Sustainable Corporate Finance and Space Activities: Towards a Sustainable Space Taxonomy

Lucien Rapp, Maria Rhimbassen and Maria Topka[*]

Abstract

Sustainable Corporate Finance (SCF) intends to respond to the climate challenge by imposing on financial operators a responsible approach in their investment operations. It takes place in the context of the European Green Deal and seeks to take advantage of the challenges and opportunities that the COVID19 crisis is offering to the spacefaring nations. Space activities should be primarily concerned by SCF. Some space activities such as earth observation contribute to the fight against climate change; they are virtuous and should attract responsible investors. Others are or may be polluting, whether it be the accumulation of space debris or the effects of uncontrolled development of space mining or space tourism. SCF could therefore contribute to reshape the global space ecosystem.

This article builds on a recent proposal for a Sustainable Space Rating (Rathnasabapathy et alii, 2020). In line with the current efforts of the European Union in the framework of the European Green Deal (Disclosure Regulation, 2019), it suggests the development of a Sustainable Space Taxonomy to encourage public and private investors to invest in industries that are sensitive and respectful to the environmental risks of outer space. To this end, it describes some contextual elements, pointing out the establishment of a new financial ecosystem following the emergence of private initiative in the space sector. It then analyzes the architecture of the various measures taken in Europe around the Disclosure Regulation. Thirdly, it shows the conditions and modalities of their adaptation to the space sector and paves the way toward a Sustainable Space Taxonomy.

Keywords: Space Traffic Management, Sustainable Space Rating, Sustainable Corporate Finance, Disclosure Regulation, European Green Deal, Sustainable Space Taxonomy

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1. Introduction

With the increase in the number of spacefaring nations and the development of numerous uses of near space – from mega-constellations[1] to space tourism[2] –, the question of space traffic management has taken on primary importance for the international community in recent years. It is nothing less than to safeguard the freedom of access to space, a cardinal principle of international space law, as enshrined in Article 1 of the 1967 Space Treaty.

If the need for an STM immediately rallies the opinion of all attentive observers of the evolution of the space sector and is today the object of an international consensus, the question as to the **form of the STM** and, even more so, the **means of effectively implementing it,** remains controversial. Should the system be separate from the air transport system or coupled to it? Should States or groups of States be encouraged to build their own system through the requirements of their national laws or within the framework of integrated trade areas? Should we elect cooperative solutions as much as possible, by multiplying international agreements, or even by seeking a global one? Should we use more subtle methods, based on incentives for operators to be transparent about their projects, the risks they entail and the means put in place to deal with them?

Relating to the later, an original idea was put forward a few months ago, that of putting in place indicators, so called Sustainable Space Rating[3] that would make it possible to identify these risks and to follow step by step the means of correcting them, if not anticipating them.[4]

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1 According to BryceTech (Small Sat by the Numbers Report, Aug.2021), 40% of all total smallsats launched in the last 10 years were launched in 2020; 43% of total upmass in 2020 was represented by smallsats; The number of commercial smallsats launched increased from three smallsats in 2011 to 1,111 in 2020; The number of smallsats launched in the first six months of 2021 already surpassed the 2020 record

2 Among the many articles published in the run-up to or in the aftermath of the two suborbital flights by Richard Branson and Jeff Bezos in May and June 2021 are: Whitman Cobb W., Space Tourism - 20 years in the making – is finally ready to launch, *The Conversation*, 28 April 2021; Freeland S., Keen to sign up for space tourism? Here are 6 things to consider (besides the price tag), *Space Policy*, 23 July 2021.

3 Rathnasabapathy M. et alii. *Space Sustainability Rating: Designing a Composite Indicator to Incentivise Satellite Operators to Pursue Long-term Sustainability of the Space Environment*, 71st International Astronautical Congress (IAC), The CyberSpace Edition, 12-14 October 2020

4 This approach is in line with the observations made by Lt. Gen. John Shaw, U.S. Space Command deputy commander, on Aug. 9, 2021, in a keynote at the 35th Small Satellite conference: "Satellite developers and owners should be thinking beyond end-of-life disposal. Satellites should be designed to ensure they do not fall apart when they get old or things happen aboard the satellites (…) Overall, the entire lifecycle the satellite has to be built with an emphasis on sustainability."

However, this approach should face two major difficulties. The first is that it is adapted to a world in which the financing of space activities still comes for a large part from public budgets, which is the case today. However, the current evolution of the financing of space activities post-Covid 19[5] makes it possible to anticipate the decline of public funding in favour of increasingly important forms of private funding. Some are already putting forward the idea of a vast public-private partnership.[6] Furthermore, although some national legislations are likely to implement effective sanction mechanisms, notably by refusing to authorize the launch or placing in orbit of space objects whose indicators are not satisfactory, one should not be under any illusion: not all national legislations do so. There is therefore a risk of forum shopping by the operators themselves.[7]
The main idea of this article is to suggest to correct these two shortcomings, by crossing the proposal for an SSR with the transparency efforts required in Europe from ethical banks and funds in the framework of the European Green Deal (Disclosure Regulation and EU Taxonomy).
This leads to a number of proposals through

- a quick reminder of some of the recent evolution of the global space industry (II),
- a description of the innovative methodology implemented by the European Union in the financial sector (III), and,
- a feasibility study of their transposition to the space sector (IV),
- leading to a few conclusive remarks (V)

2. Elements of context

Recent evolutions are deeply transforming the world space ecosystem. Most of them affect the space infrastructure itself, in relation with the deployment of mega-constellations. The launch of the first satellites of these mega-constellations (2.1) favors the emergence of a new industrial eco-system (2.2) and stimulates the imagination of financial intermediaries (investment funds, banks, insurance companies), in search of lucrative investments in innovative sectors (2.3).

5 2021 looks to have started with a strong headline number of around US$480 million of space financing rounds in the sole month of January (Roettgen R., Space Watch Global, Jan 2021): McCurdy Howard E., Financing the New Space Industry, Breaking Free of Gravity and Government Support, Palgrave Studies, 2019, Morgan Stanley, *Space Investing in the Final Frontier*, 24 July 2020,

6 Howard D., *Between traditional procurement and venture capital: an update on P3s in the space sector*, SIRIUS' Talks, 2018 (www.chaire-sirius.eu).

