United Nations Industrial Development Organization

(UNIDO)

“First Operational Phase of the Caribbean Centre for Renewable Energy and Energy Efficiency – CCREEE”

Project SAP ID: 130200

Deliverable

a. Inception Report

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1. UNDERSTANDING OF THE SCOPE AND OBJECTIVES OF THE PROJECT

Within the framework of UNIDO's "Sustainable Energy Island and Climate Resilience Initiative" (SIDS DOCK), the regional organizations, ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE), the Caribbean Centre for Renewable Energy and Energy Efficiency (CCREEE) and the Pacific Centre for Renewable Energy and Energy Efficiency (PCREEE) are developing an "Online Capacity Building and Certification Program on Sustainable Energy Solutions for Islands and Territories in the Pacific, Caribbean, Africa and Indian Ocean". The activity is implemented with financial support of the Spanish and Austrian Governments.

In line with the project document and based on previous cooperation, CIEMAT, Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas, as subcontractor will develop, test and hand-over the "First Operational Phase of the Caribbean Centre for Renewable Energy and Energy Efficiency – CCREEE."

To this purpose, CIEMAT proposal aims to design, develop and implement a training strategy facing the challenge 100% renewable for the energy sustainability in Islands.

This program has been designed and will be based on the deliverables of the "Capacity Building Programme in RES for Latin America and the Caribbean" developed by CIEMAT and UNIDO in 2014 within the context of the Observatory of Renewable Energies in Latin America and the Caribbean.

This proposal aims to be developed with the participation of experts from the different research departments of the CIEMAT, as well as the University of Alcalá de Henares (UAH) and the Technological Institute of the Canary Islands (ITC), R&D&I Institutions of excellence in the field of energy, energy efficiency and the environment. In close collaboration with the University of the South Pacific and PacTVET, the University of Cape Verde, the University of West Indies and the Energy Unit of the CARICOM Secretariat.

Based on the Terms of References provided by UNIDO, a total of 9 online training modules will be part of this First Operational Phase of the Caribbean Centre for Renewable Energy and Energy Efficiency – CCREEE with the construction of an **Online Capacity Building Programme on Sustainable Energy Solutions for Islands**. The general methodology for the implementation of this project is described in chapters below. The overall total project duration is 15 months.

2. INTRODUCTION

Energy demand is closely linked to the global challenges faced by the world today, as progress in social matters, the reduction of poverty, environmental degradation, climate change and food security, and therefore constitutes a key issue of our times. Industry needs available and affordable energy. The energy demand at a global scale that involves the promotion and growth of economies, especially those in development, at the same time require a proper balance between the growing energy demand and the urgent necessity of protecting the environment and climate a top priority of the policies to combat climate change, and one of the purposes of the Millennium Development Goals of the United Nations.

In this scenario, Islands face particular energy challenges. Costly imports of fossil fuels, can burden island's budgets and inhibit investment in socio-economic development. In contrast, indigenous renewable energy resources and energy efficiency can reduce the dependence on imports while enabling the atmosphere for local business to be created and so, employment opportunities. Besides, islands are the best scenario to proof that isolated communities can meet 100% of their energy demand without greenhouse gas emissions.

In that regard, the United Nations Industrial Development Organization (UNIDO) and the Sustainable Energy Island and Climate Resilience Initiative (SIDS DOCK), in close coordination with the regional organizations, are establishing a network of regional sustainable energy centres in the Pacific, Caribbean, Indian Ocean and Africa. The post-2015 multi-stakeholder and triangular partnership is directed to implement the SAMOA Pathway, SDG 7, SDG 9 and the Intended Nationally Determined Contributions under the Paris Agreement (SDG 13).

Through regional methodologies and tools, the centres assist Island Countries and Territories to address existing barriers and strengthen drivers for sustainable energy markets, industries and innovation. The centres focus on the up-scaling and replication of national efforts in the areas of capacity development, knowledge management and innovation, awareness rising, as well as investment and business promotion. Capacity building and skills certification are important areas of work of the centres.

As a first joint activity, the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE), the Caribbean Centre for Renewable Energy and Energy Efficiency (CCREEE) and the Pacific Centre for Renewable Energy and Energy Efficiency (PCREEE) are developing an "Online Capacity Building and Certification Program on Sustainable Energy Solutions for Islands and Territories in the Pacific, Caribbean, Africa and Indian Ocean". The activity is implemented with financial support of the Spanish and Austrian Governments.

Further information is available at: http://www.sidsdock.org, http://www.pcreee.org, http://www.ccreee.org, http://www.ecreee.org and http://www.se4allnetwork.org.

The online capacity building program responds to the urgent need for affordable training and certification programs on sustainable energy in islands. Lack of capacities is a major barrier for the creation of sustainable energy markets and industries. Without a considerable strengthening of capacities, most of the small island developing countries and territories will not achieve their sustainable energy targets in the Intended Nationally Determined Contributions (INDCs).

Technical knowledge is required to establish a critical mass of policy makers, project financiers and engineers who will be able to manage all aspects of sustainable energy development and implementation. The following table summarises the capacity requirements of the different stakeholder groups. The online capacity building will take these needs into account and in collaboration with the counterparts; the EUPacTVET qualification system will be reviewed and considered in the development of this project.

Stakeholder group	Capacity needs
Policy makers in the renewable energy and energy efficiency sectors and the energy sector in general.	• Developing and operationalize coherent, comprehensive and evidence based policies, laws and regulations that create a level playing field for RE&EE technologies • Understanding the energy sector and its dynamics – how do RE, EE, Power, Petroleum, etc. interact to shape a country energy direction and policies • The measure of the performance of the energy sector – commonly used energy security indicators • The role of the Utility / Energy regulators • Implementing rural energy planning • Negotiating power purchase agreement (PPAs) with independent power producers (IPPs) and setting viable feed-in tariffs • mainstreaming climate resilience and gender
Policy makers from non-energy sectors like agriculture, tourism, health, water, private sector, transport sectors etc.	• Basic design of renewable energy systems • Integrating renewable energy and energy efficiency components into their sectors
Entrepreneurs, project developers, equipment manufacturers, consultants and industry support bodies	• Development of vocational and higher education courses adapted to the RE&EE requirements and languages of the region • Certification for conducting energy audits • Identifying, developing and packaging a pipeline of potential RE&EE investment projects • Negotiating viable power purchase agreement with investors • Preparing quality business plans that are consistent with existing financing mechanisms • Identifying and developing potential CDM projects • Mobilizing and structuring investments in RE&EE projects • Mainstreaming climate resilience of energy infrastructure and gender • Developing funding proposals to the private sector funds of the financing mechanisms like the GCF • How can local firms competitively bid for the increasing number of > $1 million projects in their countries
Utilities	• Ability to tender RE&EE efficiency projects • Negotiate power purchase agreements (PPAs) • Integrate RE generation in the grid
Recipients/buyers of energy services and technologies	• Willingness and ability to pay for the services or technologies • Ability to assess the energy implication or cost in daily choices and decisions such as selecting electric equipment
Academia and research community	• Increase capacities and expand the curricular offer in the field of low carbon technologies, energy efficiency and climate change mitigation actions and to promote the implementation of sustainable energy solutions in the target regions

STARTING DATE OF THE PROJECT: 1ST OF JULY, 2017

2.1. SCOPE OF THE ACTIVITIES

In line with the project document and based on previous cooperation, UNIDO has subcontracted the Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (CIEMAT) to develop, test and hand-over the "Online Capacity Building and Certification Program on Sustainable Energy Solutions for Islands and Territories in the Pacific, Caribbean, Africa and Indian Ocean."

The program is based on the deliverables of the "UNIDO Online Renewable Energy Capacity Building Program for Latin America", developed by CIEMAT for the Observatory for Renewable Energy in Latin America and Caribbean, UNIDO's regional program. A total of five modules of this program will be updated and their practical case will be oriented to the specific island realities. Four new modules will complete this program contributing to meet the SIDS requirements and to increase the access to knowledge in the Pacific, Caribbean and West Africa islands regions.

The **Online Capacity Building Programme on Sustainable Energy Solutions for Islands** as a whole aims to offer a solid and specialized training program in technology and sustainable energy for the islands regions. Organized in nine modules, the Program will be wide disseminated specially among key stakeholders (organizations, companies and governments) for the public sector, private sector and civil society of the Islands regions. The activities under the subcontract are expected to be implemented during a period of 15 (fifteen) months.

