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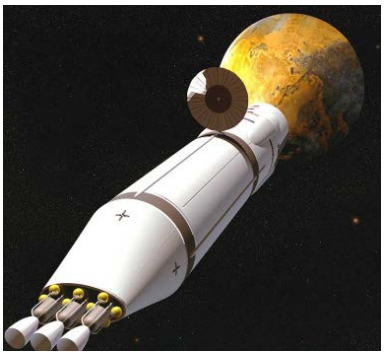
Highlights 2014

Yearly status report

EDEN Initiative

The Year 2014



Artist impression of a future mission to Mars [Phil Smith, Mars Foundation]

Introduction

The EDEN initiative is now in its fourth year of existence. Much has happened in the last years, but 2014 was an extraordinary one!

Sustained human presence in space requires the development of new technologies to maintain environment control, to provide water, oxygen, food and to keep the astronauts healthy and psychologically fit. Bio-regenerative Life Support Systems (BLSS) in conjunction with in-situ resource utilization will initially reduce and ultimately eliminate consumables from the logistics chain. Minimizing the need for resupply while ensuring human safety will allow astronauts to travel further and stay longer in space than ever before. Therefore, major goal of the EDEN group is the investigation of Controlled Environment Agriculture (CEA) processes and developing the associated technologies for space.

Following this direction, several important milestones were accomplished during 2014, such as the opening of the new Space Habitation Plant Laboratory (SHPL), the organization of the 4th international Agrospace Workshop, participation in the HI-SEAS II analogue mission, and the successfully performed Concurrent Engineering (CE) study of ESA's Lunar greenhouse module. But without any doubt, the most significant was the successful evaluation of the Horizon 2020 EDEN ISS proposal, which scored with 14.5 out of 15 points. Starting early 2015, the EDEN group will take over the project lead and will coordinate 13 international partners over the next four years. Exciting times ahead!

Worthwhile to mention is the *Strategy & Portfolio* document, which was published for the first time by the EDEN team in 2014. It outlines the group's key research domains, the involved projects, the spin-off projects, and outreach activities.

Nearing the end of 2014, Lucie Poulet left the group in order to pursue her PhD research at the Université Blaise Pascal, France. Although her departure is hard for the group, we wish her all the best and are looking forward collaborating with her in the future.

Daniel Schubert

Table of Content

The EDEN Initiative

In 2011, the DLR Institute of Space Systems launched its research initiative called EDEN: **E**volution & **D**esign of **E**nvironmentally-closed **N**utrition-Sources. The research initiative focuses on Bio-regenerative Life Support Systems (BLSS), especially greenhouse modules, and how these technologies can be integrated in future human-made space habitats.

EDEN was established within the DLR internal project CROP (Combined Regenerative Organic-Food Production) – a joint research endeavor between the *Institute of Aerospace Medicine* (ME) and the *Institute of Space Systems* (RY).

It is the goal of the EDEN team to further advance the latest cultivation technologies and to adjust these developments into space related applications. Even though present scenarios for future human missions to Moon and Mars are still several years from coming to fruition, the time to develop these technologies needs to start today. Only this way, will highly-reliable and resource-efficient BLSS be ready for implementation into the mission architecture for humanity's journey to the Moon and Mars and - even more importantly – enable a sustainable and continuous presence there.

EDEN Initiative logo, designed by University of Arts, Bremen.

Organized by the Department of System Analysis Space Segment (SARA), the EDEN Initiative facilitates its own Space Habitation Plant Laboratory (EDEN Lab), as well as the institute's Concurrent Engineering Facility (CEF). Furthermore, the group receives support from the institute's Electronic Laboratory (E-Lab), and utilizes the institute's laboratory building (incl. integration hall) in order to foster the development of cutting-edge plant cultivation technologies.

DLR Institute of Space Systems (left) and its main laboratory building (right).

Research Team

Daniel Schubert studied at the Technical University of Berlin and has an engineering diploma in industrial engineering with emphasis on aerospace and production techniques. In 2011, he initiated the EDEN group at the DLR Institute of Space Systems for technology investigations on Bio-regenerative Life Support Systems (BLSS) and is since then the team leader of this group. His research expertise is set on habitat interface analysis and plant accommodation and dynamic plant production planning.

Dr. Matthew Bamsey holds a M.Sc. in aerospace engineering (University of Colorado, USA) and conducted his Ph.D. in environmental biology with the University of Guelph (Canada). Matthew worked as a postdoctoral researcher at the University of Florida where he supported suborbital plant growth payload developments. He spent over ten years working as an intern at the Canadian Space Agency where he worked with the Arthur Clarke Mars Greenhouse project. Within EDEN, he conducts research related to nutrient delivery systems.

Lucie Poulet has a *Diplôme d'Ingénieur* from Mines de Nancy (France) and a M.Sc. in Aerospace Engineering from Purdue University (Indiana, USA). She joined the EDEN research team in 2012. She is an expert in plant illumination systems. Furthermore, Lucie participated in two analogue test studies - a 14-day mission at MDRS (Utah, USA) and a four-month isolation mission at HI-SEAS (Hawaii, USA). During both analogue missions, she conducted several plant cultivation experiments.

Paul Zabel studied aerospace engineering at the Technical University of Dresden. He joined the EDEN team in 2012. Mr. Zabel is the deputy manager of the EDEN Lab and is working on acquiring funding and projects for EDEN. His research expertise is hybrid Life Support Systems (LSS) containing greenhouse modules and physical/chemical LSS. Funded over NPI (ESA) he is doing his Ph.D. about the dynamic behavior of such hybrid systems.

Since January 2011 Conrad Zeidler is member of the EDEN research team. Within his Industrial engineering diploma at the Technical University of Braunschweig he specialized on aerospace engineering and has profound knowledge trade-off analysis techniques (e.g. AHP). He is an expert in simulation methods and control software. Within EDEN, he is responsible for monitoring and controlling the plant growth and environment parameters.

