

**THE REGULATION OF ROCKET EMISSIONS**

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## **ABSTRACT**

The accelerated pace of commercialisation of outer space activities indicates a drastic proliferation in rocket launches when activities such as space tourism and asteroid mining become feasible. However, the environmental impact of rocket emissions fails to be adequately governed by international space law. This thesis examines the need to regulate rocket emissions and aims to establish founding principles that may be applied to a mechanism for the international space sector. Chapter 1 presents the environmental hazards posed by rocket emissions, in particular focusing on the relationship between emissions, ozone depletion and climate change. Chapter 2 then substantiates the necessity for new regulation by identifying how rocket emissions fall beyond the scope of the space treaties. This chapter also presents an overview of the UNFCCC framework and raises the issue of fragmentation in international environmental law. Chapter 3 then considers arguments in favour of and against a blanket tax and emissions trading scheme, to develop principles that may be applied to either form. Chapters 4 and 5 thereafter undertake comparative studies of emissions regulation in international air transport and international maritime transport respectively. Based on these two studies, the author proposes principles in Chapter 6 which could serve as the foundation of a mechanism on rocket emissions for the international space sector.

## RÉSUMÉ

La viabilité des activités comme tourisme spatial et extraction d'astéroïdes peuvent engendrer une accélération de la commercialisation des activités cosmiques. Cela peut causer une prolifération drastique des lancements de fusées. Toutefois, le droit international en espace ne parvient pas à régler l'impact environnementale de ces lancements de fusées. Cette thèse examine l'importance de régler des émissions de fusées. Elle vise à établir les principes fondamentaux qui peuvent être appliqués dans un mécanisme de secteur spatial international. Le premier chapitre présente les hasards environnementaux engendrés par les émissions de fusées. Particulièrement, il se concentre sur la relation entre les émissions, la déplétion de couche d'ozone et le changement climatique. Le deuxième chapitre justifie la nécessité des nouvelles réglementations en identifiant comment les émissions de fusées ne sont pas régies par les traités sur espace. De plus, ce chapitre présente un aperçu de cadre de la CCNUCC et pose la problématique de fragmentation du droit international sur l'environnement. Le troisième chapitre considère les arguments pour et contre une taxe forfaitaire et un système d'échange de droits d'émission, pour développer des principes qui peuvent être appliqués en ces cas. Les quatrième et cinquième chapitres entreprennent des études comparatives sur les réglementations d'émissions en transport aérien international et en transport maritime internationale. Basée sur ces études, l'auteur propose, dans le sixième chapitre, les principes qui peuvent fonctionner comme la fondation d'un mécanisme sur les émissions de fusées dans le secteur international sur l'espace.

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## **Chapter 1 – The need for regulation on rocket emissions**

## 1.1 “Why care?” A summary of the hazards of climate change and ozone depletion

The official international registry for space objects records the number of space objects launched on a yearly basis. A comparison of the launches in 2010 as against the launches in 2018 reveals the exponential growth in the number of launches per year.<sup>1</sup> Specifically in the private sector, SpaceX completed a total of 21 missions in 2018 alone.<sup>2</sup> With ventures planned for space tourism<sup>3</sup> and a colony on Mars,<sup>4</sup> SpaceX is just one of the companies intending to multiply launches within the next decade. With these projections, it is evident that the number of rockets launched per year will grow within the decade.

The exploration and use of space has provided humanity with an “overview effect” of our own planet.<sup>5</sup> This perspective has contributed to increasing awareness, and growing alarm, at the environmental degradation taking place on Earth, as well as within the Earth’s atmosphere.

As human forays into the great unknown show considerable promise, we have concurrently reached a critical period of climate change in our Earth environment, termed “a global emergency.” The Intergovernmental Panel on Climate Change (IPCC) established under the United Nations framework, has declared that the temperature rise to date, has already resulted in profound alterations to human and natural systems, including increases in droughts, floods, and other types of extreme weather, sea level rise, and biodiversity loss.<sup>6</sup> Climate change has been included in reports by the World Health Organisation (WHO), which has attributed climate change as the cause

<sup>1</sup> See over 100 launches documented in 2018 by astrophysicist Jonathan McDowell, online: *Planet4589* <planet4589.org/space/log/launchlog.txt>; Also see official UNOOSA registry, “Online Index of Objects Launched into Outer Space”, online: *UNOOSA* <www.unoosa.org/oosa/osoindex/search-ng.jsp?lf\_id=#?c=%7B%22filters%22:%5B%7B%22fieldName%22:%22object.launch.dateOfLaunch\_year\_s%22,%22value%22:%222010%22%7D%5D,%22sortings%22:%5B%7B%22fieldName%22:%22object.launch.dateOfLaunch\_s%22,%22dir%22:%22desc%22%7D%5D,%22match%22:null%7D>.

<sup>2</sup> SpaceX, “Completed Missions”, online: *SpaceX* <[www.spacex.com/missions](http://www.spacex.com/missions)>.

<sup>3</sup> SpaceX, “Making Life Multiplanetary”, online: *SpaceX* <<https://www.spacex.com/mars>>.

<sup>4</sup> Id.

<sup>5</sup> The expression “overview effect” was coined by Frank White to describe the mental shift astronauts experience when they consider the Earth as part of a larger whole. See Frank White, *The Overview Effect: Space Exploration and Human Evolution* (American Institute of Aeronautics, 2014); Also see Inverse, “Six NASA Astronauts Describe the Moment in Space When ‘Everything Changed’,” online: *Inverse*, <[www.inverse.com/article/42902-nasa-astronauts-describe-overview-effect-everything-changed](http://www.inverse.com/article/42902-nasa-astronauts-describe-overview-effect-everything-changed)>.

<sup>6</sup> IPCC, “Special Report, Global Warming of 1.5°C”, online: *IPCC* < [www.ipcc.ch/sr15/](http://www.ipcc.ch/sr15/) [*IPCC Report*].

of thousands of deaths due to cardiovascular and respiratory diseases.<sup>7</sup> The WHO has also linked increasing temperatures and air pollution with millions of asthma cases around the world.<sup>8</sup> Rather than simply portray the need for an effective policy response to climate change, this study presents statistics on rocket emissions to substantiate the need for policy intervention specifically in the space industry. This chapter seeks to establish that regulation is necessary due to the foreseeable increase in rocket launches and consequential environmental impact.

### **1.1.1 Climate change statistics published by the IPCC**

In recognition of the need to regulate climate change, the IPCC conducted a study through the auspices of the United Nations Framework Convention on Climate Change<sup>9</sup> (IPCC Report).<sup>10</sup> The report declared that if the current warming rate continues, the world would reach human-induced global warming of 1.5°C by 2040.<sup>11</sup> The IPCC has defined global warming as “[a]n increase in combined surface air and sea surface temperatures averaged over the globe and over a 30-year period.”<sup>12</sup> The authors of the report distinguish between human-induced global warming (i.e., the component of warming attributable to human activities) and effects of other climate drivers, further emphasising that anthropogenic emissions should be reduced due to the impact of the latter.<sup>13</sup>

The IPCC Report was controversial for several reasons, including, very prominently, the presentation of data supporting the disproportionate impact of climate change on poorer and more vulnerable economies.<sup>14</sup> This data corroborated the fact that the most affected communities are from low and middle income countries, some of which have experienced a decline in food security, which in turn is partly linked to rising migration and poverty.<sup>15</sup> The IPCC Report attributed different contributions to the problem, first stating that the benefits from industrialisation have been unevenly distributed and that those who historically benefited most, have contributed most

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<sup>7</sup> World Health Organization, “Climate Change and Health”, online: WHO <[www.who.int/news-room/fact-sheets/detail/climate-change-and-health](http://www.who.int/news-room/fact-sheets/detail/climate-change-and-health)> [WHO Report].

<sup>8</sup> Id.

<sup>9</sup> *United Nations Framework Convention on Climate Change*, 9 May 1992 1771 UNTS 107 (entered into force 21 March 1994).

<sup>10</sup> IPCC Report, *supra* note 6.

<sup>11</sup> Id., at 81.

<sup>12</sup> Id., at 51.

<sup>13</sup> Id.

<sup>14</sup> IPCC Report, Summary for Policymakers, *supra* note 6 at 9.

<sup>15</sup> IPCC Report, *supra* note 6 at 53.

to the current climate problem and therefore bear (or should bear) greater responsibility.<sup>16</sup> The IPCC Report further stated that the worst impacts tend to fall on those least responsible for the problem, within States, between States, and between generations.<sup>17</sup> The report highlighted the subsequent inability to respond, as the worst-affected States, groups, and individuals do not receive sufficient representation to facilitate efficient strategies.<sup>18</sup> In addition, the report affirmed that there is an asymmetry in future response capacity, as some States, groups, and places are at risk of being left behind as the world progresses to a low-carbon economy.<sup>19</sup>

These effects of climate change demand the implementation of measures to limit activities which contribute to warming. However, as stated in the IPCC Report, this limiting of warming to 1.5°C depends on greenhouse gas (GHG) emissions over the next few decades, where lower GHG emissions in 2030 lead to a higher chance of keeping peak warming to 1.5°C.<sup>20</sup> This objective would require reaching net zero carbon dioxide (CO<sub>2</sub>) emissions globally by approximately 2050.<sup>21</sup> The IPCC specified that these mitigation pathways would require energy demand reductions, and decarbonisation of electricity and other fuels among other measures.<sup>22</sup> Perhaps most significant is the IPCC's clear and unequivocal emphasis on the need for future policies to reflect a high price on emissions.<sup>23</sup> While the IPCC Report was a wake-up call for most nations, it is pertinent to note that it did not clearly identify the status of countries which would most severely experience the effects of climate change and endure possible climate-driven refugees fleeing their nations.<sup>24</sup> For the effective reduction of emissions, measures must be implemented across the globe, across industries, and across sectors of transportation.<sup>25</sup> Due to the impending surge in commercial

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<sup>16</sup> Id. at 55.

<sup>17</sup> Id.

<sup>18</sup> Id.

<sup>19</sup> Id.

<sup>20</sup> IPCC Report, *supra* note 6 at 95.

<sup>21</sup> Id.

<sup>22</sup> Id.

<sup>23</sup> Id.

<sup>24</sup> The need for stringent action, including towards the issue of climate-driven migration was recently highlighted by President of the European Commission, Ursula von der Leyen in the Green Deal for Europe, which aims for a carbon-neutral European Union by 2050. Several strategies will be implemented to achieve this goal, including reducing greenhouse gas emissions from air travel. See The Guardian, "European Green Deal will change economy to solve climate crisis, says EU", online: *The Guardian*, <<https://www.theguardian.com/environment/2019/dec/11/european-green-deal-will-change-economy-to-solve-climate-crisis-says-eu>>; Also see National Observer, "A Call to Climate Action: Europe's Green Deal", Opinion, Ursula von der Leyen, online: *National Observer* <<https://www.nationalobserver.com/2019/12/12/opinion/call-climate-action-europes-green-deal>>.

<sup>25</sup> IPCC Report, Chapter 1, *supra* note 6 at 61.

activities in outer space, this author contends that the space sector must also be included within this ambit.

The IPCC Report classified greenhouse gases into two categories - long-lived and short-lived, based on their effects. For example, CO<sub>2</sub> and nitrous oxide (N<sub>2</sub>O) fall within the first category and have been declared to have a “very persistent” impact on radiative forcing (discussed further below), with the effects of N<sub>2</sub>O possibly lasting over a century, and CO<sub>2</sub> lasting hundreds to thousands of years.<sup>26</sup> The warming impact of these long-lived climate forcers depends primarily on the total cumulative amount emitted over the past century or the entire industrial epoch.<sup>27</sup> On the other hand, methane and black carbon, the latter being a common pollutant of rocket launches, are considered short-lived climate forcers and their warming impact depends primarily on current and recent annual emission rates.<sup>28</sup>

The IPCC Report acknowledges that while it is unlikely that most sources of emissions can realistically be brought to zero due to techno-economic inertia, there is a subsequent need to commit to the reduction of future emissions.<sup>29</sup> On this basis, this author contends that it is imperative to introduce emissions regulation for the global space sector, to include emissions from rockets within the scope of anthropogenic emissions.

### **1.1.2 Assessment of ozone levels**

The Scientific Assessment of Ozone Depletion published in 2018 (Ozone Assessment) stated that the ozone layer is now recovering from severe depletion.<sup>30</sup> While examining the present status of the ozone, this report notably links stratospheric ozone with climate, stating that stratospheric ozone changes can impact climate by changing the large-scale atmospheric state, including impacts on the tropospheric circulation and ultimately surface weather, or by changing the amount of UV radiation that reaches the surface, both altering surface temperatures and biogenic processes.<sup>31</sup> The

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<sup>26</sup> Id.

<sup>27</sup> IPCC Report, Chapter 1, *supra* note 6 at 66.

<sup>28</sup> Id.

<sup>29</sup> IPCC Report, Chapter 1, *supra* note 6 at 66.

<sup>30</sup> World Meteorological Organization, United Nations Environment Programme, National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration, US Department of Commerce, European Commission, “Global Ozone and Research Monitoring Project – Report No. 58; Scientific Assessment of Ozone Depletion: 2018”, online: World Meteorological Organization <[www.esrl.noaa.gov/csd/assessments/ozone/2018/downloads/2018OzoneAssessment.pdf](http://www.esrl.noaa.gov/csd/assessments/ozone/2018/downloads/2018OzoneAssessment.pdf)> [Ozone Assessment].

<sup>31</sup> Id. at 5.11.

inverse of this relationship is also true, as the Ozone Assessment notes that “[o]zone levels in some regions of the atmosphere could exceed natural levels, due to climate change.”<sup>32</sup> Chapter 5 of the report elaborates upon this relationship, noting that ozone depletion in the Antarctic region has caused changes in tropospheric weather patterns which have in turn affected temperature, salinity and circulation in the Antarctic Ocean.<sup>33</sup> Ozone depletion and climate change are therefore separate environmental issues, but acutely interconnected. Due to the immediate impact of rocket emissions, the stratosphere through which Earth-to-space modes of transportation transit, has the potential to affect both ozone levels and consequently, climate.

The Ozone Assessment reveals that the deleterious impact of Ozone Depleting Substances (ODs) has begun to gradually decline due to the measures taken under the Montreal Protocol.<sup>34</sup> The Antarctic ozone hole appears to be on its way to recovery, while ozone loss in the Arctic remains likely if a high concentration of ODs continues.<sup>35</sup> The Ozone Assessment further establishes that the measures implemented by the Montreal Protocol have positively resulted in prohibiting the rise of global sea levels by several centimeters.<sup>36</sup> The efficacy of this instrument is studied in the following chapter on the relevant international law governing these environmental issues.

## **1.2 Environmental damage caused by rocket emissions**

### **1.2.1 Types of rocket fuels**

A rocket has been broadly defined as a machine that burns fuel in an organised and predetermined manner.<sup>37</sup> Rockets may be classified as expendable, meaning that they can be used once, or are reusable, implying their use multiple times. It is a significant technological development that rockets today are capable of being designed to be fully reusable. For instance, vehicles in the past such as the Space Shuttle, were reusable but their launch vehicles were not, which left the rocket booster or fuel tank to burn in the atmosphere or sink to the oceans. Fuels types vary between solid, liquid and hybrid propellants. The burning of these fuels produces thrust and pushes the rocket and

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<sup>32</sup> See Ozone Assessment, Chapter 6, *supra* note 30.

<sup>33</sup> See Ozone Assessment, Chapter 5, *supra* note 30.

<sup>34</sup> *Montreal Protocol on Substances that Deplete the Ozone Layer*, 16 September 1987 1552 UNTS 3 (entered into force 1 January 1989); See also Ozone Assessment, Chapter 4, *supra* note 30.

<sup>35</sup> *Id.*

<sup>36</sup> See Ozone Assessment, Chapter 5, *supra* note 30.

<sup>37</sup> Notes from Professor Ram Jakhu’s introductory lecture on General Principles of Space Law, McGill Institute of Air and Space Law, September 2018.

its payload forward.<sup>38</sup> The marked increase in the use of certain types of solid propellants, which are considered comparatively “dirtier” relative to their counterparts, has been deemed a harmful contaminant by experts in the international space community.<sup>39</sup> However, even the liquid-based “cleaner” propellants contribute to pollution, from both the rocket fuels and the combustion products resulting from their ignition.<sup>40</sup> Say, some liquid-fueled rockets may emit water as a by-product (which is relatively benign). On the contrary, rockets such as the Falcon 9 and Falcon Heavy employ hydrocarbon fuel comprised of RP-1 (kerosene). When such hydrocarbon fuels are employed, they are often paired with liquid oxygen or more toxic fuels such as hydrazine derivatives.<sup>41</sup> Solid propellants range from ammonium to aluminum compounds, and such rocket motors can release aluminum, nitrogen oxides, and hydrogen chloride, all of which damage the ozone layer of the upper atmosphere.<sup>42</sup> Hybrid systems involve nitrous oxide as the oxidiser and various fuels, an example being solid hydroxyl-terminated polybutadiene fuel, which was incorporated into the Sierra Nevada Dream Chaser and SpaceShipOne.<sup>43</sup> SpaceShipTwo switched from this fuel to an aluminum polyamide fuel, which can create similar polluting effects.<sup>44</sup> On the basis of this information, an initial policy consideration could involve debating which rockets are responsible for the most pollution. It has been proposed that such a measure must call for the elimination of all rocket fuels which discharge carbon as a by-product, as carbon is scientifically proven to have tremendously damaging effects on the stratosphere.<sup>45</sup>

### 1.2.2 Ozone depletion caused by rocket launches

To fully understand pollution caused by rockets, attention is invited to the difference between rocket “emissions” and rocket “exhaust.” Rocket exhaust comprises the particles of hot gases at the nozzle exit, while rocket emissions refer to the cold plume wake that mixes into the stratosphere.<sup>46</sup> In a notable study by scientists Dr. Darin Toohey and Dr. Martin Ross, the authors

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<sup>38</sup> Id.

