

International Cooperation for Space Exploration (1)  
International Cooperation for Space Exploration (2) (2)

Author: Dr. Stefaan De Mey  
European Space Agency (ESA), The Netherlands, stefaan.de.mey@esa.int

Dr. Silvia Ciccarelli  
Italian Space Agency (ASI), Italy, silvia.ciccarelli@asi.it

Mr. Marc Haese  
DLR, German Aerospace Center, Germany, marc.haese@dlr.de

Dr. Juergen Schlutz  
European Space Agency (ESA), Germany, juergen@schlutz.space

Mr. Jean BLOUVAC  
Centre National d'Etudes Spatiales (CNES), France, jean.blouvac@cnes.fr

Dr. Markus Landgraf  
European Space Agency (ESA), The Netherlands, Markus.Landgraf@esa.int

Mrs. Kandyce Goodliff  
National Aeronautics and Space Administration (NASA)/Langley Research Center, United States,  
kandyce.e.goodliff@nasa.gov

Mr. John Guidi  
NASA, United States, john.guidi@nasa.gov

Dr. Christian Lange  
Canadian Space Agency, Canada, Christian.Lange@canada.ca

Mr. Matthew Bamsey  
University of Guelph, Canada, mattbamsey@yahoo.ca

Mr. Naoki Satoh  
Japan Aerospace Exploration Agency (JAXA), Japan, naoki.satoh1@jaxa.jp

AN UPDATED REFERENCE LUNAR SURFACE EXPLORATION SCENARIO FOR THE GLOBAL  
EXPLORATION ROADMAP (GER): THE GROWING GLOBAL EFFORT AND MOMENTUM  
GOING FORWARD TO THE MOON AND MARS.

**Abstract**

In January 2018 the International Space Exploration Coordination Group (ISECG) issued its third edition of the Global Exploration Roadmap. It reflects the consensus of ISECG space agencies on a common strategy and roadmap for expanding human presence into the Solar System, with the surface of Mars as the long-term goal. Since then many ISECG agencies have been renewing and updating their plans for exploration and corresponding science goals and technology development strategies.

Starting in 2019, to further support the coordination of lunar exploration plans of agencies, ISECG is updating the GER reference lunar surface exploration scenario. Based on the "ISECG Exploration Goals" and "Sustainability Principles", and building on inputs from the various agencies, lunar surface exploration objectives have been formulated. A sustainable operation on and around the Moon is recognised as a shared goal directly contributing to enabling human missions to Mars. Key elements for achieving higher levels of sustainability are longer surface missions by surviving the lunar night, and the introduction of reusable elements. ISECG also initiated further analysis related to the potential of In-Situ Resource

Utilisation, including the use of regolith and water ice on the lunar surface, which may create opportunities in the coming decades.

This paper will describe the updated reference lunar surface exploration scenario, which will be documented in an Addendum to the GER. It details the exploration architecture element concepts that are required for an exploration campaign to progressively meet the formulated goals and objectives. The updated scenario not only supports coordination amongst space agencies to prepare for future missions, but also provides context and anchor points to test and implement ideas for concrete partnerships and missions. Such partnerships amongst government agencies, academia, public-private partnerships and purely private sector partnerships will bring to bear the best ideas and solutions from around the globe.

In the Global Exploration Roadmap the Moon is a key destination on the pathway to Mars as well as in its own right. The GER highlights a conceptual Gateway in lunar orbit and its importance for sustainable human exploration. It shows how the Gateway will be used as a staging post for human and robotic missions to the lunar surface and deep space.

The ISECG membership is steadily increasing, reflecting a growing global effort and momentum going forward to the Moon and Mars. Since the 2018 GER release, the number of ISECG members grew from 15 to 22 participating agencies.