7 Rhimbassen M., *An Introduction to Space Antitrust, Open Lunar Foundation*, 6 June 2021.

2.1. New space infrastructures

The new space infrastructures[8] have three characteristics that determine their specificity compared to those of the previous generation:

- They are designed to meet **very terrestrial needs**: those of emerging markets such as East and South Asia, those of additional broadband capacity in the era of 5G and the Internet of Things, and those still linked to the need for ubiquity (positioning, surveillance, communication), mobility (transport and logistics), and the mobilization of increasingly precise information in a global economy. In so doing, it widens the gap between the **near space** dedicated to terrestrial uses of space technologies (communication, earth observation, positioning) and the **deep space**, which remains an object of exploration; the former can be financed by private capital, the latter remains dominated by major public programs launched by States and conducted by their national agencies;
- They are a source of **new needs in outer space itself**, for the maintenance of constellations whose satellites have limited capacities and lifetimes, also referred to as "midstream" activities. It requires the mechanization of construction operations and the establishment of real production lines for small satellites. It presupposes their availability "in bulk" and their launch, in "rideshare". It calls for the multiplication of intervention operations and their perpetuation in space itself, in the form of dedicated services (in-orbit services). But it is also the source of new concerns, related to orbital congestion and the accumulation of debris in near space and the need for surveillance, if not joint space traffic management (SSA, STM), which do not yet exist and will have to be created;
- They produce **space-derived data** whose considerable mass and the possibility of processing it in large number. Advances in artificial intelligence should open up promising markets for many commercial applications of space technologies. These space infrastructures are thus evolving into enablers of industries and markets that rely on the data sets and imagery transmitted to provide applications spanning across very diverse sectors, such as navigation, the oil and gas industry, communications, forestry, agriculture or even the military sector. Because of the operation of such space infrastructure, the markets for applications is becoming increasingly diversified.

8 By mid-2021, 1,500 of the 42,000 microsatellites have already been launched. With the current projects, 7,000 new microsatellites should be launched in the next 10 years. From the year 2022, an average of 550 satellites should be put into orbit each year.

With the development of constellations of small satellites, the space infrastructure is diversifying beyond reason, branching out to excess, becoming commonplace, losing its specificity. But in doing so, it is also becoming dematerialized, privatized and internationalized, increasingly escaping the control of states.[9] Perhaps tomorrow it will be wholly externalized, spreading out in space itself, without any established link with State?

2.2. New space industry

The new space infrastructures encourage the arrival on the market of a whole set of new entrants, whose the logic is the antithesis of the public programs that characterized the beginnings of the space adventure. Because these companies cannot always count on public funding, they have built their projects on strategies that combine different factors:

- cost-efficiency – a particular and almost obsessive attention to costs and their reduction (e.g. developing reusability capacities, employing design-to-cost techniques, additive manufacturing),
- expanding one's customer bases – the generous promise of access for the greatest number of people to the new technologies resulting from advances in space research, echoing the founding principles of international space law,
- sustainable markets – an ecosystem-based approach to markets that emphasizes club effects and whose slogan is explicit: the more suppliers and customers there are in a given market, the more sustainable the market itself,
- new business trends and models – solid industrial partnerships that are only destined to become permanent as long as each partner remains the complement of the other and does not aspire to become its competitor,
- diversification strategies – vertical integration (into up-, mid- and downstream sectors), data-driven business models, careful gap analyses and attention to emerging market opportunities,
- novel financing methods and risk-sharing – since institutional funding is not always available, attention is turning towards private funding- and investment schemes (e.g. venture capital funds, private equity, seed capital, "angel investors"). As a result, risks and responsibility are shared with, or even transferred to, the industry rather than the public sector.

9 Rapp L. and Topka M., Small Satellite Constellations, Infrastructure Shift and Space Market Regulation, in Annette Froehlish (ed.), *Legal Aspects around Satellite Constellations, Vol.2, Studies in Space Policies*.

2.3. New space finance

The opportunities offered by the above two developments occur in a financial context dominated by four important factors:

- an exceptional abundance of investment-ready cash,
- a lesser enthusiasm for government bonds, even if they remain very attractive to international investors. This lesser enthusiasm could increase if, given the extent of the indebtedness of many States, particularly in the context of the COVID19 pandemic, interest rates were to rise, putting the most vulnerable States at risk of default. In Europe, the solidarity between the Member States of the European Union could also meet with limits and cause difficulties for the States of Southern Europe, which are the most exposed;
- a desire of many investors not to miss out on the next industrial revolution. Many of them missed out on the previous one, because of a lack of anticipation. They are now keen to invest in the sectors that appear to be the most innovative, even if the prospects for a return on investment are not immediate;
- the growing attractiveness, stimulated by several government initiatives, notably in Europe, for ethical financial products in the double sense of financial products in environmentally friendly sectors and financial products, which go in the direction of inclusive development.

Space is one of the few economic sectors that offers the most opportunities today (start-ups, growth scenario, mega- constellation projects …).

Space and Finance

Following the development of more and more private and commercial space activities, the links between space and finance are becoming closer. These links were first built around the delicate issue of financing space explorers while safeguarding terrestrial finance (Cahan, Marboe and Roedel, 2016), and more particularly, the valuation of space-based assets and securities that could be taken on them. The Cape Town Convention helps to bring legal solutions to this important question. In recent months, they were articulated around the question of financing space start-ups (space angels, venture capital) with a current focus on the exit conditions of initial investors (acquisition, IPO through SPAC, growth equity). The links between space and finance could tomorrow raise the question of the regime of financial companies installed on space platforms and operating outside the scope of financial regulations. We can anticipate what the problems of financial regulation would be if these platforms were to market operations denominated in crypto-currencies. However legal solutions can be found, based on the distinction between the service provided and the platform itself (Rapp, Topka and Mallowan, 2021).

These projects have led to the emergence of a number of highly innovative financing systems, from start-up fundraising to the IPOs of a few unicorns, via the use of shell companies and SPAC-type financial arrangements.[10] In the first six months of 2021, a total of 227 billion US dollars was raised on the international financial markets, mainly in the United States, through 700 SPACs (Special Purpose Acquisition Companies). Significantly, nearly one third of this amount was invested in numerous start-ups in the space sector, including the following companies: Redwire, Adcole Space, Deep Space Systems, Deployable Space Systems, Momentus, Spire, Virgin Orbit …

Therefore, a specific financial eco-system is progressively being implemented, which, significantly, is now likely to provide the growth capital necessary for any emerging industrial project. This new financial eco-system dedicated to investments in the space sector is not bound to replace the public financing system, which for a long time seemed to be the only system for financing space activities, notably because of the scale of the investments to be made. It should complement it. Their joint mode of operation is illustrated by the commercial practices of the SpaceX company, whose development owes much to the financial support of NASA through the programs and missions that have been entrusted to it. This financial support accounts for half (53%) of the financing needs of SpaceX, which raises the additional sums it needs both from the private financial sector (25%) and from its own shareholders (22%). In addition, the rates offered by SpaceX for the launch of its customers' satellites on a Falcon 9 rocket can remain very attractive given the market prices (from 40 to 60 million U.S. dollars), because SpaceX charges NASA more than 90 million U.S. dollars for its launches.

The idea supported in this article is to go through this financial ecosystem to put pressure on the industrial ecosystem itself and to force it to respect a set of specific requirements allowing to reduce the risks incurred by the congestion of the near space and perhaps in the long term to reduce the need for space traffic management systems. As previously noted, it stands as an extension of the recent proposal for a sustainable space rating (SSR), which it seeks to complete, by clarifying it and even more, by making it implementable on the model of the efforts currently being made by the European Union in the framework of the Green Deal.

3. Description of the methodology implemented within the EU Green Deal

The following developments describe the efforts made within the European Union in the framework of the EU Green Deal, with particular attention to the methodological aspects. The methodology followed within the European

10 Rapp L., *From Space to SPAC, Proceedings of the SFDI Symposium*, held in Toulouse, on 5-6 May 2021, Pedone, Paris 2021 (publication expected in November 2021).