<sup>39</sup> Ram S. Jakhu & Joseph N. Pelton, eds. *Global Space Governance: An International Study*, (Springer, 2017) at 436 [GSG Study].

<sup>40</sup> Id.

<sup>41</sup> Id.

<sup>42</sup> Id.

<sup>43</sup> Id.

<sup>44</sup> Id.

<sup>45</sup> Notes from telephonic interview with Dr. Darin Toohey, atmospheric scientist, November, 2018 [Toohey].

<sup>46</sup> Martin Ross et al, “Limits on the Space Launch Market Related to Stratospheric Ozone Depletion” (2009) 7 *Astropolitics* at 59 [Ross].

explain how exhaust from a rocket is modified by secondary combustion reactions which are driven by atmospheric oxygen mixing into the plume, creating an “afterburning” effect, which results in the conversion of hydrogen particles to water and carbon, and soot to carbon dioxide.<sup>47</sup> It is clearly stated that this afterburning effect has not been accounted for when global models have assessed the environmental impact of rockets, due to the lack of focused study on these specific chemical reactions and subsequent effects.<sup>48</sup>

As stated above, the types of fuel are also significant to understanding the environmental impact of rocket emissions. While some of the most successful and widely publicised launches (such as the NASA Space Shuttle), have relied on solid rocket motors (SRMs), these rockets have been conclusively classified as heavy contributors to both atmospheric pollution and ozone depletion. As early as 1976, noted space law scholar Carl Christol evaluated the potential of the Space Shuttle to contribute to atmospheric pollution.<sup>49</sup> At the time, studies concluded that by-products from launches of the Space Shuttle would be negligible, including the discharges of chlorine from SRMs.<sup>50</sup> These results were supported by NASA’s further reassurance that the organisation would change the SRM propellants if it were demonstrated that this fuel, and its effluents, would have an adverse effect on man, other animals, and plant life.<sup>51</sup> In evaluating the potential environmental impact of the Space Shuttle, NASA released a statement that “[i]t appears very likely that the Space Shuttle will have a negligible effect on the protective ozone layer.”<sup>52</sup> This statement was based on two factors, the first being that there was no scientific evidence (at the time) which proved that the rocket fuels employed by the Shuttle would adversely influence the ozone, and second that the projections for launches of the Shuttle were limited.<sup>53</sup>

In their seminal study, Ross and Toohey also differentiated between the impact of emissions on climate change and ozone depletion, expressing concern over the latter.<sup>54</sup> The stratospheric ozone layer generally resides between 20–30km altitudes, absorbing harmful solar ultraviolet radiation

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<sup>47</sup> Id.

<sup>48</sup> Id.

<sup>49</sup> Carl Q Christol, "Stratospheric Ozone, Space Objects and International Environmental Law" (1976) 4 Space L. J. 23 [*Christol*].

<sup>50</sup> Id. at 27.

<sup>51</sup> Id. at 26.

<sup>52</sup> Id. at 27.

<sup>53</sup> Id. at 27.

<sup>54</sup> Ross, *supra* note 46 at 52.

before it reaches the Earth's surface.<sup>55</sup> The impact of emissions on the stratosphere begs to be regulated and considered by policy-makers, as (in terms of atmospheric effect), the stratosphere is perhaps 100 to 1,000 times more likely to be polluted than the atmosphere at sea level due to how thin the atmosphere is in the so-called protozone regions.<sup>56</sup> The molecular density of Earth's stratosphere is therefore much less dense, so pollutants, especially particulates at the highest elevations of the stratosphere, have extremely harmful effects.<sup>57</sup>

The authors confirmed that rockets emit gases which contribute to climate change, but warned that their data exhibited a greater threat to stratospheric ozone depletion.<sup>58</sup> As stated in the study, "[r]ocket combustion products are the only human-produced source of ozone-destroying compounds injected directly into the middle and upper stratosphere."<sup>59</sup> In comparing the findings of this study with the aforementioned Ozone Assessment, the latter determined that the current loss is small in comparison to other sources of ozone loss, and on this basis, excluded rocket emissions from any regulatory framework protecting the ozone layer.<sup>60</sup> While this is less than desirable, given the impending boom of the private launch market, this assessment does acknowledge the gaps in understanding rocket emissions and their combined chemical, radiative, and dynamical impacts on the global stratosphere and in projections of launch rates, affirming that periodic assessments in this area are warranted.<sup>61</sup>

In this author's interview with Dr. Darin Toohey, it was revealed that the environmental impact of rocket emissions began here, with concerns over ozone, while the study of the extent of environmental impact brought by rockets which in turn spur climate change, is yet to be fully assessed.<sup>62</sup> As elaborated by Dr. Toohey, the lifetime of rocket exhaust is long, roughly five years, while the by-products of rocket emission products will linger for much longer, approximately 100,000 times greater for a given material.<sup>63</sup> Given the level of uncertainty in scientific data, we

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<sup>55</sup> Ross, *supra* note 46 at 54.

<sup>56</sup> GSG Study, *supra* note 39 at 439.

<sup>57</sup> *Id.*

<sup>58</sup> *Id.*

<sup>59</sup> *Id.*

<sup>60</sup> Ozone Assessment, *supra* note 30.

<sup>61</sup> *Id.*

<sup>62</sup> Toohey, *supra* note 45.

<sup>63</sup> *Id.*

are presently restricted to working with limited evidence which does not give us further information about the precise impact of these pollutants.<sup>64</sup>

Today's space launch market appears to be inclined towards the use of liquid rocket engines (LREs), which should then be deemed a significant improvement from their preceding SRM counterparts. However, in the same study, the authors demonstrate how even water vapor emissions from LREs, widely considered inert, contribute to ozone depletion.<sup>65</sup> Consequently, even though some rockets may be "cleaner" than others, no rocket can be said to be perfectly "green." In fact, the study states that LREs also contribute to ozone loss, which can be significant at high enough flight rates.<sup>66</sup>

### **1.2.3 Global warming and radiative forcing driven by suborbital launches**

To fully grasp the environmental impacts of rocket emissions, the concept of "radiative forcing" is relevant to understand. The term is officially defined by the IPCC as "[t]he change in the net radiative flux at the tropopause or top of atmosphere due to a change in a driver of climate change, such as a change in the concentration of CO<sub>2</sub> or the output of the Sun."<sup>67</sup> As a result, radiative forcing is constantly employed in the study of the impact of climate change.

A 2010 study details the environmental impact of an increase in suborbital launches, citing a global climate model that predicts that emissions from a fleet of 1000 launches per year of suborbital rockets would create a persistent layer of black carbon particles in the northern stratosphere, which would in turn cause potentially significant changes in global atmospheric circulation, and distributions of ozone and temperature.<sup>68</sup> The study further states that a spike in the suborbital launch rate will result in changing tropical stratospheric ozone abundances by a degree of 1%, while polar ozone changes may occur up to 6%.<sup>69</sup> Furthermore, the changes of polar surface temperatures would have significant impacts on polar sea ice fractions.<sup>70</sup> Interestingly, the study compares the radiative forcing of black carbon of one decade of continued launches to the current

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<sup>64</sup> Id.

<sup>65</sup> Ross, *supra* note 46 at 52.

<sup>66</sup> Id. at 75.

<sup>67</sup> IPCC Report, Glossary, *supra* note 6 at 556.

<sup>68</sup> Martin Ross, Michael Mills, Darin Toohey, "Potential climate impact of black carbon emitted by rockets" (2010) 37 Geophysical Research Letters 10; Also see Martin Ross, JR Benbrook, R. Sheldon, PF Zittel and DL Mackenzie, "Observation of stratospheric ozone depletion in rocket exhaust plumes", 390 Nature 62 (1997).

<sup>69</sup> Id.

<sup>70</sup> Id.

subsonic aviation market, and states that the former would be equivalent to the latter.<sup>71</sup> As a result, the authors of the study express concern over continued hydrocarbon launches and caution against the continued pollution by discharge of black carbon from such rockets.<sup>72</sup>

These studies underscore the uncertainty surrounding the complete effect of rocket emissions and urge global coordinated efforts to understand the same. Ross *et al* relate this uncertainty not only to the incomplete scientific understanding of rocket emissions, but also raise the conundrum of regulatory uncertainty.<sup>73</sup> Notably, the outlook adopted in these scientific studies does not mirror an alarmist cry for complete prohibition, or even a reduction in launches, but simply a demand for regulatory intervention in a manner that simultaneously supports the burgeoning launch market and ensures the sustainability of the outer space environment. This author begins this study on regulation for rocket emissions on a similar note.

### **1.3 The regional impact of rocket pollution**

Based on the aforementioned studies, it can be concluded that rocket emissions present serious environmental threats, though the complete scope of impact is unknown. Rocket pollutants have been tied to both ozone depletion and climate change. It is thus vital to acknowledge the disparate regional impact of these phenomena, as confirmed by the IPCC Report. This view is supported by scientists such as Dr. Toohey, who has advised that policy-makers would have to consider not only the number of launches or the price of emissions, but also study the type of fuel, the size of the rocket and perhaps most contentiously, “[t]he location from which it is launched.”<sup>74</sup>

Professors Lyall and Larsen provide an example of the Russian use of the Baikonour Cosmodrome following the independence of Kazakhstan, which resulted in pollution of the Kazakh steppes by Russian rocket fuel.<sup>75</sup> In this dispute, the fact that Russian fuel was the direct cause of pollution meant that international responsibility could (arguably) be attributed to an identified State A for environmental harm in identified State B.<sup>76</sup> However, given the uncertainty in atmospheric and

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<sup>71</sup> Id.

<sup>72</sup> Id.

<sup>73</sup> Ross, *supra* note 46.

<sup>74</sup> Toohey, *supra* note 45.

<sup>75</sup> See Francis Lyall & Paul B Larsen, *Space Law: A Treatise* (Farnham, Surrey, England ; Burlington, VT: Ashgate, 2009) at 251-252 [Lyall and Larsen].

<sup>76</sup> Id.

climate science, the author considers instead responsibility for *subsequent* environmental harm, the contours of which are more clearly defined under international law.

*Consider the following scenario:* Air rises in the tropics and sinks in the poles; a launch from State A is taking place at the equator in State B. This launching site was chosen by State A to benefit from the geostationary orbit. State A's launches continue, in the absence of any regulation, and each launch exacerbates climate change (however minor). In such a situation, what happens when the actual effects of climate change appear in other States such as Canada and Russia? Can a specific State be held responsible? If yes, under the space treaties, can liability be conclusively determined? This raises the question of differing regional impacts of rocket pollution and how policy-makers should approach this issue.

#### **1.4 Future considerations**

The way forward for policy-makers is riddled with ambiguity. In the absence of comprehensive data on rocket emissions, there is insufficient input to formulate the kind of global climate model required by the scientific community.<sup>77</sup> Other writings on this issue have proposed various solutions, for example approaching the emissions problem by questioning the maximum number of rockets that could be launched per year without significantly changing the upper atmosphere.<sup>78</sup> This was reiterated in other views commenting on the regulation of rocket emissions.<sup>79</sup> However, this author dissents with this approach because it is restrictive and discouraging, particularly for an industry which is in its initial stages of development, and when private or non-State actors are increasingly participating in the launch industry. There is little doubt that the very suggestion of regulation by limiting rockets launched per year will face resistance from all industry stakeholders.

Furthermore, some of these actors, including SpaceX, have implied a long-term objective to reduce emissions from spaceflight to net zero.<sup>80</sup> This indicates that the launch industry would be open to

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<sup>77</sup> Martin N. Ross and Patti M. Sheaffer, "Radiative Forcing Caused by Rocket Engine Emissions" (2014) 7 *Earth's Future* at 178.

<sup>78</sup> See W. W. Kellogg, "Pollution of the Upper Atmosphere by Rockets" (1964) 3 *Space Science Reviews* 275.

<sup>79</sup> See Jennifer Friedberg, "Bracing for the Impending Rocket Revolution: How to Regulate International Environmental Harm Caused by Commercial Space Flight" (2013) 24 *Colorado Natural Resources, Energy & Environmental L Rev* 197.

<sup>80</sup> See Inverse, "SpaceX: How Elon Musk wants to reach zero-carbon rocket flights," online: Inverse <<https://www.inverse.com/article/59489-spacex-how-elon-musk-wants-to-reach-zero-carbon-rocket-flights>>; Also see Los Angeles Times, "Can we get to space without damaging the Earth through huge carbon emissions?" online: LA Times <<https://www.latimes.com/business/story/2020-01-30/space-launch-carbon-emissions>>

a conversation on regulation for emissions reduction. As a significant stakeholder, the commercial launch industry cannot be excluded from a conversation about the regulation of launches. Instead, a regulatory approach emphasising cooperation would be far more productive in promoting a complete scientific understanding of the global repercussions of rocket emissions.<sup>81</sup> This would entail a collaborative and transparent policy initiative which includes all stakeholders. The instrumentation and expertise to conduct these studies presently exist within the engineering and scientific communities,<sup>82</sup> yet there is a lack of awareness of the extent to which rocket launches can result in destructive environmental repercussions.

In this thesis, the author argues that these studies and reports presented in Chapter 1 substantiate the impact flowing from an increase in rocket launches. Regardless of the present understanding of the exact extent of pollution, these studies indicate that rocket emissions can result in severe environmental damage. Based on this rationale, the author contends that it is imperative to commence discussion on regulation. Chapter 2 of this study will identify how rocket emissions fail to receive adequate regulation under international law, particularly the space treaties. Chapter 3 presents an overview of applicable regulatory mechanisms to identify advantages and disadvantages of each system for the space sector. The author then conducts a comparative study of the international air transport sector, and international maritime sector respectively, to determine principles that may be applied to a mechanism for the global space sector. The series of principles proposed by this author in Chapter 6 can form a foundation upon which prudent regulation for rocket emissions can be shaped.

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<sup>81</sup> See Martin Ross and James Vedda, “The Policy and Science of Rocket Emissions” (2018) Aerospace Corporation.

<sup>82</sup> Toohey, *supra* note 45.

## **Chapter 2 – Scope for rocket emissions regulation in international law**

Chapter 1 established the potential environmental effects of rocket emissions. This chapter will examine applicable international law and justify the need for further regulation specifically for rocket emissions. The starting point of this chapter is space law-making and identification of provisions from the space law treaties which fail to accommodate rocket emissions within their scope. Thereafter, additional governing frameworks applicable to emissions regulation are presented. The chapter concludes that the present patchwork of regulations will not suffice, and that additional regulation must be introduced for the governance of rocket emissions.

### **2.1 The evolution of space law-making**

The origins of space law-making can be traced to the 1960s in the aftermath of the Cold War, where States engaged in negotiations to safeguard the use of outer space for peaceful purposes. Space law therefore emerged as a subset of international law, where the space treaties<sup>83</sup> laid down basic principles for the exploration and use of outer space. The nature of space law-making has transformed significantly since, where it can no longer be characterised as a purely “international” process.<sup>84</sup>

This evolution in part can be attributed to the need for State Parties to implement Article VI of the Outer Space Treaty, which imposes a responsibility on all State Parties to bear responsibility for “national activities” in outer space, including activities conducted by non-governmental entities.<sup>85</sup> The provision additionally requires States to authorise and continuously supervise the activities of such non-governmental entities.<sup>86</sup> Article VI triggered the enactment of domestic legislation to

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<sup>83</sup> *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies*, 27 January 1967, 610 UNTS 205, 18 UST 2410, TIAS No 6347, 6 ILM 386 (entered into force on 10 October 1967) [*Outer Space Treaty*]; the *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched Into Outer Space*, 22 April 1968, 672 UNTS 119, 19 UST 7570, TIAS No 6599, 7 ILM 151 (entered into force 3 December 1968) [*Rescue and Return Agreement*]; the *Convention on International Liability for Damage Caused by Space Objects*, 29 March 1972, 961 UNTS 187, 24 UST 2389, 10 ILM 965 (1971) (entered into force 1 September 1972) [*Liability Convention*]; the *Convention on Registration of Objects Launched into Outer Space*, 6 June 1975, 28 UST 695, 1023 UNTS 15 (entered into force 15 September 1976) [*Registration Convention*]; *Agreement governing the Activities of States on the Moon and Other Celestial Bodies*, 5 December 1979, 1363 UNTS 3 (entered into force 11 July 1984) [*Moon Agreement*].

<sup>84</sup> The dynamic character of space law can be attributed to the growing importance of domestic space laws, as the national legislations and official positions of States may constitute evidence of customary international law. See Julian Hermida, *Legal Basis for a National Space Legislation*, (Dordrecht, Kluwer Academic, 2004); Also see Ram Jakhu, *National Regulation of Space Activities* (Dordrecht: Springer, 2010).

<sup>85</sup> *Outer Space Treaty*, *supra* note 83, art VI.

