

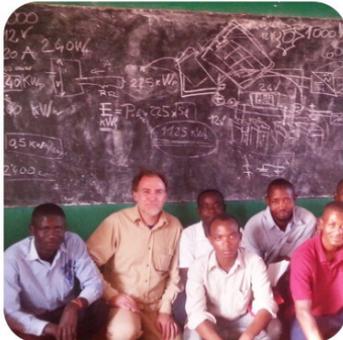
ENGINEERING FOR SUSTAINABLE DEVELOPMENT
Renewable energy systems, environment conservation and humanitarian aid

FIELD STUDY ABROAD

Travel, Learn, Research and Work in developing communities



XI FSA EDITION IS IN EAST AFRICA (UGANDA-RWANDA-KENYA)
from 25th March 2018 to 15th April 2018



“Abroad you will discover different cultures, you will develop new perspectives and abandoning the daily life, you will improve your social and cultural awareness, which will make you valid for any team.”
(Mary Boyce, Head of Department of Engineering at Cqlumbia University)

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1. Overview

Universities all around the world are gaining a key role in **sustainable development** and **cooperation** through an increasing number of graduates and PhDs focused on these topics.

There is also a **need to reduce distances between the technical view of cooperation and the social sciences**, as well as between the didactics and the **practical experience on field**. Professionals from the technical, economic and social sectors involved in development cooperation are called to interact in interdisciplinary and transnational contexts. Such skill has nowadays become essential for a meaningful and sustainable contribution within the working environment.

This is the goal of the course "Engineering for Developing Communities (EDC)" at Columbia University, New York, of the "Co-operation and Design for Development (CDD)" course at the Sapienza University of Rome, "Global Leadership and Sustainable Development "(GDLS) of Hawaii Pacific University and the Center for Sustainable Development (CSD) at the University of Cambridge (UK).

Interactions among these matters are well elaborated during the **Field Study Abroad** promoted by the Interuniversity Research Center for Sustainable Development, **CIRPS**, of the University of Rome "La Sapienza" and the non-profit organization, **Tecnologie Solidali**, with the advisory of **Meridiana Energy consulting**, an innovative start-up, founded in 2014 with the aim of promoting the development and dissemination of sustainable technologies for society and the environment.

Field Study Abroad places students within an international **project management in the field of sustainable development and renewable energies, covering all phases from prefeasibility studies, to project design, construction until monitoring and final evaluation**; topics are approached with academic methodology and research purposes in order to involve students in scientific discussions.

Further goal of the FSA is the preparation of young professionals capable to discuss technological, political and social solutions to be addressed to the challenges of developing countries in both urban and rural areas, with a participatory approach regarding the identification of needs.

The characteristic approach of the FSA lies in the concept of "**learning by doing**", with frontal lessons during field activities, as well promoting students' engagements with Universities, International Organizations and Public Institutions for internships, trainings or job opportunities.

From 2014 Field Study Abroad has seen 10 editions, mainly in Central and Latin America, counting on more than 150 participants.

The Field Study Abroad had a **nomination of excellence** in the Italia Decide Award 2018, **for the Technological Innovation of Sustainable Development** and specifically as the Innovation of higher education. The awards took place on the occasion of the presentation of the "ITALIADECIDE 2018 Report" at the Sala della Regina of the Chamber of Deputies, in the presence of the President of the Republic, Sergio Mattarella. The award was received by prof. Andrea Micangeli, FSA Founder and FSA staff

Field Study Abroad – 11° edition will take place in **East Africa (Uganda, Rwanda, Kenya) from 15th March 2017 to 25th April 2018**.