Union is very instructive and can inspire a comparable methodology in the space sector.

In the following developments, we shall observe that in order to reach a global and ambitious objective called the **EU Green Deal**, the European Union has identified, as it generally does, a certain number of legal projects to be undertaken, which are as many groups of actions to be implemented in order to achieve the result. Among these legal projects is that of **sustainable finance** (**SF**), which is essentially based on a European regulation, the **Disclosure Regulation**, imposing an obligation of transparency on financial intermediaries (banks, insurance companies, investment funds, etc.) that market financial products deemed "green".

To achieve this, the European Union was led to specify the objective of sustainable finance, and then to classify the industrial activities concerned into three categories, depending on whether they contribute substantially to the objective pursued, do not cause irremediable harm to it or meet a set of minimum criteria of acceptability. Thirdly, it had to develop a **Taxonomy** with quantitative elements and specific metrics that would allow how and to which extent the intermediaries concerned and their products fulfil these objectives or fall within these classifications. The whole constitutes a particularly interesting and sophisticated process, that provides a precise and operational measuring instrument of the strategies of the financial intermediaries concerned.

3.1. EU Green Deal

The European Green Deal[11] is an EU growth strategy that consists of policy initiatives, taken with the overarching aim to render Europe a climate-neutral continent by 2050 and transform the European economy into a clean, resource-efficient, circular economy. The goal is to eliminate net emissions of greenhouse gases by 2050 and protect and conserve EU's natural capital by promoting an economic growth that is "decoupled from resource use."[12] Considering that the aim the Green Deal is to respond to climate- and environment related challenges, it is also a key part of the European Commission's strategy to implement the United Nation's 2030 Agenda and its Sustainable Development Goals.[13]

11 European Commission, The European Green Deal, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, COM/2019/640 Final, 2019, https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1588580774040&uri=CELEX:52019DC0640 [hereinafter: "The European Green Deal"].

12 European Commission, The European Green Deal, sec. 1.

13 European Commission, The European Green Deal, sec. 1.

In order to achieve and attain the above, in its Communication of 11 December 2019 titled "The European Green Deal", the Commission designates several policy areas in which various strategies, measures and investments will have to be pursued.

One of the main ways in which the Commission aims to pursue these objectives is the use of green finance and green investment mechanisms. In this objective, the European Commission presented the Sustainable Europe Investment Plan[14] that includes dedicated financing to fund sustainable investments and proposals conductive to green investment.[15] Apart from European public funding, one of the most important stepping-stones for achieving the objectives of the EU Green Deal will be the financial system itself, which -- through the directing of financial and capital flows to green investment-- will contribute towards achieving Europe's green transition.

In this respect, the private sector will also have its own role to play in transforming Europe into a climate-neutral economy. Notably, the realization of the green transition will rely (**i**) on the requirement that companies and financial institutions increase their **disclosure on climate and environmental data pertaining to their activities**.[16] Such disclosure will increase transparency and thus it will aid investors to be fully informed about the sustainability of their investments. To this end, the Commission will also promote measures, such as clear labels for retail investment products, or by developing an EU green bond standard, so that it is easier and more convenient for investors and companies to identify sustainable investments.

On the other hand, in order to strengthen the very foundations for sustainable investment, the Commission proposed in its Communication that (**ii**) the European Parliament and the Council determine and adopt the **taxonomy necessary to classify environmentally sustainable activities**.[17] A common, harmonized EU taxonomy will enable the implementation of the European Green Deal by providing appropriate definitions to companies, investors and policymakers on which economic activities can be considered environmentally sustainable.[18] This came about with the adoption of the EU Taxonomy Regulation (see below) which is expected to create security for

14 European Commission, Sustainable Europe Investment Plan & European Green Deal Investment Plan, Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions, COM/2020/21 Final, 2020, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0021 [hereinafter: "Sustainable Europe Investment Plan"].

15 European Commission, The European Green Deal, sec. 2.2.1.

16 European Commission, The European Green Deal, sec. 2.2.1.

17 European Commission, The European Green Deal, sec. 2.2.1.

18 "EU Taxonomy for Sustainable Activities," European Commission, accessed June 27, 2021, https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en.

investors, mitigate market fragmentation and ultimately shift investments towards financial products and services that support the green transition.[19]

3.2. Disclosure Regulation

As mentioned previously, sustainable finance is one of the cornerstones of the EU Green Deal. One of the ways to achieve it is through sustainability-related disclosure in the financial services sector, which in turn will help align investment decision-making with sustainable investment objectives. The Disclosure Regulation[20] renders sustainability-related considerations a key component of the European financial policy. The Regulation lays down harmonized rules which require financial market participants (i.e. all entities offering financial products where they manage clients' money, such as asset managers[21]) and financial advisers to be transparent and disclose specific information regarding sustainability-related impacts, integration of sustainability risks and further sustainability-related information concerning their processes and financial products (Article 1 of the Regulation).

Such disclosure will reduce information asymmetries, which in turn will help end-investors identify environmentally sustainable investment opportunities.

In order to facilitate the coherent and consistent application of its provisions, the Disclosure Regulation provides a **harmonized definition of the term "sustainable investment**." Article 2(17) of the Regulation defines it as:

(i) an investment in an economic activity that contributes to an environmental objective,[22] or,
(ii) an investment in an economic activity that contributes to a social objective,[23] or,
(iii) an investment in human capital or economically or socially disadvantaged communities.

Having established what constitutes a sustainable investment, the Regulation then lays down in concrete terms several transparency/disclosure indicators

19 "EU Taxonomy for Sustainable Activities."
20 Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector, Official Journal of the European Union L 317/1 (2019) [hereinafter: "Disclosure Regulation"].
21 "EU Taxonomy for Sustainable Activities," European Commission, accessed June 27, 2021, https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en.
22 "[A]s measured, for example, by key resource efficiency indicators on the use of energy, renewable energy, raw materials, water and land, on the production of waste, and greenhouse gas emissions or on its impact on biodiversity and the circular economy…"
23 "[I]n particular an investment that contributes to tackling inequality or that fosters social cohesion, social integration and labour relations …"

and requirements that financial market participants and financial advisers are under. These encompass:

- **sustainability risk policies** – the obligation to release information about their policies on the integration of sustainability risks in their investment decision-making process and in their investment or insurance advice, respectively (Article 3);
- **adverse sustainability impacts at entity level** – "adverse sustainability impacts" refer to the impacts of investment decisions and advice that result in negative effects on sustainability factors.[24] Accordingly, financial market participants are under the obligation to publish and maintain on their websites their due diligence policies adopted to deal with the adverse impacts of investment decisions on sustainability factors depending on the particularities of the financial product they make available, while financial advisers on the other hand must be transparent on whether they consider in their investment advice or insurance advice such adverse impacts (Article 4);
- **adverse sustainability impacts at financial product level** -- for each financial product, a clear and reasoned explanation should be provided to answer to the question of whether and how this financial product considers principal adverse impacts on sustainability factors; but if the financial market participant does not consider these adverse impacts, then a statement explaining the reasons why should be included (Article 7);
- **their remuneration policies** – remuneration policies should include information on how those policies are consistent with the integration of sustainability risks (Article 5).

