

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

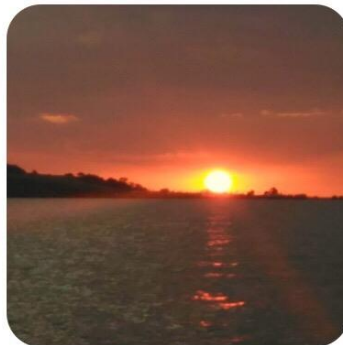
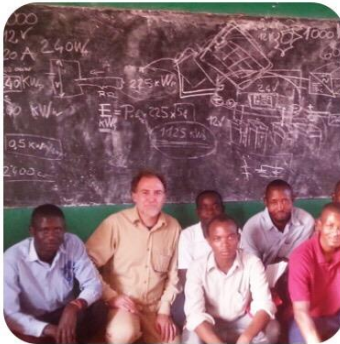
## FIELD STUDY ABROAD

*Travel, Learn, Research and Work in developing communities*



**XVI FSA EDITION - EAST AFRICA**

*from 28<sup>th</sup> December 2019 to 25<sup>th</sup> January 2020*



**"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 Columbia University)**

## Index

---

|   |           |
|---|-----------|
| <b>1. Overview.....</b>   | <b>3</b>  |
| <b>2. Co-organising partners .....</b>                                  | <b>4</b>  |
| 2.1 Cirps.....  | 4         |
| 2.2 Tecnologie Solidali.....  | 4         |
| 2.3 EnGreen.....  | 4         |
| <b>3. Field Study Abroad XIII – East Africa .....</b>                   | <b>5</b>  |
| 3.1 Admission requirements and course duration .....                    | 5         |
| 3.2 Topics.....   | 5         |
| 3.3 “Learning by doing” approach.....                                   | 5         |
| 3.4 University contacts and partner institutions.....                   | 6         |
| 3.5 Course Mode – Students & Teachers .....                             | 7         |
| 3.6 Didactic.....   | 7         |
| 3.7 Students, partner organizations and local communities outcome ..... | 8         |
| 3.8 East Africa Projects initiatives, technologies and softwares .....  | 9         |
| 3.9 Micro-Grid Academy Project .....                                    | 11        |
| <b>4. Costs .....</b>   | <b>12</b> |
| 4.1 Budget .....  | 12        |
| 4.2 Accommodation in East Africa .....                                  | 12        |
| 4.3 Guidelines to students about health and safety .....                | 13        |
| 4.4 About outfit and useful things .....                                | 13        |
| <b>5. Contacts.....</b>   | <b>14</b> |

## 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 Onlus**, with the technical assistance of **EnGreen**, an innovative start-up 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 15 editions, mainly in Central and Latin America, counting on more than 250 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

## 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. <sup>[1]</sup><sub>SEP</sub>

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.

### 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, <sup>[1]</sup><sub>SEP</sub> especially because of lack of funding.

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 EnGreen

EnGreen 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 looks 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, EnGreen co-founder, is a trainer during Field Study Abroad.

### 3. Field Study Abroad – East Africa

---

#### 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 + 1 optional internship,** for an additional period of work experience

#### 3.2 Topics

- **Renewable energies:** wind turbines, photovoltaic systems, hydroelectric power generation, waste to energy systems, smart grids, urban and rural electrification. Agronomy and food processing technologies are discussed within the international cooperation for development on the purpose of finding appropriate solutions to identified problems.; students can develop their thesis or project work directly on the field;
- **Project management tools:** Logical Framework Analysis, stakeholder analysis, environmental impact assessment, project monitoring and evaluation.
- **Financial evaluation:** funding opportunities, 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. <sup>[1]</sup><sub>[5EP]</sub>

#### 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, tutors assign project works to individuals or 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 and which can host FSA participants for internships or work experience (the stage is for individual students, but in some cases a small group of two to three students is allowed).

