

Global Future Council  
on Space Technologies 2019-2020



# Six ways space technologies benefit life on Earth

BRIEFING PAPERS

SEPTEMBER 2020



# Contents

3	Space technologies for the SDGs
5	Climate: Monitor, understand, prepare and act
7	Space technologies enable connectivity
9	A more secure world through space
11	Promoting responsible business through space
13	Space fuels the global economy
15	Council members – 2019-2020 term
16	References and resources

The space sector's value to life on Earth is difficult to overstate. Satellites that circle the globe provide the most accurate weather reports and warn us of impending storms; they monitor our climate every day, helping to track increasing rates of climate change and its effects, such as rising seas and changing moisture levels, wildfires and atmospheric changes; they connect millions of people and have the ability to connect billions more who currently lack access in rural areas; they help us see and stop illegal fishing and deforestation; and help to ensure transparency and security of states by monitoring and verifying actors' behaviour.

Scientific research that takes place in orbit is helping to push the frontiers of our understanding of health and material science, robotics and other technologies. The direct economic impact of the sector is important and growing, but it is the indirect impact that highlights how critical space is for our life on Earth.

Although hostile, the space environment is also fragile, specifically in key orbits where ensuring sustainable behaviour and operations will be essential for this invaluable resource to be secured for future generations.

This compendium of briefing papers explores how space supports and/or affects the following six focus areas and the opportunities for action:

- Sustainable Development Goals (SDGs)
- Climate
- Connectivity
- Global security
- Responsible business
- Economy

This document was prepared by the members of the Global Future Council on Space Technologies 2019-2020 and references should be used as a high-level exploratory and informative resource, as a compendium of six briefing papers presented jointly, or as separate two-pagers for any of the six cases. A full list of members and references can be found at the end. The information expressed may not represent the opinions of the individual members.



# Space technologies for the SDGs

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### Examples of **benefits**

#### SUSTAINABLE DEVELOPMENT GOALS

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	

UN

The **United Nations** specifically refers to space technologies to support the SDGs

1/3

**Remote sensing satellites** make up **approx. one third** of all operational satellites in orbit

100%

**Almost all SDGs** benefit from space technologies

49%

**Space can help connect the remaining 49% of the world's population;** the current lack of ubiquitous terrestrial infrastructure contributes directly to many challenges behind the SDGs

300%

High Throughput Satellites (HTS) supply over Africa increased by **nearly 300% from 88 Gbps in 2015 to 255 Gbps in 2018**

80

**Over 80 countries** have placed at least one satellite in orbit

+100


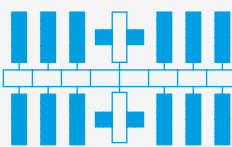

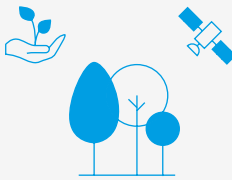

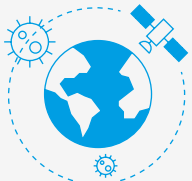
**Over 100 satellites** have been launched **solely for monitoring the Earth's atmosphere**

50%

**Nearly 50%** of all countries have space capabilities, of which **1/3** are lower middle income or below



## Examples of **benefits**

	<p><b>Satellites</b> cover the entire globe enabling high capacity connectivity over wide &amp; hard-to-reach areas including deserts, mountain ranges, islands, rainforests or wetlands</p>		<p><b>30%</b></p> <p><b>Quality of solar energy forecasts</b> can be improved by 30% using space technology</p>
	<p><b>+50%</b></p> <p><b>Over half of essential climate variables</b> can only be measured from space</p>		<p><b>Space technology</b> provides spatial information regarding water and food production, precision irrigation and farming techniques</p>
	<p><b>\$73 billion</b></p> <p><b>Satellites</b> help stop illegal logging, illegal fishing and illegal wildlife trade that account for more than 73 B\$ per year</p>		<p><b>Earth Observation and Global Positioning tools</b> have been developed to display real-time cartography of infectious disease locations, identifying hotspots</p>