<sup>86</sup> *Id.*

facilitate sufficient licensing, approval and monitoring procedures for non-governmental entities. This was a key observation of the authors in the Global Space Governance Study of 2017, where the authors highlighted the evolution of space law-making through the introduction of space legislation by way of various domestic enactments and policies.<sup>87</sup> The expanding capabilities of the private sector have also contributed significantly to this trend, as more non-State actors now have the technology and means to venture into space. State governments are therefore compelled to introduce new laws to ensure compliance with the space treaties or even clarify ambiguities under international space law, so as to encourage private sector participation.

In 2013, the General Assembly adopted Resolution 68/74 regarding “Recommendations on national legislation relevant to the peaceful exploration and use of outer space” which proposes several key elements that States should include in national space legislations, including procedures to enhance authorisation and supervision of activities.<sup>88</sup> The adoption of the Long-Term Sustainability Guidelines is additional evidence of the international community’s consensus on the need to adopt national space legislation or policies governing space activities.<sup>89</sup> These instruments additionally reflect a growing preference for soft law measures which are received more favourably due to their non-binding character.

## **2.2 Stratospheric pollution as environmental damage under international space law**

To understand the extent to which the space treaties address rocket emissions, it is important to confirm whether emissions displaced in the stratosphere would be considered environmental pollution. Would this be classified as pollution of the Earth environment, or space environment?

At the outset, this may trigger the question of where airspace ends and where outer space begins. With delimitation being the oldest item on the COPUOS agenda,<sup>90</sup> this author argues that engaging

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<sup>87</sup> See GSG Study, Chapter 4, *supra* note 39.

<sup>88</sup> UNGA, *Recommendations on national legislation relevant to the peaceful exploration and use of outer space*, UN Doc A/RES/68/74 (2013).

<sup>89</sup> UNCOPUOS, *Guidelines on Long-Term Sustainability of Outer Space Activities*, UN Doc A/AC.105/L.318/Add.4 (2019) [*Guidelines on Long-Term Sustainability of Outer Space Activities*]; Also see additional non-binding instruments such as the Space Debris Mitigation Guidelines. UNOOSA, *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space*, UN Doc A/AC.105/890 (2007) online: UNOOSA <[www.unoosa.org/pdf/bst/COPUOS\\_SPACE\\_DEBRIS\\_MITIGATION\\_GUIDELINES.pdf](http://www.unoosa.org/pdf/bst/COPUOS_SPACE_DEBRIS_MITIGATION_GUIDELINES.pdf)>.

<sup>90</sup> See UNCOPUOS, *Report of the Scientific and Technical Sub-committee on the work of its Fifth Session*, UN Doc A/AC.105/39 (1967).

in the delimitation debate to answer this question is unnecessary. This reasoning is derived from the notion that the term “environment” includes outer space and therefore, the classification of the stratosphere as airspace or outer space is irrelevant. Several international instruments support this argument. One of the objectives of the Limited Test Ban Treaty of 1963<sup>91</sup> was to “...put an end to the contamination of man's environment by radioactive substances.”<sup>92</sup> This treaty included nuclear test explosions in the atmosphere within its purview, “including outer space.”<sup>93</sup> Thereafter, in 1977, the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques<sup>94</sup> included outer space within the application of the term “environment modification techniques.”<sup>95</sup> Furthermore, the Preamble of the Stockholm Declaration<sup>96</sup> considers the environment in broad terms, as one that provides mankind “physical sustenance and affords him the opportunity for intellectual, moral, social and spiritual growth.”<sup>97</sup> The outer space environment presently provides numerous resources on which mankind is dependent, as well as potential for future exploration, and thus falls squarely within this definition. Noteworthy subsidiary sources of international law support this conclusion, as the International Law Commission report of 1980 concluded that “a threat to a vital ecological interest” can take place in the outer space environment as well.<sup>98</sup> Moreover, academics argue that the term “environment” encompasses the outer space environment in international law.<sup>99</sup>

Therefore, the author contends that regardless of whether the stratosphere falls under the classification of the Earth environment or space environment, stratospheric pollution by rocket emissions would be considered environmental pollution under international law.

### 2.3 The abstruse provisions of the space treaties

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<sup>91</sup> *Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space, and Under Water*, 5 August 1963, 14 UST 1313, TIAS No 5433, 480 UNTS 43) (entered into force 10 October 1963) [*Limited Test Ban Treaty*].

<sup>92</sup> *Id.*, preamble.

<sup>93</sup> *Id.*, art 1(a).

<sup>94</sup> *Convention on the prohibition of military or any other hostile use of environmental modification techniques*, 10 December 1976, 1108 UNTS 151 (entered into force 5 October 1978) [*ENMOD*].

<sup>95</sup> *Id.*, art II.

<sup>96</sup> UN, “Declaration of the United Nations Conference on the Human Environment” in *Report of the United Nations Conference on the Human Environment, Stockholm, 5-16 June 1972*, UN Doc. A/CONF.48/14/Rev.1 [*Stockholm Declaration*]

<sup>97</sup> *Id.*, preamble.

<sup>98</sup> See ILC, *Yearbook of the International Law Commission*, vol. II(2), UN Doc. A/CN.4/SER.A/1980/Add.1 (Part 2) (1980), at 40, para. 16.

<sup>99</sup> See David Kuan-Wei Chen, *The Legality of the Use of Space Weapons: Perspectives from Environmental Law*, (Montreal: McGill University, 2012) at 46-48.

The provisions potentially applicable to rocket emissions are Article IX of the Outer Space Treaty, which mentions “due regard,” “harmful contamination,” and “harmful interference,” or Article III, which could impose an obligation to conduct activities in outer space in compliance with international environmental law. Alternatively the author considers Articles II and III of the Liability Convention regarding “damage”. Let us consider each in turn.

### **2.3.1 Article IX of the Outer Space Treaty: Rocket emissions within the scope of “due regard,” “harmful contamination” and “harmful interference”**

Article IX is a meaty provision, addressing several different matters. Among these, the language of Article IX echoes principles of international environmental law, such as Principle 12 of the Stockholm Declaration, which requires States to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or areas beyond the limits of national jurisdiction.<sup>100</sup> Principle 2 of the Rio Declaration<sup>101</sup> adopted in 1996, mirrors this wording. These principles form the cornerstones of international environmental law (elucidated below).

Article IX stipulates that a State must conduct its activities with due regard to the “corresponding interests of other State Parties” as well as conduct the exploration of outer space in a manner that avoids harmful contamination.<sup>102</sup> Furthermore, the provision requires States to undertake consultations if it has “reason to believe” that the activity of another State may cause potentially harmful interference with the peaceful exploration and use of outer space.<sup>103</sup> Much to the chagrin (or delight) of space law scholars, none of the expressions “due regard”, “harmful contamination” or “harmful interference” have been defined. This author will attempt to interpret these phrases by comparing how these principles have been applied in parallel international conventions and additionally refer to the preparatory works of the Outer Space Treaty.

This analysis begins with the Chicago Convention,<sup>104</sup> as this was the first international treaty to incorporate the concept, as early as 1944. The phrase “due regard” in Article IX could possibly be construed using the wording of Article 3 of said treaty, which exempted State (including military)

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<sup>100</sup> *Stockholm Declaration*, *supra* note 96, Principle 12.

<sup>101</sup> UN Conference on Environment and Development, *Rio Declaration on Environment and Development*, UN Doc. A/CONF.151/26 (vol. I) reprinted in 31 ILM 874 (1992) [*Rio Declaration*].

<sup>102</sup> *Outer Space Treaty*, *supra* note 83, art IX.

<sup>103</sup> *Id.*

<sup>104</sup> *Convention on International Civil Aviation*, 7 December 1944, 15 UNTS 295, Can TS 1944 No 36, ICAO Doc 7300/9 (entered into force 4 April 1947) [*Chicago Convention*].

aircraft from ICAO procedures and required these aircraft to fly with “due regard for the safety of civil aviation.”<sup>105</sup> Some authors have interpreted the phrase “due regard” to mean “a duty of due diligence upon operators of State and military aircraft to ensure the navigation of civil aircraft.”<sup>106</sup> This argument was corroborated by the fact that the ‘due regard’ rule remains the principal treaty obligation imposed on States for the regulation of the flight of military aircraft applicable during times of peace and armed conflict.<sup>107</sup>

In later years, the ‘due regard’ principle appeared in additional conventions, such as the United Nations Convention on the Law of the Sea (UNCLOS)<sup>108</sup> which states that “...these freedoms shall be exercised by all States with due regard for the interests of other States in their exercise of the freedoms of the high seas.”<sup>109</sup>

In tandem with the connotation of the phrase in the Chicago Convention and the UNCLOS, the authors of the Cologne Commentary interpreted “due regard” under Article IX of the Outer Space Treaty as “the performance of an act with a certain standard of care, attention or observance.”<sup>110</sup> As per this interpretation of “due regard”, it could be argued that State Parties to the Outer Space Treaty have an obligation to ensure that the emissions from their rocket launches do not contribute to environmental damage of the stratosphere. However, this argument has substantial shortcomings. This is because Article IX does not expressly mention “environment” in any of the subjects it addresses. The term “due regard” is specifically used with respect to States, not with respect to environmental protection. This interpretation is in accordance with the plain text of the treaty, following the rules of interpretation in the Vienna Convention on the Law of Treaties.<sup>111</sup> Since the ordinary meaning excludes rocket emissions from its scope, this leads to the conclusion that there is no correlation between “due regard” and pollution by rocket emissions.

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<sup>105</sup> Id, art 3.

<sup>106</sup> Sergio Marchisio, “Article IX” in S Hobe, B Schmidt-Tedd & K-U Schrogl, eds, *Cologne Commentary on Space Law*, vol 1 (Cologne: Carl Heymanns Verlag, 2009) [CoCoSL] at 175.

<sup>107</sup> Id.

<sup>108</sup> *United Nations Convention on the Law of the Sea*, 10 December 1982, 1833 UNTS 397 (entered into force 16 November 1994) [UNCLOS].

<sup>109</sup> Id., art 87(2).

<sup>110</sup> CoCoSL, *supra* note 106 at 176.

<sup>111</sup> *Vienna Convention on the Law of Treaties*, 23 May 1969, UN Doc A/Conf.39/27, 1155 UNTS 331, 8 ILM 679 (1969), 63 AJIL 875 (1969) (entered into force 27 January 1980).

The duty to avoid “harmful contamination” is also provided in Article IX. The *travaux préparatoires* reveal that this provision was introduced by the drafters to address the concern of possible contamination of the Earth from outer space, specifically “biological, chemical and radiation contamination.”<sup>112</sup> The provision envisages two possible situations of contamination, the first being “forward contamination” of outer space, and the second being the “back-contamination” of Earth.<sup>113</sup> The latter, deemed an “Earth-oriented perspective” by the authors of the Cologne Commentary, could be applied to scenarios of damage envisaged by Article II of the Liability Convention.<sup>114</sup> Yet, as seen below, the definition of “damage” under the Liability Convention does not encompass rocket emissions within its scope. The former criteria of “forward contamination” has been proposed to include the introduction of such items, substances and energy into outer space which results in endangering the health of cosmonauts, causing hindrance for legitimate outer space activities, and causing damage to outer space objects.<sup>115</sup> Possible sources of contamination of celestial bodies were therefore suggested as including the release of chemical markers, radioactivity resulting from nuclear explosions and generation of gases in connection with soft landings.<sup>116</sup> On the other hand, backward contamination considered the re-entry of space vehicles that may potentially contaminate the Earth.<sup>117</sup> As the impact of rocket emissions is both indirect and intangible, in the sense that there is no immediate event triggering either of these envisaged situations, rocket emissions would not fall within the scope of this expression either.

Turning to the expression, “harmful interference,” the *travaux préparatoires* are most illuminating as exhibiting the legislative intent behind this provision. The negotiating history reveals that in 1963, the USSR protested the conduct of the US West Ford space communications experiment, contending that the same constituted a “military criminal experiment” and required consultation with the international community.<sup>118</sup> It was this event which was responsible for the drafters’ incorporation of the “harmful interference” language in Article IX. Avoiding potentially harmful interference was more linked to the critical issue of the use of outer space for peaceful uses,

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<sup>112</sup> See UNGA, *Report of the Ad Hoc Committee on the Peaceful Uses of Outer Space*, UN Doc A/4141 (1959) at 47.

<sup>113</sup> CoCoSL, *supra* note 106 at 176.

<sup>114</sup> *Liability Convention*, *supra* note 83, art II.

<sup>115</sup> Y. M. Kolossov, “Legal Aspects of Outer Space Environmental Protection” (1980) 23 *Colloquium on the Law of Outer Space* 103, at 103.

<sup>116</sup> CoCoSL, *supra* note 106 at 171.

<sup>117</sup> *Id.*

<sup>118</sup> See *Letter from the Permanent Representative of the Union of Soviet Socialist Republics addressed to the Secretary General*, UN Doc A/AC.105/15 (1963).

military purposes and military experiments.<sup>119</sup> Given that the drafters clearly did not intend to include stratospheric rocket pollution within the scope of this term, it is therefore argued that Article IX is lamentably ambiguous, and not strong enough to provide a basis for future legislation on rocket emissions.

From this section the author concludes that while an evolutive interpretation of Article IX certainly does not contradict the sentiment of protecting the outer space environment, and may encourage regulating rocket emissions, the lacunae illuminated above render the provision too weak to stand as the sole foundation for a new mechanism to regulate rocket emissions.

### **2.3.2 The Liability Convention: Rigidity in envisaging situations of damage**

The Liability Convention was drafted with the intention of compensating damage caused by launches to outer space.<sup>120</sup> The convention classifies damage into two broad categories: the first is a situation regarding compensation for damage caused by a space object on the surface of the Earth or to aircraft in flight.<sup>121</sup> The second situation arises where damage is caused “elsewhere than on the surface of the Earth” to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State.<sup>122</sup> The standards of liability are clearly different for each situation, but only apply in case of “damage”.

Article I(a) defines damage as “[l]oss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organisations”.<sup>123</sup> Unfortunately, it is unclear whether “damage” would include rocket pollution in the outer space environment. Reference is made to the Canadian claim in the Cosmos 954 incident, which centered on the subsequent radioactive debris constituting “damage to property” under the convention.<sup>124</sup> The latter claim refers to damage to Canadian land, i.e. the Earth environment, which would fall within the scope of damage under the Liability Convention.

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<sup>119</sup> CoCoSL, *supra* note 106 at 172.

<sup>120</sup> See *Liability Convention*, *supra* note 83, preamble.

<sup>121</sup> *Id.*, art II.

<sup>122</sup> *Liability Convention*, *supra* note 83, art III.

<sup>123</sup> *Id.*, art I(a)

<sup>124</sup> See Canadian Department of External Affairs, *Protocol between the Government of Canada and the Government of the Union of Soviet Socialist Republics, (Re: Disintegration of Cosmos 954 over Canadian Territory In 1978)*, (1981) at para 19; Also see Ram Jakhu, “Legal Issues Relating to the Global Public Interest in Outer Space,” Center for International and Security Studies at Maryland (2005) at 57.

However, Article II of the Outer Space Treaty prohibits national appropriation and prevents the outer space environment from being considered “property” in this sense. While the impact of emissions could be argued to include this definition of damage (climate change and emissions ultimately affecting human health and life), pollution by rocket emissions does not fall within a plain reading of the two categories of damage caused on (i) the surface of the Earth, or (ii) to aircraft in flight, or (iii) to another space object.

### **2.3.3 Article III of the Outer Space Treaty: Application of international environmental law**

Article III of the Outer Space Treaty requires all activities in outer space to be conducted in accordance with international law and includes a specific reference to the UN Charter.<sup>125</sup> Article III could thus possibly provide an avenue for the application of general principles of international environmental law, as applicable law includes not only international norms for the environmental protection of outer space, but also rules of international law at large, whether such rules are customary or conventional.<sup>126</sup>

There is merit to this argument. However, Article III by itself is unlikely to result in a change in States’ attitudes toward rocket emissions regulations, to the effect that new regulations will immediately be adopted. Still, it is useful to provide evidence of how rocket emissions regulations would be in accordance with the following instruments and legal positions under international environmental law. The next section will analyse relevant principles and treaties that may extend to rocket emissions in the future.

## **2.4 Principles under international environmental law**

While several instruments have led to the formation of customary sources of environmental law, international environmental law has been largely codified through the formation of treaties among States. Certain treaties regarding emissions and climate change relevant to this thesis are also briefly surveyed below.

### **2.4.1 Stockholm Declaration**

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<sup>125</sup> *Outer Space Treaty*, *supra* note 83, art III.

<sup>126</sup> CoCoSL *supra* note 106, at 177.

This instrument can be considered a turning point in international environmental law, even though it was a “declaration” rather than a binding treaty adopted in 1972. The form of the instrument does not diminish the fact that it represented a collective effort by States to recognise rights and corresponding obligations regarding the environment.<sup>127</sup> Principle 12 is particularly relevant because it enumerates the general obligation to ensure prevention of damage, and typifies the same mentality as that of the drafters in the Article IX negotiating process. Principle 12 essentially provides the right to exploit resources pursuant to a State’s own environmental policies, and the subsequent responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.<sup>128</sup> This principle therefore applies the concept of avoiding activities which cause harm to environments that fall under “a global commons”, which includes outer space, Antarctica and the high seas within its purview.

