

Changing the
future today



It is said that life is a game of give and take. But when it comes to matters of sustainability, there is an immediate imperative for all of us to make sure that our net contribution is a positive one.

Thinking about the space industry in the context of sustainability tends to divide people. Some consider the industry's vital contribution to measuring and monitoring climate change and think of space as intrinsically sustainable. Others look at the carbon impact of the rocket that carries a spacecraft into orbit and think the opposite.

As an organisation that has worked in the space industry for forty years, and one that is recognised for our sustainability credentials¹, we felt drawn to provide our own assessment. Our Europe-wide space business features quite a few mathematicians working alongside the scientists, consultants and engineers. So we decided to apply a system of debits and credits as a form of rational methodology, which we call the Space Sustainability Ledger.

What to count

Before we begin, it is important to consider what to put in our ledger and set some ground rules. We use the United Nations preferred full cost accounting model, best known as Elkington's Triple Bottom Line (TBL)². This entails looking at people, planet and profit to make a full assessment.

In order to set some further parameters, we'll be taking a European view of the space industry; however many elements will be similarly applicable at a national level for all space-faring nations across the globe.

Our assessment deliberately stops short of making a full quantitative impact analysis. However journals such as the Human Development Report suggest further quantitative assessment techniques for those wishing to take the concepts presented here to a deeper level of rigour.

So against that backdrop, let's start with People.



1 Verdantix, Green Quadrant® Sustainable Technology Services – and Carbon Disclosure Project, <https://www.cdproject.net/en-US/WhatWeDo/Pages/consultancy-partners.aspx>

2 Cannibals with Forks: the Triple Bottom Line of 21st Century Business, Elkington 1998

PEOPLE

The People section of the Space Sustainability Ledger features a strong credit balance for the space industry. In the first instance, we consider the vital contribution space makes to people's safety. Programmes such as EGNOS and Galileo enhance the precision of global positioning data. This means it can be used in safety-critical applications - to land planes, to manage train and road infrastructures so they are safer, and to guide ships at sea and in port whatever the weather.

Taking this safety aspect still further, emergency management is another important area to consider. Satellites can not only provide an early alert system to warn of an emergency before it occurs, minimising loss of life, but they can also help to monitor and mitigate the impact of disasters after the event. They are the emergency communications medium of choice in all major disasters – earthquakes, tsunamis, terrorist attacks, floods, famines and war zones. Communications via satellite gives victims access to external resources and also relays news about those that have been affected.

Telemedicine is yet another area where satellites provide essential life-saving medical services to inaccessible areas. An ESA initiative is already underway in sub-Saharan Africa³ but against a backdrop of an aging population globally, the reach and impact of telemedicine services is expected to grow.

Satellites also provide a valuable contribution to bridging the digital divide. All over the world, there are people who cannot access digital services that the majority of us take for granted. This includes broadband internet or cable television.

Terrestrial communications infrastructures have always focussed on the most accessible places, leaving a digital gap between the most developed areas and rural, remote or mountainous areas. It becomes an even bigger problem in the knowledge economy of the future as people without internet connections miss out on its "friction-free" commerce, as Bill Gates called it⁴. There are two particularly apt examples for this sustainability paper. One is universal access to smart metering infrastructures⁵, and the other is reducing the need for remote workers to travel to get the connectivity they need to contribute to the knowledge economy.

Since satellites provide uniform wide area coverage, they can give equal quality of service to everyone on a country-wide or even continental scale. Satellites connect to the most remote user just as easily as to the city dweller, whereas cable or telephone connections can take years to reach the more remote areas (if ever). This is why we give space another credit in our ledger of sustainability.

The global social impact of satellite TV is rarely accorded the enormous importance it deserves. The political impact of TV imagery via satellite from war zones has been with us since the Vietnam War 40 years ago. The same technology brought the Ethiopian famine into our living rooms almost 30 years ago. The immediacy of today's news is coupled with its global reach – sports events, celebrity weddings, political scandals and disaster stories.

