IMES

MASTER IN BIOENERGY AND ENVIRONMENT

The IMES Master Programme

The IMES Master Programme is built to reach the main goal of the Master, which is to provide to the students the professional skills required for private or public entities undertaking in bioenergy field, from the production process to the management of energy projects.

Since the "Biomass to Energy Chain" is a highly interdisciplinary topic, it involves several independent issues, which have been included within the course outline.

The Master tackles this strong Education and Training Challenge; in fact, it covers all the specific aspects related to the conversion of biomass into a sustainable and environmental friendly energy source, including the integration with other renewable energy sources.

The knowledge of market, normative and legislation in environmental and bioenergy fields also play a key role in the biomass to energy management of projects with a Local, National or Global scale, and it is included as well within the IMES Master Syllabus.

The skills obtained with the Master are suitable for Industries, Companies and Public Administration, like Departments of Environment Politics, National or International Energy Agencies.

Organised and Managed by:

C.R.E.A.R. CENTRO RICERCA ENERGIE ALTERNATIVE E RINNOVABILI

UNIVERSITÀ DEGLI STUDI FIRENZE

IMES

MASTER IN BIOENERGY AND ENVIRONMENT

The Syllabus: Five Main Topics

Biomass Production

- Forest Biomass Production, Agricultural Energy crops and residues, Cultivation and harvesting techniques

Power Generation And System Analysis

- Introduction to Energy Conversion Principles, Power plant technologies

Renewable Energy & Bioenergy Generation

- Renewable Energy Technologies, Biomass Energy Conversion Technologies, Chemical and Physical Characteristic of Biofuels

Environment

- General ecology, Environment and Air Pollution, Environmental Impact Assessment of Bioenergy System

Business Management and Economy

- Energy Market & EMS, Principles of economic and financial analysis of projects, Environmental legislation

UNIVERSITÀ DEGLI STUDI FIRENZE

IMES

MASTER IN BIOENERGY AND ENVIRONMENT

UNIVERSITÀ DEGLI STUDI FIRENZE

IMES
Biomass Production

Forest Biomass Production

- Fundamentals of Forestry
- Forestry biomass: definition and sources
- Woods and Forests: landscape, silviculture and evaluation of biomass availability
- Timber and Wood Arboriculture
- Forestry as an energy source, forest residues and Short Rotation Forestry (SRF)
- Energy and chemical characterisation of forestry biomass
- Evaluation of energy available from forestry biomass

Agricultural Energy crops and residues

- Energy and chemical characterisation of agricultural biomass and residues
- Energy Crops, Agricultural Residues and their valorisation
- Crops for Biofuels Production: Biodiesel, Bioethanol and advanced Biofuels

Cultivation and harvesting techniques

- Evaluation of suitable and available areas
- Estimating the environmentally compatible bioenergy potential from agriculture
- Sustainability Criteria for Biofuels
- Cultivation and harvesting techniques
- Mechanisation: techniques, tools and operating machines

UNIVERSITÀ DEGLI STUDI FIRENZE

IMES

MASTER IN BIOENERGY AND ENVIRONMENT

UNIVERSITÀ DEGLI STUDI FIRENZE

IMES
Power Generation And System Analysis

Introduction to Energy Conversion Principles

- Basics and Thermodynamic Principles: Energy classification and Basic Concepts
- Fundamentals of Energy Engineering
- Thermodynamic Cycles: Thermodynamic plans; ideal, limit, and real cycles;
- Processes: compression/expansion
- Cycles: Steam cycles (Rankine and Hirn Cycle), Brayton-Joule, Combined Cycle, Diesel and Stirling Cycles

Power plant technologies

- Introduction to Turbomachinery: definition and basics of Fluid Dynamics
- Turbines, Steam Plants, Internal and External Combustion Engines: cycles, components and schemes
- Organic Rankine Cycles (ORC)
- CHP, Cogeneration and Trigeneration
- System Analysis: System design and performance, performance calculation methods, System techno-economic analysis
- Small and Medium Size Heating and CHP Plants, District Heating

Power and Heat Biomass Conversion Plant within the Bioenergy Chain

- Interfacing Production and Conversion
- Drying in Bioenergy Systems: Drying of biomass, equipment, drying characteristics, heat sources

UNIVERSITÀ DEGLI STUDI FIRENZE

IMES

MASTER IN BIOENERGY AND ENVIRONMENT

UNIVERSITÀ DEGLI STUDI FIRENZE

IMES
Renewable Energy &
Bioenergy Generation

Renewable Energy Technologies

- Energy potentials from Renewables, Fossils and Nuclear: World Scenarios
- Wind energy, Solar Heating and Cooling, Photovoltaics, Concentrated Solar Power, Mini Hydro, Geothermal, Carbon Storage
- Integration of Biomass with other Renewable Energy Sources