#### **2.4.2 Rio Declaration**

The 1992 UN Conference on Environment and Development culminated in the adoption of 27 principles on sustainable development.<sup>129</sup> Principle 2 of the Rio Declaration echoed Principle 21 of the Stockholm Declaration, strengthening the position that States should abstain from polluting any area in the global commons.<sup>130</sup> This declaration further develops the wording of Principle 12 of the Stockholm Declaration and introduced the fundamental notion of the precautionary approach in Principle 15. This principle stated that, “[i]n order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”<sup>131</sup>

The incorporation of this language into a declaration adopted by numerous States denoted a substantial step forward by adding this “precautionary approach” to the earlier traditional “no-harm” rule. The precautionary principle is distinguished from the no-harm principle, in that the latter was traditionally engaged in the event of a known or objectively determined risk of

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<sup>127</sup> See *Stockholm Declaration*, *supra* note 96, preamble.

<sup>128</sup> *Id.*, Principle 12.

<sup>129</sup> *Rio Declaration*, *supra* note 101.

<sup>130</sup> See Philippe Sand, *Principles of International Environmental Law*, (New York: Cambridge University Press, 2003) at 231 [Sand].

<sup>131</sup> *Rio Declaration*, *supra* note 101, Principle 15.

significant environmental harm, while the precautionary principle, in contrast, does not require ‘full scientific certainty’ if there are ‘threats of serious or irreversible damage’, and its lower evidentiary threshold could strengthen the protective potential of international environmental law.<sup>132</sup> However, although Principle 15 of the Rio Declaration as quoted above, constitutes the most commonly invoked version of the precautionary principle, debate persists among States and several academic commentators about the precise contents of the principle, and whether or not it has acquired the status of customary international law.<sup>133</sup> This can understandably also be attributed to the actual wording of Principle 15, as though the words “shall be” have been incorporated, the qualifying phrase “according to their capabilities” significantly weakens the principle.

## 2.5 Notable international cases

As a subsidiary means for determining the law,<sup>134</sup> certain judicial pronouncements have additionally contributed to the corpus of international environmental law.<sup>135</sup>

### 2.5.1 Trail Smelter Arbitration, 1941

The Trail Smelter arbitration<sup>136</sup> produced the earliest international pronouncement on transboundary pollution, which forms the backbone of international environmental law today.<sup>137</sup> The case centered around transboundary air pollution which originated in British Columbia, Canada and impacted Washington State, US. The resultant air pollution affected livestock and farmland located in the latter State. In a landmark ruling, the arbitral tribunal established under the Convention for Settlement of Difficulties arising from Operation of Smelter at Trail, British Columbia<sup>138</sup> determined that no State had “the right to use or permit the use of its territory in such

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<sup>132</sup> D. Bodansky, J. Brunee, L. Rajamani, *International Climate Change Law*, 1<sup>st</sup> Ed., (Oxford, Oxford University Press, 2017) at 43 [*International Climate Change Law*].

<sup>133</sup> Id.

<sup>134</sup> *Statute of the International Court of Justice*, 26 June 1945, 3 Bevans 1179, 59 Stat 1031, TS 993, 39 AJIL Supp 215 (entered into force 24 October 1945) [*ICJ Statute*], art 38.

<sup>135</sup> See dissenting opinion of Judge Azevedo in *Asylum (Colombia v. Peru)* [1950] ICJ Rep 266; Also see Ian Brownlie, *Principles of Public International Law*, (Oxford University Press, 2008) at 20, where he asserts, “[s]ince 1947, the decisions and advisory opinions in the *Reparation*, *Genocide*, *Fisheries* and *Nottebohm* cases have had decisive influence on general international law.”

<sup>136</sup> *Trail Smelter Arbitration (United States v Canada)*, 35 AJIL (1941) 684 [*Trail Smelter Arbitration*].

<sup>137</sup> See Sand, *supra* note 130 at 30.

<sup>138</sup> US-Canada, *Convention for Settlement of Difficulties arising from Operation of Smelter at Trail, British Columbia*, 15 April 1935, No. 893 of 1935.

a manner as to cause injury by fumes in or to the territory of another” and additionally required that said injury must be “of serious consequence” and further “established by clear and convincing evidence.”<sup>139</sup> Thus three founding principles emerged: first, that of transboundary pollution from activities conducted by one State affecting the territory of another; second, that the harm so incurred must be severe; and third, that specific evidence is required to prove such an injury.<sup>140</sup> Furthermore, the tribunal introduced the concept of reparations for transboundary environmental damage, directing Canada to pay the US compensation, (possibly the first known instance of the “polluter pays” principle in environmental law), and additionally requiring that Canada introduce measures to ensure prevention of any future damage.<sup>141</sup>

### **2.5.2 ICJ Advisory Opinion on the Legality of the Threat or Use of Nuclear Weapons 1996**

In 1996, the ICJ issued an Advisory Opinion in response to the titled question “[i]s the threat or use of nuclear weapons in any circumstance permitted under international law?” submitted by the General Assembly.<sup>142</sup> Among its other pronouncements on the subject, the ICJ unequivocally stated that “[t]he general obligation of States to ensure that activities within their jurisdiction and control respect the environment of other States or of areas beyond national control, is now part of the corpus of international law relating to the environment.”<sup>143</sup> However, the ICJ did not classify the nature of this obligation in accordance with the sources of law under Article 38 of its Statute, i.e. whether such an obligation is custom, or requires manifestation in treaty form.

### **2.5.3 Gabčíkovo-Nagymaros Project Case 1997**

The ICJ rendered its decision in the Gabčíkovo-Nagymaros Project Case<sup>144</sup> in 1997, in which Hungary had claimed that (then) Czechoslovakia violated the provisions of a treaty when it appropriated the Danube River to construct a dam. The Court directed that the joint regime be restored to achieve the relevant treaty’s common objectives, and cited the aforementioned Advisory Opinion regarding nuclear weapons, additionally expressing “the great significance that [the Court] attaches to respect for the environment, not only for States but also for the whole of

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<sup>139</sup>*Trail Smelter Arbitration*, *supra* note 136.

<sup>140</sup> *Id.*

<sup>141</sup> *Id.*

<sup>142</sup> *Legality of the Threat or Use of Nuclear Weapons*, Advisory Opinion, [1996], ICJ Rep 226.

<sup>143</sup> *Id.* at 242.

<sup>144</sup> *Gabčíkovo-Nagymaros Project (Hungary v. Slovakia)* [1997] ICJ Rep 7.

mankind.”<sup>145</sup> This statement is especially influential, because it reflects the ICJ’s recognition of applying international environmental law to areas of the global commons. This would, by default, include the stratosphere and regulate any pollution by rockets in this region or beyond.

#### **2.5.4 Pulp Mills Case 2010**

The Pulp Mills case<sup>146</sup> is pertinent as the ICJ developed two facets of the “no-harm” rule in its decision. The first facet is the obligation to take appropriate measures for “prevention of harm” to the environment of other States or to any global commons.<sup>147</sup> The ICJ further held that there is a responsibility on the State to act with due diligence, which entails “not only the adoption of appropriate rules and measures, but also a certain level of vigilance in their enforcement and the exercise of administrative control applicable to public and private operators.”<sup>148</sup> The second facet of the no-harm rule thus lies in the State’s corresponding duty to actively exercise caution in preventing environmental harm. “Due diligence” was acknowledged, in this judgment, as an intrinsic obligation which required active efforts undertaken by States.

#### **2.5.5 ITLOS Advisory Opinion, 2011**

The ITLOS Seabed Disputes Chamber issued an Advisory Opinion on Responsibilities in the Area,<sup>149</sup> which noted the evolving importance of the precautionary principle in various international instruments and concluded that it “initiated [a] trend towards making [the precautionary principle] part of customary international law.”<sup>150</sup> Interestingly, the Chamber identified prevention of harm and the precautionary principle as two separate but interconnected concepts, opining that “[t]he precautionary approach is also an integral part of the general obligation of due diligence.”<sup>151</sup> Therefore, the Chamber considered the failure of a State to take all appropriate measures to prevent damage, even in situations where scientific evidence is insufficient, but “where plausible indications of potential risks were evident”<sup>152</sup> as being a violation of the obligation of due diligence. The Chamber did additionally note that there is no

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<sup>145</sup> Id. at 41.

<sup>146</sup> *Pulp Mills on the River Uruguay (Argentina v. Uruguay)* [2010] ICJ Rep 14.

<sup>147</sup> Id. at 79.

<sup>148</sup> Id.

<sup>149</sup> *Responsibilities and obligations of States sponsoring persons and entities with respect to activities in the Area, Advisory Opinion* [2011] ITLOS Rep 10.

<sup>150</sup> Id. at 47.

<sup>151</sup> Id.

<sup>152</sup> Id.

fixed threshold for diligence, implying that every case must be evaluated on an individual basis. This rationale is vital to the regulation of rocket emissions because, as considered in the previous Chapter, scientific evidence is uncertain as regards the extent of damage, but nevertheless accounts for “plausible indications of potential risks” to the stratosphere. On this basis, a new mechanism for rocket emissions could perhaps contain procedural steps to prove that the State has acted with due diligence and taken the minimum precautionary measures to ensure limited harm to the outer space environment.

### **2.5.6 Costa Rica v. Nicaragua 2018**

At the time of writing, the most recent ICJ decision regarding environmental law concerned Costa Rica’s claim for compensation by Nicaragua due to the loss of environmental goods and services sustained from Nicaragua’s alleged breaches under several international conventions.<sup>153</sup> This claim included compensation for Nicaragua-excavated channels on Costa Rican territory for gas regulation and air quality services, including carbon sequestration.<sup>154</sup> The ICJ held that Nicaragua had violated Costa Rica’s territorial sovereignty and directed Nicaragua to pay compensation. This was the first time that the Court had to consider how to determine payment of compensation for environmental damage. Markedly, the ICJ determined that the value of environmental goods and services with regard to carbon sequestration could not be estimated as a one-time loss.<sup>155</sup> This implies that the future use of resources was included in the ICJ’s determination of compensation payable- a factor relevant when compared to the use of outer space as a resource for mankind.

At the regional and national level, numerous suits have also been filed within the context of environmental law, which include litigation against corporations and governments alike, for contributing to climate change under instruments ranging from the European Union Emissions Trading System (discussed in Chapter 4) and the Kyoto Protocol (see below).

## **2.6 Other relevant international conventions**

### **2.6.1 UNFCCC**

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<sup>153</sup> *Certain Activities Carried Out by Nicaragua in the Border Area (Costa Rica v. Nicaragua)* [2018] ICJ Rep 2

<sup>154</sup> *Id.* at 19.

<sup>155</sup> *Id.* at 23.

The UNFCCC<sup>156</sup> is a milestone in multilateral environmental treaties, simply due to the overwhelming number of States which signed the convention, (some begrudgingly) as the world came to terms with regulating climate change. The large number of signatories to the UNFCCC however, does not directly translate into tangible success. This criticism stems largely from the soft, mostly aspirational and non-binding language which was incorporated to encourage States to join the overall framework.<sup>157</sup> This first step was designed to contain a basic framework, (which was the UNFCCC itself), with subsequent agreements or protocols to be further developed under the UNFCCC umbrella. The UNFCCC defined emissions as “[t]he release of greenhouse gases and/or their precursors into the atmosphere over a specified area and period of time.”<sup>158</sup> The definition of “greenhouse gases” was enumerated as “[t]hose gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation.”<sup>159</sup>

Article 2 sets out the objective of the UNFCCC, “to achieve, in accordance with the relevant provisions of the Convention, stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.”<sup>160</sup> This goal is however qualified by the language, “[s]uch a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.” This wording evokes that of the Montreal Convention of 1999,<sup>161</sup> which was introduced to modernise the Warsaw Convention<sup>162</sup> and provide fair compensation to passengers on international flights.<sup>163</sup> Article 2 of the UNFCCC as quoted above is reminiscent of the preamble of the Montreal Convention, which advocates the need to provide uniformity and protect consumer interests, but

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<sup>156</sup> *United Nations Framework Convention on Climate Change*, 9 May 1992 1771 UNTS 107 (entered into force 21 March 1994) [UNFCCC].

<sup>157</sup> See UNFCCC, art 3 regarding “Principles” which uses language such as “...Parties shall be guided by the following”; Also see UNFCCC, art 4 regarding “Commitments” which imposes obligations on the basis of the principle of common but differentiated responsibilities, but only based on the State Party’s “specific national and regional development priorities, objectives and circumstances.”

<sup>158</sup> UNFCCC, *supra* note 156, art 1(4).

<sup>159</sup> *Id.*, art 1(5).

<sup>160</sup> UNFCCC, *supra* note 156, art 2.

<sup>161</sup> *Convention for the Unification of Certain Rules for International Carriage by Air*, 28 May 1999, 2242 UNTS 309 (entered into force 4 November 2003) [Montreal Convention].

<sup>162</sup> *Convention for the Unification of certain Rules relating to International Carriage by Air* 12 October 1929, 137 LNTS 11 (as amended at the Hague, 1955, and by Protocol No. 4 of Montreal, 1975).

<sup>163</sup> *Montreal Convention*, *supra* note 161, preamble.

also pointedly mentions a parallel need for development of air transport operations.<sup>164</sup> This dual objective is a hurdle that will be faced by any mechanism to regulate rocket emissions, as there has been a constant fear of added regulation “at the cost of industry and development.” The fact that this provision was inserted into the UNFCCC evidences this thinking.

At the time that the UNFCCC was drafted, there were various factions discernible through the negotiations, beginning with a demarcation between developed and developing nations on the basis of who should bear primary responsibility for climate change.<sup>165</sup> Some countries were vehemently opposed to any form of binding targets, in particular the US, Canada, Iceland, Japan, New Zealand, Norway, Australia and Russia.<sup>166</sup> Developing nations placed their opposing views on hold and were supported by the EU, collectively arguing for strict regulation by way of national policy measures to limit emissions.<sup>167</sup> The varied concerns of these emerging groups were addressed through Article 3, which introduced the contentious concept of “Common but Differentiated Responsibilities”<sup>168</sup> (CBDR), classifying countries into Annex I and non-Annex I states. Countries falling under the latter category had relatively more flexibility and regulations of a more general nature. These distinct groups represent the political division of States according to the CBDR principle, which frequently causes negotiations to stall, or result in States reaching an impasse due to the inability to agree on a compromise that benefits all parties involved.<sup>169</sup> As the CBDR approach has been divisive, the author contends that it is advisable to move away from this concept and develop a new concept entirely for the international space sector. By introducing emissions regulation in the space sector on a different basis, States might finally reach an international consensus - which would in turn lead to a stronger source of law (regardless of the form that the regulations may take, as we have seen that Guidelines in the space sector are equally significant).<sup>170</sup>

## 2.6.2 Kyoto Protocol

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<sup>164</sup> Id, preamble.

<sup>165</sup> See generally, International Climate Change Law, *supra* note 132 at 118-157.

<sup>166</sup> Id., at 106.

<sup>167</sup> Id.

<sup>168</sup> UNFCCC, *supra* note 156, art 3.

<sup>169</sup> See *infra*, Chapter 4 on comparative study with the aviation sector for examples from the 40<sup>th</sup> Assembly at ICAO, where the CBDR principle continues to prevent States from reaching a consensus.

<sup>170</sup> See *Guidelines on Long-Term Sustainability of Outer Space Activities*, *supra* note 89; Also see *Space Debris Mitigation Guidelines*, *supra* note 89.

The UNFCCC system is comprised of numerous instruments, each of which exhibit the evolution of various States' positions on emissions regulation. It is significant to note these developments, to learn how to frame obligations and emission reduction targets in a mechanism for rocket emissions.

Following the adoption of the framework convention, the UNFCCC operationalised its provisions through a new instrument, i.e. the Kyoto Protocol,<sup>171</sup> which exclusively focused on the reduction of greenhouses gases by developed countries. The Kyoto Protocol represents a compromise between the differing views of States, with a flexible mechanism that imposes greater limitations on emissions. The Protocol encourages States to participate in emissions trading to meet their targets.<sup>172</sup> Article 12 of the Kyoto Protocol also introduced the Clean Development Mechanism (CDM), which is a system that enables developed countries to receive credit if they implement schemes to reduce emissions in developing countries.<sup>173</sup> The Protocol therefore sets targets and leaves the method of achieving these targets to regulation at the national and regional levels. The principle of CBDR is reflected in the variegated levels of responsibility for developed and developing nations, as the latter had the option of voluntary caps on emissions. The reference to CBDR is evident from the preamble itself, and attempts to build a regime that recognises the structural inequalities between the global North and South. The Protocol therefore promotes the idea that developing countries should be allowed the right to develop, while developed nations have the obligation to continue to develop in a sustainable manner.<sup>174</sup> This bifurcation has not been viewed favourably by the US, which withdrew from the Kyoto Protocol in 2001.<sup>175</sup> The Protocol thus focused on setting binding targets for Annex I parties, but ensured that there was flexibility in nationally implementing these targets to make it more palatable to certain States. There were clear caps, but each State had the discretion to decide which greenhouse gases to focus on, the sectors on which these measures would be imposed, and the form of the measures themselves. Furthermore, the Protocol left implementation of additional regulations open, to be clarified in subsequent instruments, such as reporting requirements and the compliance mechanism. This led

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<sup>171</sup> *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, 11 December 1997, 37 ILM 22 (entered into force 16 February 2005) [*Kyoto Protocol*].

