



COLLABORATIVE FIELD COURSE IN BRAZIL
**ENERGY, WATER AND THE
ENVIRONMENT**



January 6th to 21st, 2010

Academic Host Institutions



*Harvard University
School of Engineering &
Applied Sciences (SEAS)*



*Universidade de São Paulo
Escola Politécnica
(Poli-USP)*



DRCLAS
HARVARD UNIVERSITY

*Harvard University
David Rockefeller Center for
Latin American Studies
(DRCLAS)*

Collaborating Academic Institutions

- ❖ Faculdade de Arquitetura e Urbanismo, Universidade de São Paulo (FAU-USP)
- ❖ Harvard Electric Utility Policy Group, Harvard Kennedy School (HKS)
- ❖ Instituto de Eletrotécnica e Energia, Universidade de São Paulo (IEE-USP)
- ❖ Universidade Federal do Rio de Janeiro (COPPE-UFRJ)

Field Sites

- ❖ Centro de Tecnologia Canaveira (CTC)
- ❖ Empresa Metropolitana de Água e Energia (EMAE)
- ❖ Escola Superior de Agricultura “Luiz de Queiroz” (ESALQ)
- ❖ Itaipu Binacional
- ❖ Petrobras’ Centro de Pesquisas e Desenvolvimento (CENPES)
- ❖ Sabesp
- ❖ Universidade Petrobras
- ❖ Usina São José – Consórcio PCJ

Support

In addition to the support of the academic host institutions, this collaborative course was made possible thanks to the generosity of the Lemann Family Endowment at Harvard University, Claudio Haddad, the Coolidge Family Fund of the Boston Foundation, Pedro Conde Filho and Santander Universities.

www.drclas.harvard.edu/brazil/seas-poli-usp-2010

Caros Participantes (Dear Participants),

Sejam bem-vindos! We are delighted to welcome you to this collaborative field course on Energy, Water and the Environment. This new initiative is a joint effort of Harvard University's School of Engineering and Applied Sciences (SEAS), the Universidade de São Paulo's Escola Politécnica (Poli-USP), and the Brazil Studies Program of Harvard's David Rockefeller Center for Latin American Studies (DRCLAS). The course includes 26 undergraduate and graduate students and will take place from January 6th to January 21st, 2010 in the states of São Paulo, Rio de Janeiro and Paraná, Brazil.

The talented students in this group come from Belgium, Brazil, Canada, China, Romania, South Korea, Spain and the United States. While the majority of Harvard students are pursuing degrees at SEAS, the course reaches across the University, including students from Harvard Law School (HLS), the Harvard Kennedy School (HKS) and Harvard's Graduate School of Arts & Sciences (GSAS). Brazilians from the Poli-USP, our host institution, include nine undergraduates, two Master's students and two Doctoral students. The course also extends across universities in the U.S. and Brazil, with one student joining us from the Massachusetts Institute of Technology (MIT) and another from Brazil's Universidade Estadual de Campinas (UNICAMP).

Core course faculty come from the engineering schools at Harvard and the USP with distinguished guest speakers and participants from a range of leading institutions in Brazil. Students will have the opportunity to learn from the experiences of professors who have served as Ministers of the Environment and of Education, Presidents of national water and electricity regulators, Deans of top engineering schools as well as climate scientists and heads of large-scale engineering projects. You will also learn a great deal from each other.

A dynamic and diverse country with over 180 million inhabitants in an area slightly larger than the continental U.S., Brazil offers a rich set of options for field sites. The course includes technical field site visits to Itaipu, the largest operational hydroelectric power plant in the world; Sabesp – ETA Guaráu, the primary drinking water treatment facility for São Paulo, a metropolitan area with a population over 19 million; the R&D center for Petrobras, a global leader in advanced deep sea petroleum exploration; the construction site of P-56, a 50,000 ton semi-submersible oil platform capable of processing and treating 170,000 barrels of liquids and 100,000 barrels of 16° API oil; the external and subterranean areas of EMAE's Henry Borden power plant; and the Centro de Tecnologia Canavieira (CTC), the largest sugarcane-based technology center in Brazil and one of the most prestigious in the world.

We intend for the impact of the collaborative course and the relationships established through it to be measured in years not days. We hope that participants will develop a thirst for continued engagement with the subject matter and with fellow students and faculty. The course should serve as a catalyst for strengthening networks and enabling follow-on research and learning. This initiative would have been cancelled were it not for the vision, engagement and support of many individuals and institutions. To all those who have contributed to the creation and execution of this collaborative course, please know that we are deeply grateful.

Grande abraço,



Monica Porto

Full Professor and Chair, Department of Hydraulic and Sanitary Engineering, Escola Politécnica da Universidade de São Paulo



Scot T. Martin

Gordon McKay Professor of Environmental Chemistry
Harvard School of Engineering and Applied Sciences



Jason Dyett

Director, Brazil Office
Harvard University
David Rockefeller Center for Latin American Studies

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ACADEMIC HOST INSTITUTIONS

HARVARD'S SCHOOL OF ENGINEERING AND APPLIED SCIENCES

Harvard University's School of Engineering and Applied Sciences (SEAS) serves as the connector and integrator of the University's teaching and research efforts in engineering, applied sciences, and technology. Its core tenets are educating broad-minded students; interdisciplinary research; integration across disciplines; and balancing theory, experimentation, and practice. SEAS offers undergraduate concentrations in Applied Mathematics (A.B.), Computer Science (A.B.), and Engineering Sciences (A.B. and an ABET-Accredited S.B. degree) and graduate programs (S.M., M.E., and Ph.D.). Graduate students may work towards a Master of Science (M.S.), Master of Engineering (M.E.), and Doctor of Philosophy (Ph.D.) degree in one of four subjects—Applied Mathematics, Applied Physics, Computer Science, and Engineering Sciences—or graduate with a Ph.D. in the Information, Technology and Management program (with Harvard Business School). Faculty number approximately seventy (73 FTEs) who have particularly close ties with the departments of Physics, Earth and Planetary Science, and Chemistry and Chemical Biology. Over the past decade, undergraduate enrollments in Applied Mathematics, Computer Science, and Engineering Sciences have ranged from 300 to 400. For additional information, please see: www.seas.harvard.edu

UNIVERSIDADE DE SÃO PAULO – ESCOLA POLITÉCNICA

The University of São Paulo (USP) is composed of 40 institutes, colleges and schools across seven campus locations. The USP is the largest higher education and research institution in Brazil. The primary campus in metropolitan São Paulo houses the Escola Politécnica (Poli-USP), which has more than a dozen departments; the Institute of Astronomy, Geophysics and Atmospheric Science; the Institute of Physics; the Institute of Mathematics and Statistics; and the Chemistry Institute. Founded in 1893, the Poli was incorporated into the Universidade de São Paulo in 1943. Poli-USP has 327 full time faculty and 434 professors. It offers undergraduate (4,524 students), graduate (1,312 Master's and 827 Doctoral students), and continuing education (7,777 students) courses and degrees. For additional information, please see: www.poli.usp.br

HARVARD'S DAVID ROCKEFELLER CENTER FOR LATIN AMERICAN STUDIES

The David Rockefeller Center for Latin American Studies (DRCLAS) is one of 11 inter-faculty initiatives at Harvard University and is overseen by the Office of the University Provost, with an administrative home in the Faculty of Arts and Sciences. DRCLAS was founded in 1994 as an initiative to promote high-quality teaching and research on Latin America and related fields at Harvard University. The mission of the DRCLAS Brazil Office in São Paulo and Brazil Studies Program at Harvard in Cambridge is to enhance collaborative research among Harvard faculty and their Brazilian counterparts; encourage faculty engagement with Brazil and student participation in language programs, internships and research projects in Brazil; and provide a hospitable environment for Brazilians at Harvard and for Harvard scholars in Brazil. In the three years since the launch of the Brazil Office in June 2006, Harvard faculty and students have engaged in and with the country across a range of disciplines. For additional information, please see: www.drclas.harvard.edu/brazil

COURSE SCHEDULE – JANUARY 2010



Wednesday, January 6

Morning

International student arrivals – Harvard students/MIT student.
DRCLAS Brazil Studies Program Staff will pick-up the students at the airport.

Afternoon

Hotel check-in for all students. Rest and free time.

Quality Faria Lima Hotel
Rua Diogo Moreira, 247
Pinheiros - São Paulo, São Paulo
Tel: +55 (11) 2197-7050
Fax: +55 (11) 2197-7051
www.atlanticahotels.com.br

7:30 p.m.

Informal welcome dinner.

Bazar da Pizza
Rua Henrique Monteiro, 164 - Pinheiros (two blocks from hotel)

Thursday, January 7

8:45 a.m.

Meet in hotel lobby.

9:00 – 10:00 a.m.

Brief driving tour of Cidade Universitária - Universidade de São Paulo (USP) campus. Group departure from hotel at 9:00 a.m.

10:00 – 10:30 a.m.

Walking tour of USP Engineering School (Poli-USP). Tour in four sub-groups, which will be led by Poli students.

10:30 a.m. – 12:15 p.m.

Welcome and Collaborative Course Overview. [Professor José Roberto Cardoso](#), the new incoming Poli-USP Dean, welcomes students; each student briefly introduces herself/himself; [Jason Dyett](#) provides overview of what to expect in the next two weeks; Professors [Monica Porto](#) and [Scot Martin](#) explain teaching and learning objectives for the course.

12:30 p.m. – 2:00 p.m.

Lunch. Group lunch at restaurant of the business, economics and accounting school of the USP (FEA-USP). A private room in the restaurant, called “Sweden”, has been reserved for the course on the 2nd floor.

2:15 p.m. – 4:00 p.m.

Lecture & Discussion: Brazil’s Energy Matrix and the Environment. [Professor José Goldemberg](#). Overview of energy, ethanol/biofuels and the environment. Discussion will include international comparisons (30-45 minute lecture followed by group

questions and discussion).

4:00 p.m. – 5:30 p.m. **Group break-outs.** The goal of the first break-out session of the four topic-focused groups is for students (in groups of six) to get to know each other and to begin to identify questions and interests for upcoming lectures and discussions.

5:30 p.m. **Return to hotel.**

Evening **Free.** Students free to gather in smaller groups.

Friday, January 8

8:30 a.m. **Depart hotel for Poli-USP.**

9:00 a.m. – 10:45 a.m. **Lecture & Discussion: Water supply in megacities – Engineering and Environmental Challenges.** Professors [Monica Porto](#) and [José Rodolfo Scarati Martins](#). (30-45 minute lecture followed by group questions and discussion).

11:00 a.m. – 12:45 p.m. **Lecture & Discussion: Urban Planning and Urban Waters.** Professors [Ricardo Toledo Silva](#) and [Rubem Porto](#). (30-45 minute lecture followed by group questions and discussion).

Lunch Brown Bag lunch will be provided.

3:00 p.m. – 5:30 p.m. **Field Site Visit: Sabesp.** Visit to São Paulo's largest water treatment station, Estação de Tratamento de Água do Guaráu ([ETA Guaráu](#)).

Evening **Free.** Possible cultural outing.

Saturday, January 9

Morning **Free.**

10:30 a.m. **Visit to downtown São Paulo (Centro).**

Lunch **Group lunch.**

Afternoon **Driving tour of São Paulo (Brooklin, Jardins, etc.). Visit to Ibirapuera park.**

Evening **Free.**

Sunday, January 10

All Day **Free.** Students encouraged to have joint informal activities/outings.

Monday, January 11

8:30 a.m.	Meet in hotel lobby.
Morning	Field Site Visit: Empresa Metropolitana de Águas e Energia S.A. (EMAE) - Henry Borden power plant. Visit to Billings Reservoir and Henry Borden power plant.
Lunch	Lunch on-site.
Afternoon	Field Site Visit continued.
Evening	Possible optional cultural event.