2 Co-organising partners

2.1 Cirps

CIRPS is the Interuniversity Research Center for Sustainable Development at the University of Rome La Sapienza. It has been active since 1988 and is involved in research, training, services, work methods and direct interventions on the territory, focusing on the spread of technical and scientific solutions to achieve a social, economic and technological development capable of ensuring growth and sharing of well-being without penalizing the environment, nor any social group, geographical area or future generation. It carries out its activity through partnerships and agreements with universities, research centers, businesses and national and international institutions. In particular:

- it focuses on local, regional, national, European and international sustainable development, and it seeks for new technologies and applications;
- it promotes initiatives for science and interdisciplinary collaborations in the universities, departments and research centers;
- it helps small and medium-sized enterprises, national and international institutions, governmental and non-governmental organizations, in particular those from developing countries, the European Union and the United Nations (UNESCO, UNICEF, UNDP), in the choice and analysis of feasibility of cooperation programs and projects and in their realization.

Field Study Abroad is part of the innovative training activities promoted by the research center and gives the opportunity to participate in the ongoing projects managed by the CIRPS.

The course was designed and realized by Andrea Micangeli, Renewable Energy Systems Professor at DIMA (the Department of Mechanical and Aerospace Engineering) University of Rome La Sapienza and S.U.N.Y Adj. Associate Professor, who coordinates the CIRPS Unit TpAA (Technologies for Autonomy and the Environment), in which he has been working, since 1994, for a more sustainable development in Italy and abroad.

2.2 Tecnologie Solidali

Further research is needed in order to achieve results that could make some people's lives better. For instance, some researchers have great ideas, but they do not have anything to develop them, especially because of lack of funding.

Research in humanitarian, environmental and social fields appears to be extremely important, but often it is not adequately supported. These kinds of research have been developed in the university context or within public research institutions. However, these contexts present a reducing possibility of funding and their request of efficiency is purely economic.

The association Tecnologie Solidali (Responsible Technologies) proposes to support this type of research initiatives, in particular in the field of technologies that reduce the damage caused by the war, the sustainable development of the weaker societies, the safeguarding and care of the environment, the autonomy of people with disabilities, and all those fields of social interest in which scientific development and technological innovation can produce new inestimable values for people's lives. This non-profit organization cares about the logistical and organizational aspects of Field Study Abroad.

2.3 Meridiana Energy

Meridiana Energy was born from the experience gained by a group of young engineers specialized in the energy field, and bases its guidelines on improving energy efficiency, and actively researching technical solutions to reduce pollution and improve the quality of life, also thanks to small daily choices.

It always look at collaborations with international research centers on rural electrification and cooperation topics: low carbon technologies assistance for climate change adaptation and mitigation actions, rural electrification projects development and implementation, with focus on productive energy and water&sanitation.

Carlo Tacconelli, Meridiana Energy Technical Director, is one of the main trainer of Field Study Abroad.

3. The content and standard of the Field Study Abroad

3.1 Admission requirements and course duration

- **Admission requirements:** any student, regardless of age and nationality, interested in a university education in a related field can participate in the Field Study Abroad.
- **1 month course** meeting local Universities, public and private sector entities working in sustainable development, and United Nations agencies
- **1 month International Stage (Internship),** optional additional period of work experience with one of the partner institutions. The stage (also known as an internship) is for individual students, but in some cases a small group of two to three students is allowed. The request for the internship must be submitted at least two months before departure, or may be made on own travel expenses after the course. For this experience, it is required the students have an acceptable English level.

3.2 Topics

- **Renewable energies:** wind turbines, photovoltaic systems, hydroelectric power generation, waste to energy systems, smart grids, urban and rural electrification. The main discussed topic is renewable energy generation and its applications; students can develop their thesis or project work directly on the field; the biggest challenge in East Africa is the production and distribution of electricity therefore the activities will be made on the purpose of finding appropriate solutions to identified problems.
- **Project management tools:** Logical Framework Analysis, stakeholder analysis, environmental impact assessment, project monitoring and evaluation.
- **Financial evaluation:** international funds for development, public-private partnerships, business planning, fundraising and management.
- **Feasibility study:** field survey methods, data collection, desktop analysis, need assessment, cross-cutting issues.
- The course also offers the opportunity to acquire and implement their knowledge in the areas of **international cooperation**, political sciences and communication and their application both on the theoretical and on the practical level. Social impact of projects: field work involves a direct relationship with the rural realities of Central America, with the poverty and real problems of community. One of the core aims of the course is to encourage local communities to organize cultural and commercial initiatives that can represent development tools for the area and design together with their innovative solutions without distorting their uses and customs.