<sup>172</sup> *Id.*, art 17.

<sup>173</sup> *Id.*, art 12.

<sup>174</sup> International Climate Change Law, *supra* note 132 at 129.

<sup>175</sup> *Id.*

to negotiations for the Marrakesh Accords.<sup>176</sup> The Marrakesh Accords expanded on how the provisions in the Kyoto Protocol would be implemented, which included introducing a “Work Plan on Mechanisms” for the aforementioned Articles 12 and 17 of the Protocol.<sup>177</sup>

Among developing nations, the CBDR principle has been criticised for its lack of effectiveness in achieving the equitable balance it was intended for. This criticism is particularly rampant among African States and small island developing States, which argue that there is a clear absence of an “equitable distribution of CDM projects” as most of such projects were being initiated within India and China.<sup>178</sup> Annex I Parties were required to comply first with “differentiated targets” which were determined on an individual basis for each State, based on their national contributions to emissions, and second, an overall “collective target” which required them to reach a level of “at least 5% below 1990 levels.”<sup>179</sup> The language in the Protocol reflects mandatory obligations for the individual targets (employing the word “shall”) as opposed to more goal-oriented language for the collective target (using the phrase “with a view to”).

Unfortunately, US withdrawal - coupled with a mere five-year commitment period - rendered the Kyoto Protocol ineffective. Negotiations to further develop emissions regulation continued following the Marrakesh Accords, with the Bali Action Plan,<sup>180</sup> the Copenhagen Accord,<sup>181</sup> the Cancun Agreements,<sup>182</sup> the Durban Platform<sup>183</sup> and the Doha Amendment<sup>184</sup>. Through the course of these negotiations, several factors contributed to the evolutionary nature of climate change regulation. This began with the conspicuous economic growth rates of certain developing states, such as India and China. The US opposed any regime which did not provide flexibility at the

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<sup>176</sup> See Seventh Conference of the Parties (COP 7), *Marrakesh Accords*, United Nations Framework Convention on Climate Change, 10 November, 2001 [*Marrakesh Accords*].

<sup>177</sup> Id., “Work Programme on Mechanisms (Decisions 7/CP.4 and 14/CP.4).

<sup>178</sup> See UNFCCC, “Equitable Distribution of Clean Development Mechanism Project Activities, Submissions from Parties”: online UNFCCC <unfccc.int/resource/docs/2006/cmp2/eng/misc01.pdf>.

<sup>179</sup> *Kyoto Protocol*, *supra* note 171, art 3.

<sup>180</sup> *Bali Action Plan*, Decision 1/CP.13 (2007), online: UNFCCC, <unfccc.int/resource/docs/2007/co13/eng/06a01.pdf#page=3>.

<sup>181</sup> *Copenhagen Accords*, Decision FCCC/CP/2009/L.7 (2009), online: UNFCCC <unfccc.int/resource/docs/2009/cop15/eng/107.pdf>

<sup>182</sup> *Cancun Agreements*, Decision 1/CMP.6, online: UNFCCC <unfccc.int/process-and-meetings/conferences/past-conferences/cancun-climate-change-conference-november-2010/cop-16/cop-16-documents>

<sup>183</sup> *Durban Outcomes*, Decision 1/CMP.7 online: UNFCCC <unfccc.int/meetings/durban\_nov\_2011/meeting/6245/php/view/decisions.php>

<sup>184</sup> *Doha Amendment*, Decision 1/CMP.8, online: UNFCCC <unfccc.int/files/kyoto\_protocol/application/pdf/kp\_doha\_amendment\_english.pdf>

national level. Meanwhile, the EU remained steadfast and advocated for more stringent international regulation. The latter's view was bolstered by support from small island developing States to maintain a level of global warming below 2°C (see earlier chapter for statistics on global warming). Canada too withdrew from the Kyoto Protocol, which resulted in other members of the "Umbrella Group" subsequently refusing new emissions targets. These instruments finally culminated in an entirely new binding legal agreement in December, 2015, titled the Paris Agreement.<sup>185</sup> This agreement is relevant to the present discussion, as it is the most recent multilateral treaty under the UNFCCC system that gained the signatures of 196 States.<sup>186</sup> This agreement sheds light on the scope of obligations that States may commit to in an emissions reduction framework, even a future mechanism that exclusively focuses on rocket emissions.

### 2.6.3 Paris Agreement

The Paris Agreement was extremely progressive at the time of its adoption. The treaty reflected States' commitment to "[h]olding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels."<sup>187</sup> The agreement was viewed as a considerable step forward for a global effort to reduce emissions, until the Trump Administration pulled the US out of the agreement through the Article 28 mechanism. Article 28 permits a State to withdraw from the agreement three years from its effective date, although the effective date of such withdrawal will only take place one year pursuant to the State's notification.<sup>188</sup> The US withdrawal from the Paris Agreement has ominous implications for the future of the agreement itself, as the US is the world's second-largest emitter, after China, with contributions estimated at approximately 15% of global emissions.<sup>189</sup>

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<sup>185</sup> *Paris Agreement*, 10 December 2015, UN Doc. FCCC/CP/2015/10/Add.1 [*Paris Agreement*].

<sup>186</sup> At this time, 195 States are signatories to the treaty. See Status of Paris Agreement as at 26 November, 2019, online: <[https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg\\_no=XXVII-7-d&chapter=27&lang=\\_en&clang=\\_en](https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-7-d&chapter=27&lang=_en&clang=_en)>

<sup>187</sup> *Paris Agreement*, *supra* note 185, art 2(1)(a).

<sup>188</sup> *Id.*, art 28.

<sup>189</sup> See United States Environment Protection Agency, "Global Greenhouse Gas Emissions Data", online: *United States Environment Protection Agency* <<https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>>; Also see World Bank, "CO2 Emissions", online: *World Bank* <<https://data.worldbank.org/indicator/EN.ATM.CO2E.PC>> and World Resources Institute, "Greenhouse Gas Emissions over 165 Years", online: *WRI* <<https://www.wri.org/resources/data-visualizations/greenhouse-gas-emissions-over-165-years>>

This author contends that the strength of the agreement will be severely diluted when a leading contributor rejects accountability or commitment to reduction targets.

Still, the Paris Agreement reflects an evolution of thought from the original UNFCCC. Most prominent is the CBDR principle in Article 2, which stated that the agreement was to reflect “equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.”<sup>190</sup> The agreement also stipulated that the parties’ nationally determined contributions (NDCs) were legally binding, with these NDCs expected to “represent a progression over time.”<sup>191</sup> This language arguably indicates a dilution of the CBDR principle, as it provides scope for future increase of responsibility on developing States. The new consensus required “developed nations to continue taking the lead by undertaking economy-wide absolute emission reduction targets, while developing countries would essentially continue with the status quo,” and were “encouraged to move over time towards economy-wide emission reduction or limitation targets in the light of different national circumstances”.<sup>192</sup> In addition, the Paris Agreement stated that the least developed countries and small island developing States “may” prepare and communicate strategies and plans for low greenhouse gas emissions development reflecting their special circumstances.<sup>193</sup> The Paris Agreement was adopted to focus on “mitigation” i.e., mitigation of GHG emissions with features for “adaptation” by the State Parties, which involves actions taken to avoid the foreseeable consequences of climate change.<sup>194</sup> The Paris Agreement hence strikes a balance between mitigation and adaptation, with Article 7(4) stating that “greater levels of mitigation can reduce the need for additional adaptation efforts.” The Paris Agreement also placed increased responsibility on developed countries for the provision of financial support to developing countries with respect to both mitigation and adaptation.<sup>195</sup> A positive development was the transparency framework established under Article 13, which aimed at tracking progress and actions undertaken by each Party towards achieving its nationally determined contributions, with respect to differing capacities.<sup>196</sup>

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<sup>190</sup> *Paris Agreement*, *supra* note 185, art 2.

<sup>191</sup> *Paris Agreement*, *supra* note 185, art 3.

<sup>192</sup> *Id.*, art 4(4).

<sup>193</sup> *Id.*, art 4(6).

<sup>194</sup> *Id.*, arts 6 and 7.

<sup>195</sup> *Id.*, art 9.

<sup>196</sup> *Id.*, art 13.

This agreement thus presented itself as a definitive step forward for international environmental law *qua* emissions. However, as stated above, the US announcement to withdraw raises alarming concerns not only from the perspective that this may encourage other States to mimic the US and withdraw after 2020, but also insofar as the US would no longer be providing any form of financial aid, nor will it be bound to implement any measures towards emissions reduction.

#### **2.6.4 Montreal Protocol**

The Montreal Protocol must be noted for its effective multilateral efforts towards regulating substances that contribute to radiative forcing and ozone depletion.<sup>197</sup> As the launch industry has great potential to impact both, this Protocol can provide lessons in regulating rocket emissions.

Ozone-depleting substances (ODS) are not directly governed by the UNFCCC framework. The UNFCCC actively delegates this area of governance and provides that ODS must be addressed by the Montreal Protocol<sup>198</sup> which was adopted pursuant to the Convention for the Protection of the Ozone Layer<sup>199</sup> to reduce emissions of substances that deplete the ozone layer. As explained in the previous Chapter, ozone depletion and climate change are separate but interconnected problems. The Montreal Protocol acknowledged this link in 2007, and set an ambitious phase-out schedule for hydrochlorofluorocarbons (HCFCs) by developed and developing countries over the following decades. This phase-out is centred in Article 2, which stipulates control measures for developed countries, and Article 5, which enlists a procedure noting the “special situation of developing countries.”<sup>200</sup> Therefore, even though the Montreal Protocol acknowledged the difference in status between developed and developing countries (an echo of the CBDR principle in the UNFCCC system), it nonetheless provided for clear goals for both factions. Further, all Parties were obliged to comply with the same reporting requirements, regardless of their status.<sup>201</sup> The author emphasises this provision, as this form of non-discrimination exhibited under Article 7 regarding reporting obligations would be a necessary component of any new regime for rocket emissions. This would maintain a level of transparency which is equally imposed on all States.

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<sup>197</sup> *Montreal Protocol on Substances that Deplete the Ozone Layer*, 16 September 1987, 1522 UNTS 3, 26 ILM 1550 (entered into force 1 January 1989) [*Montreal Protocol*]

<sup>198</sup> *Id.*

<sup>199</sup> *Convention for the Protection of the Ozone Layer*, 22 March 1985, 1513 UNTS 323; 26 ILM 1529 (entered into force 22 September 1988).

<sup>200</sup> *Montreal Protocol*, *supra* note 197, arts 2 and 5.

<sup>201</sup> *Id.*, art 7.

The Montreal Protocol has been amended to include substances that were not directly included under the UNFCCC framework (Kigali Amendment).<sup>202</sup> This facilitated the regulation of hydrofluorocarbons (HFCs), which are “short-term climate forcers” that remain in the atmosphere for shorter periods of time, such as black carbon and methane. As Chapter 1 has presented the negative effects of black carbon emitted by certain rockets, the mechanics of this Protocol can assist in framing a new instrument for rocket emissions.<sup>203</sup>

The passing of the Kigali Amendment is a forward-looking step, as it demonstrates States’ inclination to commit to regulating specific forms of harmful pollutants. Indeed, the overall recovery of the ozone today is a testament to the success of this Protocol. The Scientific Assessment of Ozone Depletion published in 2018 reveals that the actions taken under the Montreal Protocol have led to decreases in ODS and additionally resulted in the start of the recovery of stratospheric ozone.<sup>204</sup> In a sense, this is due to certain features of the Montreal Protocol, which include fixed commitments from States, procedural transparency and scheduled phase-out procedures for various substances, with the end-goal of complete elimination. The fact that these schedules have been adhered to by States, and the Protocol itself receiving universal ratification has led to this instrument being termed (quoting former Secretary General Kofi Annan), “...the single most successful international agreement to date.”<sup>205</sup>

## **2.6.5 Convention on Long Range Transboundary Air Pollution and Gothenburg Protocol**

Although the Convention on Long Range Transboundary Air Pollution (LRTAP Convention)<sup>206</sup> has fewer signatories, it is relevant, as it regulates air pollution from a range of pollutants including black carbon. 51 States entered into this agreement, including the US, Canada, Russia, EU and the Arctic States. The Convention functions in a similar fashion to the UNFCCC system, i.e., a primary over-arching instrument with subsequent protocols or agreements. The LRTAP Convention

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<sup>202</sup> *Amendment to the Montreal Protocol agreed by the Twenty-Eighth Meeting of the Parties*, Kigali, 15 October 2016, (entered into force 1 January 2019).

<sup>203</sup> See Chapter 1, Section 1.2.3 for effects of black carbon emitted by rockets.

<sup>204</sup> See World Meteorological Organization Global Ozone Research and Monitoring Project, *Scientific Assessment of Ozone Depletion: 2018*, online: < [https://library.wmo.int/doc\\_num.php?explnum\\_id=5704](https://library.wmo.int/doc_num.php?explnum_id=5704)>.

<sup>205</sup> See UN, “International Day for the Preservation of the Ozone Layer,” online: UN, <<https://www.un.org/en/events/ozoneday/background.shtml>>

<sup>206</sup> *Convention on Long-Range Transboundary Air Pollution*, 13 November 1979 1302 UNTS 217, 18 ILM 1442 (entered into force 16 March 1983) [*LRTAP Convention*].

concerns air pollution by identified chemicals through the adoption of seven protocols, including the Gothenburg Protocol<sup>207</sup> which pertains to black carbon.<sup>208</sup>

The Preamble of the LRTAP Convention emulates Principle 21 of the Stockholm Declaration, and reiterates that States have the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.<sup>209</sup> The expression “long-range transboundary air pollution” has been defined as “air pollution whose physical origin is situated wholly or in part within the area under the national jurisdiction of one State and which has adverse effects in the area under the jurisdiction of another State at such a distance that it is not generally possible to distinguish the contribution of individual emission sources or groups of sources.”<sup>210</sup>

The Gothenburg Protocol was amended in 2012 to include emission reduction commitments that had to be achieved by 2020 and also introduced “fine particulate matter” as a regulated pollutant.<sup>211</sup> Again, black carbon is a component of such “fine particulate matter”. However, the scope of the Gothenburg Protocol is more limited as the Protocol introduces regulation to curb pollution of short-lived climate forcers on an international scale, but only binds State Parties. Major contributors to these pollutants such as India and China are excluded from the purview of this instrument, indicating a limit to how effectively it can achieve global reductions.

#### **2.6.6 Arctic Council’s Framework for Action on Black Carbon and Methane**

The Arctic Council, comprised of the US, Canada, Russia, Denmark, Sweden, Finland and Iceland, has also begun to evaluate pollution by black carbon. In 2015, the Arctic Council established a framework to exclusively deal with black carbon, dubbed the Arctic Council’s Framework for Action on Black Carbon and Methane.<sup>212</sup> The Arctic Council simultaneously established an Expert Group, primarily tasked with monitoring the progress of the implementation of the framework. A pertinent feature of this system is the invitation extended to “Observer” States.<sup>213</sup> This provision

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<sup>207</sup> *Protocol to Abate Acidification, Eutrophication and Ground-level Ozone*, 30 November 1999 2319 UNTS 81 (entered into force 17 May 2005) [*Gothenburg Protocol*].

<sup>208</sup> See Chapter 1, Section 1.2.3 for effects of black carbon emitted by rockets.

<sup>209</sup> *LRTAP Convention*, *supra* note 206, preamble.

<sup>210</sup> *Id.*, art 1(b).

<sup>211</sup> See *Gothenburg Protocol*, *supra* note 207, definitions.

<sup>212</sup> Expert Group on Black Carbon and Methane, Arctic Council: online: Arctic Council <[arctic-council.org/index.php/en/expert-groups/339-egbcm](http://arctic-council.org/index.php/en/expert-groups/339-egbcm)> [*Arctic Council Framework*].

<sup>213</sup> *Id.*

facilitates the inclusion of other States who contribute to and are affected by emissions. Therefore, even though the framework was adopted a specific group of States, other States have the opportunity to stay informed.

The most recent report of this Expert Group on the summary of progress makes several alarming observations on the impact of black carbon in the Arctic. The Expert Group has adopted a sectoral approach, studying the emissions of black carbon from various industries, including the oil and gas sectors and the and maritime sector.<sup>214</sup> The aviation industry (let alone the space sector) is completely excluded as a current or indeed future potential contributor to black carbon. An additional feature worth noting is that recommendations formulated by the Expert Group in 2017 were “voluntary” actions that States may wish to apply in different combinations to reduce emissions.<sup>215</sup> As to assessing how effective this regulatory model is, the Report notes that “many of the actions taken to reduce emissions of black carbon and methane will take effect gradually.”<sup>216</sup> Seven of the Arctic States – excluding Russia – have successfully reduced black carbon emissions by 16% percent according to the 2016 assessment.<sup>217</sup> However, the report notes that Russia has failed to deliver any projections, thereby making it impossible to identify how much Russia has reduced its emissions, especially since Russia accounted for nearly half (49%) of the total reported 2013 emissions of black carbon.<sup>218</sup>

All of the aforesaid instruments have different ranges of application and varying subject matter and pollutants. This has resulted in a collage of intersecting treaties and protocols that may encompass different aspects of rocket pollution, such as the pollutants that contribute to ozone depletion, or exclusive focus on black carbon in the Arctic. The author concludes that these systems, in addition to the inadequacy of the space treaties highlight the need for an entirely new mechanism specifically for the space sector.