3 http://www.esa.int/esaTE/SEM4CVQ08ZE_index_0.html

4 <http://www.microsoft.com/presspass/exec/billg/writing/shapingtheinternet.msp>

5 <http://www.logica.co.uk/we-are-logica/media-centre/articles/smart-metering-for-dummies/>



A further area of consideration is the enormous power of the space industry to inspire and encourage young people to take up Science, Technology, Engineering and Mathematics (STEM), which in turn has a favourable impact on the wider industries that benefit from these skills. STEM is the growth engine for so many industries and economies; for example witness the rise of the Indian Tigers and Chinese Dragons.

The space industry recognises the influence it has and the importance of STEM in creating a sustainable future for itself as an industry, and for other markets too. The precise impact of space in attracting young people into STEM subjects remains hard to quantify but efforts have been made⁶, and the major space agencies continue to invest heavily in outreach, education and awareness.

Of course there is always room to do more, so this is an area we can return to if, at the end of the analysis, it is felt to be necessary.

The only potential area for the debit side of the ledger, we think, is privacy. Satellites are routinely used to monitor military and security situations and some people are concerned about the same satellites invading their privacy. These concerns are reinforced by TV programmes and films that show government agencies identifying car number plates, recognising faces and even seeing through walls. The Hollywood version of space is indeed a threat to privacy but the reality is much less invasive. The fact that Osama bin Laden escaped detection for ten years should reassure people that governments do not possess an all-seeing eye in space. Space imagery can tell if there is a car in your driveway but can't distinguish its details; space imagery can show that you have built an extension to your house (did you get the necessary permits?). These examples show that space can infringe on individual privacy to some extent.

Space Sustainability Ledger: People	
Credit	Debit
✓ improves transport safety	X raises concerns with privacy issues
✓ enhances access to telemedicine in remote areas	
✓ better emergency management and response	
✓ bridges digital divide	
✓ inspires young people	



PLANET

The Planet aspect of the Triple Bottom Line is the one most people think of when they think of environmental sustainability, as it is the part that pertains to the natural world and ecological practices. Of course the first point to the credit of the space industry is that without earth observation satellites, we wouldn't be able to monitor and measure mankind's impact on the planet with any confidence. Earth observation satellites can analyse and accurately measure all manner of climate variables and pollutants, for example polar ice cap and glacial melt, global and regional temperatures, weather patterns, deforestation, depletion of rivers and lakes, rise in sea level, and marine pollutants.

Many of today's leading environmentalists date their commitment to the green agenda to the first images of Earth taken from space. The full Earth images taken by the Apollo astronauts from the Moon have been particularly influential⁷.

Navigation satellites promote more efficient road usage, helping to cope with over-crowded roads, and reducing fuel usage. The same space technology underpins the new generation of air traffic management systems that will optimise flight routing and thereby save money and reduce carbon emissions.

On the negative side, there is the effort involved in physically propelling a space vehicle from Earth into space. Interestingly, although this is thought to be high, most of the carbon footprint of launching a spacecraft takes place in the manufacturing process rather than the physical launch. The Ariane 5 rocket for example is mainly fuelled on liquid oxygen and hydrogen, making its launch carbon footprint comparatively modest. The space industry is undertaking extensive research and development (R&D) into launcher technologies and systems to reduce this even further.

Of course once in space, satellites are very environmentally friendly, being solar powered (they run on sunlight) so this gives a credit in favour of space.

We should also consider the amount of travel the sector undertakes. Admittedly the carbon impact is low as space is still a relatively small sector employment-wise, but as a fast growing sector it is worthy of attention. In Europe, teams are geographically dispersed and regularly travel for face to face working. Spacecraft launches need to take place in countries with the correct attributes for launch. For European missions, this is typically French Guiana. Logica's advice to mitigate the impact of these two activities would be to encourage more remote and virtual working to reduce European air travel, and to increase use of remote control during launch activities so that fewer people need to be there physically. For example flying 200 people from Europe to French Guiana for a launch is the equivalent to running a standard personal computer (PC) constantly for over 1200 years⁸. If the launch is postponed, the cost may have to be repeated.