Tuesday, January 12

8:30 a.m.	Pack, check-out and be prepared for departure to airport.
9:00 a.m. – 10:30 a.m.	Lecture & Discussion: Itaipu Binacional and Electricity Distribution. Prof. Lineu Belico dos Reis. <i>Note: this lecture and discussion will take place at the DRCLAS Brazil Office.</i>
11:15 a.m.	Depart hotel to airport. Brown Bag lunch will be provided.
1:25 p.m. – 3:05 p.m.	TAM Flight #3559 Departs from São Paulo (Guarulhos - GRU) Arrives at Foz do Iguaçu, Paraná (IGU)
Afternoon	Hotel check-in. Rest and free time. Nadai Confort Hotel Avenida República Argentina, 1332 Centro – Foz do Iguaçu, Paraná Tel: +55 (45) 3521-5050 www.nadaiconforthotel.com.br
5:30 p.m. – 7:00 p.m.	Lecture & Discussion: Renaissance Engineers – What they are and why? Dr. Marie Dahleh . Design equations for building and operating a hydroelectric plant. Jaime de Aguinaga Garcia .

Wednesday, January 13

8:30 a.m.	Depart hotel for Itaipu Binacional.
All Day	Site Visit: Technical Site Visit to Itaipu Binacional Full day site visit at the world's largest operational hydroelectric power plant.
6:00 p.m. – 7:30 p.m.	Lecture & Discussion: Key Concepts of Fossil-based Fuels. Professor Scot Martin . Introduction to the key concepts of fossil-based fuels (e.g., energy content) and their extraction and use.
7:45 p.m.	Group dinner.

Thursday, January 14

- 8:30 a.m. **Check-out of hotel.**
- 9:00 a.m. **Group Visit to Foz do Iguaçu.** Tour from the Brazilian side of scenic waterfalls and boat tour.
- 12:30 p.m. **Lunch at waterfalls.**
- 2:00 p.m. **Depart for airport and flight to Rio de Janeiro.**
- 4:00 p.m. – 6:00 p.m. GOL Flight #1757
Departs from Foz do Iguaçu, Paraná
Arrives at Rio de Janeiro (GIG)

Evening **Hotel check-in.** Rest and free time. The following hotels are located within three blocks of one another.

(Students & DRCLAS organizers)
Atlantis Copacabana Hotel
Rua Bulhões de Carvalho, 61
Copacabana – Rio de Janeiro, RJ
Tel: +55 (21) 2521-1142
Fax: +55 (21) 2287-8896
www.atlantishotel.com.br

(Course Faculty)
Orla Copacabana Hotel
Avenida Atlântica, 4122
Copacabana – Rio de Janeiro, RJ
Tel: +55 (21) 2525-2425
Fax: +55 (21) 2287-9134
www.orlahotel.com.br

Friday, January 15

- 7:45 a.m. **Depart hotel for Petrobras Universidades**
- 8:30 a.m. – 11:00 a.m. **Presentation and Discussion: Universidade Petrobras. From Monopoly to Free Market Challenges; The Challenges of the “Pre-sal”** Izeusse Braga Jr, International Communication Manager.
Universidade Petrobras – Corporate Education. Gustavo Tamara, International Coordinator.
- 11:00 a.m. – 12:30 p.m. **Presentation and Discussion: Pre-salt: Technological Challenges and Opportunities for the Brazilian Industry.** Antonio Carlos Pinto – E&P-Presal Project Manager
- Lunch** Lunch at Universidade Petrobras.
- Afternoon** **Field Site Visit: Visit to Petrobras Research Center (CENPES).** Guided tour of the laboratories and facilities of the CENPES.
- 7:30 p.m. **Dinner with Presentation & Q&A: Science & Technology and Innovation Institutions of the 21st Century.** Professor [Venkatesh “Venky” Narayanamurti](#). Dinner including all course participants, alumni and special guests.

Saturday, January 16

7:45 a.m.	Depart hotel for Angra dos Reis. Scenic drive along beautiful coast of Rio de Janeiro (approx. 160 km).
Late morning and early afternoon	Field Site Visit: Deep sea oil platform construction site for P-56, a 50,000 ton, 110 meter long and wide and 125 meter tall platform (one of the largest in the world).
Lunch	Lunch in Angra dos Reis.
Evening	Free.

Sunday, January 17

Free	Sightseeing and/or beach time. Informal, optional groups will be formed.
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Monday, January 18

10:00 a.m.	Depart for airport and flight to Campinas.
12:00 p.m. – 1:20 p.m.	GOL Flight #1956 Departs from Rio de Janeiro (Galeão/Tom Jobim – GIG) Arrives at Campinas, São Paulo (Viracopos – VCP) Bus travel to Piracicaba, São Paulo.
3:15 p.m. – 5:00 p.m.	Field Site Visit: Centro de Tecnologia Canavieira (CTC). Presentation and Q&A session with Jaime Finguerut, Chief of Research and Development, and André Elia Neto, Specialist in Agroindustrial Technology and Environment. Hotel check-in. Beira Rio Palace Hotel Rua Luiz de Queiroz, 51 Centro – Piracicaba, São Paulo Tel: +55 (19) 3401-1000 www.beirariopalacehotel.com.br

Tuesday, January 19

Morning	Field Site Visit: Usina São José – Consórcio PCJ Ethanol plant visit in Rio das Pedras.
Lunch	
Afternoon	Field Site Visit: Escola Superior de Agricultura “Luiz de Queiroz” (ESALQ) – Bioenergy TBC. Visit to ESALQ, a unit of the Universidade de São Paulo and a leader in Brazil in research on bioenergy, agriculture and agricultural-related sciences.

Late afternoon **Return to São Paulo by bus.**

Evening **Hotel check-in.** Rest and free time.
Quality Faria Lima Hotel
Rua Diogo Moreira , 247
Pinheiros - São Paulo, São Paulo
Tel: +55 (11) 2197-7050
Fax: +55 (11) 2197-7051
www.atlanticahotels.com.br

Wednesday, January 20

8:30 a.m. **Depart hotel for Poli-USP.**

9:00 a.m. – 10:45 a.m. **Lecture & Discussion: Global Water Management.** Professors [John Briscoe](#), [Ben Braga](#) and [Francisco Gomide](#).

11:00 a.m. – 12:45 p.m. **Regulation of the Energy Sector.** Professors [Jerson Kelman](#) and [Ashley Brown](#) Professor Kelman will give an overview of regulation and tariff impact on investment; Ashley Brown will discuss the Brazilian experience in a comparative context with the United States.

Lunch

Afternoon **Student groups prepare for presentations.**

Dinner **Free.**

Thursday, January 21

8:30 a.m. **Depart hotel for Poli-USP.**

9:00 – 10:30 a.m. **Course online evaluation.**

10:45 a.m. **Brief student group presentations & certificate ceremony.**
Dean of Poli-USP, Dr. Ivan Gilberto Sandoval Falleiros, will participate in the certificate ceremony. Harvard alumni, special guests and course supporters will be invited.

Lunch **Closing lunch.** The collaborative course will close with lunch at the restaurant at FEA-USP.

Evening **International Departures.**

COURSE LOCATIONS

Brazil

With a population of 190 million and an economy of approximately US\$1.83 trillion, Brazil has developed strong macroeconomic stability over the past decade. The country, which is slightly larger than the continental United States and is the largest in South America, is comprised of 26 states and a Federal District, Brasília (see map below).



São Paulo, São Paulo

We will spend the first five days of the course in São Paulo not far from the campus of the Universidade de São Paulo, called the “Cidade Universitária.” São Paulo is the most populous city in the southern hemisphere and is the capital of the state of São Paulo. While São Paulo’s population is approximately 11 million, the greater metropolitan area is home to almost 20 million inhabitants. Metropolitan São Paulo has a GDP of approximately US\$146 billion (12% of Brazil’s GDP) and is home of the Bovespa, the largest stock exchange in Latin America. The city brings together many cultures, with 3 million people of Portuguese descent, 3 million of Italian descent, 1.5 million of African descent, 1 million of German descent, 850 thousand of Lebanese descent and more than 1 million people of Japanese descent (largest Japanese city outside Japan). The final two days of the course will also take place in São Paulo, São Paulo.

Foz do Iguaçu, Paraná

We will spend two days based in Iguaçu, a full day of which will be dedicated to our technical site visit to Itaipu dam. Home to the striking Iguaçu Falls, this city has a population of just over 300,000 inhabitants. Foz do Iguaçu is an international tourist destination at the border of Brazil, Argentina and Paraguay.

Rio de Janeiro, Rio de Janeiro

We will spend four nights and three days based in Rio de Janeiro, know as the “Cidade Maravilhosa” (Marvelous City) for its natural beauty. The second largest city in Brazil, Rio was the country’s capital for nearly two centuries until the capital moved to Brasília in 1960. Rio also has the largest and second largest urban forests in the world.

Angra dos Reis, Rio de Janeiro

During our time in the city of Rio de Janeiro, we will take a full day trip to Angra dos Reis, which is located in the southwest of the state, approximately 160 km (100 miles) from the city. Most of the drive is along Rio’s beautiful coastline which is home to over 365 islands.

Piracicaba, São Paulo

We will spend one day and one night in Piracicaba, a city of 365,000 located 80 km (50 miles) from Campinas, São Paulo – the city where we will land after departing Rio. The name “Piracicaba” comes from a word in the indigenous Tupi language that means "place where the fish stops". Piracicaba is also home to the leading sugar-based ethanol research center, CTC, and to many biofuel plants. From Piracicaba, the group will return to the city of São Paulo for the final days of the course.

SITE VISITS

***An Important Note of Thanks to our Field Site Hosts:** On behalf of all its participants, the course organizers would like to thank the tremendous generosity, openness and hard work of the many institutions and individuals who have made the following field site visits possible. Unfortunately, we are certain to miss many of you in this brief note of acknowledgement. Please know that, despite our omissions, we appreciate your contributions and recognize that you are integral to this collaborative course's existence and success.*

Sabesp – ETA Guaraú

❖ Cláudia Mota dos Santos Pereira

EMAE

❖ Antonio Bolognesi
❖ Mario Luiz do Nascimento Oliveira
❖ Paulo Sérgio de Ponti

Itaipu Binacional

❖ Cicero Bley Jr.

Petrobras

❖ André Garcez Ghirardi
❖ Carlos Tadeu da Costa Fraga
❖ Daysi Piva
❖ Geraldo Castro
❖ Gustavo Támara
❖ José Carlos Vidal
❖ Ricardo Salomão
❖ Ricardo Uchoa
❖ Rodrigo Horta
❖ Rubin Diehl

CTC:

❖ André Elia Neto
❖ Jaime Finguerut
❖ Nilson Boeta
❖ Patrícia Lopes Simões
❖ Carolina Costa (UNICA)
❖ Nayana Rizzo (UNICA)

Usina São José - Consórcio PCJ

❖ Alexandre Villela
❖ Felipe Vitti
❖ Guilherme Valarini

ESALQ

❖ João Martines-Filho

SABESP ETA GUARAÚ – (DRINKING WATER TREATMENT)



Sabesp is the largest water and wastewater company in Latin America, based on the number of customers and net revenues. It operates in 366 municipalities, including the city of São Paulo, providing services to more than 26 million people.

In 1973, with the implementation of the National Sanitation Plan, the state sanitation companies were created. In the State of São Paulo, as a result of the fusion of the companies and the autarchies that until then managed the water services and the sewage collection services in the cities, Sabesp was created. A company characterized by mixed economy and open capital, SABESP finds in the Government of the State its main shareholder and has its shares traded in the New York and São Paulo Stock Exchanges.

Today, Sabesp supplies 60% of the State's population, providing services to 365 out of the 645 cities and supplies treated water to 6 others that take care of their own distribution. Sabesp plans, executes and operates water, sewage and industrial wastewater systems, preserving the environment and improving the life conditions of a population that is twice as large as the population of Belgium. Since 2007 Sabesp is allowed to geographically expand the scope of its business and to add new types of services related to environmental sanitation and energy. To provide quality services, it has a gigantic structure and in the last 5 years it has invested nearly U\$ 3 billion in a capital expenditure program designed to meet growing demand for potable water, increase the percentage of households connected to its sewage system, increase sewage treatment, improve overall operating efficiency and reduce water losses.

Sabesp currently provides water services to 100 percent of the population in its concession area, 78 percent with sewage collection and 63 percent with wastewater treatment. The company aims to maintain and improve these levels going forward, with an emphasis on increasing wastewater treatment.

