# A MELiSSA inspired metric for circular economy development

**Key Words:** Industrial ecology, industrial metabolism, Life support, circular economy.

**Abstract:**

MELiSSA stands for “Micro-Ecological Life Support System Alternative. The nature of the MELiSSA project is characterized by a biological and chemical/physical approach based on first principles modelling and implementation of a suitable deterministic engineering approach with the goal of developing a closed life-support system. Circular systems are essential in space regenerative life support systems and becoming important for high human density location on Earth (e.g. cities, schools, hospitals,..) as well as in remote and harsh locations. They have to be functional and efficient to allow the continuous recovery of various products, such as food or water, from diverse waste resources. These resources recovery functions are also needed in the concept of circular economy, although a few challenges differ, especially in terms of actors, constraints and models.

In this sense, the circular system expertise acquired in the MELiSSA project can be extremely useful when considering terrestrial economy evolutions. The quasi-cyclic feature of MELiSSA is particularly interesting for enhancing the economic and environmental potential of the bio-refineries approach.

The goal of this activity is 1) to assess relevance of the MELiSSA metric (ALISSE) for circular economy platform, 2) to study and elaborate complementary criteria and associated calculation tools and methodology, 3) to test the proposed methodology on existing industrial platforms.

During this PhD, MEliSSA system tools will be used (e.g. ALISSE, EnRum, Simulink,..) as reference tools. Concrete terrestrial cases will be considered as study case.

**MELiSSA partners:**

UNILausanne (CH), UCLermont Auvergne (FR), SEMiLLA (NL), Sherpa (FR), Enginsoft (IT), UAntwerpen (BE)'

**Expected Deliverables:**

Requirements, Bibliography, Mid-term report, Test plan & Test Report, Peer review publications, Dissertation report.

**Impact on MELiSSA:**

This study will open new perspectives of utilisation of MELiSSA know-how, precisely with economical and industrial sector. Existing tools to quantify energy and material balances MELiSSA loop, will benefit of operational evaluation and test.

**References**:

Strategies for symbiotic urban neighbourhoods. Lufkin S., Rey E., Erkman S. ISBN 978-3-319-25610-8, 2015,

Applied industrial ecology. Erkman S., Ramaswamy R., 2003, ISBN 8188848018, 9788188848010, 159 pages.

Circular economy scientific knowledge in the European Union and China: A bibliometric, network and survey analysis (2006–2016). J. of Cleaner Production, Vol 197, part 1, October 2018, Page 1244-1261.

Design of indicators for measuring product performance in the circular economy. Cayzer S., Griffiths P., Berghetto V. Int J. of sustainability engineering. Vol 10, 2017, Issue 4-5.

Spiller, M., Muys, M., Papini, G., Sakarika, M., Buyle, M. & Vlaeminck, S.E. (2020). Environmental impact of microbial protein from potato wastewater as feed ingredient: Comparative consequential life cycle assessment of three production systems and soybean meal. Water Research, 171, 115406.

Sfez, S., De Meester, S., Vlaeminck, S.E. & Dewulf, J. (2019). Improving the resource footprint evaluation of products recovered from wastewater: A discussion on appropriate allocation in the context of circular economy. Resources, Conservation & Recycling, 148, 132-144.

Coppens, J., Meers, E., Boon, N., Buysse, J. & Vlaeminck, S.E. (2016). Follow the N and P road: high-resolution nutrient flow analysis of the Flanders region as precursor for sustainable resource management. Resources, Conservation & Recycling, 115, 9-21.

**Desired knowledge**:

Candidates should possess a degree in process engineering, chemistry, or related. Experience in establishing material flow analysis (MFA) or life cycle assessment (LCA) as well as good knowledge of conversion technologies are considered as a plus.