The e-learning programme includes nine online e-learning modules on the following topics and technologies:

1. General introduction into Island energy and climate change mitigation and resilience
2. Solar thermal Systems and Applications for water heating and industrial process heat
3. Grid-connected and decentralized Photovoltaic Systems
4. Efficient energy use and thermal optimization in buildings and industry
5. Geographic Information Technologies and Renewable Energy
6. Bioenergy. Anaerobic digestion of organic waste to energy solutions
7. E-mobility
8. Minigrids, Grid Stability in Insular Power Systems and Energy Storage
9. Ocean Energy

These modules will provide a technical review on the different topics and technologies, including a practical case focused on the island regions. According to the guidelines, the corresponding e-learning modules will be prepared in English, Spanish and Portuguese.

Participants will receive a digital cost-free certificate, issued by UNIDO and the developers or for example a University from the Pacific if preferred, upon successful competition of the knowledge assessments.

2.2. OBJECTIVES OF THE PROGRAM

The overall objective of the project is to develop a competent capacity building program on sustainable energy integrated by a variety of e-learning modules which will be installed on the ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE), the Caribbean Centre for Renewable Energy and Energy Efficiency (CCREEE) and the Pacific Centre for Renewable Energy and Energy Efficiency (PCREEE) main Portal webs and in order to cover the knowledge requirements in renewable energies, energy efficiency and the energy in general of the different stakeholder groups.

The centres will be the owners and direct beneficiaries of the program. The final beneficiaries are experts from the public and private sector, which are benefiting from the online trainings. To increase the impact and sustainability or the program, it is envisaged to make the online course part of the curricula of existing sustainable energy master programs of the University of Cape Verde in Mindelo (UNIVC), the University Of West Indies (UWI) and the University of the South Pacific (USP).

SPECIFIC OBJECTIVES OF THE PROGRAM

- To meet the objectives and requirements of UNIDO and Sustainable Energy Island and Climate Resilience Initiative (SIDS DOCK) to support the implementation of an accredited training and certification program within the join activity “Online Capacity Building and Certification Program on Sustainable Energy Solutions for Islands and Territories in the Pacific, Caribbean, Africa and Indian Ocean” launched by ECOWAS Centre for Renewable Energy and Energy Efficiency (ECREEE), the Caribbean Centre for Renewable Energy and Energy Efficiency (CCREEE) and the Pacific Centre for Renewable Energy and Energy Efficiency (PCREEE).
- Increasing access to knowledge and specialized data in low carbon technologies. This will promote the development and adoption of renewable energy initiatives in the target region helping

- To increase the access to sustainable energy and energy security, by diversifying the energy mix.

- To provide a deep and specialized knowledge on the different technologies to achieve global energy access

- Making students aware of the opportunities within energy efficiency and sustainable energy solutions field in the island target regions and promote research projects.

- To develop a program adequate to chase the following main <u>General objectives / specific skills</u>:

    1. To be formed to develop and operate sustainable energy projects in a complex and changing environment

2. Trainning in the promotion and management of low carbon energies and energy efficiency industry professionals, in a participatory environment and a practical approach

- Part of the program will also provide a global overview of the technologies and sustainable energy topics and in order to be widely disseminated throughout the general public.

- To develop the nine following e-learning modules to face the challenge of contributing to energy sustainability in the target regions:

1. General introduction into Island energy and climate change mitigation and resilience
2. Solar thermal Systems and Applications for water heating and industrial process heat
3. Grid-connected and decentralized Photovoltaic Systems
4. Efficient energy use and thermal optimization in buildings and industry
5. Geographic Information Technologies and Renewable Energy
6. Bioenergy. Anaerobic digestion of organic waste to energy solutions
7. E-Mobility
8. Minigrids, Grid Stability in Insular Power Systems and Energy Storage
9. Ocean Energy

2.3. EXPECTED RESULTS

The learning outcomes must be specified regarding what a learner knows, understands and is able to do on completion of a learning process. They will be defined in terms of knowledge, skills and competences. **The terms must be understood according to the following definitions:**

- **Knowledge** means the outcome of the assimilation of information through learning. It is the body of facts, principles, theories and practices that is related to a field of work or study.
- **Skills** mean the ability to apply knowledge and know how to complete tasks and solve problems.
- **Competence** means the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development.

In the framework of this **Online Capacity Building Programme on Sustainable Energy Solutions for Islands**, after delivering the e-learning modules, the students must be able to:

1. Get the fundamental knowledge and skills for the understanding and implementation of the different technologies and sustainable energy systems.

2. Ability to apply knowledge acquired in the energy and environmental field

3. Being able to communicate verbally and in writing, including technical reports using the terminology of specialized personnel in the energy world
4. Develop learning skills for acquiring knowledge can be produced continuously and autonomously
5. Compare and select technical alternatives
6. Functional design of equipment and facilities
7. Making specific calculations in the field of energy
8. Have an overview of the technology and sustainable energy solution developed in the module

3. TRAINING PROGRAM MODULES

In this section is described the general information, content and objectives pursued in each module to be addressed in the subsequent development of the program.

3.1. MODULES

1. GENERAL INTRODUCTION INTO ISLAND ENERGY AND CLIMATE CHANGE MITIGATION AND RESILIENCE

This expert course combines different subjects related to climate change island issues with the objective of providing general understanding of the problem of climate change and the strategies that have been developed in the law and environmental economics:

- Tackling climate change from the climate system, climate cycles, climate models, and the impact of climate change, the change mitigation and response to climate change
- Vulnerabilities of SIDS [environment and economically]
- Overview on sustainable energy targets and scenarios in various regions (e.g. SIDS DOCK targets, CARICOM, Pacific, AIMS).
- Analyze environmental policies (eg: Paris Agreement)
- Study the macro ecological aspects involved in the climate change on the planet

2. SOLAR THERMAL SYSTEMS AND APPLICATIONS FOR WATER HEATING AND INDUSTRIAL PROCESS HEAT

The purpose of this module is to provide a general overview of the potential applications of solar thermal technologies. Starting from physics fundaments on which these technologies base up to offering an outline for developing new approaches, the students

will acquire the capability to define and design, at an elementary level, some solar thermal systems for a specific location.

- Physical principles of the use of solar energy
- Potentials
- Plant engineering for the use of solar energy (electric, thermal)
- Planning, construction, implementation, operation, and maintenance
- Island and territories practical case

3. GRID-CONNECTED AND DECENTRALIZED PHOTOVOLTAIC SYSTEMS

The overall aim of this module is to supply students with the knowledge necessary to understand the basics of photovoltaic conversion, the current state of technology, how it has evolved from its beginnings to the point of actual development and the different types and characteristics of photovoltaic systems. Participants are intended to acquire the skills necessary to provide the potential for the development of this energy source in their home countries or in other countries in which they will perform their work, thus contributing to the expansion of the energy generated by photovoltaic means.

- Physical principles of the use of solar energy;
- Potentials
- Plant engineering for the use of solar energy (electric, thermal)
- Planning, construction, implementation, operation, and maintenance
- Island and territories Practical Case based on an analysis and evaluation of the environmental and socioeconomic aspects associated with Photovoltaic Solar Energy and its applications

4. EFFICIENT ENERGY USE AND THERMAL OPTIMIZATION IN BUILDINGS AND INDUSTRY

The objective of this module is to provide essential knowledge of the key concepts to analyse buildings on an energy basis, incorporating to the student's knowledge the techniques and concepts of energy efficient in buildings. The module includes not only the energetic aspects of the architectonic design, but also the integration of active solar systems for heating and cooling.

- Physical principles, energy demand of buildings, building services engineering
- Optimized building concepts, potentials, opportunities
- Energy efficiency in the public sector and in companies
- Energy management standards in industry and SMEs
- Island and territories practical case

5. GEOGRAPHIC INFORMATION TECHNOLOGIES AND RENEWABLE ENERGY

Provide the student with a basic knowledge that will allow him to begin to address the problem of the integration of renewable energies in islands using the tools of the geographic information technologies.

- GIS. Functions and application. Geographical information: structure and data.

- Spatial analysis with GIS. Thematic Mapping.
- Solar Energy and Geographical information technologies.
- GIS and renewable energies.
- Application of GIS for rural electrification.
- Development of a geographical model for the evaluation of PV potential in urban environments
- Island and territories practical case

6. BIOENERGY. ANAEROBIC DIGESTON OF ORGANIC WASTE TO ENERGY SOLUTIONS

The general objective is to provide a global perspective of Biogas in an energy and environment context. The module presents the theoretical foundations concerning the anaerobic digestion process, and the technical aspects needed to obtain a broad understanding of this renewable energy are disclosed, from the source of production to final use, in its different areas such as: resource characteristics, available technologies, composition and production, current applications and new developments. In addition, information on projects related to biogas, that are currently underway will be provided.