The Regulation covers both (i) financial products that have sustainable investment as their objective, and (ii) financial products that promote, among other characteristics, environmental or social characteristics. Both types of financial products must adhere to the following obligations:

- **pre-contractual disclosure** – before entering into contractual agreements with investors, financial market participants must make disclosures concerning how sustainability risks are integrated into their investment decisions (including how these risks might affect the returns of the pertinent financial products); similarly, financial advisers must make descriptions of which sustainability risks are integrated into their investment or insurance advice (Article 6). Then,

24 Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector, Official Journal of the European Union L 317/1 Recital 20.

  - if the financial product has sustainable investment as its objective, information that should be disclosed concerns either (a) any index that might have been designated as reference benchmark, or (b) an explanation on how that objective is to be attained (Article 9);
  - if the objective is the promotion of environmental or social characteristics or both, then information should be provided concerning how those characteristics are met, and if an index has been designated as a reference benchmark, then information on whether and how this index is consistent with those characteristics should also be included (Article 8).
- **product-level website disclosures** – for each financial product, financial market participants should publish on their websites information, such as, e.g., that product's environmental or social characteristics or the sustainable investment objective it pursues, as well as the methodologies used to assess these characteristics and the sustainable impact of the financial product in question (Article 10);
- **disclosure by means of periodic reports** – information concerning the extent to which environmental or social characteristics are met, or the overall sustainability-related impact of the financial product (Article 11).

In order to precise the content, methodologies and presentation of the relevant information to be disclosed under this Regulation, the aforementioned disclosures will then be accompanied by regulatory technical standards (RTS) jointly developed by the European Supervisory Authorities (consisting of EBA, EIOPA and ESMA; collectively "ESAs") for this very purpose.[25]

3.3. EU Taxonomy

To meet the EU's climate and energy targets for 2030 and fulfil the wider objectives of the European Green Deal, the EU adopted on 18 June 2020 the Taxonomy Regulation.[26] Through the adoption of a clear, detailed and robust EU-wide taxonomy, it lays down a common language and a harmonized set of criteria concerning which economic activities should be deemed to qualify as environmentally sustainable.

25 "Sustainability-Related Disclosure in the Financial Services Sector," European Commission, accessed June 30, 2021, https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/sustainability-related-disclosure-financial-services-sector_en.

26 Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the Establishment of a Framework to Facilitate Sustainable Investment, and Amending Regulation (EU) 2019/2088, 22 June 2020, Official Journal of the European Union L198/13 [hereinafter: 'Taxonomy Regulation'].

More specifically, the Taxonomy Regulation introduces first an exhaustive list of environmental objectives that sustainable economic activities should contribute to. These objectives are (a) climate change mitigation, (b) climate change adaptation, (c) the sustainable use and protection of water and marine resources, (d) the transition to a circular economy, (e) pollution prevention and control and (f) the protection and restoration of biodiversity and ecosystems (Article 9 of the Regulation).
Then the Regulation lays down the criteria based on which an economic activity is to be considered as environmentally sustainable, namely:

(a) it contributes *substantially* to one or more of the aforementioned environmental objectives;
(b) it does not significantly harm any of the other environmental objectives;
(c) it complies with minimum safeguards pertaining to social and governance aspects, and
(d) it complies with technical screening criteria developed by the Commission for each environmental objective.

These technical screening criteria serve to assess whether the contribution to an environmental objective is substantial or whether the economic activity in question causes significant harm to one or more objectives. They are to be developed through delegated acts by the Commission and they may take the form of quantitative thresholds or minimum requirements, relative improvement, sets of qualitative performance, process or practice-based requirements, etc., depending on the type of economic activity being considered.
A first delegated act concerning the "climate change adaptation" and the "climate change mitigation" objectives – referred to as "EU Taxonomy Climate Delegated Act"[27] – is currently under scrutiny by the co-legislators, while a second delegated act on the remaining environmental objectives is expected to be published in 2022.[28]

27 Commission Delegated Regulation (EU) …/... Supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by Establishing the Technical Screening Criteria for Determining the Conditions under Which an Economic Activity Qualifies as Contributing Substantially to Climate Change Mitigation or Climate Change Adaptation and for Determining Whether That Economic Activity Causes No Significant Harm to Any of the Other Environmental Objectives, C/2021/2800 Final (2021), available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=PI_COM:C(2021)2800 [hereinafter: 'EU Taxonomy Climate Delegated Act'].

28 EU Taxonomy for Sustainable Activities," European Commission, accessed June 27, 2021, https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en.

4. A Sustainable Space Taxonomy (SST)

In an era where private investment in space-enabled activities is increasingly more common, such investment could play an instrumental role towards the promotion of a more sustainable use of the outer space. For this reason, it is proposed that a financial regulatory framework should be set in motion that will integrate Sustainable Corporate Finance (SCF) considerations in the context of space activities, so as to ensure that financial resources are directed towards activities that promote space sustainability and/or space activities that have limited negative effects onto it.

In order to render such a regime feasible from a legal standpoint, it is first essential to determine **what constitutes a sustainable space activity** and subsequently establish what a sustainable investment in the space sector is. This may be achieved through the adoption of a "space taxonomy" laying down a common language for what can be considered an environmentally sustainable activity in the outer space context. Based on this space taxonomy, then, various requirements may be set forth so as to promote investments in sustainable space activities. These may include **space sustainability related transparency- and disclosure requirements** which will serve a two-fold purpose: on one hand, they will oblige financial operators to follow a responsible approach in their investment operations and, on the other, they will enable end-investors to make considerably more informed decisions concerning the impact of their investments on space sustainability.

4.1. Elaborating a space taxonomy

The first step to determine the sustainability of a given commercial space activity, would be to define what is to be considered as a **sustainability objective** in the context of space activities. Within these lines, the Space Taxonomy could be established in order to identify, name and classify space activities according to their contribution to space sustainability objectives. In fact, the Space Taxonomy may even serve as a means to operationalize sustainability objectives set forth by international space law instruments, such as the UN COPUOS's Guidelines for the Long-term Sustainability of Outer Space Activities, COSPAR's Planetary Protection Policy, the International Charter Space and Major Disasters (UN-SPIDER), IADC Space Debris Mitigation Guidelines etc.

Based on these premises, examples of space sustainability objectives may include:

- **Sustainable space traffic –** maintaining and ensuring a safe, secure and predictable access to, return from, operation in and use of outer space (e.g. through space debris mitigation, reduction of orbital crowding, mitigation of space weather effects, management of uncontrolled reentries)

- **Sustainable use of outer space resources –** promoting best practices in the space industry so as to ensure efficient utilization of natural (space) resources and orbits, including the equitable and efficient use of the radio frequency spectrum,
- **Circular space economy –** promoting the recycling and reuse of materials, in-situ resource utilization, adaptability and resilience of systems to space phenomena etc., so as to decrease the need to transport material from the Earth into space, and
- **Planetary protection –** avoiding, for example, forward- and backward contamination, inter alia.