4 Aeroponic cultivated dwarf apple trees within the EDEN lab (Master Thesis M. Dorn; University of Vienna; 2014)

View towards the Closed-loop Test Facility within the Space Habitation Plant Laboratory (SHPL); Left: P. Zabel

Space Habitation Plant Laboratory

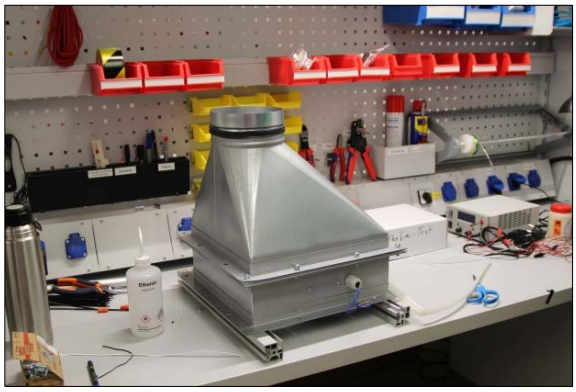
Experiment. Fail. Learn. Repeat.

In 2014, the Space Habitation Plant Laboratory (EDEN Lab) was opened. After 14 months of intensive construction activities, the EDEN lab could finally open its door for the scientists and engineers.

Located in the basement of the institute, the laboratory offers a unique set of cultivation chambers for conducting plant growth studies. Key focus is the development of new Controlled Environment Agriculture (CEA) technologies for optimized plant growth under space conditions.

The heart of the laboratory is the Closed-loop Test Facility, which allows the deployment of hardware tests under nearly closed environmental conditions (analogue to ISS or future planetary habitats).

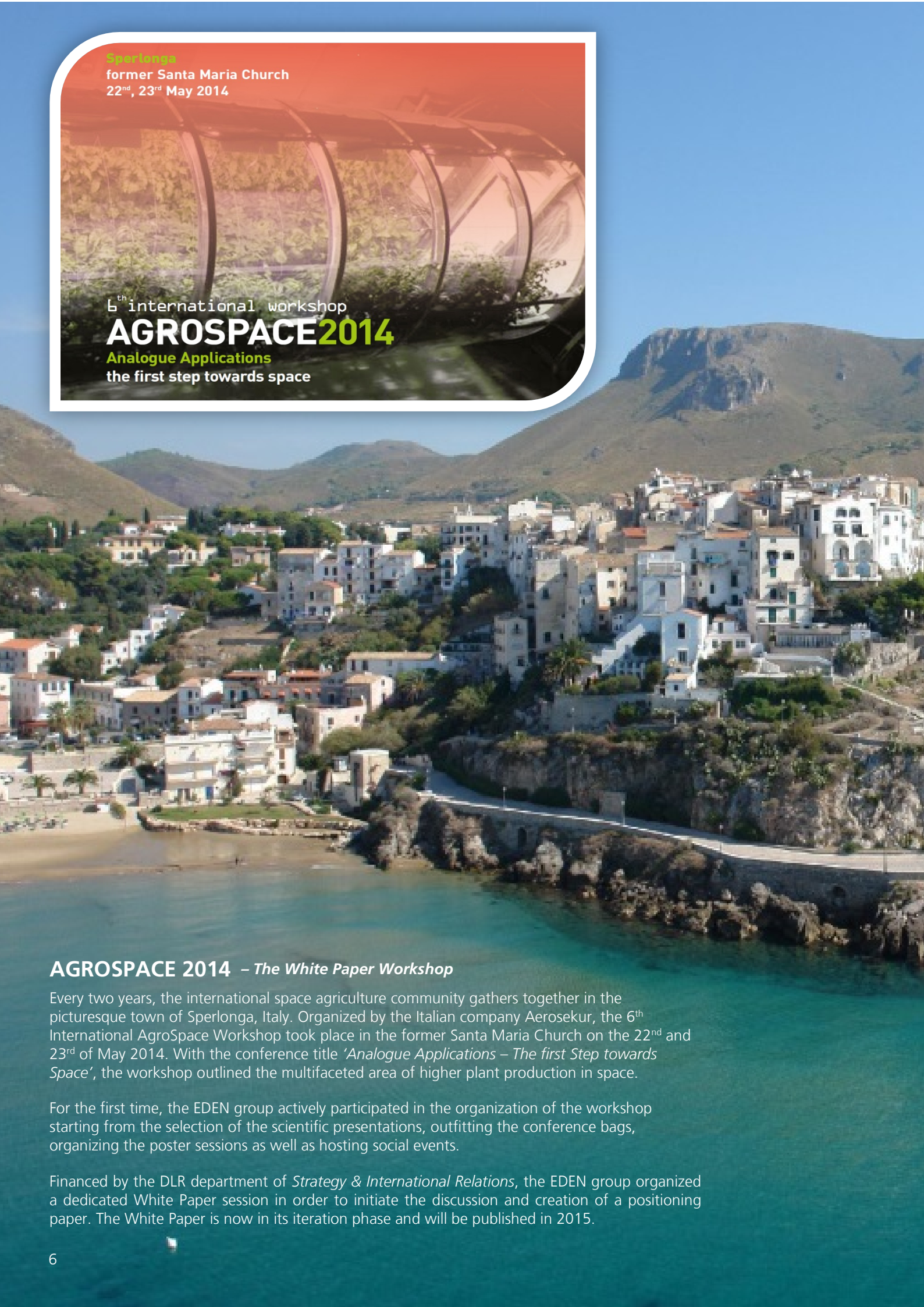
During 2014 the first plant growth experiments were performed with lettuce, cucumber, tomatoes and even dwarf trees (apple).



Air UV sterilization unit before integration

Dr. Bamsey checking the aeroponic irrigation system

Lettuce (cultivar: Butterhead) just before harvest



AGROSPACE 2014 – *The White Paper Workshop*

Every two years, the international space agriculture community gathers together in the picturesque town of Sperlonga, Italy. Organized by the Italian company Aerosekur, the 6th International AgroSpace Workshop took place in the former Santa Maria Church on the 22nd and 23rd of May 2014. With the conference title *'Analogue Applications – The first Step towards Space'*, the workshop outlined the multifaceted area of higher plant production in space.

For the first time, the EDEN group actively participated in the organization of the workshop starting from the selection of the scientific presentations, outfitting the conference bags, organizing the poster sessions as well as hosting social events.

Financed by the DLR department of *Strategy & International Relations*, the EDEN group organized a dedicated White Paper session in order to initiate the discussion and creation of a positioning paper. The White Paper is now in its iteration phase and will be published in 2015.