- Problems and consequences of inadequate waste management.
- Analyze the different aspects of the generation of municipal solid waste
- Provide fundamental knowledge of management systems and good environmental practices.
- Analyze the different components of municipal waste collection systems, priorities and different techniques that can be applied to management. Management Plans.
- Introduce treatment technologies for municipal waste from reuse, to recycling, recovery and disposal in controlled landfill, organic waste to energy technologies
- Practical island and territories examples Island and territories Practical Case based on an analysis and evaluation of the environmental and socioeconomic aspects associated with Biogas and its applications

7. E-MOBILITY

The main objective of this course is giving knowledge in the electric mobility solutions and technologies focused in the target regions.

- The electric mobility.
- Technical aspects of the electric vehicle.
- Model of implementation of the electric vehicle and impact of the electric vehicle on the energy system of insular territories.
- Infrastructure of recharge.
- Island and territories practical case

8. MINIGRIDS, GRID STABILITY IN INSULAR POWER SYSTEMS AND ENERGY STORAGE OPTIONS

The objective of this module is that the students learn which are the main criteria that they should take into consideration to achieve a high penetration of unmanageable

renewable energy sources in insular power systems with a focus on Storage, Demand, Management and Scheduling tools.

- Minigrids. Overview of Insular Power Systems
- Insular Power system management with High RES penetration
- Stability analysis of the integration of PV in isolated diesel dominated microgrids
- Storage Systems
- Island and territories practical case

9. OCEAN ENERGY

The main objectives of this module are to provide the theoretical basis on the ocean energy technologies, in particular the wave energy conversion, to be applied in island areas. The main technologies used nowadays will be described, the theoretical concepts to understand the energy conversion from wave to grid and the analysis of the energy potential in a certain sea site.

- Principles and potential analysis to utilize ocean energy in islands
- Planning, construction, implementation, operation, and maintenance
- Analysis of the most important parts of an industrial project
- Island and territories practical case
- The co-benefits from ocean technologies (address water shortage, cooling, aquaculture farming, fertilizers…)

4. KEY EXPERTS ASSIGNED TO THE PROGRAM

This online capacity building program is leaded by the Division of Knowledge Management and Training of CIEMAT which is responsible for the coordination and technical direction of the project as well as the methodological and didactic development of the capacity building program, the quality control and the e-learning modules production. Content development is carried out by experts from the different research departments of the CIEMAT, as well as the Spanish Office of Climate Change (OECC), the University of Alcalá de Henares (UAH) and the Technological Institute of the Canary Islands (ITC), R&D&I Institutions of excellence in the field of energy, energy efficiency and the environment. IT support is provided by the Computer Service in the Unit of Development of Applications and Computer Systems of CIEMAT.

➢ CIEMAT EXPERIENCE

CIEMAT as a Public Research Centre in the fields of energy, environmental and technology develops I+D+i activities and projects in these areas, trying to become a nexus between I+D+i and the social interest objectives. Dedicated to transfer the capabilities and research results to the industry and society through Capacity Building activities.

Spain is in a leading position internationally in the area of Renewable Energy, and also is an important part of the work of CIEMAT, covering the wind energy study, concentrating solar

systems for both electricity generation as for application to industrial processes and solar energy, not to mention energy efficiency in building designs by considering sustainable architecture and renewable energy integration.

The Division of Knowledge Management and Training of CIEMAT has a wide and long experience in implementing knowledge management and knowledge transfer activities, as well as carrying out, coordinating and participating in several Capacity Building projects on Renewable Energy, Energy Efficiency and Environment at the national and international levels. CIEMAT, through this Division, has a long history of participation in educational cooperation and training projects focused in Latin America and developing regions, and collaborates with different organizations and institutions of excellence in order to transfer the results of the most relevant research projects developed at the Centre: Economic and Technological Development Distance Learning Centre Foundation (CEDDET Foundation), Spanish Agency for International Development Cooperation (AECID), World Bank, IRENA's Renewable Learning Partnership (IRELP), AIEA, etc.

- **Spanish Office of Climate Change (OECC)**

Is the governing body under the Ministry of Environment of the Ministry of Agriculture and Fisheries, Food and Environment of Spain, that has attributed the functions directed to the prevention of climate change. Its main activity is to develop policies related to climate change. The OECC is closely related to the United Nations, and also to the European institutions, Public administrations, NGOs, public and private institutions and other social partners to collaborate with Initiatives related to the fight against climate change, it also advises the General State Administration in matters related to climate change.

The OECC is responsible for formulating the national policy on climate change, in accordance with international and Community legislation in this area, and proposes the legislation and the planning and administrative instruments that allow the fulfilment of the objectives established by the policy.

- **University of Alcalá de Henares (UAH)- Robotics Services and Technologies for Road Safety**

Is a modern university, and acknowledged as a model to be imitated in Europe and America. In addition to classical humanistic studies and the social sciences, the University of Alcalá has incorporated the most modern qualifications in all scientific fields, such as Health Sciences and the various engineering sciences spread across its campuses, which with the Science and Technology Park are a decisive factor in its international profile and a boost to business in our region.

Its more than 29,000 students, 1,627 teachers and researchers and 762 administrative and service staff members are engaged in more than 38 official degree courses, and a wide range of postgraduate and continuing education courses. The recognised quality of its studies, the development of important research lines, its international relations, the artistic-historical interest of its iconic buildings, its new and modern facilities and its complete adaptation to the demands of today's labour market place at to the forefront of public universities.

➢ ITC- Renewable Energy Department

ITC is a state-owned company that belongs to the Industry Council of the Canary Island Regional Government. Its R&D facilities are located in the southeast of Gran Canaria, next to the coast, occupying a 109.000 m² plot on a site with excellent renewable energy conditions (annual mean wind speed 7.8 m/s, with wind energy potential of more than 4,000 equiv. hours/year; Solar irradiation on a horizontal Surface: 5.7 kWh/m²; day Sun Hours: 3,000 h/year).

The staffs of ITC is made up of 185 professionals from a wide range of disciplines, with 35 engineers and physicists working directly in renewable energy-based production systems for water desalination, cooling, heating and hydrogen production. Its main fields of research in renewable energies are:

- Electricity production from renewable energy sources
- Fresh Water production (water desalination) using renewable energy systems
- Cold and ice production using renewable energy systems
- Development of small to medium sized wind energy systems (incl. wind-diesel)
- Testing of solar thermal collectors and systems
- Penetration of renewable energy systems in weak electrical grids
- Production of hydrogen by renewable energy systems
- Wind and solar prediction tools (based on climatic model MM5, WRF and statistics process)

ITC is currently involved in several projects related to RES integration in islands: Energy storage and its integration with renewable energy technologies (for both stationary and mobile applications), wind farm grid integration in islands for desalination support, scheduling tools for microgrids in islands, power electronics and storage management tools for supercapacitors integrated in microgrids and RES forecasting for grid operation in Canary Islands (project in developing with REE). ITC has a wide and proven experience in both participating and managing large-scale and complex EU and non-EU projects and has been selected in order to combine academic and scientific know-how with the strict requirements and management skills of industry.