From 2009 to 2013 Sabesp will invest nearly U\$5 billion to continue providing water to the entire population of the cities that Sabesp supplies, as well as widening the sewage collection and treatment rates. Thus, its goals for 2013 are to provide: 100% of treated water; 90% of collected sewage; and 88% of treated sewage.

The Guaraú Water Treatment Plant is responsible for treating water of the Cantareira System, one of the largest in the world. With a capacity of more than 36 cubic meters per second of water being treated, it is the largest drinking water plant in South America. Only the Chicago Drinking Water Plant is as large as Guaraú. It's capacity is equivalent to 720 million gallons per day. In comparison, the Latham, New York Drinking Water Treatment Plant, treats only 15 million gallons per day (0.6 cubic meters per second). The Guaraú Treatment Plant uses alum to coagulate and flocculate particles, which are then removed by settling and filtration. Chlorine is added to kill any bacteria and fluoride is added for the prevention of tooth decay.

EMAE - EMPRESA METROPOLITANA DE ÁGUA E ENERGIA S.A. (SÃO PAULO METROPOLITAN WATER AND ENERGY COMPANY)



EMAE's principal activity is the generation and marketing of electric energy. It is proprietor and operator of the hydraulic and electric energy generation system located in the metropolitan area of São Paulo, Medium Tietê and Paraíba do Sul River Valley. The Company deals with the planning, construction and maintenance of production systems, storage, preservation and marketing of energy and water dams. The Company has 5 hydroelectric and 2 thermoelectric plants in Brazil, and nearly 800 employees. Its hydraulic and electric energy generation system consists of reservoirs, channels, power plants and associated structures, whose main characteristic is to demand an operation focused on the rational use of surface waters, on the several hydraulic resources available, providing the generation of energy on sites strategically scattered in charge centers, on the flood management in the Metropolitan Area of São Paulo, and on the preservation of the water supply for the public in general. Its origins date back to the British "São Paulo Railway, Light and Power Company Limited", founded in Brazil in 1899. Light's first hydroelectric power plant, the Parnaíba Power Plant, started operating in 1901.

Billings Reservoir

Located on the highlands, the Billings Reservoir encompasses areas of the Municipalities of São Paulo, Santo André, São Bernardo do Campo, Diadema, Ribeirão Pires and Rio Grande da Serra. With approximately 1.1 billion cubic meters of water (35 billion cubic feet, or more than 264 billion gallons), it is EMAE's largest accumulation volume reservoir. It was built in 1937 with the objective of receiving the waters from the Tietê and Pinheiros Rivers, by means of pumping action of the Traição and Pedreira step-up plants, in addition to the waters of its own basin, for the electric energy generation at Henry Borden Power Plant in Cubatão. In 1981 the reservoir was divided by means of the construction of the Anchieta Dam, at Riacho Grande, next to the Anchieta Highway, resulting in two compartments: the Pedreira and the Rio Grande. The objective of this division was to preserve the quality of the water of the Rio Grande compartment, from which SABESP collects water for general public supply. In a multi-use conception, the waters of this reservoir are used for the generation of electric energy, water supply to the public, through the reversion of the Taquacetuba Arm into the Guarapiranga Reservoir, sanitation, floods management and leisure, among others.

Billings-Pedras Dam

The Billings-Pedras Dam is located between the Billings Reservoir and the Billings-Pedras Channel. This structure is intended to control the water flow from the Billings Reservoir to the Rio das Pedras Reservoir, where lay the water intakes of the Henry Borden Power Plant, in Cubatão. The regulated discharges to the Rio das Pedras Reservoir is performed by three wagon type floodgates, which supply a total flow rate of 400 cubic meters/second (14,125 cubic feet/second). It has a maximum height of 28 meters (app. 92 feet), and a 359 meter-long ridge (app. 1,178 feet).

Henry Borden Hydroelectric Power Plant

The Henry Borden complex, located on the foot of the Serra do Mar, in Cubatão, encompasses two high (720 meters; nearly 2,400 feet) fall power plants, called External and Underground, with 14 groups of generators, powered by Pelton turbines, totaling an installed capacity of 889 MW, for a flow rate of 157 cubic meters/second (5,545 cubic feet/second).

External Power Plant: The oldest of the power plants encompasses eight penstock, and a conventional power house. The first unit was inaugurated in 1926, and the others were installed until 1950, totaling eight generation groups, with an installed capacity of 469 MW. Each generator is powered by two Pelton type turbines, activated by the waters driven from the Rio das Pedras Reservoir, which reach the Valves' Housing where, after passing through two butterfly valves by means of penstock, go down the hillside reaching their respective turbines, completing an approximate distance of 1,500 meters (nearly 5,000 feet).

Underground Power Plant: The Power Plant encompasses six generation groups, installed inside the rocky massive of the Serra do Mar, in a cave 120 meters long (394 feet), 21 meters wide (69 feet) and 39 meters (128 feet) high, with 420MW of installed capacity. The first generation group started operating in 1956. Each generator is powered by one Pelton turbine, activated by four water jets.

ITAIPU (HYDROELECTRIC DAMN)



The Itaipu power plant is the world's largest hydroelectric power plant in terms of electricity generation, arguably making it the world's largest generator of renewable and clean energy. Itaipu Binacional is a public company with a unique legal make up, given its double nationality (Brazilian and Paraguayan). It is a company that prizes maintenance and operation efficiency according to strict labor safety and accident prevention standards; it is attentive to the constant development of its organization and the value chain it belongs to, and which carries out initiatives related to corporate governance, knowledge management, and technology research and innovation. Itaipu Binacional is of vital importance for the development and dynamism of Brazilian and Paraguayan economies and for the integration of those areas, and employs the best social-environmental responsibility practices in the electricity generation industry, contributing to the sustainable, environmentally healthy, and socially responsible development of both Brazil and Paraguay.

The construction of Itaipu Binacional solved a diplomatic standoff involving Brazil Paraguay. Since the 18th century, the two countries claimed possession over the land in the Seven Falls area, today covered by the power plant's lake. The Paraguay War (1865-1870) rekindled the controversy about the borders in the Seven Falls area. According to the Peace Treaty (1872), the territories should be divided by the Paraná River up to the Falls, and by the summit of the Maracaju Mountain Range. The document received different interpretations because as it neared the river, the Maracaju mountain range split into two branches, one above and one below the Seven Falls. After a mixed committee finished its work of detailing the limits between the two countries, the demarcation stopped 20 km from the falls, due to disagreements between the parties.

The dispute for the Seven Falls intensified in the 1960s. The discovery of the Paraná River's hydroelectric potential again placed Brazil and Paraguay on a direct collision route. But instead of engaging in conflict, the two governments made a wise decision: to join forces. In 1962, the idea of the two countries coming together to generate electricity was considered for the first time. The Brazilian government had just commissioned studies on the hydroelectric use of the water from the Seven Falls and that of the long canyon downstream from them. The job was entrusted to the office of engineer Octávio Marcondes Ferraz. The final proposal, which was never implemented, comprised a 10 thousand megawatt power plant capable of generating 67 million megawatts-hour yearly, equivalent to three times the Brazilian consumption at the time.

In 1965, the dialogue was hindered by the deployment of a Brazilian military detail to area in dispute. Facing the threat of a new war, Brazil and Paraguay intensified its efforts towards a diplomatic

solution. The inauguration of the Bridge of Friendship bolstered the collaboration spirit by enabling the export of Paraguayan products through Brazilian territory. In 1966, after intense negotiations, a mutual agreement expressed the willingness to study the use of water resources jointly held by the two countries along the Paraná River stretch “from and including the Seven Falls up to the Iguazu River mouth”. The diplomatic agreement paved the way for technical studies to start. The solution proposed by a consortium of foreign companies establishing the inundation of a large part of the area in dispute ended the contention for land on the border. Itaipu in the indigenous tupi language means “the singing boulder”.

In 1973, Brazil and Paraguay signed the Itaipu Treaty, the legal instrument authorizing both countries to use the Paraná River for hydroelectric purposes, and the Itaipu Binational company was created the following year to manage the power plant's construction. 1973 coincided with the emergence of the worldwide crisis precipitated by the increase in oil prices. The exploration of renewable alternative energy sources was intensified as a means to ensure a robust development for both countries.

Only a small portion of the area in dispute was left unflooded. That land was turned into a binational ecological reserve to be maintained by Itaipu. The Brazilian government was responsible for procuring the resources for the construction. The power plant was financed by short-term credits from private financial institutions and public foreign banks. The debt will be fully repaid in 2023.

The understanding between Brazil and Paraguay for the construction of Itaipu Binacional unsettled the relations of both countries with Argentina. The Argentines feared the power plant would damage their rights and interests over the waters of the Paraná River. The issue even became the theme of a UN General Assembly in 1972. The solution came with the signature of the Three-Party Agreement between Brazil, Paraguay and Argentina in 1979. The document established the rules for the use of water resources along the Paraná River stretch from the Seven Falls up to the mouth of the Prata River. This agreement established river levels and permitted variations for the different hydroelectric undertakings in the basin shared by the three countries. Before the power plant construction was completed, complex and demanding diplomatic work had reached its end.

At the construction site, the first task was to alter the course of the Paraná River by removing 55 million cubic meters of soil and rock in order to excavate a 2 km detour channel which enabled the original course of the river to be dried up to accommodate the construction of the main dam. The concreting of the dam was a gigantic undertaking. On one single day in 1978, the site received 7,207 cubic meters of concrete, the equivalent of a ten-story building every hour. Or 24 buildings on the same day. The feat was only accomplished due to the use of seven aerial cables that laid the concrete. Between 1978 and 1981, up to 5 thousand people were hired every month. At the peak of the dam's construction, Itaipu Binacional directly mobilized about 40 thousand workers on the job site and at support offices in Brazil and Paraguay. The filling up of the reservoir affected the lives of thousands of people living on the banks of the Paraná River between Foz do Iguaçu and Guaíra. The population of Foz sees the river empty out downstream from the dam because of the closing of the gates, while Guaíra grieves over the flooding of the Seven Falls. Guaíra residents carried out protests, and artists paid homage to the gorgeous falls that ended up covered by the reservoir. In the angst to say good-bye to the Seven Falls, 32 tourists died in January 1982 when a walkway over the river collapses. Along the submerged 170 kilometer stretch between Foz do Iguaçu and Guaíra, 8,519 urban and rural properties were flooded on the Brazilian side, for which their owners were compensated.

Itaipu Binacional is a hallmark for the electricity sector of both countries. Before that, the Paraguayans only had a small-size hydroelectric power plant, Icaray. The Brazilians consolidated their option for the electricity generated by the power of rivers. The power plant basically doubled Brazil's electricity generation capability. The power plant's cost was approximately US\$ 1,000 per installed kilowatt, or nearly US\$ 14 billion. The updated cost including interests and inflation converted into dollars for the period reaches US\$ 16 billion.

Itaipu's installed capacity (power) is 14 thousand megawatts (MW). There are 20 generating units, 700 MW each. In 2008, the Itaipu power plant reached a new historic record for electricity production by

generating 94,684,781 megawatts-hour (MWh). The previous record had been set in 2000, when Itaipu generated 93,427,598 MWh. The electricity generated by Itaipu in 2008 would be enough to supply the entire worldwide consumption for two days; or serve a country like Argentina for one year; and Paraguay, a partner in this enterprise, for 11 years. It could also supply the electricity demand of 23 cities the size of greater Curitiba for one year. The peak of Itaipu Binacional's participation in the Brazilian market was reached in 1997, when 26% of the country's electricity demand was supplied by the plant. Itaipu Binacional's output is exceptional, even when compared to future power plants. The Chinese Three Gorges will generate approximately 85 billion kilowatts-hour, 8.4 billion kilowatts-hour less than the maximum capacity already achieved by Itaipu Binacional.

The electricity generated by Itaipu and intended for the Brazilian market is conveyed by Furnas Centrais Elétricas up to the State of São Paulo, from where it can be distributed to the five Brazilian regions, including the north and northeast. The city of Foz do Iguaçu, the seat of the power plant on the Brazilian riverbank, is supplied with electricity by Companhia Paranaense de Energia (Copel). Itaipu uses its own electricity in the industrial area. In average, 31 MW are consumed every month. The power plant's outside area buildings (Executive Center, Eco-museum, Visitors Reception Center, and Biological Sanctuary) are supplied by Copel.