Packing and organizing the conference bags

The EDEN group moderates the White Paper session

Conference session in the former church of Santa Maria Church in Sperlonga (Italy)

View of the old city of Sperlonga, Italy
(~120 km south of Rome)

Lucie Poulet on an EVA during the HI-SEAS Mission in Hawaii (Credits: A. Caraccio)

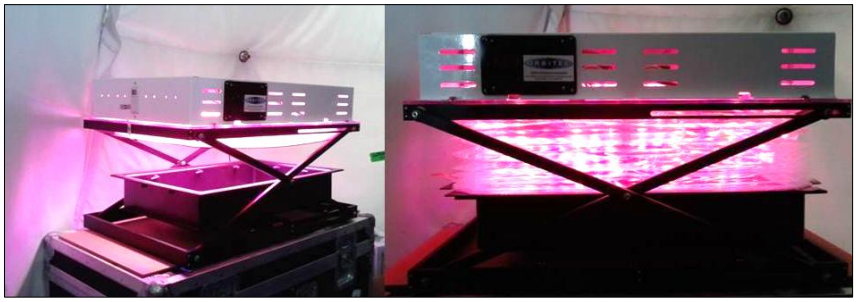
HI-SEAS Analogue Mission

Growing plants on Mars

In 2014, Lucie Poulet was selected from several hundred candidates to participate in the HI-SEAS Mission II (Hawaii Space Exploration Analog and Simulation). For four months, she lived together with five other crew members in a dome-shaped habitat on the slopes of the volcano Mauna Loa on the Big Island of Hawaii. HI-SEAS missions are conducted by the University of Hawaii and are funded by the NASA Human Research Program. Similar to future planetary missions, the crew had limited resources, daily briefings with a dedicated ground control and a variety of scientific and technological experiments and demonstrations to carry out.

Together with the Kennedy Space Center, Heliospectra and ORBITEC, the EDEN group supported Lucie with the plant cultivation experiments in the habitat.

In the Hi-SEAS habitat, she deployed the BPSe (Biomass Production System for Education) - the educational unit of the plant cultivation system VEGGIE (ORBITEC). She also performed a plant cultivation outreach activity together with the DLR School_lab, involving school classes in Germany, USA, and France.

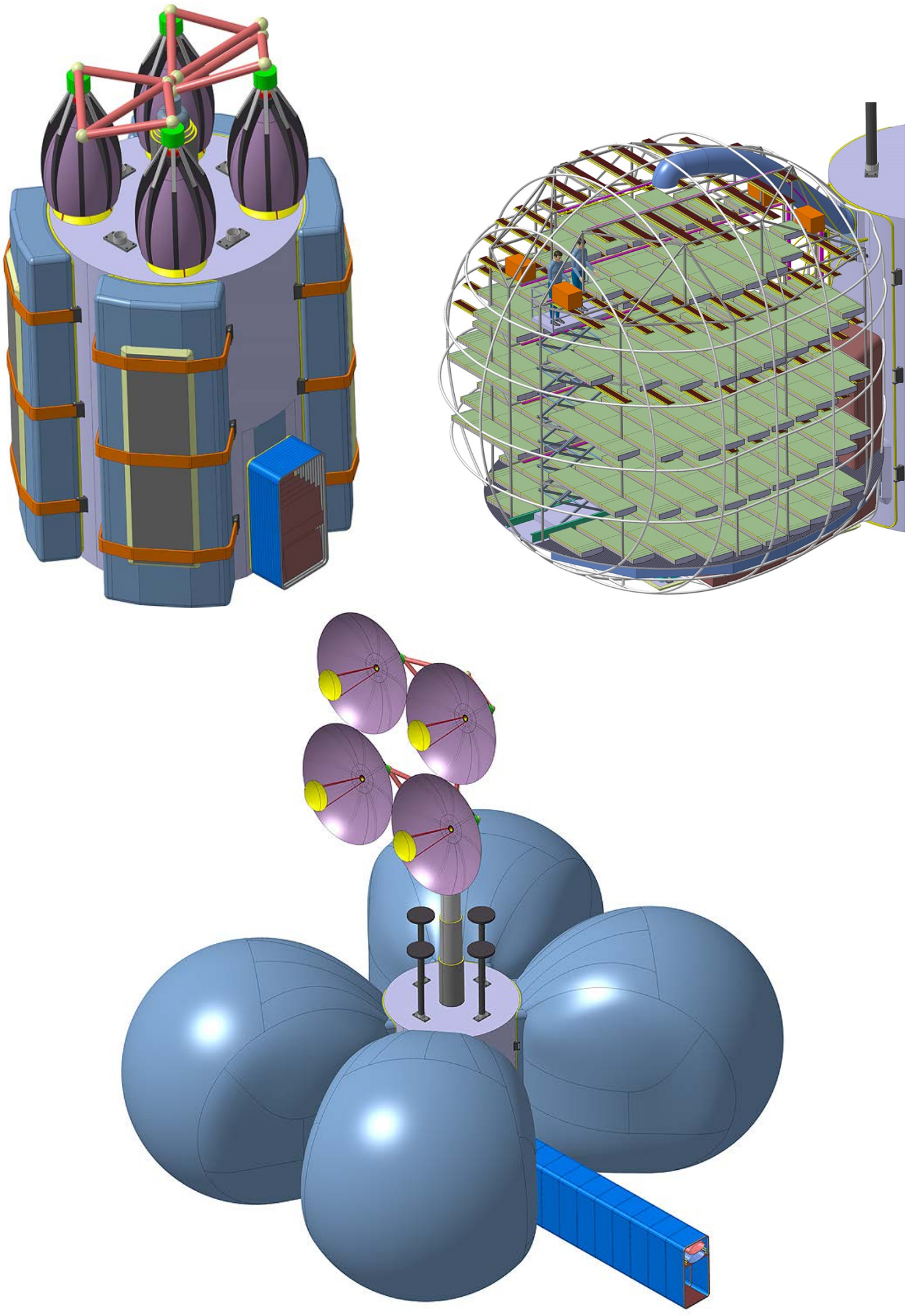


Biomass Production System for education (BPSe/ ORBITEC) inside the HI-SEAS dome

Post-harvest plant analysis of NASA and Heliospectra illumination tests

Bottle Crops as part of EDEN's outreach activity

HI-SEAS habitat on the slopes of the volcano Mauna Loa on the Big Island of Hawaii (Credits: R. Lockwood)



10 Top left: Greenhouse system in launch/ fairing configuration (SLS-Launch system); Top right: Grow accommodation within one production petal; Bottom: Total view of the deployed lunar greenhouse system

Concurrent Engineering Study for ESA

Five Days of intensive design work

CE study team; From left to right: Prof. F-G Schröder (HTWD), E. Mazzoleni (Enginsoft), Dr. M. Bamsey (DLR), P. Zabel (DLR), L. Poulet (DLR), A. Bell (DLR), C. Zeidler (DLR), N. Domurat (HTWD), D. Schubert (DLR), D. Gyimesi (DLR), V. Vrakking (DLR), R. Lopez (DLR), Dr. P. Kern (Airbus D&S), S. Schröder (DLR) and J. Kempf (OHB)

Study Team during off-line work session 3

Ch. Paille (ESA), Dr. P. Kern (Airbus D&S), and Prof. F-G Schröder (HTWD) discussing the best plant cultivation strategy

In September 2014, the EDEN group conducted the phase-A Concurrent Engineering (CE) study, in the frame of the ESA project 'Greenhouse Modules (GHM) for Space'. The overall project goal was to analyze different design options for an automated plant production facility, utilizing mass production principles while minimizing mass, volume, and power demands. Here, the CE study marked an essential milestone of the project. Organized and led by the EDEN group, the CE study was supported by the project partners and by OHB Systems (expert for humans factors).

