Using Life Cycle Analysis model to quantify the environmental impact of a developed device in order to measure greenhouse gas emission in agricultured

*I. Voukkali *, P. Loizia *, M. Tsangas **, A. Zorpas *, S. Zorpa *, I. Papamichael **

** Institute of Environmental Technology and Sustainable Development, Department of Research – Development, P.O.Box 34073, 5309 Paralimni, Cyprus*

(E-mail: voukkei@yahoo.gr)

*** QSHE Engineering Services, P.O Box 70784, 3802, Limassol, Cyprus*

Introduction

Figure 1: LIDAR device installed at a pilot field

Under the European program **ClimaMED LIFE17 CCM-GR-000087**, the objective of the study was to conduct Life Cycle Analysis (LCA) to quantify the environmental impact of the developed arrays of devices and services that will be developed in order to measure Greenhouses Gas Emission (GHGs) fluxes and Soil Organic Carbon (SOC) stock changes, which are: i) LIDAR devices, ii) arrays of devices and technical procedures to measure SOC stock changes, iii) the telemetric system and iv) IT services (web app, CMM) (Figure 1).

In order to implement LCA in this study, ISO 14040:2006 standard was used. Consequently, considering ISO 14040, the LCA consist of four distinctive stages. Firstly, goal and scope definition are set in order to explain the study purpose, introduce the functional unit for analysis, set up system boundaries, outline the impact categories chosen for analysis, justify the assessment method used and explain the assumptions applied to perform the appraisal. Secondly, a Life cycle inventory that involves data collection and systematization will be done. In this stage all environmental inputs and outputs into the system, associated with the devices and the services produced by ClimaMed, throughout their life cycle will be established and then assembled and presented in the form of an inventory.