PETROBRAS – CENPES & P-56 PLATAFORM CONSTRUCTION



Petrobras is the world's eighth biggest global company in market value, according to a survey carried out by Ernst & Young. The study was based on the companies' stock value in the end of the first half of the year and shows the recovery of Petrobras' stock after the most critical moment of the global financial crisis, in 2008. Petrobras is among top ten outfits that appreciated the most in the world in the first half of the year.

Petrobras' market value soared from \$95.9 billion to \$164.8 billion, allowing the Company to surge from the 37th place to the eighth place in the ranking of the world's biggest corporations. Only three Brazilian companies made the survey's list of the 100 biggest. Together, the three had the biggest appreciation, with an increase of 101%, a percentage well above that of the Russian companies, which accumulated 42% and scored second.

Petrobras is headquartered in the city of Rio de Janeiro, and has offices and administration managers in major Brazilian cities, such as Salvador, Brasília and São Paulo. Given the new highly competitive scenario of the energy industry, Petrobras has taken a new stance toward the future, using the most modern management tools. A new strong, well-positioned structure is helping the company achieve its strategic goals of growth, internationalization, profitability and productivity. Under the new organizational structure model, the company now operates in four business areas - E&P (Exploration and Production), Downstream, Gas & Energy, and International -, two support areas - Financial and Services -, and the corporate units directly linked to the CEO. The new structure not only improves all operational aspects and company results, but also provides room for the employees to develop their potential, and to benefit from the added value business. In addition to its holding activities, the Petrobras System includes subsidiaries - independent companies with their own executive boards, linked to the head office.

Petrobras performs various activities overseas, and maintains a steady international operation, for example, in petroleum procurement, technologies, equipment, materials and services; following the development of American and European economies; financial operations with banks and stock

exchanges; recruitment of skilled personnel; ship chartering; support at international events. And Petrobras is also present in other countries, namely Angola, Argentina, Bolivia, Colombia, Nigeria, and the United States, as well as having the support of its overseas offices in New York (ESNOR), and Japan (ESJAP), for example.

Cenpes - the Leopoldo Américo Miguez de Mello Research and Development Center

Cenpes is the Petrobras research center, which has one of the most advanced technologies in the world and is internationally renowned for its high proficiency. The purpose of the Cenpes - the Leopoldo Américo Miguez de Mello Research and Development Center - is to meet the technological demands that drive Petrobras. With more than 1,500 employees over an area of 122,000 square meters, the Cenpes has 30 pilot units and 137 laboratories that attend the Company's agencies. The technologies the Cenpes has developed have resulted in 950 applications for international patents and 500 for Brazilian patents, in addition to a considerable number of registered trademarks.

In 1992 – and again in 2002 – Cenpes consolidated its status as the largest Research Center in Latin America and was awarded from Offshore Technology Conference, the top prize in the world oil sector. That same year 1992, Petrobras now allocated 1% of its gross income to Cenpes, becoming one of the companies that contribute most to research and development in the world.

Currently, the work carried out by the Center's researchers - 22% of whom have Master's degrees or Ph.D.s - has resulted in at least 50 patents in Brazil and ten in the USA every year. Some 500 new research and development projects are in progress, a number that continues on the increase and which is likely to grow significantly after its facilities have been expanded as planned.

Besides the processing and product technologies, the Cenpes has also developed capacity in areas such as Biostratigraphy, Sedimentology, and Geochemistry, reaching a world-class standard. Several projects rank Brazil among the holders of state-of-the-art technology, including deepwater production platforms; offshore production systems; refinery building, enhancing, and upgrading projects; robots and remotely-operated vehicles for underwater work; catalyzers; engines; special vessels; mooring systems; and many other innovations.

Petrobras' current technological development strategy leads the Cenpes to four priorities: to increase technological qualification for production in deep and ultradeep waters; to increase oil recovery from oil fields; to creating new refining technologies to adapt the byproducts both to the oil available in the country and to its consumption characteristics; and to developing new energy source technologies.

In order to continue making history in creating innovative technologies and striving for even further technological excellence, the Cenpes is renewing its infrastructure by enhancing its facilities – over an area of 183,000 square meters next to the current facilities –, in which not only will there be data processing, training, videoconferencing and meeting rooms but also laboratories for research currently underway. Moreover, the innovative center of virtual reality and all biotechnology-related areas will be built in that new space. The new Center shall also be a Petrobras benchmark for the most advanced environmental performance and energy saving methods.

Therefore, what is now called the Green Building will strive for the main eco-efficiency certifications in the world, ranging from the French Haute Qualité Environnementale (HQE) to the North American Leadership in Energy and Environmental Design (Leed), using rainwater collection, natural ventilation and lighting, and other techniques.

P-56 Semi-submersible Platform - Angra dos Reis

The P-56 platform currently under construction, which we will be visiting, will be a copy of the P-51, the first semi-submersible-type platform built entirely in Brazil. The P-56 will be positioned at depths of 1,700 meters and about 124 km off the coast. Capable of processing and treating 170,000 barrels of liquids and 100,000 barrels of 16° API oil, 6 million cubic meters of natural gas, and of injecting some 280,000 barrels of water in the reservoir, the P-56 will operate connected to 22 wells, 11 of which oil

and gas producers and 11 used to inject water. The platform will weigh 50,000 tons, be 110 meters long and wide, 125 meters tall and be dimensioned to operate for 25 years.

Semi-submersible platforms consist of a structure of one or more decks supported by submerged pontoons. A pontoon moves in accordance with the action of waves, currents and winds, and this may damage the equipment that is to be lowered into the well. That is why it must be set in position on the surface of the sea, within a tolerance radius dictated by the sub-surface equipment. Two kinds of system are responsible for positioning the pontoon: the anchoring system and dynamic positioning system. The anchoring system consists of 8 to 12 anchors and cables and/or chains, like springs that produce efforts that can put the pontoon back in position when it is moved by the action of the waves, winds and currents. In the dynamic positioning system, there is no physical connection between the platform and the seabed, except in relation to the drilling equipment. Acoustic sensors determine the driftage, while the computer-controlled propellers in the hull bring the platform back into position. Semi-submersibles may or may not be self-propelled. In any event, they are more mobile and are preferred for drilling wildcat wells.

This production unit, one of the largest of its dimensions in the world, is expected to kick its commercial operations of in late 2010 and to contribute to Petrobras reaching the oil and gas production goals the company's Strategic Plan calls for.

CTC – CENTRO DE TECNOLOGIA CANAVIEIRA (SUGARCANE TECHNOLOGY CENTER)



The Centro de Tecnologia Canaveira (CTC), based in Piracicaba in the interior of the state of São Paulo, is the largest and leading sugarcane research institute in Brazil, developing new varieties with improved processing efficiency and yield. It is further involved in phytosanitary research, biotechnology, agronomy, agricultural and industrial mechanization as well as sugar, bioenergy and biofuel production itself. The CTC is a non-profit whose aim is to disseminate knowledge, best practices and inputs to the sugarcane sector in Brazil.

CTC has 40 years of activities and is a worldwide technological reference in sugarcane breeding. CTC has 182 members producing sugar, ethanol and energy. It serves about 12,000 sugarcane growers and maintains experimental stations and regional units in strategic areas of the Southeast, South and the Midwest in Brazil. The main objective of the center is to develop and transfer cutting-edge technology to its members. These together account for 60% of cane processed in Brazil, or a total of 450 million tons during the 2008-09 season.

With the largest germplasm sugarcane bank in the world, CTC carries out research in the industrial, logistics and agronomic areas: varieties of sugar cane, planting and mechanized harvest, biotechnology, biological pests control, healthy plants, geoprocessing, satellite images, location of production environment, sugar production, energy generation and production of ethanol from 1st and 2nd Generation. In biotechnology, CTC conducts state-of-the-art research, using a 5,000 m² greenhouse, authorized by CTNBio and employing highly qualified, including master and PhD level, professionals. For more information: www.ctc.com.br.

Brazilian universities and scientific organizations have become world leaders in researching, developing and breeding sugarcane varieties. It was Brazil that first sequenced the energy crop's genome, and the country plants more of the genus than any other country. It also houses the world's largest library of genetic information on different sugarcane species. In 2007 six

new varieties have been developed by the CTC, which yielded around 20% more biomass and contain higher levels of saccharose - the disaccharide that ends up as table sugar and ethanol. This results in increased profits per hectare of between 12.5 and 38 percent.

The CTC's new varieties of the grassy crop are suitable for a specific region of the large country, known for its varied regional climatic conditions, its different soils and its different planting and harvesting seasons. The key to increased productivity is to develop varieties with the precise genetic material to match best with a specific region, and to plant them in the correct place. If this condition is not met, basic actions like correct fertilization and cutting the cane at the optimal moment of maturation are in vain.

In August 2009 it was announced that German chemical firm BASF entered a plant biotechnology cooperation agreement with the goal of bringing sugarcane varieties that are drought-tolerant and with yield increases of 25% to the market within about the next decade. This would result in an almost unprecedented jump in productivity for any crop, meaning that the average quantity of sugarcane harvested could rise from 80 to 100 tons per hectare. The yield increase that the partners are targeting will create significant additional value that will be shared among sugarcane, ethanol and energy producers, as well as CTC and BASF. The agreement also provides the possibility for both companies to evaluate the development of sugarcane varieties with herbicide-tolerant characteristics in the future. With this agreement, BASF is launching its biotechnology activities in the sugarcane sector. In the partnership, BASF provides plant biotech knowhow as well as its most promising genes, and CTC, in turn, brings its broad expertise in sugarcane and adds selected genes to its most promising sugarcane varieties.

USINA SÃO JOSÉ – CONSÓRCIO PCJ



The Watershed Consortium of Piracicaba, Capivari and Jundiá (PCJ Consortium) is a not-for-profit organization comprised of 30 companies in 43 cities that aim to recover their areas' watersheds. Usina São José is a PCJ member that controls a sugarcane field in the city of Rio das Pedras, 15 km from the city of Piracicaba. Usina São José is located amongst the most traditional clusters of the sector. It currently has production capacity of 1 million tons.

ESALQ – ESCOLA SUPERIOR DE AGRICULTURA “LUIZ DE QUEIROZ” (LUIZ DE QUEIROZ AGRICULTURE SCHOOL)



The "Luiz de Queiroz College of Agriculture" (ESALQ) is the fruit of the idealism and initiative of Luiz Vicente de Souza Queiroz (1849-1898), who in 1892 donated his farm to the Government of the State of São Paulo. His aim was to establish a teaching institute dedicated to the education of professionals in agriculture. The State Government committed to establish an agricultural school

within 10 years. Student enrollment started in 1901, with eleven students. The college functioned under the São Paulo State Department of Agriculture until 1934, when it was integrated with the University of São Paulo (USP) as its College of Agriculture. In 1964 ESALQ started offering graduate degrees at the Master's of Science level. Ph.D. programs began in 1970. An undergraduate Forestry degree joined the traditional Agriculture program in 1972; in 1998 an undergraduate degree in Economics (Agribusiness) was implemented; and Food Sciences and Biological Sciences and Environmental Management degrees were started in 2001 and 2002. Today ESALQ is one of the most important institution in science, technology, teaching and extension in Brazilian agriculture.

Two hundred undergraduate students are admitted annually to the Agriculture course, 40 to the Forestry course, 40 to the Food Sciences, 30 to Economics, 30 to Biology and 40 to Environmental Management. Since its foundation, the College has graduated 8,582 Bachelors of Science (B.Sc.) in Agriculture and 503 B.Sc. in Forestry. A Home Economics course, established in 1967, graduated 338 B.Sc. but was discontinued in 1991.

The undergraduate degrees in Agriculture and Forestry require five years, and the Economics, Food Sciences and Environmental Management require four years, during which students undertake at least 329 courses, among compulsory and optional. In 1995 a degree for high school and vocational teachers in Agriculture was established. ESALQ offers a residence program for final year students, which enhances the professional formation of the students.

Current departments at ESALQ include: Agri-Food Industry, Food and Nutrition; Science Soil; Biological Sciences; Exact Sciences; Forest Sciences; Economics, Administration and Sociology; Agricultural Engineering; Entomology and Acarology; Plant Pathology and Nematology; Genetics; Crop Science; and Animal Science.