7 "History of environmental awareness in the Western world":
http://www.oup.com/uk/orc/bin/9780199533916/01student/exmaterial/page_74.htm

8 Figures courtesy of Terrapass and Time for Change; please contact space@logica.com for calculation information

We've talked about satellites and the digital divide, and there are advantages for the Planet in this realm too. They deliver communications and broadcasting services without having to dig up roads to lay cable or creating disruption, delays, dirt and noise pollution. Furthermore they avoid hundreds of transmitters around the world which consume large amounts of electricity, are often visual pollutants and a deadly hazard for migrating birds.

A final area to consider for the debit column is space debris. There are currently tens of millions of pieces of space debris orbiting the Earth, most under 1cm and relatively harmless. Various initiatives are underway to measure, monitor and mitigate the impact of space debris. We include it here however because it introduces an interesting new take on Elkington's Triple Bottom Line model – should it be updated to a Quadruple Bottom Line to include the universe... Space itself? As reliance on - and interest in - space grows, and man explores deeper into the origins of the universe, perhaps a future iteration of the model will include this aspect.

Space Sustainability Ledger: Planet	
Credit	Debit
✓ monitors the world's health using Earth observation satellites	✗ creates emissions from launch and manufacture
✓ uses solar power to operate	✗ increases people travel
✓ lower footprint than ground based alternatives	✗ generates space debris
✓ improves transport efficiency	
✓ sustains the global village	



PROFIT

An holistic view of sustainability takes account of the need of organisations to remain profitable. It's the only way they themselves can have a sustainable future and, more importantly, sustain the economic benefit they contribute to the wider society.

Space extravaganzas such as sending men to the moon have become a relatively small part of the space economy (<10%), and are getting smaller as commercial and ecological uses of space expand and become "mainstream". The main benefits of exploring the universe and the planets, or of sending humans into orbit, are social and political rather than economic and thus are difficult to quantify. The potential to create wealth by sending humans into space, or of using space to study the universe is maximised in Europe through the European Space Agency (ESA). Unlike some of its international counterparts, ESA is required by its "constitution" to "improve the worldwide competitiveness of European industry... by making use in the first place of the existing industrial potential of all Member States"⁹.

In any case, mainstream Space "pays its way" and can be measured in terms of its economic health.

First of all, Space has shown itself to be recession proof, continuing to grow at 6% per year in the UK¹⁰ through the recent economic dip, and 5% per annum world-wide¹¹. What is more, it is an industry that demonstrates a multiplier effect; for example in the UK, space directly employs around 27,000 people, however the indirect employment (for example those that provide services to or create services from the space industry) exceeds 90,000¹².

But the main reason for this multiplier effect is all the applications that are enabled by space and satellites. Satellite TV and satellite navigation underpin hundreds of profitable examples. Furthermore, this list is growing as satellites become more cost effective, accurate and reliable, and as developers think of innovative new ways to turn these into value added services.

Space Sustainability Ledger: Profit

Credit	Debit
✓ has an economic multiplier effect	✗ proves difficult to measure financial benefits of scientific and human missions
✓ increases cost effectiveness	
✓ enables value added applications	

9 "ESA Convention", article VII.1.b, ESA SP-1300, Sept 2005, p22

10 <http://www.bis.gov.uk/assets/bispartners/ukspaceagency/docs/10-1195-size-and-health-uk-space-industry-2010>, Nov 2010, p13

11 <http://www.sia.org/wp-content/uploads/2011/06/2011-State-of-Satellite-Industry-Report-June-2011.pdf>

12 <http://www.bis.gov.uk/assets/bispartners/ukspaceagency/docs/10-1195-size-and-health-uk-space-industry-2010>, Nov 2010, p8



CONCLUDING COMMENTS

The observations contained here provide a crude if interesting analysis of how Space fits into a sustainable world. A general conclusion we can begin to draw is that Space most certainly does contribute far more to society than it takes out. But let's turn to a second source to attempt to verify this.

