is the executive director, Peter R. Jones is the assistant director for research, Paul Arsenault is administrative and financial officer, Dr. Scott Kennedy is the assistant director for education, Danielle Atwell is the manager of outreach, and Leslie Quinn is the program's administrative assistant.

**Duane Boning**  
**Director**