After five days of intensive work, the study team presented a solid design, meeting all essential systems requirements. The greenhouse module consists of a rigid core, with four inflatable/ pressurized chambers ('petals'). The petals provide isolated environments for crop cultivation, while the rigid core houses the majority of the subsystem components and functions as interface between the greenhouse and the lunar habitat.

EDEN ISS

EDEN ISS - *The Horizon 2020 Project for the next 4 years*

The excitement and relief was great when the EDEN team members received final notice that the submitted EDEN ISS proposal was evaluated with 14.5 Points (out of 15). The proposal was submitted within the Horizon2020 under COMPET 7 - 2014: 'Space exploration - Life support'. The consortium comprises of European and Canadian experts in the domain of human spaceflight and Controlled Environment Agriculture (CEA).

Starting in 2015, the EDEN team together with its partners will design and test essential CEA technologies using an International Standard Payload Rack (ISPR) cultivation system for potential testing on-board the ISS. The highlight of the project will be a one year mission to the isolated Antarctic Neumayer Station III, operated by the Alfred Wegener Institute. Here, fresh food will be provided to the overwintering crew.

This EU 4.5 M€ project marks the biggest design and hardware project of the group and will keep the team busy until mid-2019.

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Key Figures - 2014

Journals

Zeidler, Conrad und Schubert, Daniel (2014) Vertical Farming: Ein Lösungsansatz für die nachhaltige Stadt von Morgen? Sonnenenergie (2/2014), Seiten 20-22. Präsidium der Deutschen Gesellschaft für Sonnenenergie (DGS). ISSN 0172-3278.

Peer-reviewed Conference Proceedings

Zabel, P., Bamsey, M., Schubert, D., and Tajmar, M.: "Review and analysis of plant growth chambers and greenhouse modules for space", 44th International Conference on Environmental Systems, ICES-2014-120, Tucson, Arizona, 13-17 Jul. 2014.

Bamsey, M., Zabel, P., Zeidler, C., Poulet, L., Schubert, D., Kohlberg, E., Graham, T.: "Design of a containerized greenhouse module for deployment to the Neumayer III Antarctic Station", 44th International Conference on Environmental Systems, ICES-2014-122, Tucson, Arizona, 13-17, Jul. 2014.

Conference Proceedings

Zabel, P.: "Mobile Greenhouse Test Facility Design for Analogue Testing at the German Neumayer III Antarctic Station", Agrospace Conference, Sperlonga, Italy, 22-23 May 2014.

Schubert, D., Bamsey, M., Zabel, P., Zeidler, C., Poulet, L.:"The EDEN Inititave - Overview of DLR'S Life Support Systems Developments utilizing Higher Plant Cultivation", Agrospace Conference, Sperlonga, Italy, 22-23 May 2014.

Zeidler, C., Schubert, D.: "From Bioregenerative Life Support Systems for Space to Vertical Farming on Earth – The 100% Spin-off", Life in Space for Life on Earth Symposium, 15.-20. Juni 2014, Waterloo, Canada.

Eriksson, K.; Doule, O.; Poulet, L.: "Architectural Concepts for a Lunar Greenhouse within the Melissa Framework", IAC-14-A5.1.9, 65th IAC, 29 Sept - Oct 3 2014, Toronto, Canada

Maiwald, V.; Poulet, L.; Schubert, D.: "Advice from ares: enhancing habitat and life support system design with martian and lunar analogue test site missions", IAC-14-A5.2.12, 65th IAC, 29 Sept - Oct 3 2014, Toronto, Canada

Caraccio, A.; Poulet, L.; Hintze, P.; Miles, J. D.: "Investigation of bio-regenerative life support and Trash-to-gas experiment on a 4 month mars simulation mission"IAC-14-AC.2.11x27070, 65th IAC, 29 Sept - Oct 3 2014, Toronto, Canada

Burke, J. D.; Poulet, L.: "Architectures for accommodating lunar plant growth demonstrations", IAC-14,E5,1.8x21007, 65th IAC, 29 Sept - Oct 3 2014, Toronto, Canada.

Poulet, L.; Doule, O.: "Greenhouse automation, illumination and expansion study for mars desert research station", IAC-14,E5,1.6x22971, 65th IAC, 29 Sept - Oct 3 2014, Toronto, Canada.

Poulet, L.; Massa, G. D.; Wheeler, R.; Gill, T.; Morrow, R.; Steele, C.; Swarmer, T.; Binsted, K.; Hunter, J.:"Demonstration test of electrical lighting systems for plant growth in HI-SEAS analog mars habitat", IAC-14,A5,2.9x25271, 65th IAC, 29 Sept - Oct 3 2014, Toronto, Canada.

Hauslage, J., Bornemann, G., Waßer, K., Tonat, T., Kraska, T.,Winzer, F.,Schubert, D., Quantius, D., Hemmersbach, R., and Anken R.: "C.R.O.P. - Combined Regenerative Organic-food Production - C.R.O.P. - Combined Regenerative Organic-food Production", Agrospace Conference, Sperlonga, Italy, 22-23 May 2014.

Invited Talks

Bamsey, M., Zabel, P., Poulet, L., Zeidler, C., Schubert, D. "Bioregenerative life support system research as part of the DLR EDEN Initiative", COSPAR 2014, Moscow, Russia, Aug 2-10, 2014.

Zeidler, C.: „Vertical Farming: Ein Lösungsansatz für die Nachhaltige Stadt von Morgen". Vertical Farming Info Tag, 07.07.2014, München, Deutschland.