	KEY STAFF NAME	TITLE
1	Ms. Marisa Marco Arbolí (CIEMAT)	Project Coordinator
2	Ms. Lara de Diego Chica (CIEMAT)	Project Coordinator
3	Ms. Mirian Bravo Taranilla (CIEMAT)	Key-Expert (KE)
4	Ms. M. del Carmen Alonso García (CIEMAT)	Key-Expert (KE)
5	Mr. Félix Santiago García Rosillo (CIEMAT)	Key-Expert (KE)

6	Mr. José Antonio Ferrer Tevar (CIEMAT)	Key-Expert (KE)
7	Ms. Silvia Soutullo Castro (CIEMAT)	Key-Expert (KE)
8	Mr. Antonio Garrido Marijúan (AIT, Austrian Institute of Technology)	Key-Expert (KE)
9	Mr. Marcos Lafoz Pastor (CIEMAT)	Key-Expert (KE)
10	Mr. Javier Domínguez Bravo (CIEMAT)	Key-Expert (KE)
10	Ms. Nely Carreras Arroyo (CIEMAT)	Key-Expert (KE)
11	Mr. Antonio Sánchez de la Fuente (CIEMAT)	Key-Expert (KE)
12	Ms. María Lorena Prado Orcoyen (OECC)	Key-Expert (KE)
13	Mr. Pedro Revenga (University of Alcalá de Henares)	Key-Expert (KE)
14	Mr. Salvador Suárez (ITC, Technological Institute of the Canary Islands)	Key-Expert (KE)
15	Mr. Jesús de León (ITC, Technological Institute of the Canary Islands)	Key-Expert (KE)
16	Ms. Celia Bueno (ITC, Technological Institute of the Canary Islands)	Key-Expert (KE)
17	Mr. Agustin Marrero (ITC, Technological Institute of the Canary Islands)	Key-Expert (KE)
18	Mr. Daniel Henríquez (ITC, Technological Institute of the Canary Islands)	Key-Expert (KE)
19	Vicente Aldasoro Yarza (Technical Consultor)	Key-Expert (KE)

Ms. Marisa Marco Arbolí. Head of the Knowledge Management Division &Training at CIEMAT. She has a university degree in Physics and a postgraduate MSc diploma. She is part of the staff of CIEMAT from 1985. Since 1990 she is responsible for Education and Training on Energy & Environmental issues and she has led the development and Implementation of the Virtual Training Centre of CIEMAT. The training provided covers the thematic fields in which the center is a leader. She has participated in a number of courses within the CIEMAT Training Program and other Institutions and coordinating the international activities at the training center. She has been a contributor to a number of lectures and part of the main FP 7 EU projects focused on E&T (EduKICs, ENETRAP, TIARA, MATISSE...). She served as expert in the IAEA training activities particularly in the development and implementation of the IAEA education and training strategy, and has participated in different missions. Member of the Steering Committee on the Implementation of a Strategy for Sustainable Education and Training in Radiation Safety.

She has also been involved as a Project Manager and Coordinator on of Educational Cooperation programs at the national and international level mainly in Latin-America and Africa in the framework of the Agencia Española de Cooperación Internacional para el Desarrollo (AECID) programs and the CEDDET Foundation in a joint initiative between the Spanish Ministry of Economy and Finance and the World Bank (Global Development Learning Network). Member of the Multilateral Working Group on Implementing the Major Economies Forum Global Partnership's. Technology Action Plans in CAPACITY BUILDING and coordinator and member of the Network of Latin-Americans Experts on Sustainable Energy CEDDET Foundation.

Ms. Lara de Diego Chica. Degree in Biology in 2001, Pedagogical Aptitude Course (CAP) in 2001, Professional Expert Course: E-Learning: Online Education (UNED) in 2007. Since 2006 works in the Education and Training Department of CIEMAT. Responsible for the online training activities in Renewable Energies, energy efficiency and environment taking place in the Department's Virtual Centre. Actively participation in the coordination, management and development of national and international Capacity Building projects focused on Renewable Energy, Energy Efficiency and Environment.

Ms. Mirian Bravo Taranilla. Degree in Environmental Science in 2005. Master's degree in Renewable Energy and Energy Efficiency in 2009. Since 2005 works in the Training Unit of CIEMAT. Organizes, manages and coordinates training activities in the field of renewable energy and environment. Actively participation in national and international education and training and Knowledge Management projects focused on Renewable Energy.

Ms. M. Carmen Alonso García. PhD in Chemistry. Universidad Politécnica de Madrid (UPM) in 2004. Thesis: "Characterization and modeling of associations of photovoltaic devices". Bachelor degree in Chemistry. Universidad Complutense de Madrid. 1989.
Since 1990 develops research activities at the Laboratory of PV systems and components of the Renewable Energy Department of CIEMAT. Her areas of expertise are Characterization and modeling of PV cells, modules and arrays, Studies of behavior and degradation of PV modules of different technologies, Evaluation of PV systems, especially with the assessment of interconnection losses, Assessment of production for different types of PV systems.

Ms. Nely Carreras Arroyo. Degree in Chemistry, PhD in Chemistry by the Autonomous University of Madrid. Postgraduate Diploma in Environmental Engineering by EOI, Postgraduate Diploma in Energy and Environment by CIEMAT and 20 Post-degree Courses
Works in CIEMAT since 1979. Head of Residues Group of the Soils Unit of the Environment Department. Sometimes. Collaborates with the MICINN in the evaluation of projects in R & D Programs and participates in panels of experts in areas related to technologies for waste management. Participates in 7 European Projects and 8 National Projects related to Waste for Energy, Anaerobic Digestion and Landfill Gas utilization. In the teaching field, has directed and participated in Masters, Courses and Technical Sessions. Co-Director of the Master Waste Management and Treatment, whose 15th edition is currently being carried out at the Autonomous University of Madrid, Institutional Coordinator of the Waste Network of the CEDDET Foundation (Center for Distance Education for Economic and Technological Development) and Associate Professor of the EOI (School of Industrial Organization).

Mr. José Antonio Ferrer Tevar. Ph.D. in Physics by the Oviedo University. Degree in Physics Science in 1987. Head of Analysis on Energy Efficiency in Buildings Group, Unit of Investigation on Energy Efficiency in Buildings of CIEMAT since 2005.
Research areas: Smart Cities, Integration of renewable energies on buildings, Bioclimatic architecture, Energy Efficiency in Buildings, District heating & cooling. Involved in numerous National and European funded projects. Of particular
relevance to this proposal is his participation in ARCHINT project (CRAFT – JOULE JOR3-CT-98-7048) and PSE1-ARFRISOL (The Singular Strategic Project called Bioclimatic Architecture and Solar Cooling,) promoted and supported by Spanish Ministry of Science and Innovation – economy and competitiveness.

Mr. Antonio Garrido Marijuán. Working at the Austrian Institute of Technology, AIT, Austria's largest research Centre. He holds a Master of Science with specialization in Energy Systems. In his research work he mainly deals with impact assessment of urban strategies and implementation plans for urban quarters. At the time being, Antonio is involved in the setup of the Smart Cities and Communities Information System for the European Commission.

Ms. Silvia Soutullo Castro. Senior Researcher in the Energy Efficiency in Buildings R&D Unit of CIEMAT. She holds a Ph.D. in Physics and has experience developing dynamics global simulations of buildings and urban areas, multi-parametric energy assessments in buildings, thermal comfort evaluations in buildings and open spaces, and meteorological assessments. She has worked in many R&D projects related to energy efficiency in buildings or urban areas. She is participating in National and International associations and committees related to energy in cities. She has written papers in scientific and technological journals and has been professor at M.Sc. level in several Spanish Universities.

Mr. Félix García Rosillo. Degree in Physics Sciences in 1989. Diploma of advanced study Polytechnic University of Madrid in 2008. PhD in Physical Sciences Polytechnic University of Madrid in 2011. Professional activity developed in the Solar Photovoltaic Energy Laboratory of CIEMAT. Analysis of autonomous photovoltaic systems for developing countries. Assembly, measurement and analysis of systems, especially the generator system, batteries of different types, search engines of maximum power and fluorescent lamps and their ballasts for photovoltaic systems.
Systems of air conditioning by photovoltaic solar energy. Lighting in photovoltaic systems. Search for simulation models of panel clusters or photovoltaic cells using Monte Carlo methods. Simulation of clusters of panels or cells from a limited number of measurements of the electrical characteristics of few samples.
Degradation tests of solar panels using a camera assay that provides ultraviolet irradiation.
In the teaching field has participated in numerous editions of the face-to-face course of Solar Photovoltaic Energy of CIEMAT. Guide of visits of students at various levels to CIEMAT's Laboratory of Photovoltaic Solar Energy. Discussions related to the efficiency of lighting and the lifetime of fluorescent lamps. Collaboration for the diffusion through the media of some research results and especially those related to fluorescent lighting and LEDs.