#### ● 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.
- 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
- RES4Africa - Kenya
- KPLC, Kenya Power and Lighting Company - Kenya
- EQUATORIAL POWER, Rural electrification utility company - Uganda and Rwanda
- UN-HABITAT, United Nations Agency - 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
- OFF GRID BOX, system integrator - Rwanda



### 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 Didactic

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

|     |                                 |    |
|-----|---------------------------------|----|
| 60h | Classes                         | 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 II (Results, Impact evaluation) 6C & 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
- Funding opportunities 4 C & FV
- How to write a Business Plan 3 C

● **Environmental Conservation: 12 h**

- Climate change adaptation and mitigation actions 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
- Pillars of ethic persuasion 4 C & FV

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

- Kitonyoni Photovoltaic Village, Kenya 25FW
- Rutenderi and Gatoki Solar Mini Grid and Water Supply, Rwanda 25FW
- Kitobo and Bukasa Hybrid PV system, Uganda 25FW

### 3.7 Students, partner organizations and local communities' outcome

● **Students:**

- thesis & Project works
- job opportunities
- internships

● **Partners:**

- project Development
- joint research collaboration
- students exchange programs

● **Local communities:**

- project writing
- fundraising advisory
- scientific tourism increase



### 3.8 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 gen-set

Phase:

- Commercial operation

Actions:

- Load management optimization
- Demand growth ramp-up



##### - Uganda – Bukasa Solar Smart Village

Description:

- 100 kW hybrid housing and energy project

Phase:

- Works commissioning and start-up

Actions:

- Load analysis
- Productive uses assessment



##### - 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 Rural Mini-grid

Description:

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

Phase:

- Commissioning

Actions:

- Productive appliances analysis
- Water supply system design
- Community engagement



- **Rwanda – Musanze 300 kw Mini Hydro**

Description:

- Rwanda has an electrification rate of 20%

Phase:

- Works and installation

Actions:

- Resource mapping
- Preliminary design
- Link up with agriculture products processing and water supply



- **Kenya – Kitonyoni Solar Mini-grid**

Description:

- Roof mounted solar and storage

Phase:




- Revamping

Actions:

- Customers mapping
- Performance analysis



## ● Softwares

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

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

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


## 3.9 Micro-Grid Academy Project

Field Study Abroad will join the Micro Grid Academy in Nairobi.

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.

## 4. Costs

---

### 4.1 Budget

- Participants are requested to submit a 3.000 Euro donation to the non-profit organization "TECNOLOGIE SOLIDALI", for Rural Project Development and all required in-country costs, **including food, transport, accommodation, field visits and meeting for the whole FSA;**
- **Participants will need to cover the East Africa Tourist Visa**, international flight tickets, vaccines and health insurance, any 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;

### 4.2 Accommodation in East Africa

Working in the field of humanitarian development requires respect and adaptation to communities lifestyle and culture. Participants and teachers will be hosted together in adequate structures according to the availability on site. Keep in mind that in poor areas sometimes hot water can be a luxury....

#### ● Uganda

- Kampala Backpackers, Albert Cook Road, Mengo, Kampala
- Banda Island Resort, Banda Island
- Casa mia B&B, Jinja

#### ● Rwanda

- St. Etienne Guesthouse, Kigali
- Akagera Resort, Kabarore, Gatsibo District

#### ● Kenya

- St. Francis Community Hostel - Nairobi

### 4.3 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>

### 4.4 About outfit and useful things

#### ● Outfit

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

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

#### ● Helpful accessories

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

## 5. Contacts

---

### ● **FSA Staff**

[info@fieldstudyabroad.org](mailto:info@fieldstudyabroad.org)

### ● **On site Team**

#### **Andrea Micangeli**

FSA Founder - Prof. University Sapienza – Rome

[andrea.micangeli@uniroma1.it](mailto:andrea.micangeli@uniroma1.it)

#### **Carlo Tacconelli**

Technical Director - EnGreen Srl, Rome

[carlo.tacconelli@engreensolutions.com](mailto:carlo.tacconelli@engreensolutions.com)

#### **Paolo Cherubini**

Ph.D. Student on Isolated Energy Systems for Developing Countries - University of Pisa

[paolo.cherubini@ing.unipi.it](mailto:paolo.cherubini@ing.unipi.it)

#### **Andrea Marcucci**

Project Manager – Trainer on Grand Challenges Scholar Program – University of Rome

[Andrea.marcucci@unicam.it](mailto:Andrea.marcucci@unicam.it)

### ● **Remote Support**

#### **Valeria Gambino**

Desk support

#### **Antonio Bisceglia**

Project assistant

#### **Chiara Capasso**

Administration

### ● **Websites**



[www.fieldstudyabroad.org](http://www.fieldstudyabroad.org)



[www.facebook.com/fieldstudyabroad](https://www.facebook.com/fieldstudyabroad)



<https://www.instagram.com/fieldstudyabroad>



[www.tecnologiesolidali.org](http://www.tecnologiesolidali.org)



<http://www.cirps.it>



<http://www.engreensolutions.com>



<http://blog.rinnovabili.it/rinnovabili-nelle-emergenze/chi-sono-16>