Subsequently, in order to assess whether a commercial space activity substantially contributes to a space sustainability objective, a dedicated **set of screening criteria** and measurement metrics will have to be elaborated for each objective. For example, metrics for the "sustainable space traffic" objective may include **space debris generation avoidance measures**, while metrics for the "circular space economy" objective may include **reusability of systems**, **ability to recycle spacecraft parts**, **percentage of electricity stemming from renewable energy sources** (rather than nuclear power sources), etc. (see Table 2). Similar metrics will also have to be established so as to ensure that each commercial space activity considered adheres to the do-no-significant-harm (DNSH) principle and, thus, does not harm any of the other sustainability objectives.
Then, in order to assess whether a specific commercial space activity contributes to an environmental objective or whether it significantly harms it, **performance thresholds** will have to be established for each metric. They may be both of quantitative character and/or qualitative ones, but this will depend on the nature and the particularities of the environmental objective being pursued.

Table 1. Examples of potential space-related adverse sustainability activities (sorted based on economic sector)

Sector	Relevant activity
Transportation	Launch services (e.g. transporting satellites to orbit) Space tourism Recovery of spacecraft …
ICT	Satellite-based internet Blockchain in space Satellite-based Internet of Things services Data processing, hosting and related activities …

Sector	Relevant activity
Data sharing	Earth observation and remote sensing data accrual and dissemination Navigation services Space Surveillance and Tracking (SST) data related services …
Manufacturing and construction	Construction of space stations and outposts On-orbit assembly, manufacturing and servicing 3D printing in space …
Energy generation and supply	Energy generation activities (through the use of He_3 /regolith, solar energy etc.) Manufacture of Hydrogen Production of Electricity from Solar PV Transmission and Distribution of Electricity Storage of Energy …

Table 2. Examples of potential criteria and proposed measurement metrics to assess whether a commercial space activity contributes to the respective environmental objective

Space sustainability objectives	Criteria/metrics
Sustainable space traffic	Space debris generation avoidance measures Debris removal or deorbiting …
Planetary protection	Backward contamination prevention measures Biological load / surface bioburden level (e.g. quantity of organisms present on a spacecraft) …
Circular space economy	Efficient use of outer space resources Degree of reusability of systems Degree of resilience of systems Recycling of materials Percentage of electricity stemming from renewable energy sources (e.g. solar power) …

4.2. Space sustainability related disclosure

Having laid down the outlines of a Space Taxonomy defining what constitutes a sustainable space activity, a **sustainable investment in the space sector** could be considered as an investment in a commercial space activity that positively contributes to a space sustainability objective, provided that it is not causing significant harm to any of the other objectives.[29] Within the context of a Sustainable Corporate Finance, it is vital that these are the very investments that financial resources are directed towards. Thus, to render this feasible, standardized transparency- and disclosure requirements may be set forth that will provide the basis for both financial operators and end-investors to determine whether an investment in space-related financial products contributes to space sustainability goals.

At entity-level, such disclosure may include policies on the integration of space sustainability risks into the financial operator's decision making processes. Simply put, this would mean that financial operators ought to be transparent about the existence and subsequent management of risks that could undermine the value of an investment and its returns, such as on-orbit collision risks, electromagnetic interference risks, risks arising due to space weather events etc. Additionally, financial operators may also be required to disclose how principal adverse sustainability impacts[30] are assessed and considered in their investment decisions. Such disclosure will include transparency about due diligence policies they have adopted against these adverse impacts and/or their level of compliance with relevant international standards and other legal instruments, such as e.g. the UN COPUOS's Guidelines for the Long-term Sustainability of Outer Space Activities.

At the financial product level, disclosures should be made regarding the integration of space sustainability risks into the investment decisions for each product, the potential effects of such risks on the returns of investments in these products and further information regarding how space sustainability objectives are pursued. It is important that such disclosures be made before entering into contractual agreements with the investors (pre-contractual disclosure), but also by means of periodic reports and website disclosure.

Evidently, in order to ensure a uniform and standardized assessment of the principal adverse impacts on space-sustainability factors, pertinent regulatory technical standards should be developed. This will require, first, the elaboration and adoption of relevant indicators specifically in relation with the outer space context, followed by the elaboration of metrics that will be

29 Cf. Article 2(17) of the Disclosure Regulation.

30 Principal adverse sustainability impacts are understood here as the impacts of investment decisions/advice that would have negative effects on space sustainability factors. Cf. Disclosure Regulation, Recital 20.

used to measure the impact of each of these indicators; such indicators and metrics may also include and expand upon those proposed under the "Space Sustainability Rating" concept[31] (see Table 3).
For example, one such adverse sustainability impact indicator may refer to "Space debris generation". Indicative metrics that could then be established to assess an investment with respect to this indicator may comprise: collision- and fragmentation risks, collision avoidance capabilities, resilient design to withstand collisions, end-of-life strategies, and so on. Table 3 proposes further additional adverse sustainability indicators and corresponding metrics that could be adopted.

Table 3. Examples of potential space-related adverse sustainability indicators and proposed metrics

Adverse Sustainability Indicators		**Indicative metrics to measure each indicator**
(Sustainable investment Objective)	**(Indicator)**	
Space Traffic	Space debris generation	1. Collision- and Fragmentation risk probability (based on the orbital position, number of other satellites and space debris present in the same orbit etc.) 2. Collision avoidance capabilities 3. Decommissioning-/end-of-life strategies (deorbiting, recycling, active removal …) 4. Adherence to IADC Space Debris Mitigation Guidelines, or others 5. Launching state has adopted national legislation requiring operators to limit space debris generation 6. Design that facilitates on-orbit servicing and repair 7. Generation of lunar dust (another form of space debris)/ containment measures

31 Letizia F. et al., "Framework for the Space Sustainability Rating," in *Proc. 8th European Conference on Space Debris* (virtual), Darmstadt, Germany, 20-23 April, April 20, 2021, available at: https://conference.sdo.esoc.esa.int/proceedings/sdc8/paper/95/SDC8-paper95.pdf.

Adverse Sustainability Indicators		**Indicative metrics to measure each indicator**
(Sustainable investment Objective)	**(Indicator)**	
	Space Surveillance and Tracking (SST)	1. Launching State carries out Registration in the UN Register of Space Objects Launched into Outer Space / is a signatory to the Registration Convention 2. Existence of SST data sharing mechanisms 3. Monitoring/prediction of the trajectory evolution of space objects 4. Ability to provide early warnings for uncontrolled reentries 5. Risk assessment of uncontrolled reentries 6. Detection/characterization of in-orbit fragmentations
	Space Weather	1. Space weather monitoring and risk assessment capabilities 2. Space weather data sharing 3. Design that ensures resilience / adaptability of systems to space weather events
Space Resources	Operational safety of mining operations	1. Adherence to the Hague Space Resources Governance Working Group's "Building Blocks for the Development of an International Legal framework on Space Resources Activities' 2. Establishment of safety zones around operations 3. Space resources mining operations being undertaken sustainably (e.g. measures to prevent lunar dust from impacting other operations or entering into lunar orbit)