Results & Discussion

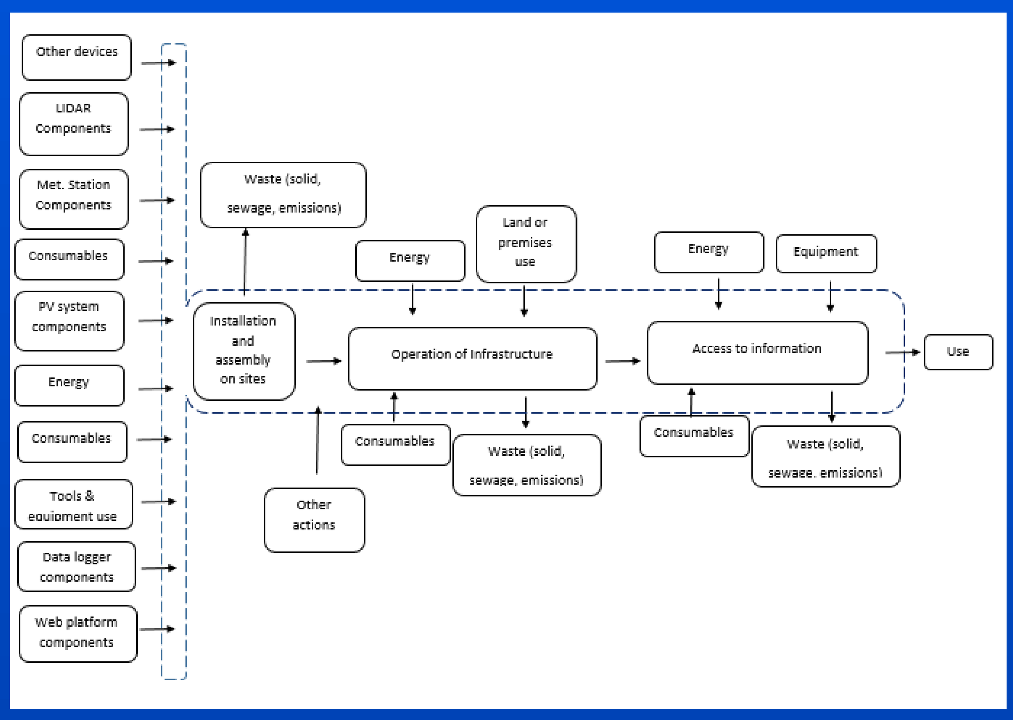

Figure 2: System Model

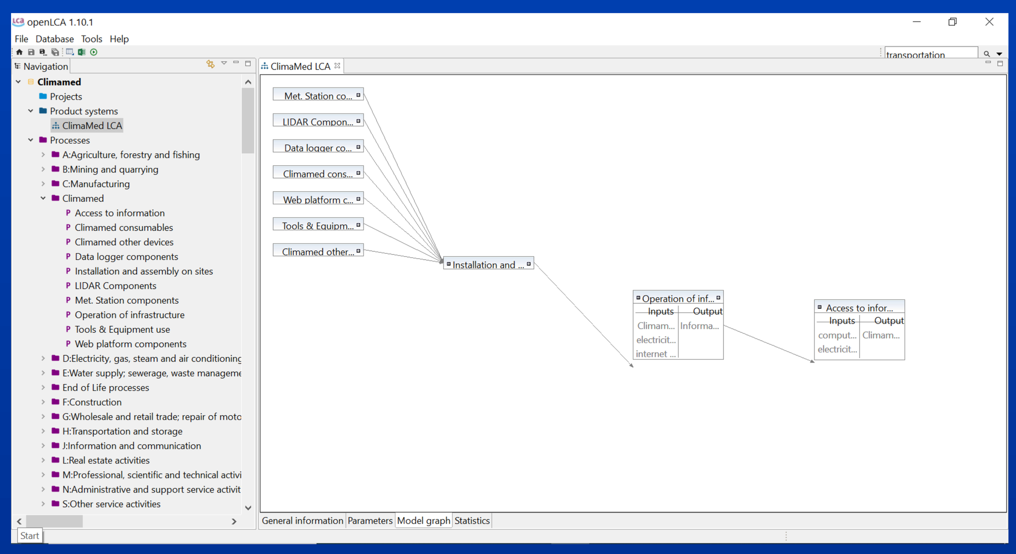

Figure 3: ClimaMED System in OpenLCA

The required data was collected through in-situ/field survey for each pilot field and the supporting infrastructure. Therefore, primary site-specific data was obtained with the use of a questionnaire which was asked to be completed by the responsible project partners.

The LCA study was carried out by using the open source software openLCA, which has been developed by GreenDelta. All needed product flows as well as processes to design the ClimaMed LCA System have been developed in the software environment interface (Figure 2).The ClimaMed LCA system model graph has also been designed using the software (Figure 3). To complete the life cycle inventory, data associated with energy, material etc., was taken from literature and available Life Cycle Inventory databases.

The chosen impact categories that characterize the potential environmental effects of the ClimaMed project activities that calculated and evaluated were: the Global Warming Potential (100 years) (GWP) in kg CO_2-eq/FU, the Acidification Potential (AP) measured in kg SO_2-eq /FU, the Eutrophication Potential (EP) in kg PO4-eq / FU, the Ozone Depletion Potential (ODP) in kg CFC-11-eq/FU, the Photochemical Ozone Creation Potential (POCP) in kg OzoneC_2H_4-eq/FU, and the Cumulative Energy Demand (CED) in MJ-eq/FU