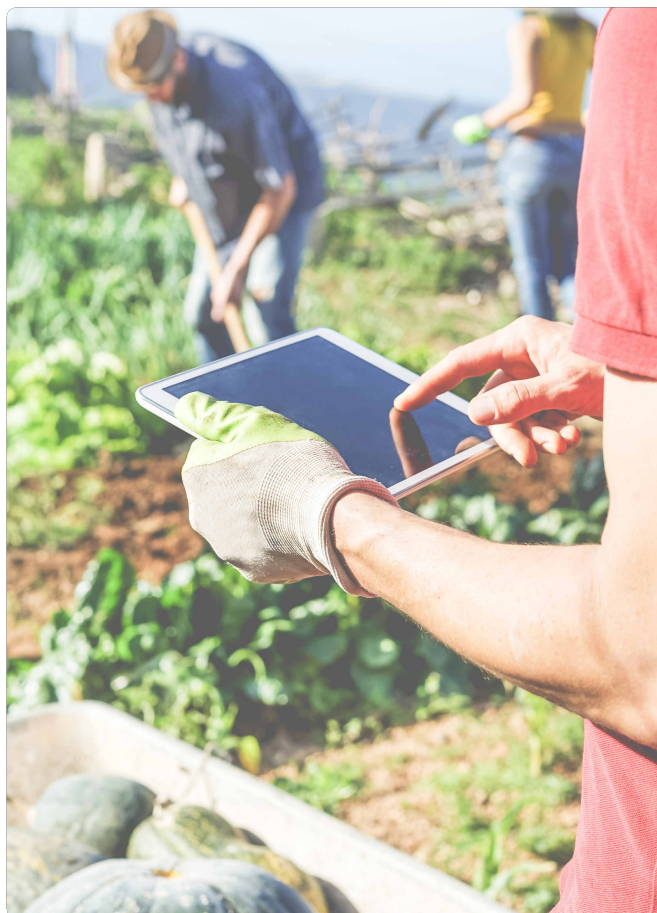
## Opportunities for **action**

### POLICY

1. **Promote** the role of satellite to connect areas unreachable by land-based technologies
2. **Enable** equitable access to space data for all
3. **Incorporate** satellite communications (“satcoms”) into digital and development policies to ensure they can play their essential role
4. **Harmonize** regulatory frameworks for satellite so that all countries can access satellite technology to drive socio-economic growth

### PARTNERSHIPS

1. **Establish** dialogues between satellite and every SDG
2. **Facilitate** awareness and capacity building to develop local expertise in using satellite technology
3. **Highlight** the role of space technologies developing policy recommendations based on use cases



# Climate: Monitor, understand, prepare and act

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### Examples of **benefits**

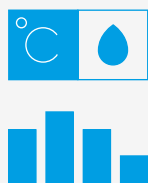


Space technologies **are** supporting climate research

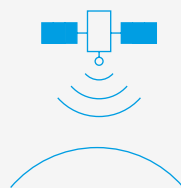


**+99%**

Over 99% of accurate weather forecasts come from space



Satellites facilitate informed **decision-making** and raise awareness of changes and evolution

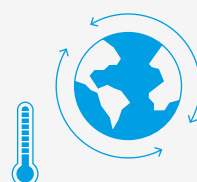


Satellite data, communications and applications offer high resolution, real-time, global-scale **monitoring of our plane**



**+160**

Currently, **more than 160 satellites** help measure the different climate change indicators



Access to information to monitor climate change impacts at **regional, territorial and national scales**



**+50%**

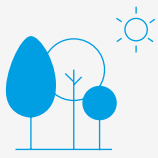
Over **half** of essential climate variables can only be measured from space



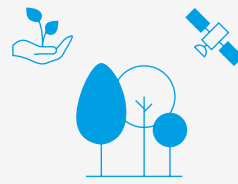
Evaluate and interpret data to support decision-makers for a balanced definition and implementation of **protective measures**

## Examples of **benefits**

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Visualize impacts and create an understanding of the **threats to our planet**



Operate on space-based climate science to stimulate the implementation of **mitigation and adaptation actions**

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## Opportunities for **action**