Biomass Energy Conversion Technologies

- Biomass Pre-treatment and Compaction: Drying, Wood Chips, Briquettes and Pellets production
- Thermochemical Conversion, Biomass Combustion, Gasification, Pyrolysis, Torrefaction
- Anaerobic Digestion: feedstock, biological process, digestion of wastes, biogas production and upgrading, conversion technologies
- Microalgae: cultivation methods, ponds, photo bio reactors, biofuel extraction, by-products

Chemical and Physical Characteristic of Biofuels

- Chemistry of Biofuels, Introduction to Organic Chemistry, Hydrocarbons and Carbohydrates
- 1st and 2nd Generation Biofuels: Vegetable Oil, Biodiesel, Bioethanol, Biomethane, Advanced Biofuels, upgrading
- Green Chemistry: Biochemicals, Bioproducts and by-products, the concept of Biorefinery

UNIVERSITÀ DEGLI STUDI FIRENZE

IMES

MASTER IN BIOENERGY AND ENVIRONMENT

UNIVERSITÀ DEGLI STUDI FIRENZE

IMES
Environment

General ecology

- Ecology of organisms: effects of environmental factors, environmental conditions, Energy budgets of organisms, ecological niche, applications in ecotoxicology
- Population Ecology: Basic principles and definitions, Static and dynamic methods in population ecology, Simple growth models, Stage- and age- structured populations, Intraspecific and Interspecific competition, Applications
- Community ecology: Definition, ecological communities, Species richness and diversity, Factors affecting community changes. The biodiversity crisis. Extinctions and their causes
- Environmental Monitoring, Applied Ecology, Natural Resources Preservation

Environment and Air Pollution

- Air quality and Air pollutants: Environmental Impact, Environmental Impact of Bioenergy Plants
- Boundary Layer Physics: Physics of atmosphere, macro and micro meteorology, Boundary Layer, Solar Radiation,
- Air Pollution Emissions: Monitoring and Dispersion Modelling, Mathematical Models, the Gaussian standard model

Environmental Impact Assessment of Bioenergy System

- Life Cycle Assessment: basics, history, definition, terminology, use, normative, phases, perspectives, weak points and tools
- Waste Management: Waste definition and Classification, Principles of Waste Management, Waste to Energy, Legal, Safety and Environmental Issues, Economics
- Globally Harmonised System of Classifying and Labelling of Chemicals (GHS), Classification Labelling Packaging (CLP), Registration, Evaluation, Authorization and Restriction of Chemicals (REACh), Safety Data Sheet (SDS)

UNIVERSITÀ DEGLI STUDI FIRENZE

IMES

MASTER IN BIOENERGY AND ENVIRONMENT

UNIVERSITÀ DEGLI STUDI FIRENZE

IMES
Business Management and Economy

Energy Market & EMS

- Normative, Accreditation, Quality, Directives
- System Management, Environmental Management and Audit Scheme (EMAS), ISO 140001, ISO 50001, Plan-Do-Check-Act (PDCA) cycle, Audit, Environmental Analysis, Energy Performance Indicators (EnPI)
- Biomass Market: solid, liquid and gaseous biomass Markets, International Trading, Biomass as a Commodity, Pellet and Vegetable Oil Market, Energy Market

Principles of economic and financial analysis of projects

- Fundamentals of Economy; Basic macroeconomic aspect: GDP growth, inflation, labour market
- The financial aspects of an energy project: net actual value, break-even point, earning ratio
- Understanding the main economic aspects of energy, the main tools to analyse and design a technical proposal on Energy
- How to submit a Proposal, funding schemes and programmes; Financial Reporting

Environmental legislation

- Fundamentals of law, Environmental protection in International Legislation, Prevention Principle, Precaution Principle, sustainable development integration in legislation,
- National and International Environmental Legislation, Waste Management, Land remediation and Environmental Damage, Air Quality, Water Protection, Environmental Impact Assessment

UNIVERSITÀ DEGLI STUDI FIRENZE

IMES

MASTER IN BIOENERGY AND ENVIRONMENT

Thesis Discussion:
April 2017

Internship and exams completed:
March 2017

Lessons End:
October 2016

Next Edition 2015/2016 Schedule

Lessons Start:
March 2016

Admission application deadline:
January 22nd 2016

UNIVERSITÀ DEGLI STUDI FIRENZE