ESALQ publishes *SCIENTIA AGRICOLA*, a journal with original articles contributing to the scientific development of Agricultural and Environmental Sciences. The Journal has a broad spectrum, including Crop and Animal Production, Agricultural Engineering, Economics and Sociology, Agroindustrial Technology, Forestry, Environmental and Soil Sciences, and Applications of Basic Sciences in Agriculture. It is indexed in Current Contents®/Agriculture, Biology, and Environmental Sciences, Science Citation Index Expanded (SciSearch®), CAB Abstracts, SciELO, AGRIS, AGROBASE, Chemical Abstracts, INIS and Tropag & Rural. Articles submitted to the Journal must be original, with no simultaneous submission to other periodicals.

WORKING GROUPS & FINAL PRESENTATIONS

The following four questions are designed to guide the discussion and learning of students in each of the course's four sub-groups: biofuels, fossil fuels, hydropower, and urban water. At the conclusion of this collaborative course, each group of students will briefly present (8-10 min per group) its answers to these questions at a closing ceremony.

1. What did you learn in this course? Provide a concise, organized summary.
2. How would you compare Brazil and the U.S. in your group's subject area? Identify one key point that attracted your attention and explain why.
3. How does the key point that your group selected in #2 above tie in to the broader focus of the course on Energy, Water, and the Environment?
4. Considering what you have learned about the subject matter and the characteristics of an engineering education at Poli-USP/in Brazil and at Harvard's SEAS/in the U.S., what areas do you think are most promising to pursue?

Following are the student assignments into thematic sub-groups.

Name	Pair #	Citizenship	School	Group
Andre de Dominicis	1	Brazil	Poli-USP	Urban Water
Andrei Roman	1	Romania	Harvard - GSAS	Urban Water
André Schardong	2	Brazil	Poli-USP (TF)	X-Group Resource
Joaquin Bonnacarrere Garcia	2	Brazil	Poli-USP (TF)	X-Group Resource
Daniel Brooke Peig	3	Brazil	Poli-USP	Fossil Fuels
Jamie De Coteau	3	USA	Harvard - College	Fossil Fuels
Felipe Aguiar Marcondes de Faria	4	Brazil	Poli-USP	Hydropower
Jaime de Aguinaga Garcia	4	Spain	Harvard - HKS (TF)	Hydropower
Felipe Lima	5	Brazil	Poli-USP	Urban Water
Peyton Greis Greenside	5	USA	Harvard - College	Urban Water
Larissa Rahmilevitz	6	Brazil	Poli-USP	Biofuels
Caroline Quazzo	6	USA	Harvard - College	Biofuels
Luisa Emi Tanaka de Almeida	7	Brazil	Poli-USP	Fossil Fuels
Danielle Streifthau	7	USA	Harvard - College	Fossil Fuels
Maira Gimenes	8	Brazil	Poli-USP	Hydropower
Janet (Jiangrong) He	8	China	Harvard - College	Hydropower
Marina Almeida de Oliveira	9	Brazil	Poli-USP	Hydropower
Patrícia Florescu	9	Romania	Harvard - College	Hydropower
Marina Marques Gimenez	10	Brazil	Poli-USP	Urban Water
Nan Du	10	USA	Harvard - College	Urban Water
Rafael de Oliveira Tiezzi	11	Brazil	UNICAMP	Fossil Fuels
Alain Goubau	11	Belgium; Canada	Harvard - HLS	Fossil Fuels
Raissa Silva de Carvalho Pereira	12	Brazil	Poli-USP	Biofuels
Rebecca Heywood	12	USA	MIT	Biofuels
Raphael Rodrigues	13	Brazil	Poli-USP	Biofuels
Daniel Oh	13	South Korea	Harvard - College	Biofuels

FACEBOOK

FACULTY

Faculty from Harvard



Scot T. [Martin](#)
Gordon McKay Professor of Environmental Chemistry, Harvard School of Engineering and Applied Sciences (SEAS)
** Harvard faculty leader for course.*



Marie [Dahleh](#)
Assistant Dean for Academic Programs and Senior Lecturer on Engineering Sciences, School of Engineering and Applied Sciences (SEAS)



Ashley [Brown](#)
Executive Director, Harvard Electric Utility Policy Group, Harvard Kennedy School



John [Briscoe](#)
Gordon McKay Professor of the Practice of Environmental Engineering, Harvard School of Engineering and Applied Sciences (SEAS)



Venkatesh [Narayanamurti](#)
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Professor of Water Resources, Federal University of Rio de Janeiro (UFRJ)



José [Goldemberg](#)
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André de Dominicis
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Andrei Roman
Harvard Graduate School of Arts & Sciences (GSAS), Ph.D. candidate in Government, 2014



André Schardong
Poli-USP, Ph.D. candidate in Water Resources Management (Teaching Fellow for Course)



Caroline Quazzo
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Daniel Brooke Peig
Poli-USP, Master's candidate in Sanitary Engineering



Daniel Oh
Harvard College, Class of 2011, A.B. (Bachelor of Arts) candidate in Chemistry



Felipe Aguiar Marcondes de Faria
Poli-USP, Master's candidate in Water Resources



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in Applied Mathematics



Rebecca Heywood
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candidate in Environmental
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student in Environmental
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student in Environmental
Engineering



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Poli-USP, 4th year undergraduate
student in Environmental
Engineering



Marina Marques Gimenez
Poli-USP, 5th year undergraduate
student in Environmental
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candidate, 2011

Alain is second-year student at Harvard Law School (HLS) with a Chemical Engineering background. His goal is to combine his technical, project management and legal backgrounds and apply them to energy and climate change questions. A dual Belgian-Canadian citizen, Alain grew up on a dairy farm in Ontario, Canada, and graduated from McGill University in Montreal in 2002. Prior to law school, he worked for three years as a field engineer based in Paris but mostly traveling abroad, including three years as a manager in China. He worked for a large industrial gases multinational and focused on the construction and start-up of industrial oxygen plants with applications in the steel, petrochemical and coal gasification industries. In combination with the collaborative field course, Alain will be completing a case study of private global governance mechanisms by documenting a recent agreement between Greenpeace, Brazil's four largest cattle producers and their customers pledging to fight deforestation and ensure the protection of labor rights.



André de Dominicis

Poli-USP, 3rd year undergraduate student andrededominicis@yahoo.com.br
in Environmental Engineering

André is in his third undergraduate year of Environmental Engineering at the Universidade de São Paulo's Escola Politécnica (Poli-USP). Since childhood, he has thought about how energy can be reused. André is particularly interested in minimizing energy and water resources waste. He would like to pursue a career that allows him to demonstrate that profitable clean technologies can help minimize natural resources wastage. As part of that goal, he plans to pursue a specialization in economics. André has spent one month in the United States (New York City and Orlando) and speaks Spanish and English in addition to his native Portuguese. He is absolutely passionate about sports and plays table tennis, volleyball and tennis - as part of the tennis federation of São Paulo. He also enjoys constructing gravity racing cars, which is a tradition at Poli-USP.



André Schardong

Poli-USP, Ph.D. candidate in Water andreschardong@gmail.com
Resources Management (Teaching Fellow
for Course)

André completed his Master's degree in the Department of Civil Engineering at the Escola Politécnica of the Universidade São Paulo (Poli-USP), where he is currently pursuing a Ph.D. in Water Resources Management. André's areas of expertise include multi-objective optimization, dynamics simulation, decision support systems for water resource planning and management, and

urban drainage. A researcher at the [Laboratory of Systems for Decision Support \(LabSid\)](#) at the Poli-USP, he has been working on the development of specialized Decision Support System Tools (DSS) for water resource management. In his free time, André enjoys listening to music, watching good movies and traveling.



Andrei Roman

Harvard Graduate School of Arts & Sciences (GSAS), Ph.D. candidate in Government, 2014

acroman@fas.harvard.edu

Andrei Roman is a Ph.D. candidate in Government at Harvard University's Graduate School of Arts and Sciences (GSAS). His research interests are centered on Latin American and Eastern European politics, in particular the study of regime transitions, party systems, electoral politics, and social policy. Andrei is a native of Romania and completed his secondary education at St. Sava National College in Bucharest. He graduated with a B.A. in Economics and International Development from Colby College and was a visiting student at the University of Oxford. Andrei has conducted field research on economic development in China, Brazil, and India. In Brazil, he performed a case study of the community driven development framework (CDD) of the World Bank's latest generation of rural poverty alleviation programs. He also obtained grant funding to research the alternative currency developed by Banco Palmas, a community bank in Fortaleza. In the summer of 2009 he worked as a research intern at the [UNDP Centre for Inclusive Growth in Brasília](#), where he wrote a policy brief on financial access. Andrei is fluent in English, Portuguese, Spanish, French, and Romanian. He is a great fan of 70s and 80s Brazilian music and loves the people and traditions of the Sertão.



Ashley Brown

Executive Director, Harvard Electric Utility Policy Group, Harvard Kennedy School

Ashley Brown is the Executive Director of the Harvard Electricity Policy Group (HEPG), a program of the Mossavar-Rahmani Center for Business and Government at Harvard University's John F. Kennedy School of Government. HEPG provides a forum for the discussion and analysis of electricity issues in the United States. Mr. Brown is counsel to the law firm of Dewey & LeBoeuf LLP. He has also served as an advisor on infrastructure regulatory issues to governments such as Brazil, Tanzania, India, Ukraine, Russia, Philippines, Zambia, Namibia, Argentina, Costa Rica and Hungary. From 1983-1993, he served as Commissioner of the Public Utilities Commission of Ohio, appointed twice by Governor Richard F. Celeste. Prior to his appointment, he was the coordinator and counsel for the Montgomery County [Ohio] Fair Housing Center, managing attorney for the Legal Aid Society of Dayton, Inc. and legal advisor to the Miami Valley Regional Planning Commission, also in Dayton. Mr. Brown has specialized in litigation in federal and state courts and before administrative bodies. He has taught in public schools and universities, frequently lectures at universities and conferences throughout the world, and publishes articles on subjects of interest to American and foreign electricity sectors.



Benedito Braga

Professor of Civil and Environmental Engineering, Universidade de São Paulo (USP)

Benedito P. F. Braga, Jr., has just completed his term as Director of the [Brazilian National Water Agency \(ANA\)](#), the agency in charge of the implementation of the national water resources system of Brazil. He has been a Professor in the Department of Hydraulic and Sanitary Engineering at the

Escola Politécnica da Universidade de São Paulo (Poli-USP) since 1990. His areas of technical expertise include: Hydrologic Forecasting, Mathematical Modeling, Water Resources Planning and Management, Multiple Objective Decision Making, Operations Research applied to Water Resources Management and Environmental Hydrology. In particular he has extensive experience in the development and application of mathematical models for the operation of multiple reservoir systems, rainfall-runoff models, multiobjective decision making models, decision support systems for real time management of water resources systems and real time flood forecasting models using meteorological radars. He is Vice President of the World Water Council and an active researcher in the field of conflict resolution and multiobjective water resources decision making processes with stakeholder participation. From 1998 to 2000 he served as President of the [International Water Resources Association \(IWRA\)](#), which in 2002 awarded Prof. Braga with the Crystal Drop Award in recognition of his lifetime achievements in the area of water resources management. He received a bachelor's degree (1972) in Civil Engineering from USP's Escola de Engenharia de São Carlos, a master's degree (1976) in Hydraulics from USP's Escola Politécnica, and a master's degree (1977) in Hydrology and a Ph.D. (1979) in Water Resources from Stanford University.



Caroline Quazzo

Harvard College, Class of 2012, A.B.
(Bachelor of Arts) candidate in
Environmental Engineering

cquazzo@fas.harvard.edu

Caroline Quazzo, a sophomore at Harvard College, is originally from Chicago, Illinois. She is concentrating in Environmental Engineering and hopes to focus her studies on climate and alternative energy solutions. After college, she hopes to blend her passion for business, technology and the environment. On campus, she is involved with the [Harvard Undergraduate Women in Business Club](#), where she ran the club's Corporate Mentorship program. She is also a co-captain of the Harvard Club Field Hockey Team and a Sunday school teacher at the University's church. Other passions include reading, running, traveling, and photography.