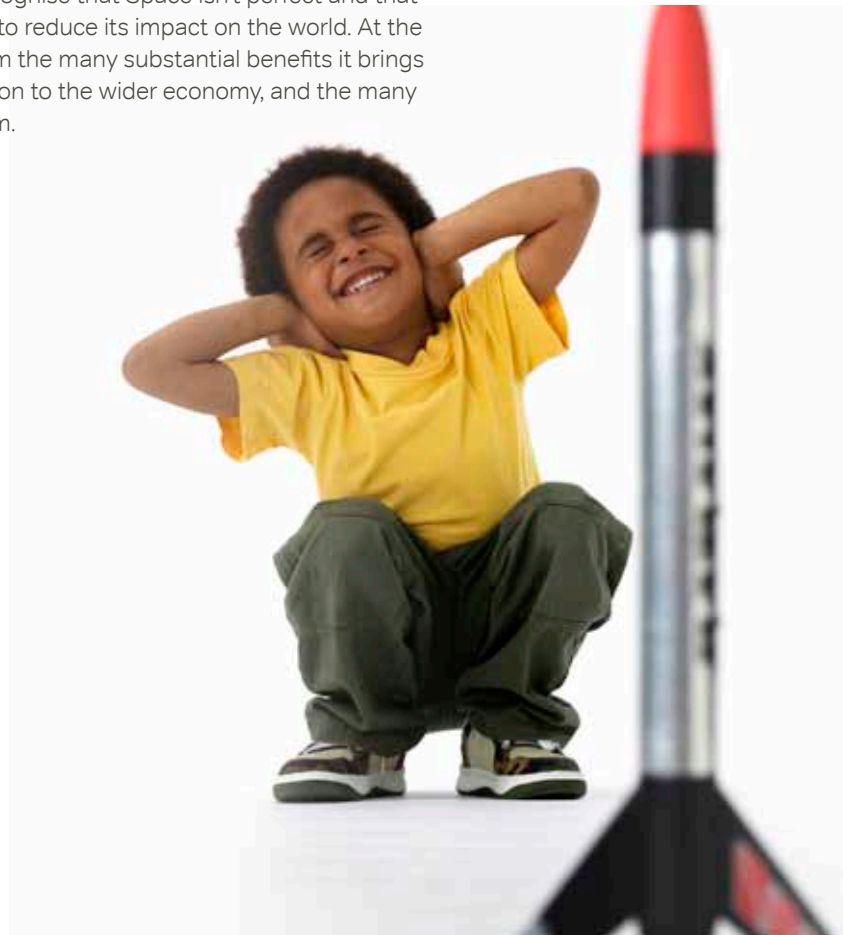
In 2011, the European Commission issued a report entitled "Towards a space strategy for the European Union that benefits its citizens"¹³. This report explored the crucial role space plays in Europe's growth and development, and how it serves both internal and external goals of the European Union (indeed the same can no doubt be said for many space-faring nations around the globe). Specifically, this report saw space contributing to four key areas:

- Environmental: combating climate change, enabling natural resources management, optimising transport, assisting energy management;
- Social: enhancing public and civil security, enabling humanitarian and development aid, decreasing digital divide;
- Economic: generating knowledge, enabling new products and new forms of industrial cooperation;
- Strategic: cementing the EU's position as a major player on the international stage.

The report went on to highlight that it was through these four areas that the space sector directly contributes to achieving the objectives of the Europe 2020 Strategy¹⁴, namely smart, sustainable and inclusive growth.

This would therefore bear out our own conclusion that Space can congratulate itself on indeed being a sustainable industry.

Here at Logica, we've worked with the space industry for the last forty years and are also regularly recognised for our own sustainability credentials. We recognise that Space isn't perfect and that there are many improvements that it can and is making to reduce its impact on the world. At the same time though, we must not allow this to detract from the many substantial benefits it brings through its power to inspire, its universality, its contribution to the wider economy, and the many value added applications and services we all benefit from.