Adverse Sustainability Indicators (Sustainable investment Objective)	(Indicator)	Indicative metrics to measure each indicator
	In-situ resource utilization	1. Contributes to decrease of dependance on terrestrial supply chains (thus reducing the need to transport material from the Earth), e.g. creation of feedstock for 3D printing purposes 2. Waste minimization processes 3. Life support
Planetary Protection	Exobiological contamination	1. Adherence to the Planetary Protection Policy formulated by the Committee on Space Research (COSPAR) 2. Bioburden reduction mechanisms 3. Contamination control protocols and strategies

Based on the results of the above assessments, it will be clarified how a space-related financial product fares in relation to each indicator, which will then be used to determine whether the financial product in question would impact negatively a given space sustainability objective. Financial operators will then be required to disclose this information on a "disclose or explain" basis, so that prospective investors can have a clear picture of the potential adverse impacts which their investments could have on outer space sustainability.
Overall, whereas the Space Sustainability Rating (SSR) aims to prompt spacecraft operators, launch service providers and satellite manufacturers to seek space sustainability related certification, the present proposal aims to approach the promotion of space sustainability goals from the financial and investment point of view. Moreover, it aims to expand the scope of these considerations so that – and in contrast to the SSR – space sustainability objectives are not constrained solely to the space debris mitigation objective, but cover, instead, additional issues that could prove to be detrimental to the sustainability of the outer space environment.

4.3. Implementing a Sustainable Space Taxonomy and space sustainability disclosure

Apart from the theoretical framework developed above, it is also necessary to consider how this framework could be implemented and put into practice in concrete terms. Three methods are proposed:

(i) International cooperation mechanisms,
(ii) Industry self-regulation through international standards-setting,
(iii) Incorporating sustainable finance rules within a space traffic management framework.

4.3.1. Implementation through international cooperation mechanisms

One method to establish a Space Taxonomy and subsequently develop a space sustainability related disclosure scheme is through an international cooperation framework whose aim would be to direct financial capital flows towards activities that promote the sustainability of outer space.

Considering that the risks that space sustainability is facing are likely to have global effects, it would be beneficial that efforts to put this into practice are as wide-reaching as possible; thus, the adoption of relevant binding international instruments on this matter would be useful. However, it is important to consider this approach from a pragmatic point of view and take into account that, in the present moment, States are rather reluctant to adopt binding legal instruments pertaining to space-related matters. Hence, for the time-being, flexible international cooperation schemes may be more preferable in the pursuit of elaborating a Space Taxonomy and sustainability related disclosure rules.

First of all, the elaboration of a space taxonomy may serve as the groundwork based on which financial disclosure rules may implemented. However, the usefulness of such a taxonomy would not be limited only to investment matters but may in fact also be relevant for the wider space sector, as the aim of the taxonomy is to elaborate what are the space sustainability objectives and determine which activities contribute to it. For this reason, it is recommended that it is developed under an international institution dedicated to space matters such as the UN Office for Outer Space Affairs (UNOOSA), and in particular the UN COPUOS Scientific and Technical Subcommittee, which could collaborate with governments, academia and industry stakeholders for this purpose. A U.N.-backed space taxonomy would be instrumental in establishing on an international level what may be understood as a space sustainability objective and lay the groundwork to determine which space activities contribute to these objectives.

The reason why it is proposed to pursue a space taxonomy via the United Nations, is because the majority States are likely to have convergent views on what constitutes a sustainable space objective and on which activities contribute to these objectives. That is because space sustainability is to a large degree a technical matter and less tainted by political considerations: simply put, the exacerbation of the debris generation phenomenon, for example, is likely to impact all actors wishing to access and operate in space, irrespective of their nationality. And although there have been some recent

instances of recklessness and irresponsibility in this regard,[32] the majority of the international community agrees that the sustainability of space is a pressing matter that is likely to affect present and future generations alike.[33]
The taxonomy would then provide an important basis for the alignment of financial considerations with space sustainability goals through financial disclosure. Willingness to adopt disclosure rules, however, is not unlikely to be dependent on national interest considerations. Thus, it is proposed that such initiatives pursued through a dedicated space sustainability related disclosure cooperation framework (e.g. established as a pertinent international forum) wherein relevant disclosure standards are developed and promoted. The development of such framework may be carried out within (or in analogy with) fora that have already been active in disclosure matters, such as the Financial Stability Board's Taskforce for Climate-related Financial Disclosures or the World Economic Forum.
Under these fora, consensus-based bodies of space-sustainability disclosure and transparency standards may be elaborated which could then be implemented by financial operators in both domestic and cross-border offerings of financial products. Apart from the development of disclosure recommendations and standards, however, such a forum could also be tasked with:

- Providing guidance and ensuring that the international disclosure standards are complied with and are implemented in a uniform manner internationally;
- Raising awareness on the importance of space sustainability and the subsequent need to disclose how investments may impact it, as well as highlighting how the financial sector itself could be affected by space sustainability related risks;
- establishing pertinent reporting and information exchange mechanisms;

32 China's Long March 5B uncontrolled re-entry in May 2021 being a recent example. See Jones A., "Long March 5B falls into Indian Ocean after world follows rocket reentry," *SpaceNews*, 9 May 2021, available at: https://spacenews.com/long-march-5b-falls-into-indian-ocean-after-world-follows-rocket-reentry/ (Accessed 1 August 2021).

33 As evidenced by the U.N. COPUOS's Guidelines for the Long-term Sustainability of Outer Space Activities which define long-term space sustainability as "the ability to maintain the conduct of space activities *indefinitely into the future* in a manner that realizes the objectives of equitable access to the benefits of the exploration and use of outer space for peaceful purposes, in order to *meet the needs of the present generations while preserving the outer space environment for future generations*" (emphasis added). Source: U.N. COPUOS, *Guidelines for the Long-term Sustainability of Outer Space Activities*, U.N. Doc. A/74/20, Annex II, 2019, sec. I para. 5.

- prompting States to enter into negotiations and pursue international agreements with each other, so as to adopt uniform rules, provide commitments relating to financial disclosure, establish common oversight and compliance mechanisms, as well as relevant networks necessary for the exchange of pertinent information, etc.

Most importantly, since these international standards and relevant policies will not initially be conceived to be binding, States should be encouraged to translate them into domestic rules that both domestic and foreign financial operators operating within their jurisdiction would be required to comply with. To draw a parallel: although space sustainability related international law instruments remain non-binding for now, many States are integrating space debris mitigation provisions into their national space legislation and translating them into legally binding rules (e.g. Australia, Canada, Finland, France, Greece, Japan, UK, USA).[34] Similar developments could also be envisaged with respect to space sustainability financial disclosure.