Daniel Brooke Peig

Poli-USP, Master's candidate in Sanitary
Engineering

daniel@brookepeig.com

Daniel was part of the first undergraduate class in Environmental Engineering at the Escola Politécnica of the Universidade de São Paulo (Poli-USP), graduating in 2006. As an undergraduate, he participated in a project that was developed in collaboration with the Massachusetts Institute of Technology ([MIT](#)) that aimed to deliver low cost engineering solutions to communities in the northern region of Brazil. Currently, Daniel works as an R&D engineer at [Perenne](#), a private company that specializes in water and wastewater treatment processes using membranes. During his free time, he swims and runs and goes on long bike rides, a passion since his early days as a Boy Scout.



Daniel Oh

Harvard College, Class of 2011, A.B.
(Bachelor of Arts) candidate in Chemistry

danieloh@fas.harvard.edu

Daniel Oh was born in Seoul, South Korea and raised near Los Angeles, California. He is a third-year undergraduate student at Harvard College concentrating in chemistry. His primary academic interest lies in the sciences but has interests ranging from health care to religion. Daniel is also passionate about volunteering, as president of the [Harvard Red Cross organization](#) and the Teaching Coordinator for the [Harvard ExperiMentors](#), a program that seeks to bring interactive science lessons to public school classrooms. He is also excited to learn about Brazil, its people and

culture. In his free time, Daniel enjoys web surfing, traveling, driving, watching films, and playing table tennis.



Danielle Streifthau

Harvard College, Class of 2011, A.B.
(Bachelor of Arts) candidate in
Biomedical Engineering - Chemical and
Materials Track

dstreift@fas.harvard.edu

Danielle Streifthau is a third-year undergraduate student at Harvard College pursuing a degree in biomedical engineering and a secondary field in economics. Her father and Brazilian stepmother both live in Brazil, although Danielle has never been to the country before. Born in Houston and raised in Missouri, Danielle participated in the Harvard College [Program for Research in Science and Engineering](#) (PRISE) and was an [MSI Fellow](#) in the summer of 2009 while she did research in Cambridge. Her extracurricular activities include co-directing [ExperiMentors](#), a Phillips Brooks House Association (PBHA) program that teaches science to local elementary school children, the Harvard University Band, and the business board of [The Harvard Crimson](#), the oldest continuously published daily college newspaper in the United States.



Felipe Aguiar Marcondes de Faria

Poli-USP, Master's candidate in Water
Resources

felipeamf@uol.com.br

Felipe Faria, who was born in São Paulo, received his undergraduate degree in civil engineering from the [Poli-USP](#). He is currently pursuing a Master's degree in Water Resources and is interested in renewable energy and anthropogenic impacts. Concurrent with his Master's work at Poli-USP, Felipe works for [Enerconsult S.A.](#), a private company that develops engineering projects for small hydroelectric power stations. While not in school or working, he enjoys surfing, cycling and playing guitar.



Felipe Tadeu de Souza Lima

Poli-USP, 4th year undergraduate student
in Environmental Engineering

felipelima@usp.br

Felipe Tadeu de Souza Lima is a fourth-year undergraduate student in Environmental Engineering at the Escola Politécnica of the Universidade de São Paulo (Poli-USP). He participated in the 3rd Entrepreneurship Marathon at Poli-USP's Minerva Entrepreneurship Center. Felipe completed an internship at [Accenture Supply Chain Management Service Line](#) where he engaged in several projects related to sustainability and logistics in leading multinationals, mostly in retail and consumer goods. Currently, he is conducting research on intelligent transport systems for São Paulo and Campinas at [Poli-USP's Department of Transportation](#). Felipe was born and raised in São Paulo and has strong interest in topics related to water treatment, alternative energy and sustainable practices and technologies. He enjoys movies, music and sports in general – although his main passions are the rugby and handball college teams and the Dave Matthews Band.



Francisco Gomide

Full Professor of Hydrology and Water
Resources, Universidade Federal do
Paraná (UFPR)

Francisco Luiz Sibut Gomide is a Full Professor (Professor Titular) of Hydrology and Water Resources in the Universidade Federal do Paraná (UFPR) in Curitiba. He served as Minister of Mines and Energy in 2002 during the presidency of Fernando Henrique Cardoso. He also served as

President of various private and public enterprises, including Itaipu Binacional (1993-1995), the electrical utility company of the state of Paraná (COPEL, 1986-1993), and the electrical utility companies of the states of Espírito Santo (ESCELSA, which was the first electrical utility in Brazil to have been privatized) and Mato Grosso do Sul (ENERSUL, 1995-2001). He also presided the Brazilian Association of Water Resources (ABRH). Prof. Gomide is currently owner of GMD Organização Industrial e Engenharia Ltda. He earned bachelor's degrees in Civil Engineering and Economics from the Universidade Federal do Paraná (UFPR) and a Ph.D. (1975) in Hydrology and Water Resources Engineering from Colorado State University.



Jaime de Aguinaga Garcia

Harvard Kennedy School, Master's in jaime_aguinaga@ksg10.harvard.edu
Public Administration and International
Development (MPA/ID) candidate, 2010
(Teaching Fellow for Course)

Jaime is a second-year student at Harvard's John F. Kennedy School of Government (HKS), where he is finishing a Master's in Public Administration and International Development (MPA/ID). Jaime is a Spanish civil engineer (B.A. and M.A. in Civil Engineering, with a major on Water and Energy), and has worked for international development organizations such as the World Bank, the Spanish Agency of International Development (AECID), and several NGOs in Spain, Tanzania, Afghanistan, Malawi, Uganda, Mexico, Chile and other locations, including several projects with Engineers Without Borders. His main fields of interest are water and sanitation, infrastructures and poverty, project management and development economics. He is now doing research on the water sector in Haiti for the government of Spain. Jaime, who is a Teaching Fellow at the Harvard Kennedy School, is also supporting this field course in Brazil as a Teaching Fellow. His passions include sports, traveling, reading and having fun with friends.



Jamie De Coteau

Harvard College, Class of 2011, S.B. decoteau@fas.harvard.edu
(Bachelor of Science) candidate in
Environmental Engineering

Jamie De Coteau, a Long Island native, is a third-year undergraduate student at Harvard College concentrating in Environmental Engineering. He is interested in the impacts of technology on the environment as well as the future of alternative energy. He spends his extracurricular time as a board member of the [Kuumba Singers of Harvard College](#) and plays Intramural Sports for [Eliot House](#). In July of 2008 he studied abroad at the Hebrew University in Jerusalem, Israel. While not in school, he enjoys film, beaches, cycling, and various pick-up sports.



Janet (Jiangrong) He

Harvard College, Class of 2010, A.B. jhe@fas.harvard.edu
(Bachelor of Arts) candidate in Applied
Mathematics - Sustainable Development
Track

Janet He is a fourth-year undergraduate student at Harvard College concentrating in Applied Mathematics and Sustainable Development. She is interested international development and specifically water resource management in developing countries. Janet is extremely excited to visit Itaipú during this field course. She is currently working on a senior thesis on transnational water allocation in the Mekong River Basin. She was born in Chengdu, China, and has been actively involved in the [Chinese Students Association at Harvard](#). She speaks Mandarin and French. In the spring of 2009 she was an international trip leader for Habitat for Humanity in Guatemala and El Salvador, and spent the summer of 2007 in Namibia with WorldTeach. After graduation, she will be working for an investment management firm in New York City. In addition to traveling, her other interests include running, piano, and drawing.



Jason Dyett

Program Director, Brazil Office of Harvard University's David Rockefeller Center for Latin American Studies - Lead Organizer for Course jdgett@fas.harvard.edu

Jason Dyett manages the activities and operations of the Brazil Office of Harvard's David Rockefeller Center for Latin American Studies (DRCLAS). He first moved to São Paulo in 1996, after two and a half years at the DRCLAS in Cambridge during the Center's launch. From 1997 to 2002, he established the Brazil office of the Economist Intelligence Unit's telecommunications research division and went on to gain experience growing technology companies backed by local and international investors. Jason rejoined DRCLAS from the Corporate Executive Board, a Washington, DC-based organization that provides executive education to public and private companies. Since the creation the DRCLAS Brazil Office in 2006, he and the Brazil-based team have worked to develop and strengthen opportunities for Harvard student and faculty engagement with Brazil in close collaboration with the Brazil Studies Program at Harvard University. He has a Master of Business Administration (MBA) in Finance from the University of Chicago Graduate School of Business (2004) and graduated Phi Beta Kappa with a B.A. in Political Science and Spanish from the University of Vermont (1994).



Jerson Kelman

Professor of Water Resources, Federal University of Rio de Janeiro (UFRJ)

Jerson Kelman served as the Director of Brazil's National Electricity Regulatory Agency (ANEEL) from its founding in 2005 through January 2009. Before joining ANEEL, he was the President of the country's National Water Agency (ANA) since its creation in 2000. Kelman contributed to shaping the current Brazilian Water Resources Law and to implementing the institutional capability to enforce it. He is a Professor of Water Resources at the Federal University of Rio de Janeiro and has acted as an Advisor to several M.Sc. and Ph.D. candidates. He is a board member of the Brazilian National Council of Energy and was a member of the Brazilian Environment Council, the Brazilian Water Resources Council and of the UNESCO-IHE Institute for Water Education in Delft, Netherlands. From 1976 to 1991, he was a researcher at the Center for Electric Energy Research (CEPEL) and, from 1991 to 1996, he was Director of Studies and Projects at SERLA-RJ (the State Superintendence Foundation for Rivers and Lakes). As a university professor, he carried out much scientific research and developed many mathematical models in hydrology and water planning. From 1996 to 1999, he was a World Bank consultant on various projects in the semi-arid region of Brazil. Beginning in 1999, Kelman led the process of designing the legal and institutional framework for an integrated water resources management system. He has worked as a consultant to several national and international institutions and was the President of the Brazilian Water Resources Association from 1987-89. He is author of a book on floods, has published over 100 articles in technical journals and edited several journals such as the *Brazilian Journal on Water Resources*, *Water International*, *Stochastic Hydrology and Hydraulics*. Kelman was the first recipient of the King Hassan II Great World Water Prize, by choice of the World Water Council. Kelman received his Ph.D. in Hydrology and Water Resources from Colorado State University (1976), his M.Sc. in Hydrology from COPPE-UFRJ, Brazil, (1973) and his B.Sc. in Civil Engineering from the Universidade Federal do Rio de Janeiro (UFRJ) in 1971.



Joaquin Garcia

Poli-USP, Ph.D. candidate in Water Resources Management (Teaching Fellow for Course) joaquinbonne@gmail.com

Joaquin earned his undergraduate degree in Civil Engineering and his Master's in Water Resources and Sanitary Engineering from the [Universidade Federal de Santa Maria \(UFSM\)](http://www.ufsm.br) in Brazil's

southern most state, Rio Grande do Sul. He is currently a Ph.D. student in Water Resources Planning and Management at the Universidade de São Paulo's Escola Politécnica (Poli-USP) and a researcher at the [Laboratory of Systems for Decision Support \(LabSid\)](#) at the Poli-USP. Joaquin's research focuses on water resources systems simulation and optimization, water quality, and urban drainage. When he's not working, Joaquin likes to watch movies, travel, and enjoy time with family and friends.



John Briscoe

Gordon McKay Professor of the Practice of Environmental Engineering, Harvard School of Engineering and Applied Sciences (SEAS)

John Briscoe's career has focused on the issues of water and economic development. He has worked as an engineer in the water agencies of South Africa and Mozambique; as an epidemiologist at the Cholera Research Center in Bangladesh; as a professor of water resources at the University of North Carolina; and, for the past 20 years in a variety of policy and operational positions in the World Bank. Most recently he has served as the Bank's Senior Water Advisor and the Country Director for Brazil. Briscoe joined the faculty at Harvard in 2009 and is directing the Harvard Water Security Initiative, a research program which draws together a wide range of disciplines relevant to water management, and which is developing cooperative research programs with a number of countries, initially including Australia, Brazil, Pakistan and the United States. In addition to the United States, Briscoe has lived in his native South Africa, Bangladesh, Mozambique, India and Brazil. Briscoe has served on the Water Science and Technology Board of the National Academy of Sciences and was a founding member of the major global water partnerships, including the World Water Council, the Global Water Partnership, and the World Commission on Dams. He currently serves on the Global Agenda Council of the World Economic Forum; is a member of the Council of Distinguished Water Professionals of the International Water Association; and will be the first Natural Resource Fellow of the Council on Foreign Relations. He has published extensively in economic, finance, environmental, health and engineering journals. Recently he authored *Water Sector Strategy*, *India's Water Economy: Bracing for a Turbulent Future*, and *Pakistan's Water Economy: Running Dry*. He received his Ph.D. in Environmental Engineering at Harvard University in 1976 and his B.Sc. in Civil Engineering at the University of Cape Town, South Africa in 1969.