## **2.7 Insufficient remedies in international law**

### **2.7.1 Articles on State Responsibility**

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<sup>214</sup> Expert Group on Black Carbon and Methane Summary Of Progress And Recommendations 2019, online: Arctic Council <[oaarchive.arctic-council.org/handle/11374/2411](http://oaarchive.arctic-council.org/handle/11374/2411)> [*Arctic Council Expert Group Report*].

<sup>215</sup> *Id.*

<sup>216</sup> Arctic Council Expert Group Report, *supra* note 214 at 10.

<sup>217</sup> *Id.*

<sup>218</sup> *Id.*

The Articles on State Responsibility (ASR)<sup>219</sup> were adopted by the International Law Commission (ILC) in 2001 and have been referred to by the ICJ in several decisions, including the *Gabcikovo-Nagymaros Project* case above. The ILC considers factors required to establish State responsibility for the injurious act of a State on another State, and stipulates remedies in this regard. The ASR also envision a situation where State responsibility is imposed for a violation of an international obligation which is not owed to one specific State, but to the international community as a whole.<sup>220</sup> This is a reference to the concept of *erga omnes partes*, recognised in international law as early as 1970 in the *Barcelona Traction* case.<sup>221</sup> In this decision, the ICJ recognised obligations therein as being, “by their very nature, the concern of all States”<sup>222</sup> and additionally that “all States can be held to have a legal interest in their protection.”<sup>223</sup> However, *erga omnes* has not been applied by the ICJ to environmental law.

To apply the ASR to damage caused by rocket emissions, there would have to be proof that a particular State has acted in a manner that constitutes an internationally wrongful act through a breach of the “no-harm” rule in international environmental law. The onus is on the State bringing the claim to provide evidence of the same.<sup>224</sup> Further, there is the standard requirement for a causal link which proves that the defendant State’s act resulted in the injury caused to the applicant State. It is also pertinent to note that damage *per se* is not required to invoke international responsibility under the ASR.<sup>225</sup> A State can invoke responsibility of another State that has breached its international obligations (although the commentary specifies that these obligations would have to be “collective obligations”, i.e. they must apply between a group of States and have been

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<sup>219</sup> International Law Commission, *Articles on Responsibility of States for Internationally Wrongful Acts*, 53 UNGAOR Supp (No. 10), UN Doc A/56/83 (2001) [Articles on State Responsibility].

<sup>220</sup> *Id.*, art 33.

<sup>221</sup> *Barcelona Traction, Light and Power Company, Limited (Belgium v. Spain)* [1970] ICJ Rep 3.

<sup>222</sup> *Id.* at 32.

<sup>223</sup> *Id.*

<sup>224</sup> See separate opinion of Judge de Castro in the *Western Sahara* advisory opinion wherein he stated that it is the duty of the parties to put forward facts and submit the evidence that they consider favorable to their claims in *Western Sahara*, Advisory Opinion, [1975] ICJ Rep 12; This was upheld by the ICJ in the *Genocide Convention* case where they declared, “[a] party that alleges a fact must demonstrate it before applying the relevant rules of international law,” See *Application of the Convention on the Prevention and Punishment of the Crime of Genocide* (Croatia v. Serbia), [2015] ICJ Rep 3.

<sup>225</sup> *Articles on State Responsibility*, *supra* note 219, art 48.

established in some collective interest).<sup>226</sup> Notably, the ILC cites “the environment” as a possible example for the application of this provision.<sup>227</sup>

In case of damage, substantiating each of the aforementioned bases will prove difficult, if not impossible, in terms of environmental damage caused by rocket emissions, as the applicant State should be able to attribute any environmental damage caused in its territory to the respondent State(s), specifically including tangible effects on climate change which may have been spurred by emissions in the latter State. How then, would the applicant hold the respondent responsible for tipping this most precarious environmental scale, which resulted say, in increased cancer rates or large numbers of climate refugees? If a State does not have to prove damage, how does the applicant State prove that there has been a breach of a State’s international obligation (such as preventing environmental damage caused by rocket emissions)? Would the mere failure to take cognisance of the problem suffice?

The ASR, although written more in the nature of guidelines rather than detailed rules on causation, illuminate the circumstances in which State responsibility can be invoked. However, the inability to determine when a State has breached an international obligation and establish damage, make the ASR an insufficient remedy at this point in time.

### **2.7.2 Draft Articles on Prevention of Transboundary Harm from Hazardous Activities**

The draft Articles on Prevention of Transboundary Harm from Hazardous Activities<sup>228</sup> have not been adopted, but are relevant to this discussion because the provisions specifically make a reference to such transboundary harm occurring in the space environment. Indeed, in the commentary, the International Law Commission notes that the prevention of transboundary harm to the environment, persons and property has been accepted as an important principle in many multilateral treaties concerning protection of the environment, nuclear accidents, space objects, international watercourses, management of hazardous wastes and prevention of marine pollution.<sup>229</sup> This signifies that the obligation to prevent pollution in the outer space environment is an accepted principle of international law. Although this instrument has not yet been adopted,

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<sup>226</sup> Id., Commentary on art 48.

<sup>227</sup> Id.

<sup>228</sup> International Law Commission, *Draft Articles on Prevention of Transboundary Harm from Hazardous Activities*, 56 UNGAOR Supp (No. 10), UN Doc A/56/10 (2001) [ILC Draft Articles on Transboundary Harm].

<sup>229</sup> Id.

the sentiment of the instrument captures the principles mentioned in the Stockholm Declaration and Rio Declaration, regarding the obligation of prevention. This is evident in the commentary, wherein the International Law Commission states, “[p]revention in this sense, as a procedure or as a duty, deals with the phase prior to the situation where significant harm or damage might actually occur, requiring States concerned to invoke remedial or compensatory measures, which often involve issues concerning liability.”<sup>230</sup>

## **2.8 Conclusion**

From the analysis of applicable space law and international law, this chapter concludes that, although emissions regulation, ozone depletion and transboundary pollution are considered by several instruments, none of these are specifically concerned with rocket emissions or the space sector. The author contends that there is a clear requirement for a new mechanism, as rocket emissions do not strictly fall within the purview of the space treaties, nor do the above instruments recognise rocket emissions as a source of pollution. To commence discussion on a new regulation for rocket emissions, the next chapter considers the forms of mechanisms typically debated in emissions regulation. The author emphasises that the purpose of this study is not to determine the form of the mechanism itself, but to instead formulate founding principles that can apply to a new mechanism on rocket emissions regardless of form.

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<sup>230</sup> Id., Commentary.

### **Chapter 3 – Measures to accommodate rocket emissions regulation**

This chapter will examine possible measures to regulate rocket emissions. The author first considers command-and-control measures, and thereafter surveys the debate between a blanket tax and emissions trading, to determine which may be most effective for the international space sector.

#### **3.1 An overview of applicable mechanisms**

Measures to combat carbon emissions have generated heated debates among economists and policy-makers. These include debates over market-based measures such as the imposition of a blanket carbon tax versus an emissions trading scheme (also known as “cap-and-trade”), or modified versions of the same which result in a “hybrid” variation. Therefore some economists, such as Robert Stavins, advance arguments favouring cap-and-trade,<sup>231</sup> while others such as Gilbert Metcalf support the form of a carbon tax.<sup>232</sup> Market-based measures can be classified as one category of policy measures to tackle emissions. Such measures can be employed to tackle not only carbon, but other pollutants as well.

Other categories comprise policy measures such as government subsidies for “greener” alternatives, and the more traditional command-and-control regulations, which may be implemented in conjunction with a market-based measure. Command-and-control regulation is a policy measure generally pursued by regulatory bodies to achieve a minimum standard in reducing pollution. For example, a State government could mandate that all manufacturers in its national launch industry incorporate a specific process or technology which is relatively less polluting, such as the US directive to coal-fired plants to install “scrubbers” that filter out sulfur dioxide.<sup>233</sup>

The author contends that this may be a starting point for regulation of rocket emissions. Prescribing the use of solely liquid rocket fuels would, at the very least, result in ensuring that comparatively less-polluting rockets are deployed in the launch market. While command-and-control regulation

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<sup>231</sup> See generally, Richard Schmalensee and Robert Stavins, “Learning from Thirty Years Cap & Trade,” (2019) 201 Resources; Richard Schmalensee and Robert Stavins, “Lessons Learned from Three Decades of Experience with Cap and Trade” (2017) 11 Review of Environmental Economics and Policy 1 at 59–79.

<sup>232</sup> Gilbert Metcalf, “Adding Quantity Certainty to a Carbon Tax: The Role of a Tax Adjustment Mechanism for Policy Pre-Commitment” (2017) 41 Harvard Environmental Law Review at 41-57.

<sup>233</sup> See Shi-Ling Hsu, *The Case for a Carbon Tax: Getting Past out Hang-Ups to Effective Climate Policy*, (Island Press, 2011) at 18.

has been criticised for clumsiness, inflexibility and tendency to encourage litigation, it is the contention here that these standards are necessary to any new conversation on emissions within a specific sector. This is because the very act of setting minimum standards for certain industries to avoid contributing to pollution is a progressive measure in itself. Additionally, command-and-control regulations can also be an option as an interim measure, while a more sustainable long-term mechanism is being debated for the space sector.

In substance, these instruments all pursue the same objective, i.e. emissions reduction but in different ways. Market-based measures are proposed with the intention of internalising “externalities.” An externality refers to costs or an impact to a third party to a transaction, which they as the third party have no control over.<sup>234</sup> A market-based measure within the aviation sector, for example, is the Carbon Offsetting and Reduction Scheme (CORSIA)<sup>235</sup> which is a responsive measure to internalise the cost of aircraft emissions within the price of service of air transportation (analysed in detail in the following chapter).

Evolving a regulatory mechanism applicable to rocket emissions, however, will require additional considerations specific to the global space community. To establish a suitable mechanism, at the outset there is a need to acknowledge the divide between space-faring and non-spacefaring nations. This divide is not unlike the division evident from the negotiations for climate change regulation in the previous Chapter, i.e., between developed and developing nations. Similarly, the positions of India and China must be noted in the space context, as these nations have space-faring capabilities and contribute to global emissions with steadily growing economies. Given that China has already multiplied its number of launches over the last year, it can be safely assumed that these nations will continue to expand their space sectors.<sup>236</sup> The same argument prevalent in the climate change context will likely arise when debating rocket emissions. Do developed nations have a greater obligation to assume emissions reductions, given that they have already contributed to the present threat of pollution? Certainly, some developing nations have eyed emissions trading

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<sup>234</sup> Felicity Deane, *Emissions Trading and WTO Law: A Global Analysis*, (Elgar Publishing, 2015) at 12 [*Emissions Trading and WTO Law*].

<sup>235</sup> See ICAO, 39<sup>th</sup> Assembly, Resolution A39-3, “Consolidated statement of continuing ICAO policies and practices related to environmental protection – Global Market-based Measure (MBM) scheme”; Also see Chapter 4 for detailed analysis of CORSIA.

<sup>236</sup> See UNOOSA, “Online Index of Objects Launched into Outer Space,” online: <[www.unoosa.org/oosa/osoindex/search-ng.jsp?lf\\_id=](http://www.unoosa.org/oosa/osoindex/search-ng.jsp?lf_id=)>

schemes warily, owing to the concern that developed nations could gain control of the economies of other nations through such regulations. Professor Shi-Ling Hsu succinctly describes this attitude of developing countries in his comment, “[c]ap-and-trade would have poor optics of having mostly Caucasian bureaucrats from Europe and North America decide how much China should get in terms of its cap.” This author proposes solutions to remedying this imbalance in the founding principles for a new mechanism in Chapter 6.

Regarding the form of emissions regulation, even economists are divided as to the most effective mechanism. For instance, David Weisbach and Eric Posner even question the correlation between distributive justice and climate change justice, arguing that the two issues must be separated to create an efficient model.<sup>237</sup> While this author disagrees<sup>238</sup>, the debate nonetheless underscores the need to engage with and understand these differing positions at a forum that provides States with a level playing field.

Most relevant to the discussion on rocket emissions, Weisbach and Posner also raise the impossibility of identifying a “tipping point” at which environmental damage caused by emissions gets dramatically worse.<sup>239</sup> Economist William Pizer modeled the effects of tipping points on the choice between taxes and permits under a trading scheme and concluded that if a tipping point was actually in sight, the differences between a blanket tax and a trading scheme would be swamped by the sheer necessity of putting in a stringent regime quickly.<sup>240</sup> In light of this argument, the need to inquire into an applicable regime for rocket emissions is all the more pressing.

Below, the author considers the applicability of a carbon tax to rocket emissions, setting it against a rocket emissions trading scheme based on prominent advantages and disadvantages.

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<sup>237</sup> David Weisbach, Eric Posner, *Climate Change Justice*, (Princeton University Press, 2010) at 46 [Weisbach and Posner].

<sup>238</sup> The arguments favouring a separation of distributive justice from climate change are founded on the premise that international climate change agreements are not the appropriate forum for wealthy nations (which have been responsible for the majority of historical emissions) to compensate poorer nations which disproportionately suffer from the effects of climate change. See Eric Posner, Cass Sunstein “Climate Change Justice” (2008) 96 Geo. L.J. 1565. However, even in this study, the authors expressly acknowledge the possibility that desirable redistribution is more likely to occur through climate change policy than otherwise. Based on this rationale, and further due to the fact that distributive justice may be beneficial for emissions regulation in the space sector – by facilitating the provision of financial and technological assistance from spacefaring nations to non-spacefaring nations, this author disagrees with the blanket rejection of distributive justice and suggests that an element of distributive justice cannot be disregarded in the international space sector (See Chapter 6).

<sup>239</sup> Weisbach and Posner, *supra* note 237 at 48.

<sup>240</sup> *Id.*

### **3.2 An assessment of advantages and disadvantages of a blanket tax on emissions as against an emissions trading scheme for the space sector**

In this section, the benefits of each mechanism is compared with regard to a future scheme for rocket emissions. It is underscored that the purpose of this analysis is primarily to spark debate on the most appropriate measure for the space sector

#### **3.2.1 Concentration of authority**

In economic terms, a carbon tax is viewed as a Pigouvian tax, named after the economist who proposed a tax mechanism to address externalities in 1920. The tax structure conceptualised by Pigou required that externalities were wholly internalised in the cost of a product, thus reducing environmental damage.<sup>241</sup> Pigouvian taxes can be considered corrective taxes, as they correct the bias of using an apparently free resource and cause the price of a product to be closer to the social cost of production.<sup>242</sup> The question of morality is entirely excluded from the tax model. Professor Shi-Ling Hsu, an ardent proponent of carbon taxes, distinguishes between the taxation of carbon at the “upstream” point, which is the point at which the carbon is extracted or processed, and “downstream”, i.e. the point immediately preceding combustion before the carbon dioxide is released.<sup>243</sup> The mechanism of a carbon tax is thus aimed at directly raising the cost of pollution.

Emissions trading schemes function differently, in that they involve the issuance of allowances to polluters that authorise them to emit a specified quantity of pollution.<sup>244</sup> Emitters can then trade using their permits within the market, with permits acting as a license that entitles them to pollute. These entities are also accorded allowances under the mechanism, which assumes the character of currency that can be traded with other entities. The European Union-Emissions Trading Scheme (EU-ETS)<sup>245</sup> is a well-recognised example which encompasses all these features.

A fundamental difference between carbon taxes and cap-and-trade lies in authority; while States retain power to impose and allocate taxes, control is transferred to the polluting entities in a trading scheme. This particular feature would require significant discussion within the rocket emissions

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<sup>241</sup> Id.

<sup>242</sup> Richard Ippolito, *Economics for Lawyers*, (Princeton University Press, 2010) at 240.

<sup>243</sup> Shi-Ling Hsu, *The Case for a Carbon Tax: Getting Past our Hang-Ups to Effective Climate Policy*, (Island Press, 2011) at 15 [Shi-Ling Hsu].

<sup>244</sup> Id. at 20.

<sup>245</sup> See Chapter 4 for analysis of the EU-ETS and discussion on applying the scheme to international air transport.

context, given the number of commercial ventures planned for outer space, coupled with the fact that States are still responsible for the acts of their non-governmental entities.<sup>246</sup> As major stakeholders, private companies may be more inclined to a cap-and-trade mechanism, given that regulatory control will not lie exclusively with the State, but within the market. This would of course, depend on the design of the scheme. The Kyoto Protocol for instance encourages States to voluntarily engage in emissions trading.<sup>247</sup> Through the Protocol, a record of the State registries established for emission trading is maintained, along with an international transaction log.<sup>248</sup> The Protocol therefore does not recognise private entities, and employs a State-specific approach to track emissions units held and traded willingly on a national basis.

### 3.2.2 Flexibility

A cap-and-trade system exhibits advantages of flexibility. The mechanism could be designed such that different trading values are assigned to allowances for various greenhouse gases.<sup>249</sup> This type of feature could be useful for rocket emissions, especially in view of the fact that atmospheric chemistry is still uncertain regarding the exact impact of chemicals emitted by rockets on the stratosphere. This feature could facilitate assignment of different values to various by-products of rocket launches, accommodating future studies. This advantage of flexibility is notably absent from a carbon tax.

