



Environmental  
Task Force



# SPACE SUSTAINABILITY

A Roadmap for Scotland

Update 2025



# FOREWORD

The past few years have marked a significant period of progress, reflection, and renewal for Scotland's journey toward becoming a global leader in sustainable space activities.

Building on the foundations established in the original ***Space Sustainability: A Roadmap for Scotland***, this update captures not only what has been achieved, but also how we propose to monitor the continuous delivery of tasks with the evolving ambition and collective commitment of the community who continue to shape this work.

Firstly, we'd like to mention, acknowledge, and thank all of our volunteers and associated supporters of all shapes and sizes, from the UK Space Agency (UKSA) to the one person operated startups; you all matter and help make a positive difference.

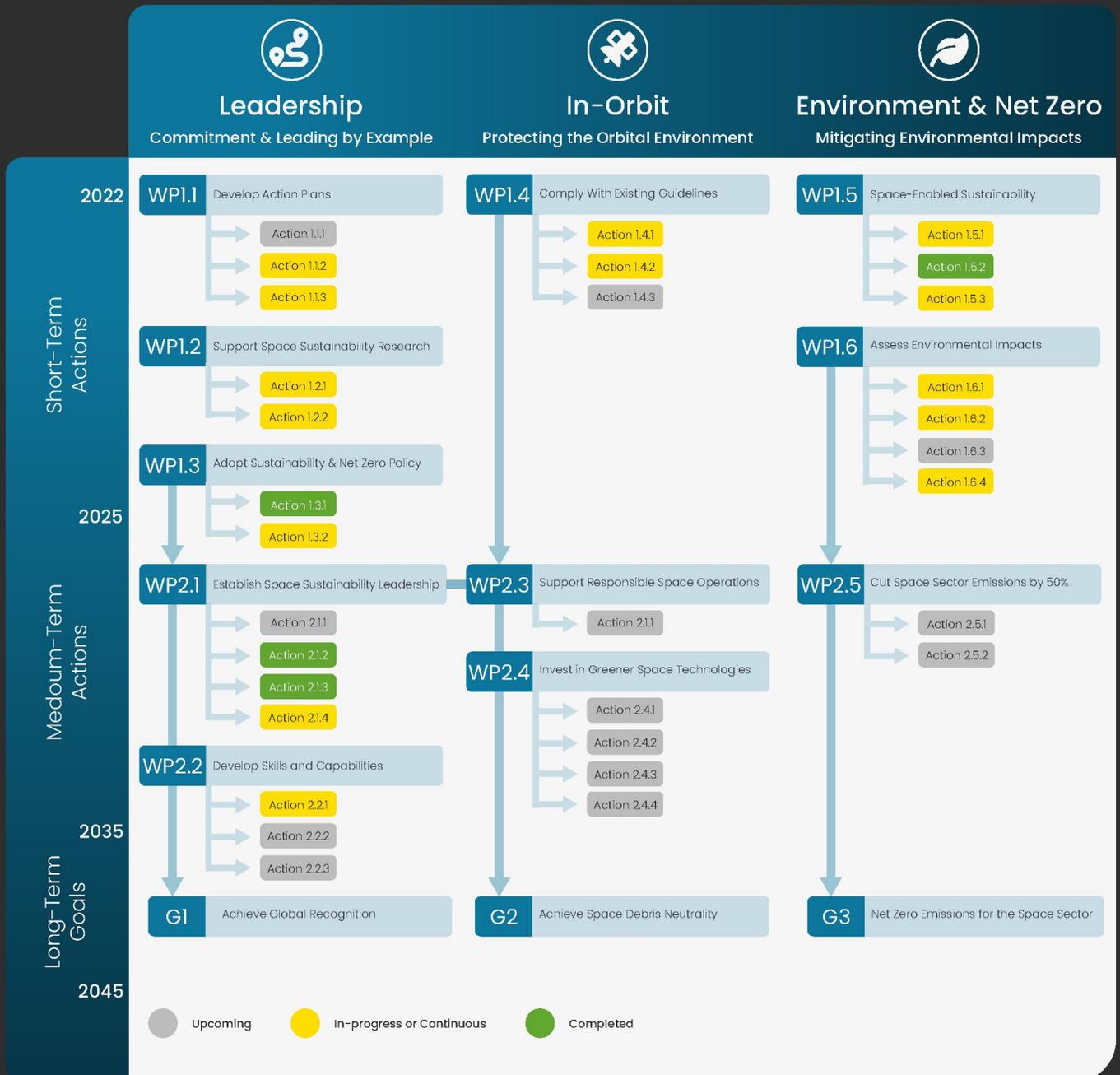
This Roadmap status update is, fundamentally, a testament to their expertise, persistence, and generosity. Many of the actions now identified as complete were advanced through voluntary contributions and the sustained efforts of individuals and organisations who believed in the vision and gave their time to realise it. Their work, whether reviewing complex policy documents, contributing research insights, advising on legislation, enabling partnerships, or finding funding to push important projects, all add up to the strengthening of Scotland's role internationally.