Similar efforts may also be pursued on a regional scale, notably within the EU. It should be noted in this regard that the Council of the EU has previously underlined the importance of space data, services and technologies for the implementation of the European Green Deal,[35] which makes it evident that the pursuit of space sustainability is also intertwined with the promotion of sustainability on Earth. Accordingly, in the European landscape, space sustainability related disclosure could be pursed in synergy with the EU Disclosure Regulation. Alternatively, within the EU this could also be pursued through "enhanced cooperation", which is a tool of flexible harmonization that enables a minimum of nine EU member-States to pursue advanced integration or cooperation in one of the areas covered by the EU Treaties.[36]

Furthermore, whether such rules are adopted internationally, regionally or domestically, their implementation is likely to require that pertinent supervisory authorities and information sharing mechanisms are established to oversee compliance. But in addition to that, there are also several other regulatory tools that could be put forth for this purpose. These may include financial incentives (ranging from tax incentives and tax exemptions to low-interest loans and grants) that will render financial products that positively contribute to space sustainability more attractive to invest in. In this manner, market demand would be re-oriented towards more sustainable investment

34 U.N. COPUOS, *Space Debris Mitigation Standards Adopted by States and International Organizations*, June 17, 2021, available at: https://www.unoosa.org/documents/pdf/spacelaw/sd/Space_Debris_Compendium_COPUOS_17_june_2021.pdf.

35 Council of the E.U., Council Conclusions on "Space for a Sustaible Europe," doc. 8512/20 Annex, June 4, 2020, p. 3, available at: https://data.consilium.europa.eu/doc/document/ST-8512-2020-INIT/en/pdf.

36 Böttner R., *The Constitutional Framework for Enhanced Cooperation in EU Law*, Leiden, The Netherlands: Brill Nijhoff, 2021, p. 8.

opportunities, which by consequence, may incentivize financial operators to comply with disclosure standards, or may even nudge them to make more sustainable financial products available. Certainly, financial rewards for compliant behavior may also be established.

Lastly, it should be recalled that the UN COPUOS's Guidelines for the Long-term Sustainability of Outer Space Activities recommend the promotion of international or regional cooperation initiatives as to achieve regulatory frameworks, standards and government methods that promote the long-term sustainability of outer space activities.[37] Thus, an international cooperation on finance that promotes investment in sustainable space activities would certainly be in line with this provision.

4.3.2. Industry self-regulation through ISO standards-setting

Another method through which disclosure requirements could be implemented is through industry self-regulation and, specifically, through international standard-setting. This could be achieved by elaborating space sustainability disclosure standards within the bosom of the International Organization for Standardization (ISO). The ISO is an independent and non-governmental international standard-setting organization which is tasked with the development of industry standards spanning across a wide variety of sectors.

More specifically, a standard is "a document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context".[38] Compliance to a standard enables interoperability, uniformity and broad functionality, which ultimately is beneficial for both consumers and product manufacturers.[39] However, ISO standards constitute non-binding soft law instruments whose elaboration and adoption is voluntary and consensus-dependent, thus compliance with them cannot be enforced. Nevertheless, it is important to highlight that ISO standards carry a special weight in the industry, particularly because adherence to them – evidenced through ISO certification – translates to legitimacy and favorable perception for the actors

37 U.N. COPUOS, *Guidelines for the Long-term Sustainability of Outer Space Activities*, op. cit. (note 5), Guideline C.3 para. 2.

38 ISO, Guide 59 - ISO and IEC recommended practices for standardization by national bodies, ISO/IEC GUIDE 59:2019(E), August 2019, sec. 3.8, available at: https://isotc.iso.org/livelink/livelink/fetch/2000/2122/4230450/8389141/ISO_IEC_Guide_59_2019%28E%29_-_ISO_and_IEC_recommended_practices_for_standardization_by_national_bodies.pdf?nodeid=8388826&vernum=-2.

39 See Bosworth D.S., Russell W. Mangum III and Matolo E.C., "FRAND Commitments and Royalties for Standard Essential Patents," in Bharadwaj A., Devaiah V.H. and Gupta I. (eds.), *Complications and Quandaries in the ICT Sector*, Singapore: Springer, 2018, pp. 20-22.

involved.[40] Hence, ISO standards have in fact been described as being practically "self-enforcing", despite not being hard law.[41]
Among the standards elaborated within the ISO framework one can also find standards relating to the space industry (pertaining to aircraft and space vehicles, space data and information transfer systems and space systems and operations), as well as sustainable finance standards.[42]
As concerns sustainable finance, in particular, the ISO standards that have been developed cover financial disclosure and reporting on environmental matters, as well. Indicatively, they standardize matters such as:

- the framework for assessing and reporting investments and financing activities related to climate change, including e.g. alignment with climate goals,
- the impact of investment decisions towards the achievement of climate goals,
- the risks to owners of financial assets arising from climate change, etc. (ISO 14097:2021);
- evaluation requirements and verification methodology for self-declared environmental claims (ISO 14021:2016);
- principles and guidelines on the environmental information to be included in companies' environmental reports (ISO 14016:2020).

With respect to the sustainability of the outer space, on the other hand, it is important to note, first and foremost, that the ISO has translated the IADC guidelines[43] into ISO standards.[44] It has elaborated standards concerning space debris mitigation, such as e.g. standards ensuring that spacecraft are designed, operated and disposed of in a manner that minimizes debris generation (ISO 24113:2019) and standards on launch vehicle disposal and safe re-entry requirements (ISO 20893:2021), inter alia.
Within this context, thus, space sustainability related disclosure could plausibly be implemented through the development of relevant standards

40 Davies J.B.P. and Woodburn J., "Approaches to and Loci for Regulation of Large and Mega Satellite Constellations," in Froehlich A. (ed.), *Legal Aspects Around Satellite Constellations, vol. 2, Studies in Space Policy*, 31, Cham, Switzerland: Springer Nature Switzerland, 2021, p. 61.
41 Ibid.
42 Ibid.
43 Inter-Agency Space Debris Coordination Committee (IADC), IADC Space Debris Mitigation Guidelines, IADC-02-01 Rev. 2, March 2020, available at: https://orbitaldebris.jsc.nasa.gov/library/iadc-space-debris-guidelines-revision-2.pdf.
44 Stokes H. et al., Evolution of ISO's Space Debris Mitigation Standards, First International Orbital Debris Conference, held in Sugar Land, TX, December 2019, available at: https://www.hou.usra.edu/meetings/orbitaldebris2019/orbital2019paper/pdf/6053.pdf.

within the ISO framework. The aim of these standards would be to promote common methodologies for risk assessment and disclosure practices in the industry. Concretely speaking, these could include disclosure requirements as proposed in Section 4.2, covering matters such as space sustainability risk management reporting and due diligence policies financial entities have adopted in order to withstand such risks. The proposed standards may determine the form and the content of the disclosure process (what information is to be disclosed), but they may also standardize the methods, procedures and measurements based on which space sustainability impacts are to be assessed by financial operators (how such information is to be disclosed). Relevant principal adverse space-sustainability impacts could be determined for this purpose, followed by the elaboration of pertinent indicators and metrics needed for the measurement of these impacts. Moreover, ISO standards could also be developed to standardize the content and formulation of pre-contractual disclosure, website disclosure and periodic disclosure (via reports, prospectuses etc.).

Having considered the above, it is important to note that, due to their pragmatic and consensus-based nature, international standards can circumvent political barriers, diplomatic objectives, and competitive rivalries,[45] and thus allow the industry to adapt more efficiently, if not rapidly, to technological developments and potential challenges arising therefrom. Hence, ISO standards may constitute a plausible means to implement and promote space-sustainability disclosure. Furthermore, it is not unlikely that over time, through a "bottom-up approach" such soft law instruments may eventually evolve to pierce together a wider, more legally binding regulatory regime.