However, emission trading schemes may not always have a determinable cap on emissions. The cap may therefore be rigid, or subject to variations based on the market and pricing features, or entirely non-existent as in the case of the CORSIA scheme. Due to this decidedly excessive flexibility, the obvious question arises- whether a cap-and-trade scheme can result in any actual reduction in emissions? This cap may be raised if the cap-and-trade system is designed to introduce “offsets,” i.e. credits that can substitute for allowances and which are awarded for projects that do not necessarily reduce existing emissions but reduce or “offset” emissions that would otherwise occur.<sup>250</sup> Offsets are one example of a pricing feature that can be employed by emitters when

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<sup>246</sup> *Outer Space Treaty*, *supra* note 83, art. VI.

<sup>247</sup> See *Kyoto Protocol*, *supra* note 171, art 17.

<sup>248</sup> See UNFCCC, “Registry Systems”, online: *UNFCCC* <[unfccc.int/process/the-kyoto-protocol/registry-systems](http://unfccc.int/process/the-kyoto-protocol/registry-systems)> ; Also see UNFCCC, “International Transaction Log”, online: *UNFCCC* <[unfccc.int/process/the-kyoto-protocol/registry-systems/international-transaction-log](http://unfccc.int/process/the-kyoto-protocol/registry-systems/international-transaction-log)>

<sup>249</sup> Shi-Ling Hsu, *supra* note 243, at 21.

<sup>250</sup> *Id.*

trading their allowances is expensive. For this reason, the perpetual question plaguing environmentalists is whether offsets – or for that matter, emissions trading schemes in general – help contribute to any actual reduction in emissions, as these offsets seem to act as more of a legitimate excuse to continue emitting at the current rate.<sup>251</sup>

Professor Shi-Ling Hsu’s criticism of mechanisms that attempt to replace the “hardness” of the cap under cap-and-trade by seeking to reduce greenhouse gas “intensity” through introduction of a price floor or price ceiling, is also a notable concern.<sup>252</sup> For example, a “ceiling” variation is one method of introducing flexibility to the cap, and contemplates the unlimited issuance of allowances at the “safety-valve” price ceiling.<sup>253</sup> If allowances are trading for a price below the safety-valve price, then the quantity of emissions remains at the cap level; otherwise, the cap increases.<sup>254</sup> Professor Shi-Ling Hsu posits that both the “ceiling” and “floor” variations of a cap and trade programme mimic a carbon tax in the objective to stabilise price, thus he poses the question – “why not simply impose a carbon tax?”<sup>255</sup> This author agrees with this rationale, on the basis that a carbon tax would facilitate a fixed price on emissions, in addition to encouraging less cumbersome administration (discussed in Section 3.2.3 below).

Economists Goulder and Schein, on the other hand, have challenged this doubt over emission trading schemes.<sup>256</sup> They argue that even when free allowances are received under an emissions trading scheme, each additional unit of emissions carries an opportunity cost, where one more unit of pollution either reduces the number of allowances the covered firm can sell, or raises the number of allowances the firm must purchase to remain in compliance.<sup>257</sup> Using this reasoning, they posit

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<sup>251</sup> Most recently these arguments have been levied against emission trading schemes by criticism of the design and implementation of CORSIA, as it is contended that this scheme will do little to effectively curb emissions in international air transport. See Ruwantissa Abeyratne, *Legal Priorities in Air Transport* (Springer, 2019) at 137-154; Also see Chris Lyle, “Beyond the ICAO’s CORSIA: Towards a More Climatically Effective Strategy for Mitigation of Civil-Aviation Emissions” (2018) 8 *Climate Law* 1 ; also see Carbon Market Watch, “Policy Briefing 2016”, online: *Carbon Market Watch* <[carbonmarketwatch.org/wp-content/uploads/2016/10/Post-Assembly-Policy-Brief-Web.pdf](http://carbonmarketwatch.org/wp-content/uploads/2016/10/Post-Assembly-Policy-Brief-Web.pdf)>

<sup>252</sup> Shi-Ling Hsu, *supra* note 243, at 21.

<sup>253</sup> *Id.*

<sup>254</sup> *Id.*

<sup>255</sup> *Id.*

<sup>256</sup> See Lawrence Goulder and Andrew Schein, “Carbon Taxes versus Cap-and-Trade: A Critical Review” (2013) 4 *Climate Change Economics* 3 [Goulder and Schein].

<sup>257</sup> *Id.* at 5.

that the carbon tax and trading scheme mechanisms both offer equivalent incentives to reduce emissions.<sup>258</sup>

### 3.2.3 Administration

It is obvious that this advantage would mark a tax preferable over a trading scheme, as the latter would have more administrative hurdles. Yet, Goulder and Schein further counter this criticism. They argue that most criticism leveled against the cap-and-trade system has frequently been advanced on the assumption that a carbon tax would be introduced upstream while the cap-and-trade program would be applied further downstream.<sup>259</sup> They then observe that both measures can be implemented either upstream or further downstream, thereby invalidating the claim of ease of administration on this basis.<sup>260</sup> However, the two economists do admit that the overall cost of administration might be somewhat higher under cap and trade, as emissions trading schemes entail further responsibility regarding the formation of the administrative body and processes for compliance.<sup>261</sup> Certainly, this is a compelling argument in favour of taxes against cap-and-trade, given that a tax would not require further debate on the implementation of the scheme after settling on the design. A blanket tax hence has the benefit of being administered more efficiently by State governments directly on their private entities involved in the space sector, while cap-and-trade would require an international agency specifically empowered to oversee and administer actions. An international agency is not necessary, but advisable, to ensure that allowances traded between States are reported accurately in the interest of ensuring transparency and preventing double counting. This regulatory agency would have to establish a registry for allowances, keep track of allowance trades and also note any associated changes in ownership of allowances.<sup>262</sup> Questions regarding monitoring, verification and compliance are sure to plague an emissions trading scheme.

Based on this difference, a tax on emissions for the space sector may possibly serve as a first step, to be implemented while other measures, particularly command and control measures, are simultaneously pursued. Shi-Ling Hsu approves of this possibility in an economic policy sense,

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<sup>258</sup> Id.

<sup>259</sup> Id. at 11.

<sup>260</sup> Id.

<sup>261</sup> Id.

<sup>262</sup> Id. at 12.

too, stating that a carbon tax has the potential to coexist with all three alternative policy measures, without legal or administrative conflicts.<sup>263</sup>

### **3.2.4 Retention of excess revenue with nation States**

The fact that tax proceeds would be retained by the State and applied or redistributed as the State sees fit immediately bathes carbon taxes in a positive light for States at the negotiating table. The proceeds from a tax on spaceflight, for instance, could become an additional source of revenue for governments. Indeed, this may even be viewed as reasonable when one considers rising industries such as space tourism, where the tax would alternatively have to be borne by the consumer.

Supporting measures may have to be adopted to ensure that States fairly apply excess revenues towards other governmental programmes. Perhaps the introduction of a penalty provision would incentivise the State and ensure that the government is diligent in carrying out this obligation. The discretionary power inherent in a tax arguably makes it appealing to countries in the context of space, which of course is a highly sensitive sector, in being closely tied to State security and defence. The counter-argument to this advantage returns to the question of the private sector. Emissions trading schemes are naturally more appealing to private corporations, today's major stakeholders in the space industry. In addition, economists have attributed this feature of recycling policy-generated revenues to both carbon taxes and emissions trading schemes if administered appropriately with a suitable system for coordination, which would mean that both mechanisms share this advantage and a decision to employ one over the other cannot be made on the basis. Despite this, the retention of excess revenue under both systems is a characteristic that could be extremely useful to a mechanism for rocket emissions.

### **3.2.5 Pricing features**

It is important to understand the arguments advanced in favour of carbon taxes and emissions trading to determine which principles would be required for a legal mechanism for rocket emissions. The study of these regulatory forms as well as the comparative study of parallel transport sectors will clarify what measures can be replicated (or avoided) in the space sector. Both taxes and cap-and-trade have disadvantages in the context of pricing. A notable disadvantage of taxes is the uncertainty associated with accurate quantification. When a carbon tax is set too high

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<sup>263</sup> Shi-Ling Hsu, *supra* note 243 at 48.

or too low due to incomplete or unverifiable information, the resultant loss would be the cost of either regulating “too much or too little.”<sup>264</sup> The inability to conclusively quantify taxes, coupled with the fact that we presently do not know enough about the impact of chemicals discharged by rockets, seemingly makes emissions trading a more favourable option from this perspective. However, economists have also argued that either instrument can be adjusted quickly to incorporate new information, resulting in little or no difference between the two instruments.<sup>265</sup>

But emissions trading schemes too, have a separate concern which does not arise under the carbon tax system i.e., price volatility. Since trading within this system is based on the price of allowances, there is a significant risk of abrupt changes in price triggered by a change in demand on the market.<sup>266</sup> Goulder and Schein cite the example of the EU-ETS, which witnessed a dramatic drop of allowance prices a year into implementation.<sup>267</sup> They propose the incorporation of a “hybrid” system by introducing a price floor, ceiling, or both, considered by Shi-Ling Hsu as well. As economists have demonstrated, each system has a different approach to uncertainty in price. The carbon tax stipulates the price of emissions and leaves uncertain the aggregate emissions level, while emissions trading schemes stipulate aggregate emissions, leaving the price uncertain.<sup>268</sup>

This difference in approach results in appeal to specific factions. Environmentalists will advocate for the policy measure which guarantees the limitation of emissions, while companies will focus on the policy measure that assures certainty in price.

### **3.2.6 Interaction with other regulations**

In creating a mechanism for rocket emissions, it is necessary that the new regulation is effective. It is thus relevant to understand how emissions regulations can sometimes fail in achieving an overall reduction. Goulder and Schein conclude that the introduction of additional policy measures parallel to a cap-and-trade system, for example a performance standard via command-and-control regulation, do not assure further reductions in overall emissions.<sup>269</sup> In comparing the introduction of another policy measure with carbon taxes, the economists noted that the price of emissions

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<sup>264</sup> Shi-Ling Hsu, *supra* note 243 at 105.

<sup>265</sup> *Id.*

<sup>266</sup> Goulder and Schein, *supra* note 256 at 13.

<sup>267</sup> *Id.*

<sup>268</sup> *Id.* at 16.

<sup>269</sup> *Id.* at 19.

would not change based on the success of the performance standard.<sup>270</sup> The fluctuation in price occurring with the cap-and-trade system, by contrast, has been termed “emissions leakage,” that offsets increase in emissions elsewhere.<sup>271</sup>

Emissions leakage refers to situations where an economic activity similar to that covered under one State’s MBM is not subject to binding carbon limits in another State, leading to the movement of economic activities that create emissions to areas which are not bound by a carbon limit.<sup>272</sup> This geographic displacement of emissions would impede the overall objective of a market-based program, for instance, resulting in entities under a State with rising allowance prices, simply shifting some of their production to facilities that exist in countries without binding carbon dioxide limits.<sup>273</sup> The potential for emissions leakage is therefore an additional reason why a global sectoral approach, particularly one that is administered by under an international agency, may be suitable for the regulation of rocket emissions.<sup>274</sup>

### 3.3 Conclusion

This chapter has considered the different types of policy measures applicable to the regulation of rocket emissions, highlighting command-and-control measures, a blanket tax and emissions trading. This discussion is by no means exhaustive, as the thesis seeks only to expose some of the numerous facets to be considered in this debate. From this analysis, it is clear that an interdisciplinary approach is vital, given that a specialist in international space law and policy cannot devise an appropriate mechanism without engaging with both economists and scientists to devise an accurate model. From a legal perspective, the following Chapters will study the aviation and maritime sectors to conclude which principles may be applied to a mechanism for rocket emissions.

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<sup>270</sup> Id. at 20.

<sup>271</sup> Id.

<sup>272</sup> Ervin Nagy and Gisella Varga, *Emissions Trading : Lessons Learned from the European Union and Kyoto Protocol Climate Change Programs* (New York: Nova Science, 2009) at 64.

<sup>273</sup> Id.

<sup>274</sup> Also see Chapter 6, Principle IX, for arguments supporting a comprehensive approach to rocket emissions regulation, which include technical and operational measures, in addition to economic or market-based measures.

## **Chapter 4 – A study of emissions regulation in the international air transport sector**

Chapter 2 established that rocket emissions evade regulation under international law. Thereafter, forms of applicable policy measures dedicated to rocket emissions were examined. This chapter studies the regulation of emissions in international aviation, focusing on the recently adopted Carbon Offsetting and Reduction Scheme (CORSIA). As the first carbon pricing mechanism for a global transportation sector, this analysis can be instructive to the regulation of rocket emissions.

### **4.1 The “Only 2%” Argument**

The Intergovernmental Panel on Climate Change (IPCC) concluded that aviation contributed to approximately 2% of global emissions, with a further 3.5% contribution to total radiative forcing.<sup>275</sup> According to the most recent IPCC study, however, these figures have been estimated to multiply by 2050, because the aviation industry, along with the maritime industry, are both considered more challenging to decarbonise as demand growth is projected to be higher than other transport modes.<sup>276</sup> While this 2% figure reflects the past contributions by States towards emissions, it is the future rate of growth which requires regulation now; a fact similar to the space launch industry. For instance, in 2013, the ICAO Secretariat concluded that the 2030-2040 period would witness a spike in traffic growth “to an average of 4.0% per annum.”<sup>277</sup> Additionally, as is the case with rocket emissions, the impact of aircraft emissions requires regulatory attention due to its direct impact on the stratosphere. Emissions from the aviation industry can thus also affect global atmospheric circulation and contribute to climate change.<sup>278</sup>

The link between aircraft emissions and climate change demands more stringent action, given that the demand for aviation is not expected to fall at any point in the near future.<sup>279</sup> It is important to

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<sup>275</sup> IPCC, “Special Report on Aviation and the Global Atmosphere”, online: *IPCC* <[www.ipcc.ch/site/assets/uploads/2018/03/av-en-1.pdf](http://www.ipcc.ch/site/assets/uploads/2018/03/av-en-1.pdf)> [*IPCC Aviation Report*]; IPCC, “Fourth Assessment Report, Working Group on Mitigation of Climate Change,” online: *IPCC* <[www.ipcc.ch/site/assets/uploads/2018/03/ar4\\_wg3\\_full\\_report-1.pdf](http://www.ipcc.ch/site/assets/uploads/2018/03/ar4_wg3_full_report-1.pdf)>

<sup>276</sup> IPCC, “Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development”, online: *IPCC* <[www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15\\_Chapter2\\_Low\\_Res.pdf](http://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter2_Low_Res.pdf)>

<sup>277</sup> ICAO, “2013 Environmental Report”, online: *ICAO* <[cfapp.icao.int/Environmental-Report-2013/files/assets/basic-html/page30.html](http://cfapp.icao.int/Environmental-Report-2013/files/assets/basic-html/page30.html)>

<sup>278</sup> *IPCC Aviation Report*, *supra* note 275; *IPCC Report*, *supra* note 6.

<sup>279</sup> The Swedish concept of “flygskam” or “flight shame” encourages a movement among travelers to limit air travel. This movement is growing in popularity, evidenced by a survey documenting 21% of 6000 people across the US, UK, Germany and France having reduced the number of flights for travel. See BBC, “Flight Shame could halve growth in air traffic” online: *BBC* <[www.bbc.com/news/business-49890057](http://www.bbc.com/news/business-49890057)>; See also Thomson Reuters, “Flight Shaming hits

note that it is not only the actual flights that contribute to this figure, but the industry as a whole, therefore including all supporting services required for air travel such as airports, cargo, ground handling etc. Furthermore, what most industry stakeholders fail to perceive is how tangible the impact of climate change would be, especially regarding actual air travel. For instance, a shift in climate zones which raises the frequency of typhoons and hurricanes will disrupt air transport services, causing great inconvenience to passengers on the one hand, while compelling carriers to incur costs in providing alternative solutions to cancelled or delayed flights on the other.<sup>280</sup>

Unfortunately, the 2% statistic continues to be exploited by industry proponents, who use this figure as a means of trivialising emissions from international air transport. This would explain why ICAO has been slow to initiate plans to combat climate change. Pursuant to the IPCC report, and in the wake of the massive climate march in late 2019,<sup>281</sup> the prioritisation of aviation emissions has risen in ICAO's agenda, although regulatory effectiveness is still ambiguous.<sup>282</sup>

## 4.2 Law-making at ICAO

ICAO is comprised institutionally of the Assembly, Secretariat and the Council, in addition to several bodies tasked with technical objectives such as the Legal Bureau and Air Navigation Commission. While the Assembly includes all participating member States, members on the Council attain seats through elections at the Assembly.

### 4.2.1 The Chicago Convention: environmental protection in an industry-oriented legislation

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air travel as 'Greta Effect'takes off" online: *Reuters* <[www.reuters.com/article/us-travel-flying-climate/flight-shaming-hits-air-travel-as-greta-effect-takes-off-idUSKBN1WH23G](https://www.reuters.com/article/us-travel-flying-climate/flight-shaming-hits-air-travel-as-greta-effect-takes-off-idUSKBN1WH23G)>

<sup>280</sup> Md Tanveer Ahmad, *Climate Change Governance in International Civil Aviation: Toward Regulating Emissions Relevant to Climate Change and Global Warming* (The Hague: Eleven Publishing, 2016) at 23 [Tanveer Ahmad].