This update also reflects lessons learned along the way. Space is complex, and space sustainability even more so; yet momentum is unmistakably growing. Through enhanced coordination mechanisms, a maturing set of "carrots" and "sticks," and increasing global engagement, Scotland is now recognised internationally as a credible, principled voice in sustainable space activity. Our stakeholders' contributions have shaped improvements to several Roadmap actions, ensuring that some measures remain ongoing rather than completed, particularly where long-term stewardship or continual funding reviews are required.

As we look ahead, the collective effort of industry, academia, government, and volunteers continues to drive Scotland toward our long-term goals such as achieving Net Zero, protecting the orbital environment, and enabling responsible growth of a world-leading space sector. To all those who contributed their expertise, time, energy, and passion: thank you. Your work has not only advanced Scotland's position but, has laid the groundwork for a more sustainable and equitable space future for generations to come.

# STATUS UPDATE

This Roadmap status update produced by the Environmental Task Force sets out to provide members of the space community, more specifically Scotland and the UK, with an update on the progress made on actions set out within the **Space Sustainability: A Roadmap for Scotland**. These actions were identified through a recent review conducted by the ETF board and its members. However, through this review it has been highlighted that many of the actions should not be marked as completed but instead should be shown to be 'active' or 'being addressed' and should not be closed as continual work on these actions would further benefit the sector.



# ACTIONS ACHIEVED

Included in this section are the actions from the *Space Sustainability: A Roadmap for Scotland* that the ETF has identified as currently in place, actively being progressed, or completed. We have indicated the actions achieved to date; although most actions have reached key milestones, many remain ongoing or represent continuous, long-term commitments. As previously mentioned, we have decided that some of the actions should stay open and be marked as “in-progress / continuous” as there is value for the group to continue working on these actions to benefit the sector. In the next section, you will find the actions from the Roadmap listed (e.g., Action 1.1.2), each accompanied by a status update indicating whether the action is “complete” or in “in progress / continuous”.

 Completed

 In Progress / Continuous

## Action 1.1.2

### **NOMINATE ORGANISATIONS RESPONSIBLE FOR IMPLEMENTING ACTION PLANS**

Nominate responsible organisations to implement action plans. These nominated bodies will coordinate the action plans, advocate for their funding and liaise between space sustainability initiatives in Scotland. Nominate a body – ideally an industry representative such as Space Scotland – to take ownership of the Space Sustainability and Net Zero Roadmap on behalf of Scottish Enterprise. As part of this process, appoint a third-party group with a mixture of environmental and space sector experience to monitor and assess progress on the action plans against the Roadmap.



## Action 1.1.3

### **ESTABLISH FUNDING AND RESOURCES**

Review Scottish, UK, and international funding sources to establish the funding required to foster sustainable development of the space sector in Scotland and establish what resources will be available to facilitate the work packages in this Roadmap.



## Action 1.2.1

### **MAKE FUNDING AVAILABLE FOR SPACE SUSTAINABILITY PROJECTS WITHIN SCOTLAND**

Provide or source strategic ongoing funding for high-impact research and development projects in Scotland to advance the goals of the action plan (A1.1.1), develop new capabilities, or accelerate work on existing projects. For example, two of Scotland’s launch vehicle companies are working on greener propellants. Take advantage of expertise and best practices from innovation centres such as CENSIS and The Data Lab.