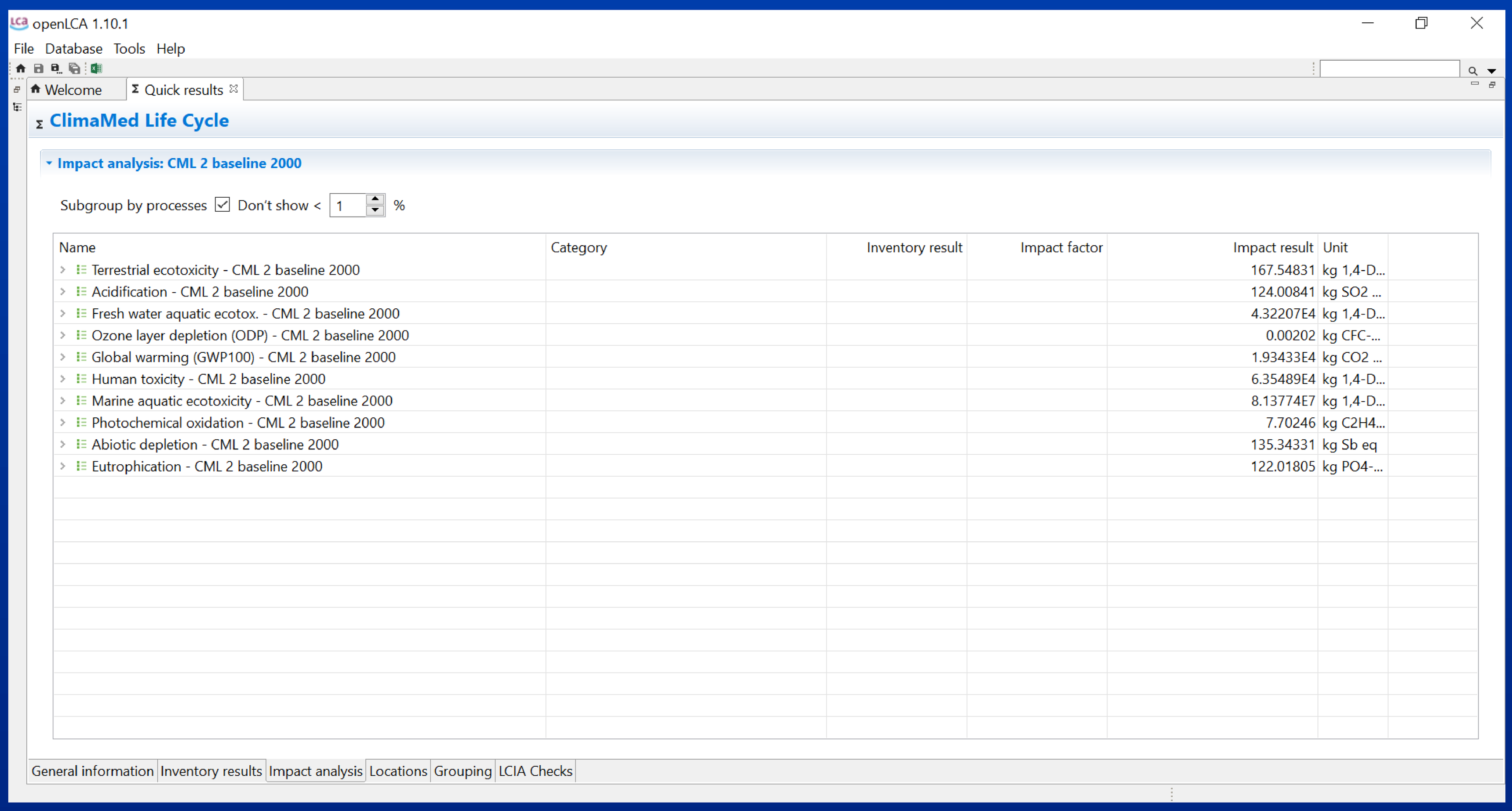

Figure 4: ClimaMED Life Cycle Assessment

Figure 4 includes the results for the calculations for the ClimaMED impact characterization factors according to the CML 2 baseline 2000 characterization method. The size of the factors, concerns the ClimaMED life and available data up to the day of their calculation and it is per FU i.e. per user of the system. Since the number of users is not final as well as the ClimaMed activities will be continued and further input as well output data will be added, those numbers are indicative and is expected to change. However, the ability to produce complete calculations shows that the ClimaMED Life Cycle system has been well designed using the OpenLCA software.

Conclusions

ClimaMED will provide technologies and tools to measure, evaluate and report GHGs emissions and SOC sequestration from agricultural land with a strong potential to be implemented to many other sectors. In specific, LIFE ClimaMED aims at developing and delivering innovative, reliable, rapid and cost-effective technologies of Tier 3 level for the on-site measurement of CO_2, CH_4 and N_2O emissions and SOC stock changes from agricultural fields at real time, in order to assist scientists, public authorities and policy makers in collecting, quantifying, evaluating, mapping and reporting spatial data for GHGs emissions and SOC stock changes from the Mediterranean agricultural sector. Life Cycle assessment of the developed arrays of devices and services will be combined with the results of the Cost Benefit Analysis, the business plan of order to optimize also the profitability of the products without imposing significant environmental impact.