Poulet, L. "My experience with MELiSSA" MELiSSA 25th anniversary, 4. Nov 2014, ESTEC Noordwijk.

Knies, G., Schubert, D., Zeidler, C.: "LED Green House - without consumption of water, and no need for arable land. The "Vertical Farm" project by DLR", DesterTec University Network (DUN), Re&Agri Conference, Tunis 2014.

Posters

Schubert, D., Poulet L., Zeidler C., Zabel P., Bamsey, M.: "DLR Vertical Farming - EDEN", Agrospace Conference, Poster, Sperlonga, Italy, 22-23 May 2014

Schubert, D., Poulet L., Zeidler C., Zabel P., Bamsey, M.: "DLR's Antarctic Greenhouse Module Project", Agrospace Conference, Poster,Sperlonga, Italy, 22-23 May 2014

Schubert, D., Poulet L., Zeidler C., Zabel P., Bamsey, M.: "Overview of DLR's Research Initiative E.D.E.N.", Poster, Agrospace Conference, Sperlonga, Italy, 22-23 May 2014

Diplom-/ Msc.-/ Bsc.-Thesis

Johan Hempel: "Untersuchung zu Wurzelstützstrukturen in aeroponischen Systemen am Beispiel von Lactuca sativa", Master Arbeit, HTW Dresden.

Hendrik Kolvenbach: „Development of an Atmosphere Management System for bio-regenerative life support systems", Master Thesis, IKT RWTH Aachen.

Markus Dorn: "Analysis of columnar apple trees for the usage in bioregenerative life support systems", Master Thesis, University of Natural Resources and Life Sciences (Vienna, Austria).

Reports (internal/external)

"GREENHOUSE MODULE CONCEPTS", ESA-GSTP, GHM for Space, 4000101818/10/NL/GLC, TECHNICAL NOTE 104.2

"Evaluation Method and Criteria Definition", ESA-GSTP, GHM for Space, 4000101818/10/NL/GLC, TECHNICAL NOTE 104.3

"GREENHOUSE MODULE CONCEPTS", ESA-GSTP, GHM for Space, 4000101818/10/NL/GLC, TECHNICAL NOTE 104.4

"Activities Synthesis & Recommendations", ESA-GSTP, GHM for Space, 4000101818/10/NL/GLC, TECHNICAL NOTE 104.5

"Abstract & Summary Report" ESA-GSTP, GHM for Space, 4000101818/10/NL/GLC

"Strategy and Portofilo", Internal Report, DLR EDEN Group (August 2014)

Miscellaneous

Organisation of the Agrospace Conference 2014 and main organisation of the White Paper Workshop, Sperlonga, Italy, 22-23 May 2014.

Head of Technical Commitee of Agrospace Conference 2014, D. Schubert, Sperlonga, Italy, 22-23 May 2014.

Session 5: "Analouge Testing", Session Chair, D. Schubert, Agrospace Conference 2014, Sperlonga, Italy, 22-23 May 2014.

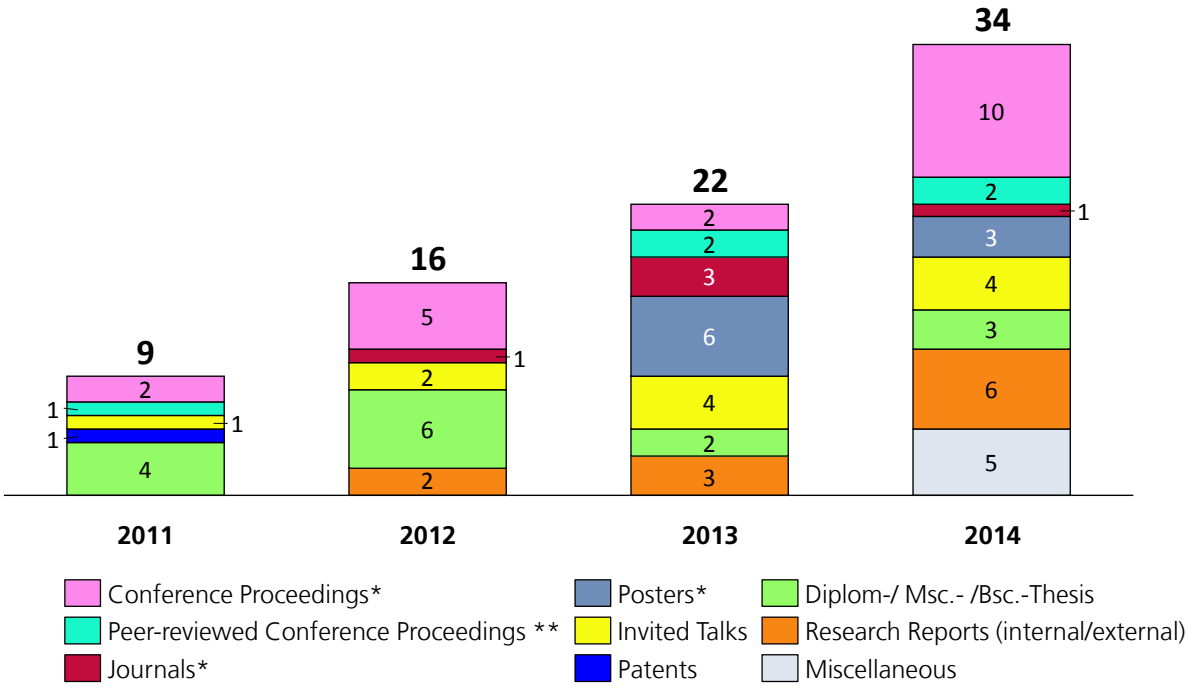
Session F4.2 - Advanced Life Support Testbeds and Facilities, Dr. Bamsey, invited CO-Chair, COSPAR 2014, Moscow, Russia, Aug 2-10, 2014.

Dr. Bamsey was nominated for membership on the AIAA Life Sciences and Systems Technical Committee, July 2014.