## Action 1.2.2

### **FUND RESEARCH INTO THE ENVIRONMENTAL IMPACTS OF SPACE ACTIVITIES**

Solicit and fund research proposals to investigate the environmental impacts of space activities on the atmosphere which close gaps in the sector’s knowledge of the environmental impacts of launch and re-entry. Engage with research councils and advocate for funding on relevant projects.



# ACTIONS ACHIEVED

## Action 1.3.1

### **COMMIT TO THE PARIS PEACE FORUM NET ZERO SPACE PLEDGE**

A representative Scottish organisation such as Space Scotland commits to supporting the “Net Zero Space” initiative, potentially on behalf of interested space companies. When announcing their support, the organisation will commit to declaring concrete, tangible examples of proposed actions they are taking towards the sustainable use of space and reducing orbital debris.



## Action 1.3.2

### **PUBLICLY COMMIT TO CUTTING EMISSIONS BY 2045**

Space Scotland makes a high-level public commitment to reducing emissions in the Scottish space sector based on the initial assessment in A1.6.1 and the action plans outlined in A1.1.1. Set quantifiable interim targets for the short- and medium-term which contribute to the 50% global reduction in CO<sub>2</sub> equivalent by 2030 targeted by the Intergovernmental Panel on Climate Change (IPCC) Special Report on Global Warming of 1.5C° and to the wider Scottish goal of achieving Net Zero by 2045.



## Action 1.4.1

### **RAISE AWARENESS OF SPACE SUSTAINABILITY WITHIN THE SCOTTISH SPACE SECTOR**

Hold workshops, publish papers, showcase progress at events, and prepare summaries on pressing issues in space sustainability for both a mainstream and industry audience, to ensure that the awareness of space sustainability issues and existing guidelines is widespread. Also highlight the peripheral impacts of space activities such as the impact of satellite constellations on astronomical observations. Develop a digital resource showcasing case studies, current issues, best practises, and promote its use in the sector and by government. Use workshops and links to existing resources to provide the Scottish space sector with guidance on effective space sustainability practices.



## Action 1.4.2

### **INCENTIVISE SCOTTISH SPACE SECTOR TO COMPLY WITH EXISTING GUIDELINE**

Engage with Scottish satellite manufacturers and operators to assess compliance with the IADC Space Debris Mitigation Guidelines, UN COPUOUS Guidelines on the Long-Term Sustainability of Outer Space Activities, the Best Practices for the Sustainability of Space Operations, the SO 24113:2019 Space Debris Mitigation Requirements, and the UN Sustainable Development Goals. Where these guidelines are not being met –for example, if small satellites cannot be passivated at the end of mission – provide support and incentives for companies to comply with existing guidelines.



## Action 1.5.1

### **PROMOTE THE SUSTAINABILITY BENEFITS OF SPACE DATA**

Raise awareness within non-space sectors of the benefits and applicability of space data to sustainability challenges through outreach and workshops building on similar initiatives already launched in Scotland.



# ACTIONS ACHIEVED

## Action 1.5.2

### **CONNECT SCOTTISH COMPANIES WITH SPACE DATA**

Build the capabilities of companies in Scotland to provide space data-enabled solutions to address challenges in other sectors following the model of Space4Impact in Switzerland. Foster connections between SMEs and experts who can demonstrate how to derive value from space data, as well as supporting start-ups making innovative use of satellite data.



## Action 1.5.3

### **SUPPORT COMPANIES TO DEVELOP INNOVATIVE ANALYTICS**

Building on Edinburgh's status as the emerging "Space Data Capital of Europe" and following A1.5.1 and A1.5.2, support Scottish companies developing innovative analytics for satellite data. Particularly focus on efforts which could provide sustainability benefits to other sectors, or which analyse data on space debris and space situational awareness. This support could consist of funding for low Technology Readiness Level projects, assistance in attracting talent to Scotland, or fostering partnerships between Scottish companies and international partners.