Mr. Marcos Lafoz Pastor. He is Industrial Engineer from the Polytechnic University of Madrid (Spain) since 1997 and holds a PhD in Electrical Engineering from the same University, obtained in 2005. He has developed his professional carrier in the Centre of Studies and Experimentation of Public Works (CEDEX) and in the private sector in the company GAMESA Electric Power Systems. Currently he is in charge of the Unit of Electric Power Systems in the Department of Technology of CIEMAT (Spain). His areas of expertise are related to Electric Generation based on Renewable Energies (wave energy in particular), Energy Storage (batteries, ultracapacitors and flywheels) and advanced electrical machines, power electronics and control strategies used in electric drives. Since 2000 he is Assistant Lecturer in the Polytechnic University of Madrid, where he teaches the course of Electrical Machines in the Degree of Industrial Technologies and since 2012 the course of Electric Vehicles in the Masters of Electric Engineering. He also coordinates the course Energy Storage Systems in the Electric Vehicle in the Masters in Engineering of Electric and Hybrid Vehicles (MIVHE) from the University Institute of Automobile Research (INSIA) since 2013, participating as a lecturer in the course Systems and Components of the Electric Vehicle of the same master since 2011. He usually gives lectures and seminars related to Ocean Energy, such as the online course Workshop on Wave Energy Conversion, and the lecture Generation Systems based on Wave Energy, included in the course Electric Generation based on Renewable Energies,

given to the Spanish TSO during 4 years. He has participated in 13 competitive research projects related to energy generation and storage, leading 3 of them. His scientific production comprises: 5 patents (one of them related to electric vehicles and other related to an energy system used in wave energy generation), 3 collaborations in books, 5 papers in journals included in the JCR, 6 in other journals, more than 40 contributions in conferences, 3 PhD thesis directed as well as more than 20 degree and master thesis.

Mr. Antonio Sánchez de la Fuente. He is Head of Computer Service in the Unit of Development of Applications and Computer Systems at CIEMAT where he has been working since 1994. He holds a degree on Computer Engineer by the National Distance Education University (UNED), 2001. He is an expert in the installation and maintenance of computer systems based on the web, in the analysis, development and implementation of software applications in various languages such as Java, Ruby or PHP, administration and management of application servers. At present he is in charge of the computer service that supports, among others, the Learning Management System based on Moodle of the CIEMAT Training Unit.

Mr. Javier Dominguez Bravo. PhD in Geography by the Complutense University of Madrid (UCM). MSc in Geographic Information Technologies, Cartography and Remote Sensing. At this moment, senior scientific researcher and Head of the Geographic Information Technologies & Renewable Energy (gTIGER) research group at CIEMAT and Honorary Professor at the Geography Department (UCM). Him research interest has focused in the application of Geographic Information Science in the field of the renewable energies by developing new models and tools. These develops has been made in several areas as national/regional planning, rural electrification or distributed generation in urban areas (https://www.researchgate.net/profile/Javier_Dominguez).

Ms. María Lorena Prado Orcoyen· Technical Advisor. Spanish Office for Climate Change· Ministry of Agriculture, Fisheries, Food and Environment. Master's Degree in Mining Engineering (University of Oviedo, 2003). Executive Master in Engineering and Environmental Management (School of Industrial Organization, Madrid, 2011). Advance course in Energy Law (IE Law School, Madrid, 2013). After 7 years working as engineer in several Spanish private companies from the construction sector, I became official for the Spanish State Administration in 2008. Between 2008 and 2015, I worked in various posts within the Secretariat of State for Energy, mainly related to International Energy Affairs. After that, I have been working in the Ministry of Finance and Public Administrations for 2 years, as technical adviser in the field of better regulation. Currently, I work in the Spanish Office for Climate Change, developing my activities in the field of Climate Change and Energy Transition.

Mr. Pedro A. Revenga de Toro. Professor in the University of Alcalá. He has been a professor in the electronics department in this University since 1990. He is an electronics engineer and PhD in the field of electronics. He has worked in projects related to the electronics field, and in particular in the field of batteries and electric vehicles. He has many publications in this field not only in specialized papers reviews but also in divulgation magazines and newspapers. He also collaborates as speaker in a Master related to renewable energies. He also works in other research fields related with robotics, computer vision and renewable energies.

Mr. Salvador Suárez. Aerospace Engineering, Master Business Administration, Master Industrial Organization. Head of the renewable Energy Department of the Canary Islands Institute of Technology, involved in projects related to stand alone renewable energy solutions for electricity generation, hydrogen production, and to power cooling and heat production systems.

Elaboration of feasibility studies of renewable energy projects: wind farms, solar photovoltaic installations, and solar thermal systems. Participation in several EC financed projects to assess the technical and economic feasibility of introduction hydrogen production from RES in islands. Participation in training and dissemination activities, related to renewable energy technologies, in the framework of projects financed by the EC and the local regional government of the Canary Islands. Professor of the Renewable Energies Master program of the University of La Laguna (Tenerife). Collaboration in task groups advising the Canary Island Regional Government in its energy policy, in particular in reference to renewable energy promotion in the archipelago: Contributions to the elaboration on the energy plan of the Canary Islands for the period 2006-2015 (PECAN 2006), territorial planning of the energy infrastructures and several RES projects with important local impacts. Participation in the elaboration of the Wind Map of the Canary Islands, assessing the wind resources of the archipelago.

Mr. Jesús de León. Industrial engineer in Power Electronics. He has participated in different projects of the EU and other regional projects, mainly in the tasks of development of electrical and power electronics for integration of renewable energy. Currently he is working on the development of power electronics solutions for energy storage for supercapacitors. He is also responsible of Electrical grids analysis and studies for RES and Storage integration.

Ms. Celia Bueno. Phd in Mechanical Engineering, Master of Business Administration. She has worked many years in the maintenance of wind farm and the PV belonging to ITC. She has participated in several EU and non-EU projects. And she has many international publications in wind hydro pumped storage. She worked in the Wind-Hydro-Pumped Station of El Hierro Island. Her work is focused in the elaboration of feasibility studies of renewable energy projects: wind farms, solar photovoltaic installations, and solar thermal systems. Currently she is working in energy planning.

Mr. Agustin Marrero. Msc. in Power System Engineering by Universidad Politécnica de Madrid, specialized in Energy Techniques. Certificate in Advanced studies (Investigation Proficiency), in the department of Power System Engineering - University of Las Palmas de Gran Canaria (Wind power penetration in weak electrical systems). He is a researcher in the Renewable Energy Department of ITC, working in the management of several R+D projects related with high renewable energy integration in isolated power systems. Agustin worked for 8 years in IDOM International, as Engineering Manager in the design, construction and commissioning of Wind Hydro System of El Hierro Island.

Mr. Daniel Henríquez. BSc in Telecommunications Engineering. He has participated in several EU and non-EU projects. Currently, he is in charge of Quality Control of PV Plants, Distributed Generation and Microgrids within RES Department. He has developed tools for energy management (including storage management) for desalination plants supplied by solar energy, designed equipment and quality protocols for PV plants connected to the grid for certification and coordination of a project with REE to develop solar photovoltaic energy forecasting tools for electrical grid operation in Canary Islands. His work is focused on scheduling, storage management of microgrids connected to electrical grids as a way to aggregate the energy microgeneration distributed in low voltage networks in islands. Currently, Daniel is Work Package leader on RES forecasting in the project TILOS, developing also probabilistic Energy Management Systems for the optimal operation of the microgrid. The project is funded by H2020 program to develop a 100% RES penetration system in Tilos Island (Greece).

Mr. Vicente Aldasoro Yarza. Technical Engineer in Industrial Chemistry (San Sebastián,1970). Master in General Management of Companies (MBA), 1.992. Master in Renewable Energy, 1.999. He has worked in the metallurgical field as Director and Manager for twenty four years. From 1995, dedicated to Water Treatment and Renewable Energies, as International consultant on wastewater treatment, wastewater reuse for agriculture, grid injection of photovoltaic modules, thermosolar panels for hot water and heating. Projects and installation of potabilization and water pumping with renewable energies. Photovoltaic electrification projects for rural populations. Training experience: Technical consultancy for the implementation in Cape Verde of a Vocational Training centre in Renewable Energies.

5. CAPACITY BUILDING PROGRAM STRUCTURE AND CONTENT

According to the needs and specifications given in "Terms of Reference (TOR) for contracts for services and work" the program will be based on the deliverables of the "UNIDO Online Renewable Energy Capacity Building Program for Latin America", which was developed by CIEMAT and UNIDO in the context of the "Observatory for Renewable Energy in Latin America and Caribbean". Some of the course modules of this program will be updated and adapted to the specific island realities. Some new modules which are of particular importance for SIDS will be added. The resulting capacity building program will be available in English, Spanish and Portuguese languages.