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1. **Offer and provide more accessible (free and commercial) climate-relevant data** and build capacities for data application
2. **Ensure space-based early-warning systems** and real-time monitoring solutions are in place to prepare for earthquakes, tsunamis, floods, wildfires, mining etc.
3. **Facilitate space-based probabilistic event attribution studies**, which have shown to-date that climate change is worsening the impact of natural disasters
4. **Promote long-term sustainability of space for Earth science** to secure a sustainable and safe space environment, which is truly a pre-condition and needs to be protected for the future
5. **Apply space science to Earth science:** Not everything that scientists need to know about climate change can be researched by only studying Earth; for example, a study of Venus alerted us to a climate threat and prompted scientists to look for an ozone hole here on Earth





# Space technologies enable connectivity

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### Examples of **benefits**



Applications using satellite communications, Earth observation and navigation **enable a sustainable, inclusive, digital society**



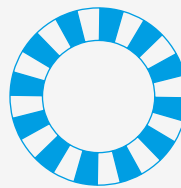
**+70%**

In times of adverse global events such as **COVID-19**, satellite broadband connections have seen a 70% increase across Western/Central Europe and Latin America



**49%**

**communications:** Satellite comms can help connect the 49% of the world's unconnected population



Satellite communications contribute to **every Sustainable Development Goal**, either directly or indirectly

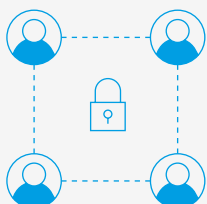


**5G**

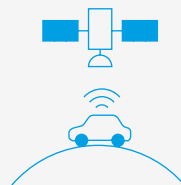
**Connectivity:** Satellites extend the reach of terrestrial networks enabling 5G on a global scale



**Broadcast:** Satellites provide live, global coverage of world events and transmission of real-time information



**Security:** Governments worldwide often rely on satellites for secure communication



**+M**

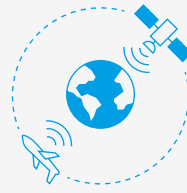
**Multicast:** Satellites can enable software and firmware over-the-air updates for millions of connected vehicles and devices

## Examples of **benefits**

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**Disaster response:** Earth observation imagery, navigation and satellite communications are vital for disaster relief and effective logistics



**Air travel:** Satellite communications are unique for aero and cockpit connectivity for transcontinental flights

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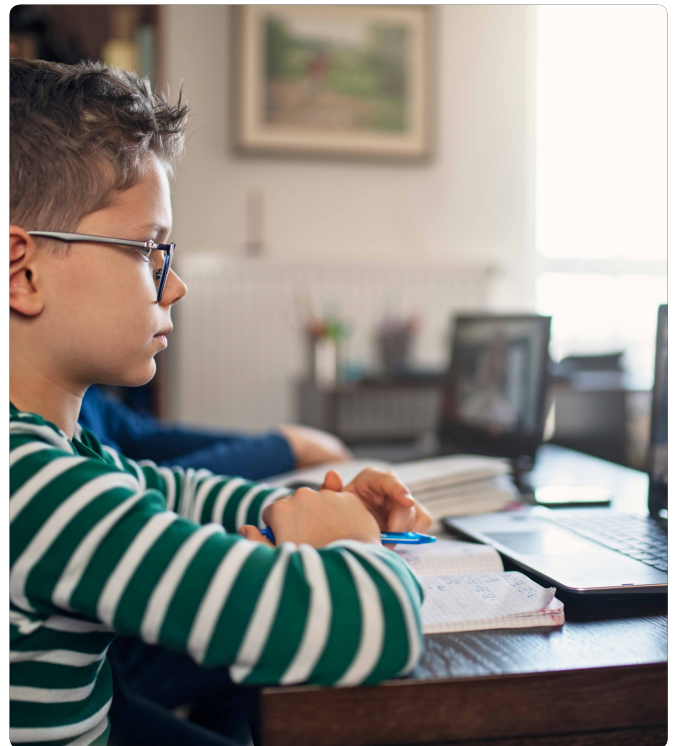
## Opportunities for **action**

### POLICY

1. **Incorporate satellite communications** into digital and development policies to ensure they can play their essential role
2. **Harmonize regulatory frameworks for satellites** such that all nations can access satellite technology to drive socio-economic growth and inclusion
3. **Develop frameworks for collision avoidance** to ensure space sustainability, in view of new constellation systems

