

HUMAN SPACE ENDEAVOURS SYMPOSIUM (B3)
New Technologies, Processes and Operating Modes Enabling Future Human Missions (7)

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CONTROLLED ENVIRONMENTAL AGRICULTURE (CEA) TECHNOLOGIES – A NEW
APPROACH FOR HUMAN SPACE EXPLORATION BY DECREASING RE-SUPPLY MASS

Abstract

The paper gives an overview about the new research initiative EDEN at the DLR Institute of Space Systems, Bremen (Germany). Under the project name Greenhouse Regenerative Agriculture for Space Systems the research group investigates different solutions for adapting Controlled Environmental Agriculture (CEA) technologies towards a space-borne greenhouse system design. The goal of this research initiative is to design an automated production facility for vascular plants that can be integrated as a subsystem within a planetary research infrastructure (habitat), allowing sustainable human exploration scenarios.

The greenhouse module considers all functions and subsystems needed for the plant life cycle under the paradigm of mass production principles and for a variety of different plant categories (e.g. gras-, tuber- and tree-like). The facility is also designed in a modular fashion, allowing the crew to adapt the system for growing different plant types. This might be necessary for long duration mission scenarios where changing diet requirements or individual crew wishes need to be fulfilled. Within the greenhouse module the vascular plants can not only be used for a continuous food supply of the crew, but also full other functions like grey- or yellow water purification, Oxygen production, different waste management tasks and even psychological health effects. For the system study the research group utilizes the new Concurrent Engineering Facility (CEF) on site, where Phase-A studies can be performed cost and time efficiently. Within this design laboratory different cutting edge horticulture techniques (e.g. High Density Vertical Growth as well as approaches out of the Vertical Farming research community) are examined for a possible space adaptation.

While a deployment of such a greenhouse module on Moon or Mars might be seen in the long term future, various terrestrial applications already over a potential nowadays. A possible test environment and even a niche market could be the deployment of such a module at an Antarctic research base in order to supply the crew with fresh fruits and vegetables. But also the deployment in highly populated areas (e.g. Tokyo, New York, Beijing) might be reasonable. The paper gives an overview of the latest developments within this new DLR initiative, showing different greenhouse module design trade-offs, preliminary system calculations and possible spin-off applications that were evaluated by the team.