Summary Key Figures (2011-2014)

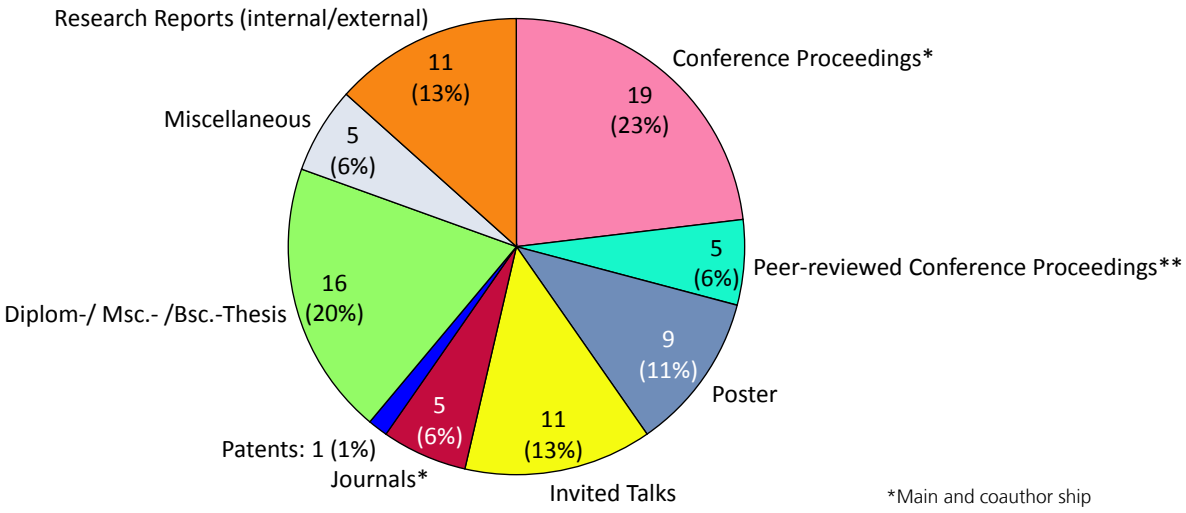
This chapter gives an overview of EDEN's key figures such as publications, budgets, media releases, and research partners.

Publications & Key Figures 2011 – 2014



* Main and coauthor ship; *only main author

Total Publications & Key Figures 2011 – 2014*



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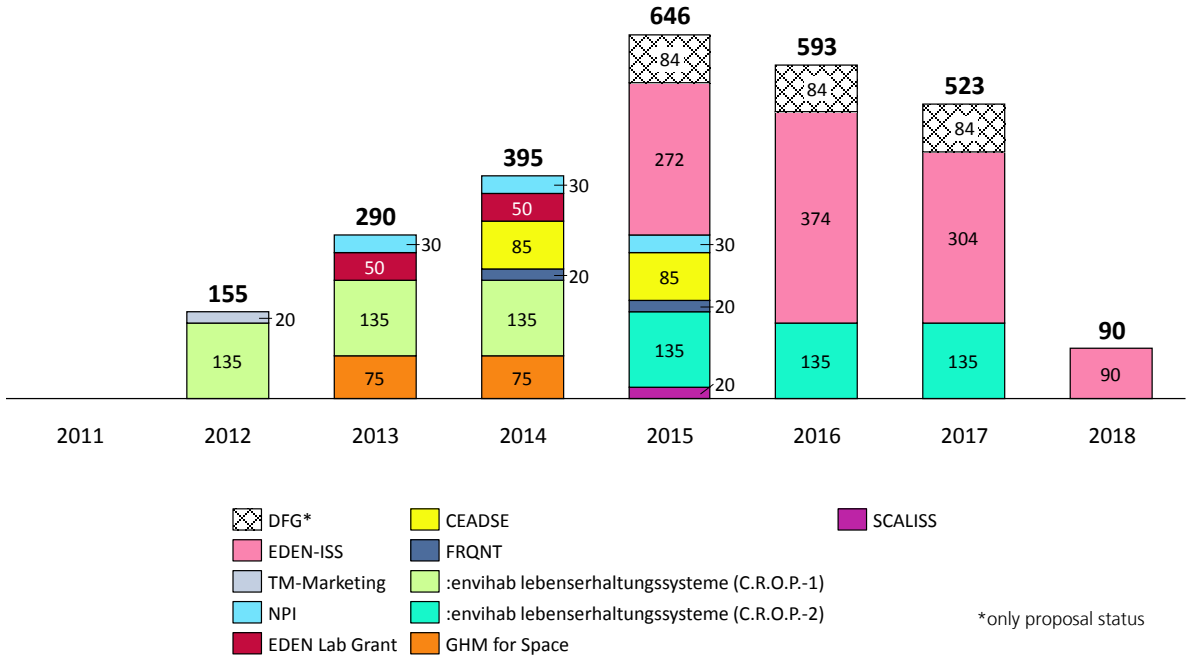
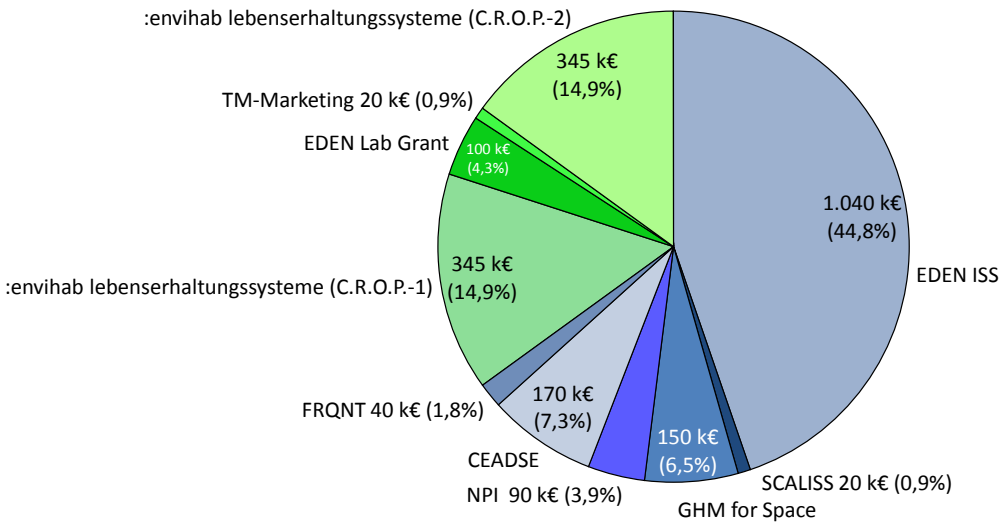
Budgets Overview & Forecast 2011 – 2018 [in k€]