The **Online Capacity Building Programme on Sustainable Energy Solutions for Islands** meet the objectives of contributing to satisfy the urgent need for affordable training and certification programs on sustainable energy in islands throughout a solid and high quality program which describes and analyses in a deep and technical approach different technologies and energy issues. The program will be developed complying CIEMAT'S quality criteria in terms of scientific and technical level, excellence and expertise, ICT tools, methodological and pedagogical resources.

This proposal includes 9 e-learning modules that will be developed to describe and analyze the different technologies and sustainable energy solutions for Islands and territories of the Pacific, the Caribbean and Cape Verde and providing a technical review on the each topic as well as practical examples of application focused on the target regions of initiative.

5.1. CAPACITY BUILDING PROGRAM STRUCTURE

This education and training program will be articulated in two directions with two different approaches to cover the needs of knowledge of the main stakeholders and target audience. Both programs are offered with e-learning methodology and self-study modality.

- **Module's General Overview: 1st Speed**

TARGET AUDIENCE	General public
OBJECTIVE	To provide an overview of each technology
LEARNING MATERIAL	Video presentation and multimedia content
DEVELOPMENT SITE	Temporarily on the CIEMAT's servers, on the LMS Moodle 3.1.6
FINAL WEBSITE	UNIDO's Regional Centres Websites

This version will provide a global overview of each technology and will be offered through multimedia and audio-visual material. These training materials will be available on the three regional centres websites being freely accessible via the website.

- **Module's specialized training: 2nd speed**

TARGET AUDIENCE	Professionals in the sector, academics and postgraduate students
OBJECTIVE	To provide a more technical and detailed view of each of the modules.
LEARNING MATERIAL	Complete learning materials including the educational didactic guide, a video presentation, the multimedia content, the extensive documentation, a case study and a final assessment test aimed at providing practical experience in each of the renewable technologies as well as to assess the progress of the participant and acquire the achievement certificate
DEVELOPMENT SITE	Temporarily on the CIEMAT's servers, on the LMS Moodle 3.1.6
FINAL WEBSITE	UNIDO's Regional Centres E-Learning Platform

Since renewable technologies and sustainable energy solutions require highly skilled personnel and the demand for qualified technicians is so high this program will target more specialized sectors that need to deepen the different technologies. Its mission is to provide a more technical and detailed view of each of the modules. Teaching materials are more complete and complex including case studies and a final self-assessment test aimed at providing practical experience in each of the renewable technologies. The program will be sited in an e-learning platform, which allows greater scope and effectiveness of the learning process.

Learning materials will be integrated by: educational guide, video presentation, synthetic content (multimedia format) and extensive content (PDF), the practical exercises (solving a case study and its resolution) and a final self-Assessment Test.

This method entails good study planning which will be properly detailed in the didactic guide, provided to assist in the objectives, mode of study and expected outcomes of each module.
At the end of the learning activity the participant will pass the final assessment test in order to receive an accredited certificate. This certificate will be issued by UNIDO and the developers

or for example a university from the Islands and territories of the Pacific, Caribbean and Cape Verde.

This modality must be performed on a learning platform, a Learning Management System (LMS), which provides interface to successful presentation of learning modules and trainings to learners as well as allows to the tracking of the participant progress and study of all learning materials needed to receive a certificate of participation.

In this sense, an open source LMS, based on Moodle 3.1.6, has been selected in so far as meets the necessary characteristics as a suitable virtual learning environment for the effective learning process and hence the expected learning outcomes can be achieved successfully. Moodle it is already installed in CIEMAT servers for the development of their current training offer. Therefore there is a wide experience in the use of this learning environment and its functionalities.

For the correct development of the activity, ensure the quality and effectiveness of the learning process, in this second option, the following indicators must be considered and effectively achieved: access to information of the training program, enrolment, access to the platform, familiarization with the platform and obtaining and unloading materials; final examination; Accreditation.

INDICATOR	
Access to the course information	via the Internet
Registration.	On line.
Platform access.	The participant obtains registration in the system and access to the virtual learning environment where the self-study activity takes place
Platform familiarization	On line.
Download procurement of learning materials	Participants come to view and download course materials.
Performing work in each module	Participants work directly on line with the activities of the modules following a detailed schedule. Issues raised in the modules are solved online.
Performing final test	Performing final test. While working in the learning materials, the platform records the participant's progress and the final result of the test. To authorize the performance of the test is required to have displayed the learning materials.
Accreditation / certification.	To obtain the final certificate is necessary to pass the evaluation criteria

Once completed the development of modules, in the last phase of the project will take place the migration of the online training program from CIEMAT's servers to the Counterparts Centres servers. In this phase, an e-learning platform, based in the Moodle proper version, should have been installed by the counterparts in the Centres servers in order to carry out the migration of the Program. In this phase is planned the edition of an online course provided by CIEMAT for the counterpart IT support staff on the installation and configuration of the Moodle platform.

5.2. CAPACITY BUILDING PROGRAM LEARNING MATERIALS

- **Educational Guide including:**

  - Objectives. In order to specify the general and specific objectives of the module.
  - Structure. The module program and a conceptual map of the contents.
  - Methodology and activity plan. Aimed to explain the student how to study and address the different learning materials and also to provide the specifications needed to address each activity.
  - Evaluation criteria for each activity.
  - Information about the certificate to be obtained.

- **Contents of study**: learning materials are presented in different files:

  - **Video presentation** by the expert author of each module, which consists of a brief presentation of the state of the art of the technology and an introduction to the module.
  - **Multimedia content** (interactive presentation in Scorm format)**.** Its objective is to encourage reading of the documents of the course in a pleasant way, to facilitate understanding of the concepts and activities and promote the retention of the key ideas of the course.
  - **A short self-assessment test:** will be displayed in order to track the progress and the overcoming of this learning element.
  - **Extensive documentation** (PDF format). It integrates all study contents that the participants must learn to achieve the objectives of the course and it is designed to facilitate the understanding of the subject, resulting comprehensive, practical and didactic. It can be complemented with bibliography, glossary, appendices and any other documentation that is relevant to the learning.
  - **A short self-assessment test** consisting in few questions about the Practical Case performance will be displayed to evaluate the understanding and learning of the practical case.
  - **A case study,** presenting the statement and the right solution for the participant to check the resolution between it and his/her own answer. In addition, the participant must respond appropriately a few questions about the case study in order to assess their learning and record their progress. As also an element for the evaluation of the course, essential for the final diploma.
  - **A Final self-assessment Test**. Multiple choice test with 3-5 response options regarding a question and only one is correct. There are variants which include more than one valid answer. The time available to do it is 1 hour and there are two attempts for this activity.

This Final Test, besides being an element to reinforce knowledge, to overcome it is necessary to receive the achievement diploma.

- **Additional documentation**: references, documentation, web links and articles of interest on its subject and related to it.

All those activities with more than one attempt for implementation will save the attempt with highest score as the final result.

The estimated time commitment to properly complete the course is 16-20 hours distributed as most convenient to the participant. Self-training modality allows flexibility in the implementation of the activities, although it is recommended regularity in the course, and a dedication of one to two hours a day, to the best use.

Self-study modality implies that the student protagonist of the teaching-learning process and for this reason goals and objectives must be clear, as it allows students know what is expected of them and the conditions and criteria to perform the different activities. All materials will be presented together with the relevant notes to guide participants in the study and resolution of activities, and applying the formats designed for the project.

The contents must be designed to facilitate understanding of the subject, using graphics, images and resources that help the progress tracking. The key to the generation of new knowledge lies in the possibility to connect new content with prior knowledge and daily experience. It is therefore important to provide practical examples focused on the Islands and Territories in the Pacific, Caribbean, Africa and Indian Ocean, as well as other activities that require a practical approach in order to encourage constructive work.

It is important to emphasize that although this training program has been prepared to facilitate the self-study it is also developed and oriented to be delivered and tutored by an expert.

5.3. CONTENT TRANSLATION: ENGLISH AND BRAZILIAN PORTUGUESE

The CB Programme is planned to be presented in three languages: Spanish, English and Portuguese.

The contents are initially prepared in Spanish, the language of the authors. Once these materials have been reviewed and validated ensuring to comply with the design criteria and objectives, are ready to be translated into the other two languages: English and Portuguese.

The completed and revised contents in the three languages are then valid to proceed to the next phase of virtualization and assembling of the series of modules.

Regarding the video presentations the recordings have been made in Spanish language, native language of the authors. This version is included in the Spanish version of the Capacity Building Program. For the English and Portuguese versions of the CB Programme the videos and multimedia material will be subtitled in the corresponding language.

