CAAS invites you to conceptualise, visualise and materialise how to tread the planet lightly. Imagine a city that you live in. Imagine that one day it just unplugs and takes off and goes and lands somewhere else. If it is a friendly city it leaves no traces of having been there; it has lived there lightly.

SPACESHIP ECOLOGIES

The study and translation of ancient Greek texts reveals that the whole Greek world and philosophy was reflected in their language and in the meaning of the words which sometimes had more holistic meanings than one would associate with them today. To define the spaceship ecologies the authors would like to introduce "oikos", the Greek word for house. "Oikos" in the Ancient Greek interpretation describes not only the house, the shelter itself, but the whole household and everything that belonged to the house. Economy and ecology have the same root, namely 'oikos'. Thus 'oikos' can be described as a system (of the house). A spaceship is not merely a house, it also resembles a whole system, a very complex system that provides shelter, energy, and nutrition, and houses inhabitants using specific technology, needing water and air, living with animals and producing waste. For CAAS, the International Space Station (ISS) can serve as a role model.

The ISS orbits the earth at 350 km, a distance that might be closer to the reader's location than some of their nearest cities, yet the Space Station shelters against temperature differences of 300 degrees and a vacuum, environmental conditions unfamiliar to most. There is only limited habitable space available, including limited resources of water and air, which are currently in a semi-closed loop. The ultimate goal is to implement bio-regenerative closed loop life support systems. These will include the inhabitants, animals, food production for all organisms aboard and their waste management. The only renewable energy source is the sun. A complex technology connects all systems, yet this technical system co-functions with the human system: human interaction of multi-cultural crews with a variety of professional backgrounds.

OIKOS

The ecologies of the System οικος Spaceship describe the interrelationships between shelter, energy, technology, nutrition, inhabitants, animals, air, water and waste management. Ecology is the relationship between the organisms and their environment.

CAAS presents the System οικος Spaceship with its' ecologies as a metaphor for thinking of future cities and urban developments. Cities are complex systems with their geographies of consumption and waste production. This complexity is crucial for developing solutions. The network of global cities is a global construct for the management of investments but also for the re-engineering of environmentally destructive global capital investments. In this sense, CAAS views the system OIKOS as not only closed; it is also open as a city – connected and closed, it is the "and" according to Ulrich Beck's description of the "*offene stadt*". Beck proposes this is about urbanity and ecology in a new "as well as" or "and". Beck also refers to cities in a world where nothing can be isolated anymore. He continues: we can identify architecture as a school of aesthetics, alternatively there is the architecture's sensitivity to develop the social ecology of a place. The reflexive architecture of the "and" discovers and expands the history of the place into the public space. The architecture proclaims: if I can not change the society, at least I would like to influence the way people move through spaces, and perceive the connections of spaces, including the built-in contradictions.

CAAS proposes the following five ecologies as foundation:

SHELTER

1. Shelter as Transformable: viewed as an envelope, that defines interior and exterior, inhabitants' shelter needs include climatic protection and distinctions between public and private spaces. On the ISS there is limited space available to each crewmember for living functions and socialisation. Storage volume is scarce, even laboratory space is finite. In highly populated cities, we experience the same issues. Multi-functional spaces, transformable spaces, and mobile systems for living and working, have already become a main topic of space design. They will become equally important for future city related concepts, designs and plans.

ENERGY

2. Energy as Renewable: In cities, consumption will rise with the integration of more technologized infrastructure and equipment. Fossil fuel resources are limited so low energy consumption for lighting, heating, computing, commuting, and communicating will be necessary. Energy sources will need to come from clean and renewable sources to mitigate the side effects of current modes of energy production. A spaceship's energy ecology meets this requirement, as it is generated from solar power.

TECHNOLOGY

3. Technology, Automation, and Infrastructure: a spaceship is a technology-rich envelope incorporating certain levels of artificial intelligence. The ISS was assembled piecemeal robotically using the 'Canadarm'; astronauts controlled and supervised the process. Onboard life support systems are automatic, yet allow for a certain degree of manual control. Other supporting technologies have been developed, such as a diagnostic tool for monitoring and logging avionics bus messages; the nerve system of the ISS. CAAS envisions future smart cities to incorporate similar levels of automation and intelligence, with manual overrides.

INHABITANTS

4. Inhabitants: ISS inhabitants include humans, plants, a few fish and from time to time other small animals. All organisms need to be integrated into the closed-loop living system. The ISS has had a permanent international crew since 2009. Crew training prepares them to anticipate and respond to cultural and social interaction challenges, but cultural sensibilities evolve through exposure, effort and training. The same applies to cities, which are and will be faced with highly heterogenic population, diverse professions and most importantly different cultural backgrounds.

LIFE SUPPORT SYSTEMS

5. Life Support Systems: In closed environments air and water resources are limited. Both are essential for life and need to be managed carefully and sustainably through recycling processes. On the ISS, astronauts drink purified water recycled from their urine. Whether on earth or in space the main challenges are producing nutrition and managing waste. We need to efficiently harvest resources in situ. Ways to achieve this include; densification (growing vertically), using substrates for cultivation of plants, and selecting plants with high-levels of minerals, proteins, vitamins, and carbohydrates. We need to develop approaches to minimise, re-use and recycle resources into useful materials. Greenhouses need to be integrated not only on the ISS, but also in cities. We also need to find effective solutions to reduce transportation and provide psychological countermeasures for the inhabitants, on and off the planet.