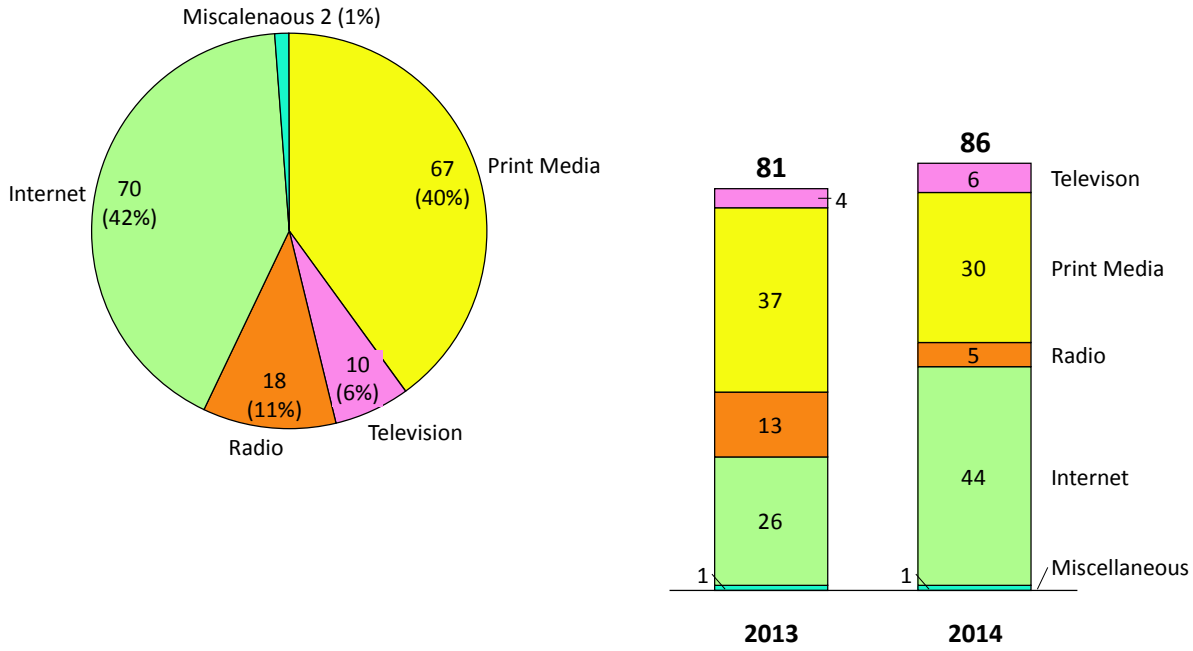


Total Budget Distribution 2011 – 2018 [in k€]

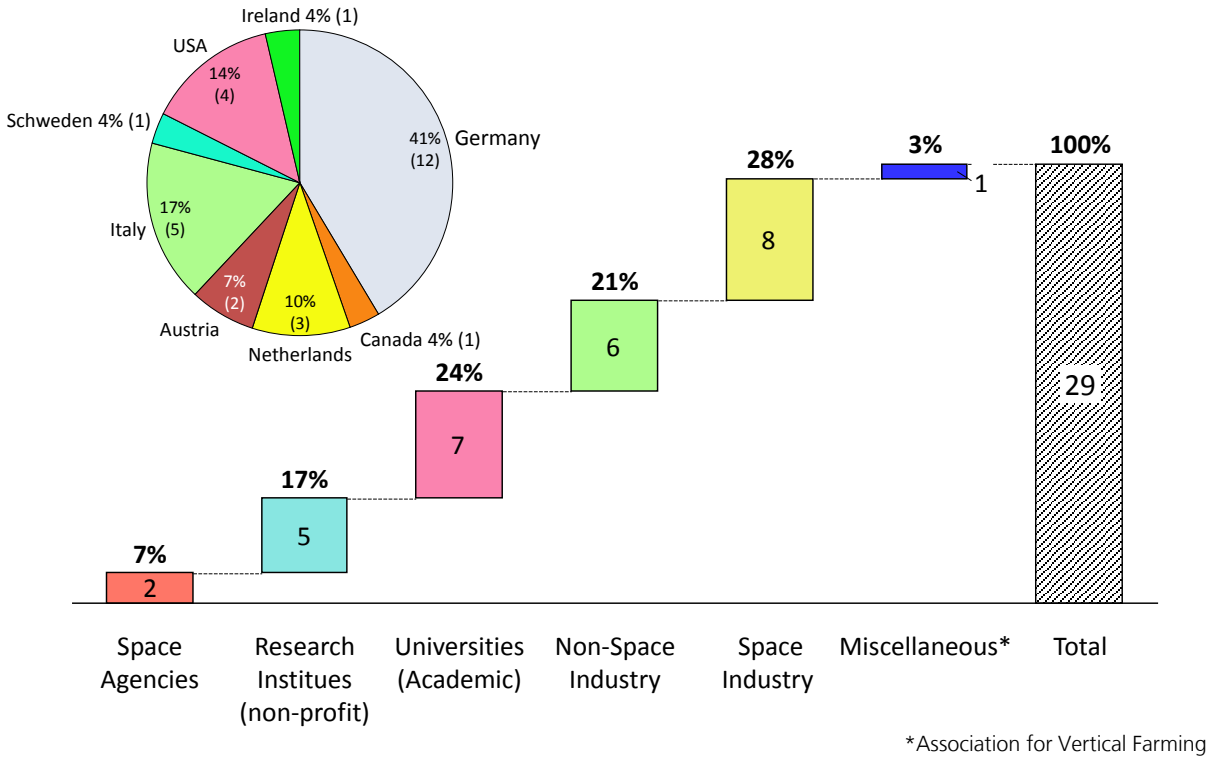


Note: Blue pies represent third-party money (total 65%; 1,51 M€); Green pies represent DLR internal budgets (total 35%; 0,81 M€); Budgets of proposals are not included in this pie chart.

Media Activities 2013 – 2014 (Total and yearly distribution)



Research & Network Partners



*Association for Vertical Farming

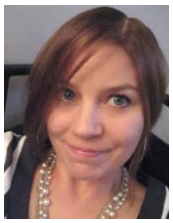
Students

During the year 2014, a total of seven students accomplished their internship or thesis at the EDEN group. Without the assistance and help of these highly-motivated students, the success of the EDEN Initiative would not have been possible! Therefore the entire EDEN Team wants to say thank you. See below what the student's tasks were and what they are doing now:

Hendrik Kolvenbach from Germany graduated from RWTH Aachen University in 2014. He wrote his Master Thesis within the EDEN group in the domain Development and Design (mechanical engineering). He focused his work on the development of a concept and a prototype for the Atmosphere Management System of the Eden laboratory. The goal of this system is to provide a controllable air temperature, air velocity, humidity and carbon dioxide concentration in the greenhouse module while avoiding a fungus/bacteria friendly environment. After his thesis work at the EDEN group he joined the German DLR Trainee Program at ESA and is currently working on Active Debris Removal technologies and orbital mechanics at the Automation & Robotics section at ESTEC, Noordwijk.