4.3.3. Incorporating sustainable space finance rules within a Space Traffic Management framework

Space Traffic Management (STM) refers to "the set of technical and regulatory provisions for promoting safe access into outer space, operations in outer space and return from outer space to Earth free from physical or radiofrequency interference."[46] Since the objective of STM is to promote the sustainability and protection of the outer space environment,[47] these

45 Oltrogge D., "Space Standards at the ISO Level," ESA-ECSL Space Debris Workshop: Regulation, Standards and Tools, ESA ESOC, Darmstadt, Germany, March 20, 2019, p. 4, available at: https://conference.sdo.esoc.esa.int/proceedings/ecsl19/paper/5/ECSL19-paper5.pdf.

46 International Academy of Astronautics (IAA), Cosmic Study on Space Traffic Management, Paris: International Academy of Astronautics, 2006, p. 10.

47 Lucken R. and Heinrich S., "Space Traffic Management & Orbital Environment Sustainability in the NewSpace Era," UNCOPUOS Scientific and Technical Subcommittee, 58th Sess., Technical Presentations, Vienna, Austria, April 22, 2021, p. 3, available at: https://www.unoosa.org/documents/pdf/copuos/stsc/2021/tech-21E.pdf.

objectives also align with the goals of a Sustainable Corporate Finance in the space sector.

As such, it should be considered whether SCF could be combined with STM, so as to promote these objectives in concert.

Generally, an STM system is comprised of two dimensions: a technical and scientific one on one hand (encompassing, e.g., concrete space traffic rules, collision warning mechanisms, etc.), and a regulatory dimension on the other.[48] The latter dimension concerns mechanisms for the implementation and control of the STM system and may include inter alia, harmonized national licensing-, enforcement-, oversight- and arbitration mechanisms.[49] Within this dimension of STM, sustainable investment requirements and transparency could be incorporated, so as to incentivize investment in activities that promote and facilitate a sound and efficient management of space traffic.

Nevertheless, when considering the feasibility of such a development, one should also take into account the possible policy constraints that may arise, despite the advantages that a comprehensive STM regime represents. First, space still remains a decidedly sensitive sector in the eyes of the states, intrinsically tied with their national interests. For this reason, when it comes to space-related legal matters, States tend to place emphasis on freedom of action and avoid legally binding arrangements that would inhibit such freedom.[50] Since an international STM entails to a certain degree the relinquishing of control over national space activities to other actors or authorities, this have hindered, initially, the development of an STM regime.[51] As a result, recourse may be made to non-binding, soft law arrangements instead, at least in the beginning. These may include cooperation- and communication schemes within a space-traffic-coordination framework, which does not foresee the establishment of supranational bodies and processes.[52] But while this would certainly be a positive development, one should also keep in mind that its non-binding character means that enforcement would depend entirely on compliance, while uniformity of practice is not a given.

As long as national interest stands in the way of the development of a full-fledged international STM regime, recourse is initially also more likely to

48 International Academy of Astronautics (IAA), Cosmic Study on Space Traffic Management, op. cit. (note 18), p. 10.

49 Schrogl K.-U. et al., "The IAA Cosmic Study on Space Traffic Management," COPUOS, Vienna, Austria, April 6, 2017, p. 11, available at: https://www.unoosa.org/documents/pdf/copuos/lsc/2017/tech-10.pdf.

50 Blount P.J., "Space Traffic Coordination: Developing a Framework for Safety and Security in Satellite Operations," *Space: Science & Technology*, 2021, vol. 2021, sec. 2, available at: https://doi.org/10.34133/2021/9830379.

51 Ibid.

52 Ibid.

be made to national legislation and domestic practice. Indicatively, the United States has adopted its own National Space Traffic Management Policy (SPD-3),[53] which – quite tellingly – also makes reference to **governmental and commercial investment** in STM science and technology as a means to improve debris mitigation and collision avoidance capacities.[54]

Alternatively, regional regimes may also emerge. For example, the new EU Space Programme Regulation[55] includes a comprehensive Space Situational Awareness (SSA) component, which EU officials have referred to as "the precursor of a European Space Traffic Management system".[56] It is not unlikely that the technological and commercial developments in the space industry will push towards the adoption of a STM-related act on a European Union level. In fact, for the EU and ESA members, this may even be triggered by the need to decrease dependency on U.S.-originating SSA data, as well as respond to US-led competition on commercial science & technology (S&T), space situational awareness, and STM related services.

Nevertheless, it should be considered that the threats that the space environment is facing are not constrained to specific States or geographical regions, but instead they are bound to have wide-reaching and long-lasting impacts if they were to materialize. This calls for common efforts and harmonized responses, instead. It follows that an international, widely participatory STM regime that also incorporates sustainable space investment provisions, would presumably contribute to these efforts better than geographically limited arrangements would.

5. Conclusion

The adoption of a common Space Taxonomy will enable, on one hand, the definition of common objectives pertaining to the protection of the outer

53 *Space Policy Directive-3, National Space Traffic Management Policy (SPD-3)* of 18 June 2018, 21 June 2018, Federal Register Vol. 83, No. 120, p. 28969, available at: https://trumpwhitehouse.archives.gov/presidential-actions/space-policy-directive-3-national-space-traffic-management-policy/.

54 Section 5(1)(i) states: "Through both Government and commercial sector [science and technology] investment, the United States should advance concepts and capabilities to improve [space situational awareness] in support of debris mitigation and collision avoidance decisions."

55 Regulation (EU) 2021/696 of the European Parliament and of the Council of 28 April 2021 establishing the Union Space Programme and the European Union Agency for the Space Programme and repealing Regulations (EU) No 912/2010, (EU) No 1285/2013 and (EU) No 377/2014 and Decision No 541/2014/EU, Official Journal of the EU L 170, 12.5.2021, p. 69-148.

56 "12th Annual Space Conference - Closing Speech by Commissioner Thierry Breton," European Commission, January 22, 2020, available at: https://ec.europa.eu/commission/commissioners/2019-2024/breton/announcements/12th-annual-space-conference-closing-speech_en.

space environment, and on the other, the adoption of a common understanding of what specific terms that pertain to space sustainability encompass. The emergence of legal discrepancies will be prevented, while practices such as forum shopping will be avoided thanks to the harmonization that a widely accepted space taxonomy will ensure.

The proposed approach is not limited to space debris concerns as is the case with the concept Space Sustainability Rating proposed by the World Economic Forum; instead, it goes a step further to include additional sustainability related aspects and elements that would make up a comprehensive and effective space traffic management system. But it does not simply stop there; it also provides the possibility to include further issues that are essential in rendering the exploration and use of space, both sustainable: these range from sustainable utilization of space resources to planetary protection considerations. These latter considerations are, in turn, not only limited to the outer space environment, but – by aligning space sustainability considerations with terrestrial environmental objectives and requiring that space activities are planned and carried out in a manner that does not harm the Earth's environment – may also play an important role in pursuing terrestrial environmental objectives, as well.