5.4. METHODOLOGY: SELF-STUDY MODALITY

Self-formative learning modality implies complete autonomy of learning. The student is responsible for learning and in terms of flexibility students can access breaking the barriers of time, space and at his own pace.

Contents are of special importance and relevance in e-Learning methodology, the student learning success largely depends on them. To do this, the contents must be designed and captured with clarity and consistency with the other elements of the course.

The implementation of the "Online Capacity Building Programme on Sustainable Energy Solutions for Islands" aims to implement the e-learning modules throughout the self-training modality with two different depth levels and approaches. The module's content is thereof suitable for two learning options that should be treated as "training at two speeds".

The First Speed Option is a general overview of the module, aimed at anyone interested in having an understanding and overview of each renewable technology while the Second Speed Option provides a specific and specialized approach on each topic, and although both are free access, the second option is aimed at users of interested sectors and stakeholders seeking to deepen into each technology and energetic topic. The programme is the same for both options, being the second one treated in a more specialized and deep manner.

5.5. ASSESSMENT METHOD AND CERTIFICATION

Implementation of assessment tools and methods is essential to have information on the way and the degree in which participants have achieved the competencies and objectives.

CB Programme, as explained in previous sections, includes two learning speeds. Since the 1st Speed: General Overview learning program aims to bring an overall vision of the program throughout the visualization of a video presentation and the multimedia material of each module, is not thereof focused on measuring the knowledge acquired by the participant and does not use the learning platform.

However, the 2nd Speed option is aimed to acquire a specific level of knowledge and contemplates the issuance of a certificate of achievement, reason why is necessary to incorporate elements of evaluation and monitoring of the learning process.

Within the second speed version, learning outcomes will be achieved and assessed by two practical activities aimed at gaining experience in each of the technologies:

- **A brief self-evaluation test** on multimedia content with the objective of evaluating the degree of learning of its content.
- **Study Cases and its resolution**: are used to analyse an approach focused on the target territories, based on the different factors involved, energy singularities and conditions. These activities incorporate a trace of reality in order that participants scrutinize it and then compare it with its subsequent resolution. The aim is also that the participant thinks about the different situations that may arise in real life about the subject under study. It is intended that participants can develop reflexive ability and be able to make decisions about the best solution to the problem or problems. Students will work with it to get to

assume it and understand it fully. Knowledge of the field by the previous study of the module content is essential to the effectiveness of the activity. After the performance of the exercise, a list of test questions will be presented aimed to evaluate the knowledge after the realization of the practical cases as well as their understanding. For each question there will be several possible answers and only one correct.

- **A final test:** multiple choice form test with 3-4 response options regarding a question and only one is correct. It's used to measure and identify very precisely, knowledge, comprehension, application and synthesis. This type of test is widely used because they discriminate well the level of competence about the knowledge of the participant and on any subject.

All the above assessment items, besides being elements to reinforce knowledge, must be overcome to pass the course and receive the final certificate of achievement. It therefore will be available electronically, once the evaluation criteria have been reached. In this sense, evaluation criteria will be established.

The learning platform, Moodle, where the learning process is performed, will track the progress and record the results of the following learning activities of the program: display of the multimedia material, results obtained in the three different tests previously detailed.

6. TECHNICAL SPECIFICATIONS

The e-learning modules to be developed are multimedia packages that contain the necessary elements (text, images, animations, etc...) to convey the main contents of the course. This multimedia material must be made with IT (Information and Communication Technologies) tools and meet a number of features to be used didactically.
These modules will be developed as SCORM (Sharable Content Object Reference Model). SCORM learning objects have, among other benefits, a full accessibility through Web technologies and the ability to be reused in multiple contexts.
For the materials development process will be used both commercial packages and open source software.
The e-learning modules will be implemented in a LMS (Learning Management System) or virtual teaching and learning environment that allows an effective learning process, the monitoring of the student performance and the study in self-formative modality.

6.1. EFFECTIVE LEARNING INTERFACE

E-learning interface design is especially important, since the effectiveness of learning and interface design are closely related. Design of an interface for an e-learning program should be determined by how people learn and the tasks they need to perform in the program.

The interface is the "space" or "surface" that connects or articulated between the user interaction with the device (computer) and the goal of an action of learning. The objective of the interface is to make available the information communicative content.

The interface must be "user-friendly" (and maximise overall usability) and provide an environment in which participants can perform tasks with effectiveness, efficiency and satisfaction

Within the two approaches defined for the “CB programme on sustainable energy solutions for Islands”, 1st Speed Option: Global Overview; will be sited and available directly on the ECREEE, CCREEE and PCREEE Websites, where the users will find the link to the modules consisting, for this option, in a video presentation and the multimedia material for each of the seven modules.

Regarding, the 2nd Speed Option it will be hosted in a learning platform, as mentioned in previous sections, in order to fulfil the requirements needed to reach the learning objectives and outcomes.

The selected LMS is Moodle, a free open source platform, since it is already installed in CIEMAT servers for the development of its current training offer. Therefore there is a wide experience in the use of this learning environment and its functionalities. In this sense, Moodle 3.1.6 shall be installed in the ECREEE, CCREEE and PCREEE Websites.

Moodle presents an excellent platform for resources and communication tools. Moodle is a template-based system to which content must be added. This makes Moodle's interface very intuitive and allows for easy navigation. Comprehensive templating system means that it can be customized and modified to look exactly the way you want. Moodle has also high usability which confers the advantages of being easy to learn and remember; efficient, visually pleasing and fun to use; and quick to recover from errors.

7. PROGRAM VISUAL DESIGN

Virtual training or e-learning requires instructional design and production of specific materials appropriate to the environment, considering different learning styles and possible technical limitations (software and hardware).

In e-learning, the virtualization process of learning materials as well as aspects related to visual design and effective learning virtual environment, require the synergy of an interdisciplinary team, where each of the contributions of the different areas are necessary for the development successful content.

For the development of e-learning seven modules that conform the Capacity Building Programme, as important is to achieve high-quality scientific and technological content as the treatment and virtual settings for creating an effective and successful learning programme able to meets the learning objectives of the future target audience.

Therefore, a sum of ICT skills and expertise is essential for optimal development. In this sense, the contents are developed by highly qualified researchers and experts both CIEMAT with teaching experience as well. Similarly, the final production of e-learning modules requires coordination of tasks of a multidisciplinary team with high experience in the development of capacity building activities and projects, implementation of e-learning methodology to them and management of virtual learning environments (VLE). Besides the production of content and

learning materials using ICT tools and based on standards and appropriate technological developments for this training modality.

7.1. LEARNING MATERIAL .VISUAL DESIGN.

Learning contents and materials must be effectively designed to facilitate understanding of the topics of the different modules, which will facilitate the achievement of expected learning outcomes for students.

The context and resources are important dimensions for e-Learning programs. The total learning process depends largely on how the content is presented, a condition for efficient perceptive-visual learning. Therefore the design of materials for e-learning is an important element that largely determines the quality of training.

To assimilate and interpret the (mainly) visual content, learners in technology-based environments develop a series of psychological processes such as visual perception, attention, understanding, motivation, memory, thinking and conscience. In order to provide a significant learning situation, effective design must rely on several basic principles aiming to support the participants' confidence and comfort, but mostly their learning performance e-learning requires different educational design considerations such as design' we mean the planning or working out of the e-learning resource. This combines tasks including lesson planning, instructional design, creative writing, and software specification.

In this sense, the design of e-learning resources requires understandings in education, multimedia content, resource publication, and electronic technologies.

Finally, it is important to realize that multimedia design is not intended to act to impact the user with graphical tools, but its main purpose is to communicate ideas, concepts and images through multimedia programs. The aesthetics accompanies helps and complements information so that it comes in a more clear and efficient end user.

In the development phase of the learning materials included in the CB programme, the authors have made use of methodology guidance and support and contents have been adapted to different templates designed for this program. This step is essential to treat the information and content correctly so that the virtualization process is the suitable and meet the objectives of learning quality.

Tools and software recommended and used by the authors for the study of the contents and resolutions of the practical cases will be open source in order to ensure their availability and universal use.

Regarding the use of images, graphics and other graphic elements, they will be of own elaboration or royalty free use, from reliable and verifiable sources that will be duly mentioned.