José Carlos Mierzwa

Associate Professor of Environmental Engineering and Water Treatment, Escola Politécnica da Universidade de São Paulo (Poli-USP)

José Carlos Mierzwa is an Associate Professor (Professor Pesquisador) of Environmental Engineering and Water Treatment, Escola Politécnica da Universidade de São Paulo (Poli-USP). His area of primary expertise is in Sanitary Engineering, with a focus on Environmental Engineering, particularly in terms of water, waste water treatment, conservation, planning, management and environmental quality, and cleaner production. He has developed a number of research projects on water treatment systems (including direct drinking water treatment by spiral wound ultrafiltration membranes), waste stream management, industrial processes, and water conservation and reuse. In 1997 he participated in the International Extension Program at the University of California, Riverside, and in 1993 spent time at the International Atomic Energy Agency working on management of radioactive waste from nuclear power. Since 2007 he has been a reviewer in the Brazilian Higher Education National Evaluation System (Sistema Nacional de Avaliação da Educação Superior). Prof. Mierzwa earned a bachelor's degree (1989) in Chemical Engineering from the Universidade de Mogi das Cruzes and a master's degree (1996) in Nuclear Technology as well as a doctorate in Civil Engineering (2002) from the Universidade de São Paulo (USP).



José Goldemberg

Professor, Instituto de Eletrotécnica e Energia (IEE), Universidade de São Paulo (USP)

José Goldemberg is an internationally recognized leading expert on energy and environment issues. He earned his Ph.D. (1954) in Physics from the Universidade de São Paulo, which he led as President from 1986 to 1989 after having directed the Energy Company of the State of São Paulo. From 1990 to 1992 he served the Brazilian federal government in various capacities: as Secretary of State for Science and Technology, then as Minister of Education, and finally as interim Minister of the Environment, during which he administered Brazil's participation in the 1992 Earth Summit in Rio de Janeiro and was responsible for ending Brazil's nuclear weapons program, which also led Argentina to shut down its program under a joint agreement. From 2002 to 2006 Dr. Goldemberg served as the Secretary for the Environment of the State of São Paulo. He currently presides the Council of Environmental Studies at the Federação de Comércio do Estado de São Paulo (Fecomercio). He was awarded the Volvo Environmental Prize (2000), the Blue Planet Prize (2008) from the Asahi Glass Foundation (Japan), and was honored by *Time* magazine (2007) as one of its "Heroes of the Environment", highlighting how Goldemberg in 1978 "co-authored a paper in the journal *Science* that showed the world what Brazil had discovered: that it's both possible and profitable to harvest a clean and renewable fuel, ethanol, from the country's abundant sugarcane." He has authored many technical papers and books on nuclear physics, environment, and energy and has served as president of the Brazilian Association for the Advancement of Science. Dr. Goldemberg also served as Chairman of the Editorial Board and a lead author of the UNDP World Energy Assessment, and spent time as a visiting professor at the University of Paris (France), University of Toronto (Canada), Princeton, and Stanford.



José Rodolfo Scarati Martins

Assistant Professor of Civil and Environmental Engineering, Escola Politécnica da Universidade de São Paulo (Poli-USP)

José Rodolfo Scarati Martins is currently an Assistant Professor at the Escola Politécnica da Universidade de São Paulo (Poli-USP) where he teaches courses on civil engineering, environmental engineering and architecture. He specializes in the areas of hydraulics, applied hydraulics, and water resources, with a particular focus on urban water drainage, water supply, mathematical modeling applied to hydraulics and flood control, including research on hydraulic transients for calibration and leak detection purposes. He is a coordinator at the Brazilian Association of Technical Standards (ABNT-Associação Brasileira de Normas Técnicas) and in 2005 was president of the Fundação Centro Tecnológico de Hidráulica (FCTH). Prof. Mierzwa earned a bachelor's degree (1981) in Civil Engineering and a master's degree (1989) and doctorate (2002) in Hydraulic Engineering from the Escola Politécnica da Universidade de São Paulo (Poli-USP).



Larissa Rahmilevitz

Poli-USP, 3rd year undergraduate student in Environmental Engineering lari_blu2@hotmail.com

Larissa Rahmilevitz is in her third year of Environmental Engineering at the Escola Politécnica of the Universidade de São Paulo (Poli-USP). Since high school, she has had a clear interest in developing engineering solutions that help preserve the environment. After she earns her degree at Poli-USP, Larissa would like to work in the government helping to organize São Paulo's extremely large and complex water and sewage system or at organizations such as the [Brazilian Institute for the](#)

[Environment and Natural Renewable Resources](#) (IBAMA), [Brazil's Ministry of the Environment](#) (MMA) or [Brazil's National Council for the Environment](#) (CONAMA). Larissa is an active volunteer with [Yad](#), a social responsibility group focused on non-formal education, and [CIP](#), an organization focused on leadership training, organizing and managing holiday camps. She enjoys outdoor activities such as soccer, swimming and cycling and loves to travel, dance and engage in interdisciplinary discussions with people. Larissa also enjoys cooking, searching for new recipes, finding new restaurants, and trying food from all over the world.



Lineu Belico dos Reis

Professor of Environmental and Electric Engineering, Escola Politecnica, Universidade de São Paulo (Poli-USP)

Lineu Belico dos Reis is Professor of Environmental and Electric Engineering at the Escola Politecnica of the Universidade de São Paulo (Poli-USP). In addition to his distinguished academic career, he is an experienced consultant in the Brazilian and international energy markets. Professor Reis earned his undergraduate, Masters and a Doctoral degrees in Electrical Engineering from USP.



Luísa Emi Tanaka de Almeida

Poli-USP, 3rd year undergraduate student in Environmental Engineering lulyemi@uol.com.br

Luísa Emi is a third-year undergraduate student at the Escola Politécnica of the Universidade de São Paulo (Poli-USP), concentrating in Environmental Engineering. Her primary focus is natural resource management, specifically on water resource management and remediation of contaminated areas. In 2010, she intends to begin a scientific research project on the impacts of the development of the coast of São Paulo state and on the most environmentally affected areas. Luísa, who was born and raised in São Paulo, speaks English and Spanish. Interested in community service, she helped bring doctors and dentists to serve a population of six thousand inhabitants in [Santa Helena de Minas](#), one of the poorest municipalities in the state of Minas Gerais. Her other interests include travelling, movies, literature, going out with friends and spending time with her family.



Máira Gimenes

Poli-USP, 3rd year undergraduate student in Environmental Engineering maira.gimenes@gmail.com

Born in São Paulo, Máira Gimenes is a third-year undergraduate student at the Escola Politécnica da Universidade de São Paulo (Poli-USP), where she is majoring in Environmental Engineering. She has a strong interest in anthropogenic impacts on water resources, an area where she plans to focus her professional pursuits. Máira is also interested in alternative methods of power generation and would like to deepen her knowledge in this area. In 2010, she would like to initiate research on the anthropogenic impact on the Santos region of São Paulo state. When not in school, she likes reading, watching movies and spending time with friends and family.



Marcio Siwi

Program Officer/Fellow, Harvard University's David Rockefeller Center for Latin American Studies (Cambridge-based support) msiwi@fas.harvard.edu

Marcio Siwi joined the David Rockefeller Center in August 2007 as a Fellow for the Brazil Studies Program under the direction of Professor Kenneth Maxwell. Previously he was at the University of Texas at Austin where he received a Master of Arts in Latin American Studies. Marcio wrote his

Master's Thesis on U.S.-Brazil cultural relations during the Cold War, particularly the role of Nelson Rockefeller and the New York-based Museum of Modern Art (MoMA) in the creation of modern art museums in São Paulo. Prior to attending the University of Texas at Austin, Marcio worked as a Research Associate for National Security Studies as well as the Latin America Studies Program at the Council on Foreign Relations (CFR) in New York. Marcio received his B.A. in Sociology and Latin American Studies from the Colorado College.



Marie Dahleh

Assistant Dean for Academic Programs
and Senior Lecturer on Engineering
Sciences, School of Engineering and
Applied Sciences (SEAS)

Marie Dillon Dahleh is the Assistant Dean for Academic Programs in the Harvard School of Engineering and Applied Sciences (SEAS). She has been in this position since August 2004, and in July 2009 was also appointed Senior Lecturer on Engineering Sciences. As part of her duties, she oversees the SEAS academic office, which handles graduate admissions and financial aid, and graduate and undergraduate academic program administration. She serves as an advisor for the graduate student life committee, the Harvard College engineering society, and Harvard College Engineers without Borders. She also teaches Introduction to Applied Math and coordinates the sophomore forum for engineering. Prior to joining Harvard, Dr. Dahleh spent 10 years at the University of California Santa Barbara, first in the Department of Mechanical Engineering and later in the College of Engineering dean's office. Her enthusiasm resulted in her selection in 1998 as one of that university's "ten most terrific teachers". Prior to UCSB, she was at UCLA in the Mathematics Department with a partial appointment at the National Center for Atmospheric Research in Colorado. Dr. Dahleh is the coauthor of an undergraduate text book on mechanical vibration. She received a bachelor's degree (1985) in Mathematics from Mount Holyoke College and an M.A. (1987) and Ph.D. (1990) in Applied and Computational Mathematics from Princeton University.



Marina Almeida de Oliveira

Poli-USP, 4th year undergraduate student maritexas@hotmail.com
in Environmental Engineering

Marina Almeida de Oliveira was born in Salvador and raised in São Paulo, where she is currently pursuing a degree in Environmental Engineering at the Escola Politécnica of the Universidade de São Paulo (Poli-USP). She aims to improve living conditions through the combination of sustainable development and social inclusion. To this end, she has worked as a volunteer at the NGO “[Um Teto para o meu país](#)” building emergency houses in poor communities. She is also carrying out a research project about “BOD and Phosphorus analysis in hydrological events at Guarapiranga and Billings Basins.” In 2010 she will begin a double degree program at Ponts et Chaussées University in France. She believes that international opportunities, such as the exchange program in France and this collaborative course between Harvard and the Poli-USP, will help her to build the knowledge to achieve her goals. Outside the classroom, Marina's passions include sports and traveling.

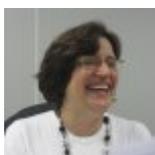


Marina Marques Gimenez

Poli-USP, 5th year undergraduate student marina.gimenez@poli.usp.br
in Environmental Engineering

Marina is a fifth year undergraduate student in Environmental Engineering at the Escola Politécnica of the Universidade de São Paulo (Poli-USP) with professional experience in transportation planning and hydrogeology. Her current interests include exploring new areas of sustainable energy

and environmental impact assessments. To build international experience and language skills, Marina participated in a one-year exchange program at the University of Porto in Portugal (2008-2009) and worked at a resort in Girdwood, Alaska, for a summer. During her free time, Marina likes to watch movies, listen to music, travel and play sports, especially basketball.