### PARTNERSHIPS

1. **Cross-sector collaboration between satellite and terrestrial communications sectors** to foster converged networks
2. **Establish dialogues** between satellite and related to every Sustainable Development Goal





# A more secure world through space

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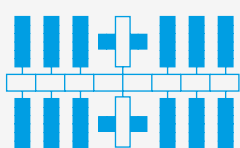
### Examples of **benefits**



Space technologies **promote** international cooperation



Space technologies help **prevent** misunderstanding and conflict



14

14 countries share the ISS, **creating** shared interests



+2,000

2,000+ navigation and communication satellites **bind societies together**



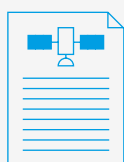
95

COPUOS, with a 25% increase in membership over the last five years to 95 total, is **one of the fastest-growing intergovernmental bodies** in the UN system



+750

Already by July, 2020 had broken the annual record for new satellites registered with UNOOSA, through the Registration Convention (1974), the only treaty-based TCBM




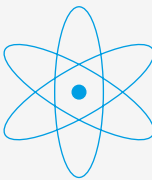

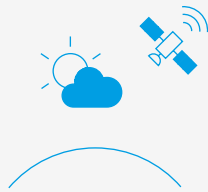
21

In 2019, COPOUS adopted 21 guidelines on supporting the **long-term sustainability** of space operations



For 50 years, satellites have **verified nuclear arms control treaties**. Satellites link sensors enabling real-time global notifications of nuclear explosions for **verification of the Comprehensive Test Ban Treaty**

## Examples of **benefits**

	<div>53</div> <p>For 53 years, the Outer Space Treaty has <b>made space and the world more secure</b></p>		Satellites enable <b>secure communications for military, public safety</b> and incident response vehicles the world over
	<div>+600</div> <p>More than 600 remote sensing <b>satellites see over borders</b>, making the world more transparent</p>		<div>55</div> <p>55 meteorological satellites from over a dozen countries contribute to <b>weather data-sharing, protecting people from natural disasters</b></p>

## Opportunities for **action**

1. **Promote space** as a shared interest; seek partnerships and dialogue
2. **Use space data** to increase global transparency and reduce misunderstanding
3. **Assist aspiring spacefaring nations** to become responsible actors in space
4. **Develop norms** of safe and friendly behaviour in orbit to reduce tension
5. **Prioritize long-term sustainability** through voluntary and binding arrangements





# Promoting responsible business through space

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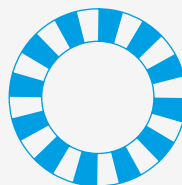
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### Examples of **benefits**



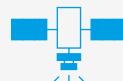
Government and industry can be **responsible stewards of space sustainability**



The space industry is a key player in **helping to achieve the SDGs**



The need for **space sustainability** has massively increased



**\$73 billion**

**Satellites** help stop illegal logging, illegal fishing and illegal wildlife trade that account for more than 73 B\$ per year



**21**

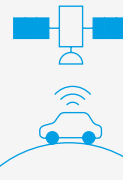
**Multilateral:** UNCOPUOS approved 21 space sustainability guidelines



**Commercial:** Industry groups are driving best practices, e.g. in data-sharing, for the global space sector



**National:** Domestic guidelines for sustainable operation are under discussion in US/ Europe/Asia



Satellites support **numerous vital services** on Earth (e.g. weather forecast, navigation, communication etc.) that can only be maintained by ensuring orbital sustainability

## Examples of **benefits**



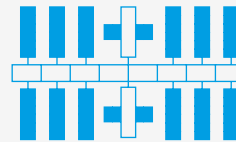
Maintaining sustainability is essential for **business continuity and near-term return on investment**, not just long-term CSR



At times of adverse global events, such as pandemics or disasters, teleworking is possible thanks to satellite services supporting **business continuity, jobs and economic resilience**



Transparency, data-sharing and open communication among stakeholders is necessary to **achieve space sustainability**



**Bilateral:** Space transcends geopolitical conflicts through collaboration

## Opportunities for **action**

1. **National governments can lead** in developing best practices and a positive regulatory environment
2. **International organizations can use** cooperation on orbital sustainability as a model for other similar global concerns
3. **Industry must work together** with governments to play a role in implementing the 21 LTS guidelines
4. **Multiple industry groups can coordinate** efforts to mutual beneficial goals
5. **A clear timeline can be set** to take steps towards space sustainability before an irrecoverable accident happens (prevention is better than the cure)