8. WORK PLAN AND SCHEDULE

CIEMAT will provide the services in the scope of the phases and activities listed below. CIEMAT will develop and execute the activities in close partnership with UNIDO, SIDS DOCK, CCREEE, PCREEE and ECREEE. The assignment will require further consultations with the energy units of the Caribbean Community (CARICOM), Pacific Community (SPC), UWI, UNICV, USP and other international partners (e.g. GIZ, IADB).

The project is organized into four main phases.

Phase I. Program management

DELIVERABLES	ACTIVITIES DESCRIPTION	Deadline
a.	Formulation of the Inception Report	1 month after contract signature
b.	Analytical Review Paper, to be used as background for the development of the capacity building program	2 months after contract signature

Phase II. Design and development of the training contents. Modules translation into English and Portuguese.

DELIVERABLES	ACTIVITIES DESCRIPTION	Deadline
c.	Adaptation, testing and quality assurance of 5 already existing Modules (developed for the Observatory of Renewable Energy in LAC). CIEMAT shall seek UNIDO approval for the content and design of each module. The adaptation includes minor changes to the materials already developed: introductory video, interactive presentation, theory dossier and test. Includes a case study for the three different regions (Pacific, Caribbean and Cabo Verde)	6 months after contract signature
d.	Development, testing and quality assurance of 4 new island training modules as selected by the counterparts. Before starting with the technical development, CIEMAT shall seek UNIDO approval for the content and design of each module. Learning materials consist of: introductory video, interactive presentation, theory dossier and test, and a case study for the three different regions (Pacific, Caribbean and Cabo Verde).	8 months after contract signature
e.	**2 days Validation Workshop: Consultative Workshop** to gather inputs and validate the draft modules of the Online Capacity Building Programme at a regional level in the **Caribbean**, at the margins of CCREEE	8 months after contract signature
f.	**2 days Validation Workshop: Consultative Workshop** to gather inputs and validate the draft modules of the Online Capacity Building Programme at a regional level in the **Pacific**, at the margins of the	8 months after contract

	PCREEE	signature
g.	**2 days Validation Workshop: Consultative Workshop** to gather inputs and validate the draft modules of the Online Capacity Building Programme at a regional level in Cape Verde, **West Africa** - at the margins of ECREEE	8 months after contract signature
i.	The 9 modules to be available in English, Spanish, and Portuguese: translation of the four new modules into Spanish and Portuguese and revision of the adapted five already existing ones.	15 months after contract signature

This phase will have its main activity during the first eight months of the project and then will be reactivated to reassess the program and contents regarding the feedback of the counterparts and UNIDO.

Activities under this phase will include a need analyses for each technology, the definition of the training objectives and the development of the program and contents (theoretical and practical) for each technology and module in English language.

The definition of the assessment methodology will be defined as well as the way of interactions between lecturers/teacher and students.

Regarding the final certificate issued by CIEMAT and UNIDO, a first draft version will be prepared for UNIDO review and approval.

A first draft version of the contents and materials of the e-learning modules will be present to UNIDO and the colleagues and counterparts of ECREEE, CCREEE and PCREEE.

Once the program and contents are confirmed with local counterparts and UNIDO in English language, the modules will be translated into Spanish and Portuguese.

Phase III. Preparation of the final version of the e-learning modules. Setting the Virtual Platform in CIEMAT servers. Design and development of the Capacity building portal within the Regionals Centers Webpage. Linking to CIEMAT Virtual Platform.

DELIVERABLES	ACTIVITIES DESCRIPTION	Deadline
h.	Installation and configuration of the Moodle e-learning platform on CIEMAT'S server in order to host the modules conforming the **Capacity Building Programme on Sustainable Energy Solutions for Islands.** Make the Course accessible from each of the Regional Centres' websites (www.ccreee.org, www.ecreee.org, www.pcreee.org). In each of them a general introduction with a briefing text on the energy situation in Islands together with a general video of the topic will appear; as well as a briefing of the different modules and its introductory videos accessible. 9 introductory videos will be developed in language Spanish and with subtitles in English and	15 months after contract signature

	Portuguese depending on the regional centre. All this provided with an open access policy in the websites stated above From there, a link to be provided to access the Moodle page (new tab will open) were registration will be needed to undertake the modules (referring to activities A. and B.). At this stage, registration is needed but anyone is able to register (for a statistics purpose). At the end of the project, CIEMAT will provide Technical support for the migration of the Capacity Building Program from CIEMAT's Moodle to the Regionals Centres own Moodle. And during the 12 months subsequent will provide support for problem solving and assistance.	

Virtualization and edition activities of the modules learning materials will be carried out to produce the modules final version.

The virtual platform will be installed and configured on CIEMAT's servers and the interface for the presentation of the program will be created on the Regional Centers Websites. Finally the courses will be made accessible through a link to Moodle Platform.

Phase IV. Transfer Know How: Train the trainers and Technical Management.

DELIVERABLES	ACTIVITIES DESCRIPTION	Deadline
j.	TWO ONLINE COURSES WILL BE DEVELOPED AND PERMORMED 1. Online Train the trainer's course on how to assess the students of the online modules to local counterparts. . One of the online modules will be tutored by the expert/author in English or Spanish in order to train the tutors of the 3 regional centres, providing the necessary skills to assess the participant's performances during the courses. 2. Online course on Moodle Platform at technical level (management, installation ...). CIEMAT will tutored a course in online modality in English or Spanish for the technical staff in charge of the management and installation of Moodle	15 months after contract signature

This Phase will be carried out once the Capacity Building program is completed, hosted on the Regional Centres' Moodle platform and accessible form the regional centers Website. Counterpart responsible for the training will be trained on how to tutor the e-learning modules and asses the student performance. On the other hand, the technical staff in charge of the management and installation of Moodle will be virtually trained by CIEMAT personnel responsible for the Information and Communication Technologies.

9. TABLE 1: PRELIMINARY TIME SCHEDULE. TIMING OF ACTIVITIES IN WEEKS FROM THE START OF THE ACTION

	MOUNTHS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DELIVERABLES	**Phase 1. TRAINING PROGRAMME MANAGEMENT**															
a	FORMULATION OF THE INCEPTION REPORT															
b	ANALYTICAL REVIEW PAPER															
	Phase 2. DESIGN AND DEVELOPMENT OF THE TRAINING CONTENTS. MODULES TRANSLATION INTO ENGLISH AND PORTUGUESE															
c	ADAPTATION, TESTING AND QUALITY ASSURANCE OF 5 ALREADY EXISTING MODULES															
d	DEVELOPMENT, TESTING AND QUALITY ASSURANCE OF 4 NEW ISLAND TRAINING MODULES															
e	VALIDATION WORKHSOP AT **PCREEE**															
f	VALIDATION WORKHSOP AT **CCREEE**															
g	VALIDATION WORKHSOP AT **ECREEE**															
i	TRANSLATION INTO SPANISH AND PORTUGUESE															
	Phase 3. MODULES FINAL VERSION. VIRTUAL PLATFORM IMPLEMENTATION. CAPACITY BUILDING PRESENTATION INTO THE CENTERS WEBPAGE															
h	VIRTUALIZATION AND EDITION ACTIVITIES OF THE MODULES LEARNING MATERIALS															
	VIRTUAL PLATFORM INSTALLATION, DESIGN AND CONFIGUATION															
	CONFIGURATION OF THE CAPACITY BUILDING PROGRAM INTO THE REGIONAL CENTERS WEBSITES. TECHNICAL SUPPORT FOR THE MIGRATION OF CB PROGRAM TO REGIONAL CENTRES' MOODLE PLATFORM															
	Phase 4. TRANSFER KNOW HOW : TRAIN THE TRAINERS AND TECHNICAL MANAGEMENT															
j	DEVELOPMENT OF AN ONLINE TRAIN THE TRAINERS COURSE															
	DEVELOPMENT OF A MOODLE PLATFORM COURSE															
	1 WEEK ONLINE COURSE "TRAIN THE TRAINERS COURSE"															
	1 WEEK ONLINE COURSE "MOODLE"															

Starting Date: 1st of July 2017

Date of complexion: 30th of September 2018

10. PROPOSAL ON INVOLVEMENT OF THE CONTRACTOR IN THE MAINTENANCE, FOLLOW-UP AND UPDATES

Maintenance, monitoring and updating services will be covered under this contract, once completed, for a period of one year. To this end CIEMAT will be operational to facilitate maintenance, monitoring and updates upon request of UNIDO SERVICES. These terms and conditions will be accepted by both parties. Budget additional costs will be necessary depending on the type and amount of work involving these maintenance actions.