## Action 1.6.1

### **DETERMINE CURRENT EMISSIONS IN THE SCOTTISH SPACE SECTOR**

Using data from companies, projects such as the Strathclyde Space Systems Database, and best practices from other sectors, draw up an estimate of the total CO<sub>2</sub> equivalent emissions of the Scottish space sector capturing emissions across the space segment, launch segment and ground segment of space missions, as well as infrastructure, including embodied CO<sub>2</sub> equivalents. Also account for or estimate the emissions of the downstream space sector, particularly the emissions caused by space data storage and analysis and the embodied CO<sub>2</sub> equivalent of existing infrastructure. This figure for aggregate space sector emissions will be the baseline for future emissions reductions. Identify hotspots of intense emissions in the space sector.



## Action 1.6.2

### **SUPPORT LIFE CYCLE ASSESSMENTS FOR SCOTTISH SATELLITES**

Accurate data on the environmental impacts of satellite components and manufacturing processes are lacking. Scotland already has the expertise to apply ESA's Space Systems Life Cycle Assessment (LCA) framework through researchers at the University of Strathclyde. Identifying the "hot spots" of environmental impacts in the industrial manufacture of satellites and satellite components is the first step towards mitigating these impacts. To make space system LCAs more widely applicable, it is necessary to incentivise Scottish satellite manufacturers to share data on the environmental impacts of their satellites, and thereby provide the source data for LCAs.



## Action 1.6.4

### **DEVELOP AN ACTION PLAN TO CUT EMISSIONS**

Based on the hotspots and emissions identified by A1.6.1 and A1.6.2, develop a detailed plan outlining the proposed actions required to make realistic cuts to emissions. Focus on quick, easy-to-implement proposed actions in the short term which can immediately cut CO<sub>2</sub> equivalent emissions if implemented. Also outline a procedure to report progress towards cutting emissions on a yearly basis. Following the lead of the aviation sector, develop science-based targets to reduce the emissions of the space sector focussing on cutting emissions where possible and offsetting any residual emissions. Within this strategy, define rules and guidelines for carbon offsetting within the Scottish space sector to avoid greenwashing, and ensure that carbon offsets are not used in place of achievable emission reduction measures.



# ACTIONS ACHIEVED

## Action 2.1.2

### **PROMOTE THE NEED FOR LEGISLATIVE CHANGE TO CATALYSE A MORE SUSTAINABLE SECTOR**

Work towards a legislative basis for space sustainability in Scotland based on the gaps identified in A1.1.1 and the experience gained by industry while applying the short-term actions of the Roadmap. Building on examples such as the French Space Operations Act, lobby for a specific, UK-wide space sustainability legislation which mandates compliance with space sustainability guidelines for UK satellites and launches. At a minimum, work to ensure the guidelines of the IADC and the UN COPUOS become legally binding.



## Action 2.1.3

### **RAISE INTERNATIONAL AWARENESS OF SPACE SUSTAINABILITY PROPOSED ACTIONS IN SCOTLAND**

Raise the international profile of Scottish space activities nationally and internationally to catalyse similar efforts and position Scotland as a leader in space sustainability. There is also an opportunity to develop links with other organisations and countries promoting space sustainability. Promote the resources developed in A1.4.1.



## Action 2.1.4

### **DRIVE UK SPACE AGENCY SPACE SUSTAINABILITY INITIATIVES**

The UK Space Agency is working to establish leadership in-space sustainability in line with the UK Space Strategy. To make as much of an impact as possible, it is vital to align with space sustainability initiatives in the wider UK to avoid duplication of effort and to pool resources effectively. This can be achieved, for example, through ongoing collaboration with the UK Space4Climate Net Zero task force. The Scottish space sector can act as a flagship region for sustainability within the UK and lead by example.



## Action 2.2.1

### **DEVELOP SKILLS IN THE SCOTTISH SPACE SECTOR**

Support the development of specific skills within the Scottish Space Sector by, for example, providing scholarships to the European Space Agency's (ESA) Industrial Space Life Cycle Assessment Course or organising bilateral sessions with leaders in other sectors to transfer best practice. Ensure that the sector has the necessary skills for the future by supporting the Scottish Space Academic Forum and engaging with Scottish universities offering courses relevant to the space sector. Support the development of green space sector jobs and contribute to the just transition in Scotland.