3.3 “Learning by doing” approach

A direct field intervention is essential for an excellent engineering preparation and engineering is one of the most important disciplines that can contribute to sustainable development.

The innovative methodology of the course is the concept of "learning by doing", to learn on the field.

The course is based on "research by doing": it combines the theoretical aspects of design with the practical experience of working experience, giving great importance to field data collection and identification of the indicators required for evaluation of the intervention.

During the course, the professor assigns a project to a student or a group of students who will be responsible for finding solutions, then the students, together with the tutors, who are specialized and experienced engineers, work on elaborating the entire project.

All topics will be explored both on theoretical aspects and on field work, enabling participants to develop appropriate solutions and gaining experience in preparation of action plans:

- the student has the opportunity to identify the appropriate solutions to the context in which he intervenes;
- developing proposals;
- preparing action plans;
- switching to implementation;
- monitoring;
- managing projects between studies and applications.

3.4 University contacts and partner institutions

The course also gives the students the opportunity to get in touch with universities, international organizations and electric companies, thanks to numerous meetings that are organized during the study period.

● Universities and Centres for research

- University "Sapienza" – Rome, Italy
- University of Perugia – Perugia, Italy
- University of Pisa – Pisa, Italy
- State University of New York – New York, U.S.A.
- University of Cambridge – Cambridge, U.K.
- Makerere University, Centre for Research in Energy and Energy Conservation - Kampala, Uganda
- University of Rwanda, African Centre of excellence in energy for sustainable development - Kigali, Rwanda
- Strathmore University – Nairobi, Kenya
- Institute of Energy Studies & Research, The Micro Grid Academy, Community in East Africa for Carbon Free project - Kenya

● **Partner institutions and companies:**

- ENEL Green Power, Main power utility company in the world - Kenya
- KPLC, Kenya Power and Lighting Company - Kenya
- ABSOLUTE ENERGY AFRICA, Rural electrification utility company - Uganda and Rwanda
- UNEP, United Nations Environment Program - Kenya
- AVSI NGO, Non Governmental Organization for human development, Uganda, Rwanda & Kenya
- ESKOM, Private hydropower operator - Uganda
- KAKIRA SUGAR, Sugar production and biomass generation player – Uganda

3.5 Course Mode – Students & Teachers

Most of the work, leisure and social activities, as well as the daily routine will be agreed between students and teachers: **teamworking** skills and availability are required from each participant.

Before field visits every project will be presented during front-stand classes, adequate support material and tips on the socio-economic context.

Output from field works will be agreed according to each participant's need or expectations.

The final program will be published prior to departure and will be coordinated throughout the trip with daily briefing in situ in case of necessary modifications.

The process of problem solving, as well as the results of each group, will be shared with other groups in a necessary exchange of information and methodologies.

Teachers will follow the daily work, allowing time for personal study.

3.6 Class

175 hours, 50% dedicated to visit and field work:

60h Frontal lessons	C
28h Exercises	E
31h Field visits	FV
56h Individual and group field work	FW

● **Preliminary Issues to Design and Manage a Field Project: 4 h**

- Class overview; teacher and projects overview, class and student objectives 1C
- Definitions of design, sustainability, development, technology, energy/water systems 1C
- Role of Global Engineering in Sustainable Development, and MDGs Projects 1C
- Role of energy for sustainable development in emerging countries 1C

● **Logical Framework Analysis: 12 h**

- LFA I (Logic and Indicators) 6C & E
- LFA III (Sources and Matrix) 6 C & E

● **Energy & Sustainable Development: technical, social, economic and environmental dimensions**
Technical Dimension: 36 h