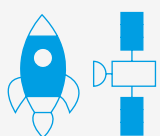


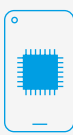
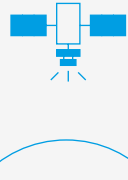
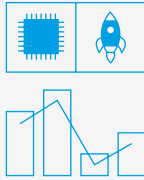

# Space fuels the global economy

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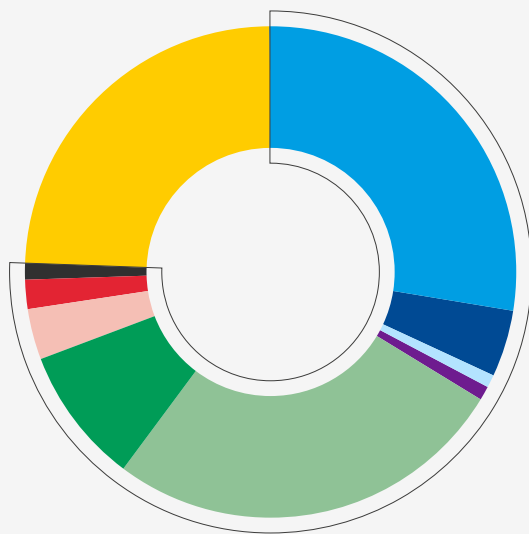


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### Examples of **benefits**

	Space capabilities <b>enable and support</b> business and government		Space systems are increasingly <b>productive and capable</b>
	<b>\$10 trillion</b> Telecom, internet, finance, other industries <b>leverage satellites</b>		<b>-80%</b> <b>Reduction in manufacturing</b> cost of satellite Gpbs since 2013
	<b>+5 billion</b> Mobile phones with satellite chips for <b>mapping, traffic routing, tracking, logistics</b>		<b>30X</b> Ten-year increase in number of <b>imagery satellites</b>
	<b>15X</b> Growth over a decade in number of space start-ups, driving <b>innovative products and services</b>		<b>+75%</b> Commercial satellite industry proportion of the <b>space economy</b>

## \$366 billion Global space economy



- 01. Consumer services – TV, radio and broadband
- 02. Leasing
- 03. Mobile
- 04. Commercial remote sensing
- 05. Navigation, positioning and timing
- 06. TV, radio and other ground equipment
- 07. Satellite manufacturing
- 08. Launch
- 09. Other
- 10. Government space budgets
- 11. Satellite Industry

Space enables global industries, new tech, science, health and safety, international telework and distance learning

## Opportunities for **action**

1. **Sustain investment** in space and satellite capabilities for global economic, safety and security benefits
2. **Protect the unique space environment** so debris does not inhibit operations
3. **Ensure new systems operate sustainably** to enable continued future activities
4. **Ensure interoperable, redundant satellite navigation systems** to deliver global mapping and other critical functions





# Council members – 2019-2020 term

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UK Space Agency

### Nobu Okada

Chief Executive Officer  
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Adviser, Strategic Projects, Office of the Director-General  
UAE Space Agency

### Anousheh Ansari

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X Prize Foundation

### Carissa Christensen

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### Simonetta Di Pippo

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United Nations Office for Outer Space Affairs (UNOOSA)

### Pascale Foing Ehrenfreund

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### Aarti Holla-Maini

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EMEA Satellite Operators' Association (ESOA)

### Tomohisa Kunisawa

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Ministry of Economy, Trade and Industry of Japan

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### Susmita Mohanty

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### Abdul Mohsen Z Al Hussein

NewSpace Entrepreneur

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### Minoo Rathnasabapathy

Research Engineer, Space Enabled Research Group  
Massachusetts Institute of Technology (MIT)

### Kai-Uwe Schrogl

Special Adviser, Space Policy  
Federal Ministry of Economic Affairs and Energy of  
Germany