# LESSONS LEARNED

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## SPACE SUSTAINABILITY IS COMPLEX

Space presents technical, regulatory, and logistical challenges. Achieving space sustainability multiplies that difficulty. The interplay between orbital debris management, green launch technology, and Net Zero ambitions requires coordination across diverse domains and various stakeholders.

## COORDINATION IS KEY BUT DIFFICULT

Translating a broad vision into tangible, trackable actions proved challenging. Establishing clear ownership for work packages and securing funding takes time and has limitations. Structured frameworks have created a coherent mechanism for accountability and progress.

## RISK AND REWARD

Progress accelerated when financial incentives were introduced to reward sustainable practices, such as funding better propellant research and development or supporting life-cycle assessments; however, the absence of enforceable regulation limits impact.

## COMMUNICATION & COLLABORATION ARE VITAL

Workshops, cross-sector partnerships, and clear communication of sustainability benefits helped align stakeholders around shared goals. Promoting transparency built credibility and trust within and beyond Scotland's space community.

## MOMENTUM AND AWARENESS ARE GROWING

Despite the hurdles, progress is tangible. There is a stronger shared understanding of what "sustainable space" truly means and growing recognition that Scotland is positioning itself as a global leader in this emerging field.

## THE IMPORTANCE OF SCIENCE

In the space sustainability debate, there is often a lack of substantiating scientific evidence. Scientific evidence should guide the development of guidelines, regulations and standards to help support informed decisions.

# INTERNATIONAL COLLABORATION

Our work has demonstrated how the global dimension of space sustainability cannot be relegated to a single nation or sector. We began in the UK, where we gained recognition from the UK Space Agency and organisations such as Space4Climate and GNOSIS. Building on this, we extended our reach, engaging with the European Space Agency by signing the Statement for a Responsible Space Sector in September 2024. The statement pledges to “provide a foundation for the sustainable, long-term economic development of the space sector ... for the benefit to all of society.”

We also connected with the United Nations Office for Outer Space Affairs (UNOOSA) under its awareness-raising and capacity-building work tied to the Guidelines for the Long-Term Sustainability of Outer Space Activities (LTS). We also have members who are part of the Inter Agency Debris Coordination committee and are working with national and international space agencies to define guidelines and seek solutions to allow a sustainable use of space.

Our engagement didn't stop in Europe! We were invited by the Australian Space Agency to review their sustainability strategy, and we were able to join the Centre National d'Études Spatiales (CNES) Space for Climate Observatory (SCO) programme (with vital support from a Scottish Development international in Paris, Sonda Dalton). Via the Scottish Government's Space Envoy, Daniel Smith, we opened discussions with Middle Eastern countries and the Malaysian Space Agency leading to a Memorandum of Understanding (MOU) signature.

Our international outreach has been multifaceted: policy and working-group participation, strategic advisory roles for non-UK agencies, and global visibility-building efforts via initiatives such as the Earth & Space Sustainability Initiative (ESSI). ESSI has already collated thousands of space-sustainability standards and is driving the development of globally recognised Space Sustainability Principles.

# **INTERNATIONAL COLLABORATION**

Reflecting on successes and challenges: the ability to secure invitations and influence shows that we are no longer just locally referenced but internationally engaged. However, achieving tangible outcomes from these global engagements requires sustained follow-through. This includes aligning multiple stakeholders, converting strategic interest into joint programmes, and embedding our voice into decision-making structures. Furthermore, the breadth of international outreach emphasises how space sustainability is not just technically complex, but deeply political and multi-layered: governance frameworks, capacity-building demands, national strategic agendas, industry dynamics all intersect and complicate the path forward. This again confirms the space sustainability domain, while exciting, demands patience and persistence.

Looking ahead, our global engagements have positioned Scotland not just as a contributor but as a convenor and influencer in the international space sustainability arena.

Our call to action is simple: let's convert this international recognition into concrete partnerships, shared research, and globally scaled programmes that amplify Scotland's impact. Together, we are moving in the right direction, and the world is taking notice.

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# Space Sustainability A Roadmap for Scotland