Derived from CAAS principles, the five main ecologies can guide the design of future cities and can be applied at micro and macro scale. CAAS cannot only be seen as the city being the spaceship but also as the house being a spaceship. A workshop held at the European Space Agency (ESA) Astronaut Training Centre in Cologne in 2012 took the first step in identifying European spaceflight technologies that could be applied to terrestrial housing. IP-STAR, a Dutch company has made this a reality in having derived a water purification system from the ESA Melissa Life Support Systems programme and applied it to larger hotel complexes. CAAS can inform approaches to apply spin-off technologies from space and the ISS. CAAS can provide conceptual guidelines for developing designs that meet the many constraints; limited space, resources and closed-loop-cycles with regard to air, water and waste. Offering a paradigm for future urban developments and staging CASS as spaceflight parameters, provides a way to look at life in Space and on Earth from a different perspective.

Source Credit: Fairburn, S., Mohanty, S. and Imhof, B., City As A Spaceship (CAAS), # IAC-14-E4.2.8, 65th International Astronautical Congress, Toronto, 2014.

"Terrasphere", Rohini Devasher, 2015

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editors: Susmita Mohanty, Sue Fairburn, Barbara Imhof
guest contributor: Rohini Devasher

The City

In CAAS, the word "City" is not literal.

Rather it is a metaphor for life on the spaceship(s) we inhabit – the "City" could well be
a village,
a neighbourhood,
a home,
an office,
a laboratory,
a transporter
or
for that matter any other (product) [eco] system or sub-system.

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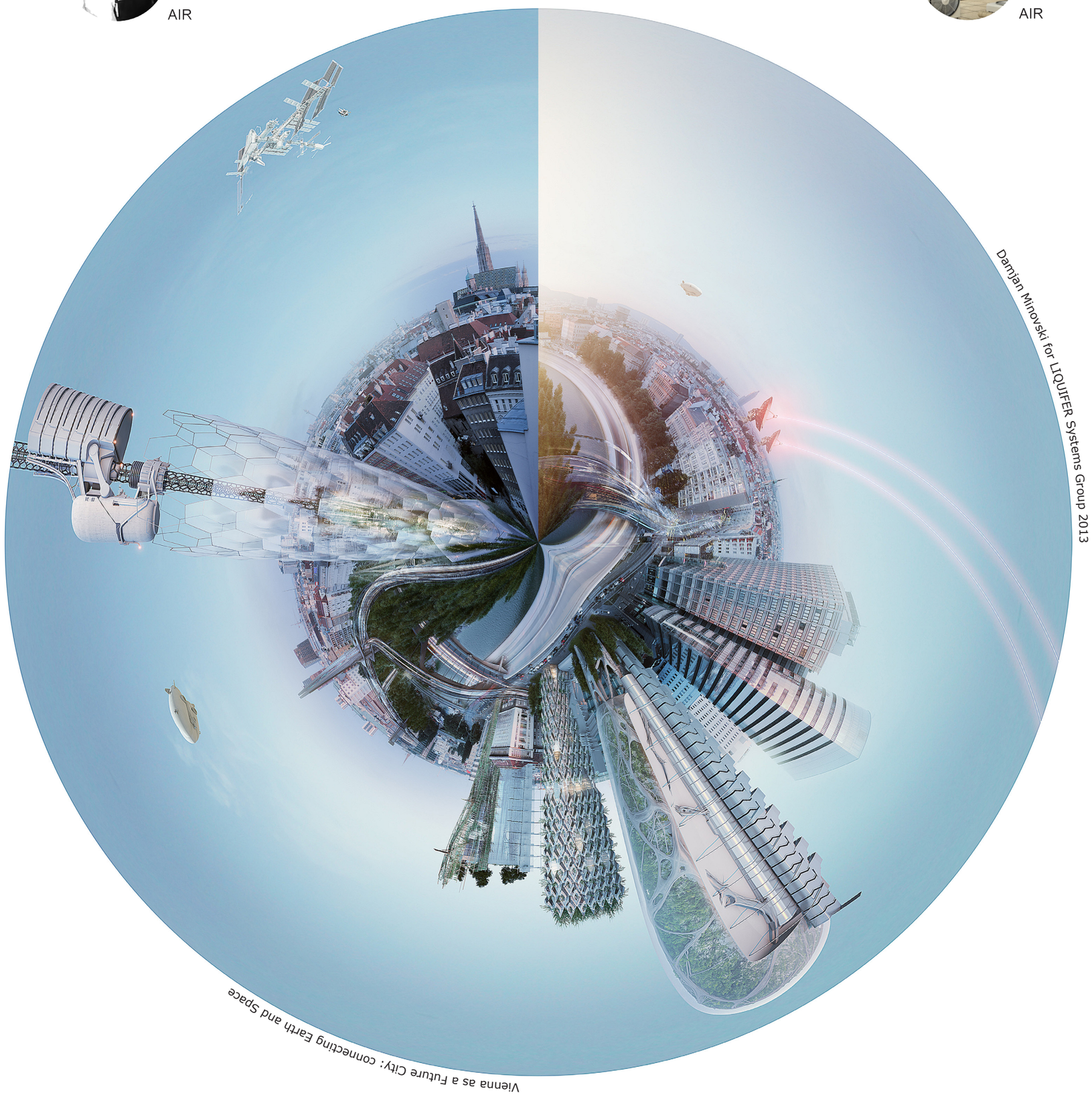
Spaceship Ecologies

City Ecologies



Farm Ecologies

By grounding space innovations and uplifting Earth innovations, CAAS can challenge and shape ideas and serve as curator and broker to the planning, designing, developing and inhabiting of near future cities. We are, by no means, propagating that the way we live in outer space is more eco-efficient than how we live on our Earth, or the other way round.

There are parallels,
there are differences and
there are reciprocities.

CAAS believes that our earthly experiences can inform and influence our extra-terrestrial explorations and vice versa.