Markus Dorn is a German student at the University of Natural Resources and Life Sciences (Vienna, Austria). He worked at the EDEN initiative already for the second time. In 2014 he prepared his Master's Thesis with the title 'Analysis of columnar apple trees for the usage in bio-regenerative life support systems (EVA-System)'. In this study he designed a growth chamber for small columnar apple trees and performed three experiments using new CEA technologies. Markus Dorn is currently working in a company for horticultural consulting company in Vienna, Austria. His work focus is set on greenhouse vegetables and various horticultural projects.

Johann Hempel (Germany) performed his Master Thesis at the ‚Hochschule für Technik und Wirtschaft Dresden (HTWD)' of Prof. F-G Schröder, who is a closed partner of the EDEN Group. His thesis had the title: "Analysis of root support structures within Aeroponic systems using the example of Lactuca Sativa". He executed several experiments within the research facilities of HTWD in Dresden. After his successful graduation, he is now junior sales representative of Monsanto Agrar Deutschland GmbH.



Frida Lappalainen from Finland has a bachelor degree on laboratory science and studied plant physiology at the University of Oulu in International Green Chemistry and Bioproduction Educational Programme where she graduated in 2014. During her master studies she spent six months in German Aerospace Center (DLR) Bremen working within the EDEN group where she was responsible of growing plants in the lab and optimizing the growing conditions. She also helped with setting up the laboratory and did a lot of literature research on plant selection for Antarctica. Currently, she works as researcher at Natural Resources Institute Finland where she is applying LED technology to modify lighting conditions and developing methods to use bioreactors in different steps for Norway spruce vegetative propagation.

Colin Shirran from Ireland first started with an Aerospace Engineering degree in Carlow IT Ireland before completing an MSc in Astronautics and Space Engineering at Cranfield University in the UK. During his time on the EDEN project he split his time between working in the lab and completing his MSc thesis titled "A Nutrient Solution Distribution System Analysis for a Multi-Crop Planetary Greenhouse Module". At the moment he is working for Airbus Defense and Space as an Electrical Systems Engineer in the UK.

Anika König studied at the Julius-Maximilians-Universität in Würzburg (Germany) and has a M. Sc. Degree in Biology. During her internship at DLR, she developed an instruction manual for good laboratory practice, configured and organized the analysis area in the laboratory, and developed the clean room specifications and procedures for the Closed-loop Test Facility (CLTF). Furthermore, she conducted several plant experiments in the CLTF and work on several system analysis- and research tasks for ESA (GHM for Space). Right now, she conducts her Ph. D. in the Graduate Program 'Immunomodulation' at the Graduate School of Life Sciences in Würzburg.

Andreas Hadjistylli comes from Cypress and studies bioengineering at the University of Sheffield (United Kingdom) in his second year. He conducted a 12 months industry placement at the EDEN group. Here, he helped the team building up the laboratory infrastructure and was basically involved in all hardware developments during his internship. He also performed plant experiments within the Closed-loop Test Facility. Andreas now is back in the UK in order to continue his studies.

Impressions 2014

The EDEN team garthered many more experiences during 2014. See below a small extrat of the activities during 2014:



Cleaning the Closed-loop Test Facility (CLTF) for the first time (March 2014).


The EDEN team visited the IPM convetion in Essen in order to see the latest plant cultivation systems (Feb. 2014)


IPM convention visit; Group picture at the company booth of Integar GmbH; an EDEN research partner from Dresden (Feb. 2014)


Wiping the floor dry of the laboratory; A malfunction of the water tap caused a huge flood in the EDEN lab (August 2014)


Normal working days within the EDEN laboratory


Finished Air Management System (AMS), a master thesis is accompliushed (left); Working on the LED system (right)


Harvest day (for lettuce) in the laboratory (May 2014)

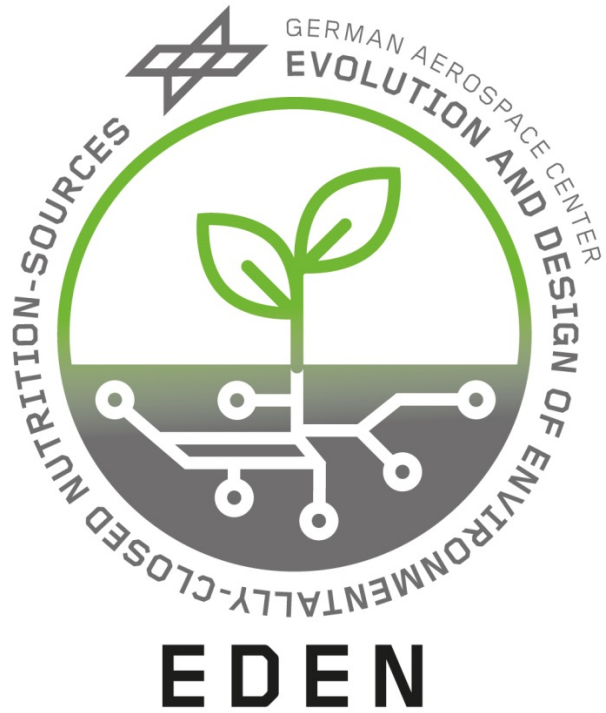


OSRAM delivery in April 2014; four custom made water-cooled LED systems (left); Integrated systems in the CLTF (right)

44th International Conference on Environmental Systems (ICES) in Tucson, Arizona (left); Visiting CEAC during the ICES (right)

Visit of Dr. Romberg (department head) in the EDEN Laboratory, looking at some plant experiments in the CLTF

BPSe (Biomass Production System for Education) from ORBITEC in the EDEN Laboratory showing a multi-crop configuration



Bremen, July 28th, 2015

German Aerospace Center
Deutsches Zentrum für Luft und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

Institute of Space Systems
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DLR has approximately 8000 employees at 16 locations in Germany: Cologne (headquarters), Augsburg, Berlin, Bonn, Braunschweig, Bremen, Goettingen, Hamburg, Juelich, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Stade, Stuttgart, Trauen, and Weilheim. DLR also has offices in Brussels, Paris, Tokyo and Washington D.C.

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