### Olga Stelmakh-Drescher

Chief Policy and Government Relations Officer  
Exolaunch

### Ellen Stofan

Director, Smithsonian Air and Space Museum  
Smithsonian Institution

### Brian Weeden

Director, Programme Planning  
Secure World Foundation

### George Whitesides

Chief Space Officer  
Virgin Galactic

### Roger Zhang Changwu

Founder and Chief Executive Officer  
Landspace Technology

## Fellow

### Doris Grosse

Optical Instrument Scientist, Research School of  
Astronomy and Astrophysics  
Australian National University

## Council Manager

### Nikolai Khlystov

Lead, Shaping the Future of Mobility  
World Economic Forum

## Council Co-Manager

### Bruce Weinelt

Head of Partner Development, North America and Europe  
World Economic Forum

## For more information

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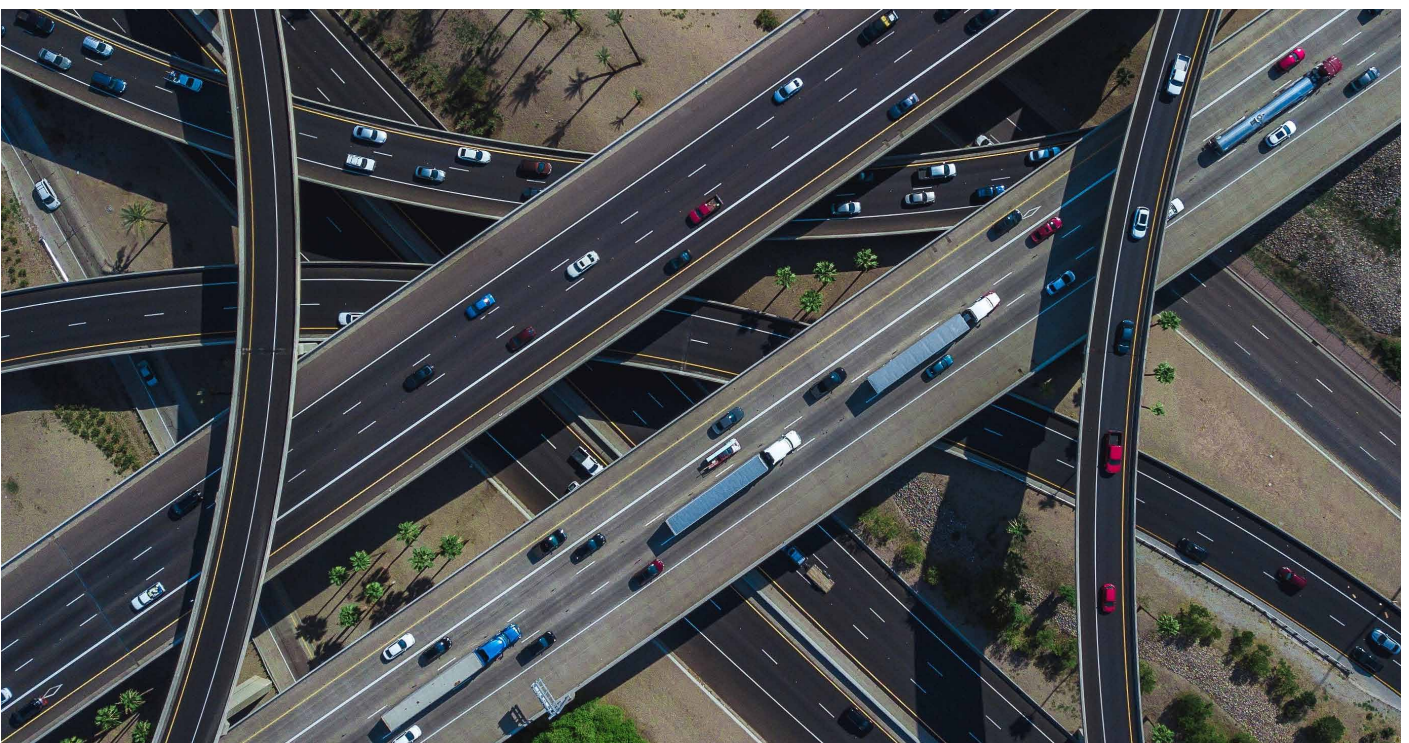
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[https://www.weforum.org/  
communities/the-future-of-  
space-technologies](https://www.weforum.org/communities/the-future-of-space-technologies)

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