Monica Ferreira do Amaral Porto
Full Professor and Chair, Department of
Hydraulic and Sanitary Engineering,
Escola Politécnica da Universidade de
São Paulo (Poli-USP) - Faculty Leader
for Course from Brazil

Monica Porto is a Full Professor (Professora Titular) and current Chair of the [Department of Hydraulic and Sanitary Engineering \(PHD\)](#) at the Escola Politécnica of the Universidade de São Paulo (Poli-USP), where she has taught since 1984. She is also President of the [Fundação Centro Tecnológico de Hidráulica \(FCTH\)](#), and previously was president of the Brazilian Association of Water Resources (ABRH). She has been an active member of a number of major water organizations including the Global Water Partnership (GWP), the Stockholm International Water Institute (SIWI), and the International Water Resources Association (IWRA). She is a researcher of the Brazilian National Council for Scientific and Technological Development (CNPq) in urban water quality. Her areas of expertise include water quality and water management of reservoirs and rivers. Courses taught at USP include Introduction to Environmental Engineering, Natural Resource Management, and Urban Water Systems. Prof. Porto earned a bachelor's degree (1978), a master's degree (1983), and a doctorate (1993) in Civil Engineering from the Universidade de São Paulo (USP), and carried out post-doctoral research in 1994 and 1995 at Colorado State University (CSU).



Nan Du
Harvard College, Class of 2012, S.B.
(Bachelor of Science) candidate in
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Nan Du, a native of Barrington, Rhode Island, is a sophomore in Harvard College who plans to pursue a Bachelor of Science (S.B.) in Biomedical Engineering and earn a secondary field in Health Policy. She is interested in applying the concepts of ingenuity and problem solving skills from engineering to real world problems. In her spare time at Harvard, Nan is an active mentor and medical committee co-chair in [Harvard China Care](#), an organization dedicated to making positive contributions to the lives of many special needs Chinese orphans; board member in [Harvard Cancer Society](#), an organization dedicated to educating and mobilizing individuals to fight cancer; and a Harvard Student Agency Posterer. Furthermore, she is involved in research. In the summer of 2009, as a participant in the Harvard College [Program for Research in Science and Engineering](#) (PRISE), she worked in the [David Mooney Lab](#), investigating angiogenesis and the impact of extracellular pH on sprouting. Her other hobbies and interests include traveling, reading, and discussing random intriguing topics late into the night.



Patricia Florescu
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Patricia Florescu is a third-year undergraduate student at Harvard College concentrating in Applied Mathematics and Architecture. Originally from Romania, she is interested in designing and implementing solutions to the problems of the developing world, especially in non-formal settlements. In her extracurricular time, she is involved with the Cambridge Microfinance Initiative

where she provides business advice for low-income entrepreneurs and the [Harvard Independent](#), a weekly student publication. Her hobbies include travelling, rock-climbing and photography, or preferably all three combined. In the summer of 2009 she participated in the Career Discovery Program at the Harvard Graduate School of Design (GSD), which explored the role that societal and cultural issues play in the success or failure of major works projects in the developing world, whether they be for housing, industrial development or expanding infrastructure. Patricia is earning a citation in German Languages and Literature, but since her mother tongue is a Romance language, she hopes she will be able to pick up basic conversational Portuguese very quickly.



Peyton Greis Greenside

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Peyton Greenside is a junior at Harvard College from Chapel Hill, North Carolina. She is an Applied Math concentrator interested in applications to engineering, the environment, neurobiology and global health. In this course she is particularly interested in how the development of large-scale engineering projects can affect the environment, productivity and industry of a community or nation. Peyton spent the summer in 2008 working in several government hospitals in Chisinau, Moldova, and traveled to the Ukraine and Romania. The summer after her sophomore year was spent in Greece through a computer science research internship with the Foundation for the Hellenic World. At Harvard, she rows for [Radcliffe Crew](#) as well as being a course assistant for Harvard's introductory computer science course [CS50](#), teaching figure skating, and serving on the board of [Student Astronomers at Harvard–Radcliffe \(STAHR\)](#). She is also currently researching chemotaxis in *C. elegans* in the [Samuel Lab](#).



Rafael de Oliveira Tiezzi

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Rafael Tiezzi received his undergraduate degree in Environmental Engineering from the Faculdade de Ciências e Tecnologia of the Universidade Estadual Paulista ([FCT-UNESP](#)). He earned a specialization in Environmental Assessment and a Master's degree in Energy Planning from the Universidade Estadual de Campinas ([Unicamp](#)). Rafael is currently pursuing a Ph.D. in Water, Environment and Energy Resources at the School of Civil Engineering at the Unicamp. His areas of research interest include climate change, water resources and hydroelectric power. Rafael is a researcher at the [Instituto de Pesquisas Tecnológicas de São Paulo \(IPT\)](#), where he works in the Water Resources and Environmental Assessment Laboratory. When not in school or working, he enjoys trekking, soccer, playing guitar and cooking.



Raissa Silva de Carvalho Pereira

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Raissa is currently completing her third year in the Environmental Engineering program at the Escola Politécnica da Universidade de São Paulo (Poli-USP). Concerned about environmental, political and social issues, she organized a group of USP students who participated in the [World Social Forum 2009 in Belém, Brazil](#). Interested in engineering education, she conducted research on the functions of internships in engineering degree programs, presenting an article about this subject at the [38th IGIP Symposium in Graz, Austria](#). Currently, she is participating in a group of students designing and seeking to implement a bike-sharing system at the USP campus in São Paulo. Raissa was selected to the double degree program at [Politecnico di Milano](#) in Italy, beginning in 2010. She plans to focus her work on urban planning and public policies related to the environment. Her passions include movies, theater, music, dance and languages.



Raphael Rodrigues

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in Environmental Engineering

Raphael Rodrigues is a fourth-year undergraduate student at the Escola Politécnica da Universidade de São Paulo (Poli-USP) majoring in Environmental Engineering. He is interested in researching sustainable technologies and their applicability to reduce environmental degradation. Raphael received two awards for his undergraduate research based on processes of water treatment using ultrafiltration membranes. At present, he works at [Poli-USP's recyclable waste management program](#). In his free time, Raphael likes to watch movies, play video games, surf the web and spend his time with friends and family.



Rebecca Heywood

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Rebecca Heywood was born and raised in Colorado. She is a second-year undergraduate student at [MIT majoring in environmental engineering](#), with a minor in applied international studies. She is interested in international development and is president of [Engineers Without Borders at MIT](#). She traveled to Uganda last summer as part of an Engineers Without Borders team to do water quality assessment and conduct community surveys. After graduation Rebecca would like to work on large-scale infrastructure projects in developing countries, such as Brazil. In addition to Engineers Without Borders, she is also a member of the MIT Openweight Crew Team and Stammtisch, a German-speaking club. Rebecca speaks German, Czech and Spanish, and is looking forward to learning Portuguese. In her free time, she enjoys reading and traveling.



Ricardo Toledo Silva

Deputy Secretary for Water, Sanitation and Energy, State Government of São Paulo

Ricardo Toledo Silva is a Full Professor (Professor Titular) of Infrastructure Technology in the School of Architecture and Urban Studies (FAU) of the Universidade de São Paulo (USP), which he led as Dean from 2002 to 2006. He is currently serving as Deputy Secretary for Water, Sanitation and Energy in the State Government of São Paulo. He is the Coordinator of FAU-USP's Urban Information Research Nucleus (INFURB), and was a researcher at the Institute of Technological Research (IPT) of the State Government of São Paulo. He coordinated integrated research projects and interventions in degraded urban areas in Brazil and abroad. He previously served as Secretary of Urban Development in the Brazilian Ministry of Housing, Urban Planning and Environment as well as Deputy Secretary in the Brazilian Ministry of Housing and Social Welfare. Prof. Toledo Silva has published about 70 works on Architecture Technology, Urban Infrastructure and Public Management. He earned a bachelor's degree, master's, and Ph.D. in architecture from FAU-USP, after carrying out graduate research at the Bouwcentrum in Rotterdam (Holland) and the Politecnico di Torino (Italy).



Rubem La Laina Porto

Professor, Department of Hydraulic and Sanitary Engineering, Escola Politecnica of the Universidade de São Paulo (Poli-USP)

Rubem La Laina Porto is a Professor in the Department of Hydraulic and Sanitary Engineering (PHD) at the Escola Politecnica of the Universidade de São Paulo (Poli-USP), where he has taught since 1985. His primary area of expertise is on Hydraulic Engineering, with a focus on Applied Hydraulics, Water Management, Urban Water, Drainage, and management of institutions active in teaching, research and development on water resources. A recent publication (2008) in partnership with Columbia University's International Research Institute for Climate and Society and the Federal University of Ceará, in Fortaleza, focused on the role of price and effective water rights enforcement in water allocation, with insights from game theory. Prof. Porto earned a bachelor's degree (1966) and a master's degree (1976) in Civil Engineering and a doctorate (1985) in Hydraulic and Sanitary Engineering from the Universidade de São Paulo (USP), and carried out post-doctoral research (1989, 1995) at Colorado State University (CSU).



Scot T. Martin

Gordon McKay Professor of Environmental Chemistry, Harvard School of Engineering and Applied Sciences (SEAS) - Faculty Leader for Course from Harvard

Scot Martin is Gordon McKay Professor of Environmental Chemistry at [Harvard University's School of Engineering and Applied Sciences](#) (SEAS). His research focuses are oceans, atmospheres, geophysics, atmospheric chemistry, climate modeling, and environmental chemistry. Since 2007, he has held a joint appointment with the [Department of Earth and Planetary Sciences](#) in the Faculty of Arts and Sciences (FAS) at Harvard. He is a Faculty Associate at the [Harvard Origins of Life Initiative](#) and chaired the [2008 Amazonian Aerosols International Workshop](#) (Rio Negro/Manaus, Amazonas). Prior to joining Harvard in 2000 as an Associate Professor of Environmental Chemistry, Martin was Assistant Professor of Aquatic and Atmospheric Chemistry in the Department of Environmental Sciences and Engineering at the University of North Carolina at Chapel Hill (1997-2000) and a Postdoctoral Fellow in Atmospheric Chemistry at the Massachusetts Institute of Technology (1995-1997). Prof. Martin received his BS in Chemistry from Georgetown University and his Ph.D. in Physical Chemistry from the California Institute of Technology. Courses he teaches at Harvard include: Environmental Science and Technology; Aerosol Science and Technology; Environmental Chemical Kinetics. He is currently chair of the [Brazil Studies Program's Steering Group](#).



Tomás Amorim

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Tomás Amorim is the Program Officer at the Brazil Office of Harvard's David Rockefeller Center for Latin American Studies (DRCLAS), serving as the faculty liaison. After two years coordinating Brazil-related activities at DRCLAS in Cambridge, Tomás moved to São Paulo in March of 2006, where he designed and led the physical set-up of the new Brazil Office. A Brazilian citizen, he is the former Director of Western Hemisphere Affairs at the Council on Foreign Relations (CFR) in New York, where he was responsible for the development of working relationships with counterpart organizations in the Americas. Previously he was Research Associate of the Latin America Studies Program and served as staff director for various initiatives, including the Independent Task Force on Brazil and a conference on reforms in Latin America. Prior to joining the CFR in 1999, Tomás worked in the Reference and Collection Development department of Firestone Library at Princeton University, where he earned a bachelor's degree in Sociology and a certificate in Latin American Studies.



Venkatesh Narayanamurti

Benjamin Peirce Professor of Technology and Public Policy; Professor of Physics, Harvard; Director, Science, Technology, and Public Policy Program, Harvard Kennedy School

Venkatesh Narayanamurti is the Director of the Science, Technology and Public Policy Program at the Belfer Center for Science and International Affairs at the Harvard Kennedy School (HKS). He is also the Benjamin Peirce Professor of Technology and Public Policy and a Professor of Physics at Harvard. For ten years he was the John L. Armstrong Professor and Dean of the School of Engineering and Applied Sciences and Dean of Physical Sciences at Harvard. Previously he served as the Richard A. Ahl Professor and Dean of Engineering at the University of California at Santa Barbara. Prior to that he was Vice President of Research at Sandia National Laboratories and Director of Solid State Electronics Research at Bell Labs. He is an elected member of the American Academy of Arts and Sciences, the National Academy of Engineering and the Royal Swedish Academy of Engineering Sciences, and a Fellow of the American Physical Society, the American Association for the Advancement of Science, the IEEE, and the Indian Academy of Sciences. He has served on numerous advisory boards of the federal government, research universities and industry. He is the author of more than 200 scientific papers in different areas of condensed matter and applied physics. He lectures widely on solid state, computer, and communication technologies, and on the management of science, technology and public policy. He obtained his Ph.D. in Physics from Cornell University and has an Honorary Doctorate from Tohoku University.

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