- Renewable Energy Sources, Plant, Design, Cost and Management 4 C
- Hydroelectric plant, Design and Management 3 C, FV
- Photovoltaic plant, Design and Management 6 CFV, FW
- Wind plant, Design and Management 6 FV
- Waste to Energy Plant, Design and Management 6 C, FV
- Micro PV System 2 C, FV
- Smart Grids for Rural and Industrial application in developing areas 12C, FW

● **Economical Dimension: 15 h**

- Energy Policies and Enterprises in East Africa 4 C
- Business Plan for Rural Electrification 2 C & FV
- Occupational Issues 2 C & FV
- Efficiency in Renewable and Fossil Energy Sources 4 C & FV
- How to write a Business Plan 3 C

● **Environmental Conservation: 12 h**

- Projects against Climate Change and Natural Resources Conservation 5 C
- Multi Criteria Analysis Deforestation and Biomass 2 C
- Eco Systems: Local plants and wildlife 2 C & FV

● **Psychological and Social Context: 18 h**

- Basic events of East Africa History 2 C
- Cultural elements of East Africa 6 C
- Energy and MDGs in the Stakeholder analysis 2 C & E
- Energy Project in Conflicts 4 C & FV

● **Field Work Case studies for Technical Design and Business Plan Development: 78 h**

- How to stay in the Field managing Safety, Security, Stress, Health, and Cooperation 3 FW
- Mini Hydro Merhu, Kenya 25FW
- Rutenderi Solar Mini Grid and Water Supply, Rwanda 25FW
- Kitobo Hybrid PV system, Uganda 25FW

3.7 Students, partner organizations and local communities outcome

● Students:

- thesis & Project works
- job opportunities
- vocational Training
- stage (Internship)

● Partners:

- project Development
- joint research collaboration
- students exchange programs
- renewable resources mapping

● Local communities:

- data Collection
- project writing
- fundraising advisory
- scientific tourism increase

4. XI Field Study Abroad Edition – East Africa

4.1 East Africa Projects initiatives, technologies and softwares

Limited access to electricity needed to support off grid communities development, to cover urgent energy supply, to guarantee the power supply at night; cooling availability to maintain the cold temperature to store food and sterilizing the water to provide drinking water to affected communities.

● Projects

- Uganda - Kitobo Hybrid Mini-grid

Description:

- 230 kW photovoltaic plant with 520 vanadium flow storage system + 80kVA back-up diesel genset

Phase:

- Commercial operation

Actions:

- Load management optimization
- Demand growth ramp-up



- Uganda - Kaalongo Hospital PV plant

Description:

- Ambrosoli Hospital is a compound in Northern Uganda with unreliable power supply

Phase:

- Preliminary survey

Actions:

- Load analysis
- System sizing and budgeting



- Uganda - Solar lanterns with Makerere University

Description:

- Makerere University has a laboratory to create special lanterns for fishermen

Phase:

- Agreement signing and start-up

Actions:

- Material pricing
- Electrical sizing and production



- **Rwanda – Rutenderi Thermoelectric Mini-grid**

Description:

- Rutenderi is an off-grid village based on maize agriculture economy

Phase:

- Executive design

Actions:

- Thermal load analysis
- Water supply system design
- Productive activities enhancing



- **Rwanda – Off-grid site identification**

Description:

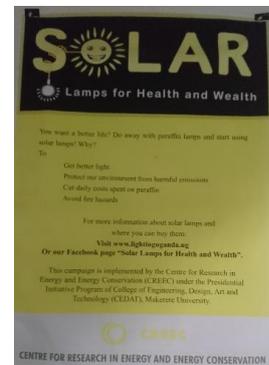
- Rwanda has an electrification rate of 20%

Phase:

- Site identification

Actions:

- Indicator selection targeting productive areas
- Resource mapping
- Preliminary design
- Scouting financing opportunities
- Link up with agriculture products processing and water supply



● Technologies

- Osec - On Site Electrolytic Chlorination

Osec technology deals with the water purification and in particular with its disinfection phase, regarding the production and the distribution of sodium hypochlorite disinfectant. It fits into the health and hygiene sector, but it is also closely linked to the education sector. Osec models are designed to easily use energy that comes from renewable sources.