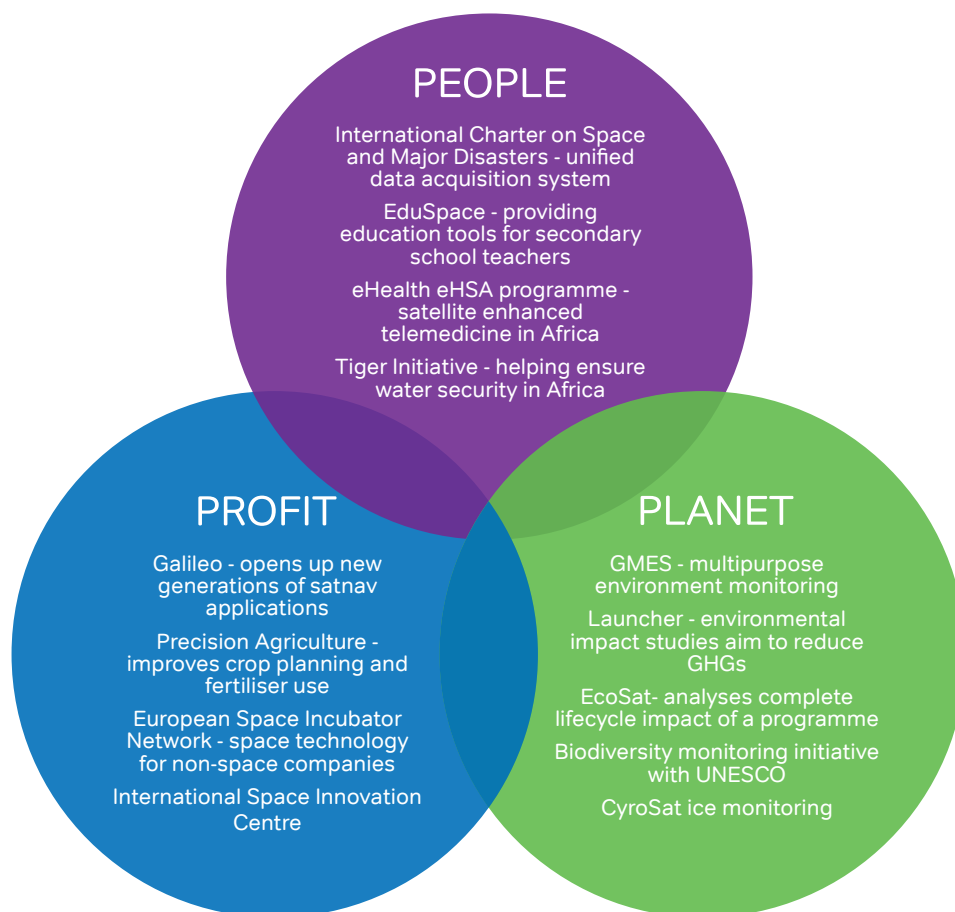


¹³ Brussels, 4.4.2011 COM(2011) 152 final.

¹⁴ Brussels, 3.3.2010 COM(2010) 2020.

Space Sustainability Ledger	
Credit	Debit
✓ inspires young people	✗ increases people travel
✓ bridges digital divide	✗ raises concerns with privacy issues
✓ improves transport safety	✗ creates emissions from launch and manufacture
✓ monitors the world's health	✗ generates space debris
✓ uses solar power to operate	✗ proves difficult to measure financial benefits of scientific and human missions
✓ has an economic multiplier effect	
✓ enables value added applications	
✓ lower footprint than ground based alternatives	
✓ increases transport efficiency	
✓ sustains the global village	
✓ better emergency management and response	
✓ enhances access to telemedicine in remote areas	





A selection of ESA programmes contributing towards a sustainable society: ESA Sustainable Development Report

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