● Softwares

- Homer

Software for microgrid and distributed generation power system design and optimization. <https://www.homerenergy.com/>



- WaSp

The waSp software suite is the industry-standard for wind resource assessment, siting and energy yield calculation for wind turbines and wind farms.



- i-tree

Software suite from the United State Forest Service (USDA) that provides urban and rural forestry analysis and benefits assessment.



4.2 Micro-Grid Academy Project

From 3th to 12th April Field Study Abroad join to Micro Grid Academy.

The Micro-grid Academy is a regional capacity building platform for trainees to learn technical and business skills through a variety of courses and the use of a 10-30 kW off grid hybrid power plant.

Located in KPLC Training & Research Institute In Nairobi, the Academy aims to train young local and international professionals and graduates on how to plan, design, build and operate a hybrid micro-grid in rural and remote areas. The Academy supports the roll-out of micro-grid projects in their local communities, thereby contributing to creating energy access, growing the green jobs market, local community economic development, and the improvement of African livelihoods.

5. Costs: food & accomodation, health & satefy, outfit & useful things

5.1 Costs and expenses on site

The cost of the program is divided into:

- 3.000 Euro to be donated to the non-profit organization "TECNOLOGIE SOLIDALI", for Rural Project Development and all required in-country costs, **including food, meetings, field visits, local transportation, lodging, for all FSA days;**
- **the student will need to cover their visa**, souvenirs, and additional drinks beyond what is provided during meals, and other personal expenditures;
the approximate cost of the students for incidentals (i.e., border taxes, visas, extra food, extra sports and cultural visit, etc.) typically does not exceed 300 Euro;
- **flight ticket is excluded;**
- health insurance and cost of vaccines are excluded.

5.2 Accommodation in East Africa

Working in the field of humanitarian development requires respect and adaptation communities lifestyle and culture.

Participants and teacher will be hosted in adequate structures according to the availability on site. In rural areas sometimes hot water is a luxury.

In different countries, places, and phases of the program, accommodation will change; in the cities we chose hotels clean and comfortable, with dormitories or private rooms, depending on the situation.

- **Uganda**
 - Bushpig Hostel, Acacia Road, Kololo, Kampala
- **Rwanda**
 - TeaHouse b&b, Kimironko, Kigali

5.3 Guidelines to students about health and safety

Before departure the students are taught during approximately one hour by Mrs. Filomena Pietrantonio, doctor, Director of Department at the hospital S.Eugenio of Rome, 10 years of experience as a teacher in the Master, an expert in tropical diseases, former chairman of "Medicine San Frontier" Italy, available 24/7 in case of emergency, speaks English, French and Italian.

Upon arrival a first orientation is dedicated to health and safety, however, they are always available a series of slides that information concerning water, food, basic medicines and personal counseling, if required.

- A certificate of health insurance and vaccines performed will be required of all students before departure.
- In East Africa we have access to:
 - St . Francis Community Hospital
Little Sisters Of St. Francis Of Assisi, Hunters, Kasarani - Mwiki Road, Nairobi, Kenya
[+254 713 969608](tel:+254713969608)
<https://maps.google.com/?cid=13557343233139247041&hl=en&gl=us>

5.4 About outfit and useful things

● Outfit

The wheater is warm and humid, therefore it recommends to bring light suits, but it could be oportune to bring:

- a K-WAY;
- a sweatshirt or a jacket;
- boots or sneakers for the fieldwork;
- nice dress for International or University meetings.

● Useful things

Working in the field of humanitarian development requires adaptation communities lifestyle and culture, so it could be useful to bring:

- hard plastic kitchen utensils;
- bag bed sheet;
- wet wipes for personal hygiene;
- soap to wash the clothes;
- universal World Wide Travel Charger Adapter US / UK / EU / AU plug to charge cell or pc.

6. Contacts

People

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<http://www.cirps.it/>



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