<sup>281</sup> See generally, The Guardian, "Climate crisis: 6 million people join latest wave of global protests," online: <<https://www.theguardian.com/environment/2019/sep/27/climate-crisis-6-million-people-join-latest-wave-of-worldwide-protests>>

<sup>282</sup> This is evident even from the framing of resolutions in ICAO's 40th Assembly. For example Resolution 17, pertaining to noise and local air quality, demonstrates how ICAO considers environmental protection, with a view to "maximum compatibility between the safe and orderly development of civil aviation and the quality of the environment," while further urging States to "refrain from environmental measures that would adversely affect the orderly and sustainable development of international civil aviation with its industry-oriented mandate, see ICAO, 40<sup>th</sup> Assembly Resolutions, Resolution 17, "Consolidated statement of continuing ICAO policies and practices related to environmental protection - General provisions, noise and local air quality" [Resolution 17].

The Chicago Convention<sup>283</sup> was adopted in 1944 to introduce provisions that would lead to the expansion of the international air transport industry. At the time, emissions from aviation were not labelled an environmental hazard. The first hindrance to regulating aircraft emissions therefore arises from the perception that environmental objectives have no place in the Chicago Convention, as the drafters never incorporated any specific reference to the same. Accordingly, even ICAO, which was established to oversee the regulations in the convention, prioritises the explicit mandate in the preamble, and focuses on the development of the air transport industry rather than environmental protection. This stems from the attitudes of member States within ICAO, as some argue that ICAO now devotes too much attention to climate change.<sup>284</sup>

However, scholars such as Ahmad argue that the Convention tacitly confers an obligation on ICAO to address emissions, since one of the objectives in the preamble is to “(i).... [p]romote generally the development of all aspects of international civil aeronautics.”<sup>285</sup> While some may argue that environmental protection is too broad to fall within the purview of this statement, the drafters would not have used such broad language as “*all* aspects“ if they had intended to exclude a particular concern. It is therefore contended that environmental protection falls within ICAO’s mandate, and further given that climate change will inevitably impact the industry, more stringent regulation in this context is crucial.

#### **4.2.2 Adoption of SARPs**

The Chicago Convention through ICAO enables the adoption of international standards and recommended practices (SARPs) in various subject areas.<sup>286</sup> The ICAO Council ensures these are updated regularly, with new SARPs adopted to meet contemporary requirements. It is pertinent to note that SARPs are not part of the Convention itself, but are adopted as Annexes to the Convention. This accords SARPs a rather ambiguous legal status, as they lack *de jure* hard law

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<sup>283</sup> *Convention on Civil Aviation*, 7 December, 1944, 15 UNTS 295 (entered into force 4 April 1947) [*Chicago Convention*].

<sup>284</sup> For instance, one State has expressed doubt that that “climate change carried the same weight as safety and security and other tasks.” For a succinct account of the attitudes of various different member States, see Alejandro Piera, *Greenhouse gas emissions from international aviation : Legal and policy challenges* (The Hague: Eleven International Publishing, 2015) at 89 [Alejandro Piera].

<sup>285</sup> *Chicago Convention*, *supra* note 283, preamble.

<sup>286</sup> *Id.*, art 37.

characteristics.<sup>287</sup> Annex 16 of the SARPS was introduced to the Chicago Convention for environmental concerns, with separate volumes demarcating noise pollution, aircraft engine emissions, CO2 emissions and now, the newly instituted emissions regime.

### **4.3 Ambiguities between the UNFCCC framework and international air law**

Chapter 2 examined the international regulation of emissions under the UNFCCC system and noted the successes and failures under specific instruments. Since the UNFCCC has exclusively delegated regulation of international aviation and international shipping to the ICAO and IMO respectively, it is important to understand the relationship between climate change regulation and public international air law, in order to develop a cohesive framework for rocket emissions, that does not conflict with other existing regimes.

#### **4.3.1 The question of exclusive jurisdiction to ICAO under the Kyoto Protocol**

The Kyoto Protocol stipulates that “[t]he Parties included in Annex I shall pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from aviation and marine bunker fuels, working through the International Civil Aviation Organisation and the International Maritime Organisation, respectively.”<sup>288</sup>

This provision does not elaborate any further on what “working through” ICAO means. The obscure language has implications for any emissions regulation in the space sector, as it raises questions regarding (i) a specialised international agency for space that can adopt measures and oversee implementation for rocket emissions and (ii) the limit of jurisdiction that such an entity would have. This provision has generated debate, as the institution is seemingly but not uncontestably accorded with the discretion to determine how to go about regulating emissions in international air transport.<sup>289</sup> ICAO is not a party to the UNFCCC or the Kyoto Protocol, which means that as an international organisation it is not bound to comply with any provisions under

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<sup>287</sup> For discussion on the legal status of SARPs, see Paul Stephen Dempsey, *Public International Air Law* (Montreal: McGill University, 2008) at 75 [Dempsey]; Also see Brian F Havel & Gabriel S Sanchez, *The Principles and Practice of International Aviation Law*, (Cambridge: Cambridge University Press, 2014) [Havel and Sanchez], at 180-181.

<sup>288</sup> *Kyoto Protocol*, *supra* note 171, art. 2.2.

<sup>289</sup> For example, some argue that ICAO cannot be bound by this provision of the Kyoto Protocol. Nevertheless, the organization has accepted the provision as its mandate, which may indicate that its subsequent conduct now implies that it be bound by the provision. For further discussion, see Alejandro Piera, *supra* note 284 at 43-45; Also see Chris Lyle, “Mitigating International Air Transport Emissions through a Global Measure: Time for Some Lateral Thinking,” *Green Air*, online: *Green Air Online* <[www.greenaironline.com/news.php?view-Story=1820](http://www.greenaironline.com/news.php?view-Story=1820)>.

either instrument. A strong argument can be made that Article 2.2. of the Protocol does incorporate the word “shall,” which would imply that the obligation to work through ICAO is mandatory.<sup>290</sup> Still, regarding ICAO’s exclusive jurisdiction, there is no such supporting provision in either regulatory framework. ICAO has proceeded on this basis, concluding that, “[w]hile the Kyoto Protocol recognises that ICAO is the appropriate body to address aviation emissions, it should be noted that ICAO’s authority in this regard does not derive from the Kyoto Protocol, nor does the Kyoto Protocol limit ICAO’s authority.”<sup>291</sup> In addition, while considering the question of the applicability of the EU-ETS to international air transport,<sup>292</sup> Advocate General Kokott of the Court of Justice of the European Union opined that “...the Parties to the Kyoto Protocol did not commit themselves in Article 2(2) thereof to pursuing the limitation or reduction of greenhouse gases from aviation exclusively by working through the ICAO.”<sup>293</sup> This language therefore cannot be interpreted as pursuing any solutions to aviation emissions solely through this one organisation, and leaves States free to entertain other multilateral or bilateral measures.

#### **4.3.2 CBDR in international aviation**

As emissions in the international air transport industry have been specifically identified as requiring regulation under Article 2.2 of the Kyoto Protocol, this may indicate that regulation of aviation emissions should follow the UNFCCC model and methodology. This approach has been controversial, as the divide evident from negotiations under the UN climate model soon became apparent in the aviation context. Even to date, as witnessed during the 40<sup>th</sup> Assembly, developed nations resist any mention of the concept of CBDR, even balking at the use of terms such as “equity”, while developing nations continue to argue that they are entitled to incorporate such language. The CBDR debate is not simplistic, for its imposition in international aviation immediately raises the question of conflicting international regimes.

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<sup>290</sup> Brian Havel and John Mulligan, “The Triumph of Politics: Reflections on the Judgment of the Court of Justice of the European Union Validating the Inclusion of Non-EU Airlines in the Emissions Trading Scheme” (2012) 37 *Air and Space Law* at 25 [*Havel and Mulligan*].

<sup>291</sup> See ICAO, 32<sup>nd</sup> Assembly, Resolution 8, “Consolidated statement of continuing ICAO policies and practices related to environmental protection”; See also ICAO, 33<sup>rd</sup> Assembly, Resolution 7, “Consolidated statement of continuing ICAO policies and practices related to environmental protection”. For further discussion, see generally, Benjamyn Scott and Andrea Trimarchi, *Fundamentals of International Aviation Law and Policy* (New York: Routledge, 2020) at 261-262.

<sup>292</sup> See Section 4.5.2 below for observations on the EU-ETS.

<sup>293</sup> Opinion of Advocate General Kokott, *Air Transport Association of America and US Airlines v. the UK Secretary of State for Energy and Climate Change*, CJEU, Case 366/10 (2011).

Described crisply by Alejandro Piera as the “differentiated, bipolar system that animates the UNFCCC regime”,<sup>294</sup> CBDR (illuminated earlier in Chapter 2), requires developed nations to commit to specific emissions reductions without imposing any such mandatory obligation on developing nations. As aviation markets in developing nations are flourishing rapidly, this would mean that States such as India, China, Brazil and even the UAE, would be exempt from any tangible obligation to reduce their emissions.<sup>295</sup> Developed nations hence argue that these differentiated responsibilities may contradict the non-discrimination principle of the Chicago Convention. Non-discrimination is a principle derived expressly from Article 44(g) of the Convention, is implicit in other provisions such as Articles 11 and 15, and prohibits discrimination against any State(s).<sup>296</sup>

The clash between the Kyoto Protocol and the Chicago Convention is demonstrative of regime fragmentation in international law. A Study Group under the International Law Commission examined conflicting regimes that arise as a result of the “diversification and expansion of international law.”<sup>297</sup> The International Law Commission has summarised the notion of a conflict as “[a] situation where two rules or principles suggest different ways of dealing with a problem.”<sup>298</sup> An additional “looser” definition is proposed, where a treaty “may sometimes frustrate the goals of another treaty without there being any strict incompatibility between their provisions.”<sup>299</sup> In this case, the two treaties may possess different background justifications or emerge from different legislative policies or aim at divergent ends.<sup>300</sup> In its report, the International Law Commission discusses four types of relationships that lawyers have typically understood to be implicated in normative conflicts: (a) relations between special and general law; (b) relations between prior and

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<sup>294</sup> Alejandro Piera, *supra* note 284 at 46.

<sup>295</sup> See Armand de Mestral and Tanveer Ahmad, “A pre-analysis of Canada–EU Aviation Relations post-ICAO Assembly Meeting Concerning Emissions Trading System”, (2013) Canada-Europe Transatlantic Dialogue: Seeking Transnational Solutions to 21<sup>st</sup> Century Problems online: <carleton.ca/canadaeurope/wp-content/uploads/2013-04-brief-demestral-ahmad-mcgill-aviation-emissions.pdf> where they note that “[t]he application of the principle of CBDR with the current categorization of States based on their development status may be considered unfair given the fact that a significant number of developing States under the Protocol have well-developed, extremely competitive, well-capitalized and rapidly growing airlines.”

<sup>296</sup> See *Chicago Convention*, *supra* note 283, art 11, “Applicability of Air Regulations,”; See also *Chicago Convention*, *supra* note 283, art 15, “Airport and Similar Charges.”

<sup>297</sup> Report of the Study Group of the International Law Commission, *Fragmentation of International Law: Difficulties Arising from the Diversification and Expansion of International Law*, 58 UN GAOR, UN Doc A/CN.4/L.682 (2006) [ILC Report].

<sup>298</sup> *Id.* at 19.

<sup>299</sup> *Id.* at 20.

<sup>300</sup> *Id.*

subsequent law; (c) relations between laws at different hierarchical levels; and (d) relations of law to its “normative environment” more generally.<sup>301</sup>

The approach adopted by the International Law Commission is open to question, however. This summary of the issue of conflict and regime fragmentation is embedded in their assumption that international law follows a “hierarchy” or, simply put, an “either/or” approach. In the context of general and special rules, the International Law Commission states that, “...sometimes [rules] will point in different directions and if they do, it is the task of legal reasoning to establish meaningful relationships between them so as to determine whether they could be applied in a mutually supportive way or whether one rule or principle should have definite priority over the other.”<sup>302</sup> The author posits that perhaps it is this very assumption regarding a hierarchy in norms that has generated further incoherence. Scholars such as Piera have criticised this approach for coercing the interpreter to pick one norm over the other, “where it establishes a hierarchy between norms where one wins and another loses.”<sup>303</sup> If one applies the International Law Commission’s recommendation for fragmentation, it would yield the result that CBDR under the Kyoto Protocol prevails over non-discrimination under the Chicago Convention, as the former is “*lex posterior*.” The Chicago Convention would thus apply only provisions compatible with the Kyoto Protocol, and in case of conflict between the two, the Kyoto Protocol would prevail.

Some scholars have proposed the reconciliation of CBDR with ICAO objectives. Among these is Ahmad, who argues that CBDR was developed from equity in general international law and can define an explicit equitable balance between developed and developing States.<sup>304</sup> Consequently, as ICAO has a positive duty to ensure that “every contracting State has a fair opportunity to operate international airlines,” this use of the term “fair” includes equality, and therefore adoption of CBDR by ICAO should not be viewed as negating principles of non-discrimination and equality of opportunity.<sup>305</sup> Despite Ahmad’s recommendation to discard the non-discrimination and equality of opportunity principles (as they were not intended to apply to contemporary issues such as climate change), it is difficult to see this practically translating into the politics of ICAO. The

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<sup>301</sup> Id. at 16.

<sup>302</sup> Id. at 114.

<sup>303</sup> Alejandro Piera, *supra* note 284 at 61.

<sup>304</sup> Tanveer Ahmad, *supra* note 280 at 109.

<sup>305</sup> Id. at 113.

divide between developing and developed States is far too acute for a choice in one principle over the other to lead to any constructive ends, and States will simply reach an impasse in negotiations.

To address the question of conflict, ICAO's Legal Bureau studied the two regimes and concluded that the Chicago Convention stands independently, with CBDR being a non-binding obligation on States.<sup>306</sup> This was based on the rationale that it "was not an obligation" for ICAO as an entity to develop policy under the Kyoto Protocol, and pursuing an appropriate international measure "was therefore up to its Member States."<sup>307</sup> As a result, the Legal Bureau considered CBDR, which was shaped by the UNFCCC system, as a "policy option," rather than a legal obligation.<sup>308</sup>

#### **4.4 The concept of SCRC**

This decision of the Legal Bureau was a serious blow to developing States, as the decision not to be bound by CBDR essentially amounts to a "clean slate" for pollution by developed States and can be viewed as an erasure of the historical global emissions record. ICAO's response to the contesting factions was thus to evolve its own unique concept, which is "special circumstances and respective capabilities (SCRC)".<sup>309</sup> This principle was introduced at the 37<sup>th</sup> Assembly with references to developing countries only.<sup>310</sup> At the 38<sup>th</sup> Assembly, this narrow scope disappeared, evident from the new language, which stated "...taking into account: the special circumstances and respective capabilities of States, in particular developing countries."<sup>311</sup> This evolution meant that the new, as yet undefined concept of SCRC, would not apply solely to developing States, even though the principle highlights that the principle will focus on such States.

Unlike CBDR, States were broadly inclined to accept SCRC as a principle that provides scope for all States on the basis of "special circumstances" and based on the capabilities of that nation to undertake obligations. The primary difference between SCRC and CBDR – and the reason why developed States have not rejected the concept – lies in the potential for SCRC to apply to

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<sup>306</sup> See ICAO, 181<sup>st</sup> Session of the Council, Minutes of the 22<sup>nd</sup> Meeting [*ICAO 181<sup>st</sup> Session of the Council*]; Also see Alejandro Piera, *supra* note 284 at 49.

<sup>307</sup> Id, ICAO 181<sup>st</sup> Session of the Council.

<sup>308</sup> Id.

<sup>309</sup> This principle was first acknowledged at the 37<sup>th</sup> Assembly when the Assembly resolved to take into account "the special circumstances and respective capabilities of developing countries." See ICAO, 37<sup>th</sup> Assembly, Resolution 19, "Consolidated statement of continuing ICAO policies and practices related to environmental protection — Climate change" [*Resolution 19 of the 37<sup>th</sup> Assembly*].

<sup>310</sup> Id.

<sup>311</sup> ICAO, 38<sup>th</sup> Assembly, Resolution 18, "Consolidated statement of continuing ICAO policies and practices related to environmental protection — Climate change". [*Resolution 18 of the 38<sup>th</sup> Assembly*].

developed nations as well, if their circumstances justify “special consideration.” SCRC is hence a modified version of CBDR, which is flexible enough to accommodate all States.

Ruwantissa Abeyratne outlines the positive response of States to SCRC at the 39<sup>th</sup> Assembly, noting that States such as China who have resolutely argued for CBDR language in past forums and resolutions, now asserted that the new market-based mechanism for aviation should include elements of both CBDR and SCRC.<sup>312</sup> This principle therefore overcomes the CBDR divide, by introducing a new principle that nonetheless reflects non-discrimination under the Chicago Convention. Still, the effectiveness of this new principle is yet to be fully determined by ICAO’s future actions.

#### **4.5 Environmental initiatives at ICAO**

Noise pollution was the first major environmental issue considered by ICAO, an important subject on the European States’ agenda and deliberated in the Committee on Aircraft Noise (CAN). A separate committee was then formed to consider aircraft engine emissions (CAEE). In 1983, the Council formed the Committee on Aviation Environmental Issues to streamline policy-making for all environmental issues in international air transport.<sup>313</sup> Membership of CAEP consisted mostly of European States, although as of 2019, India, China and Brazil have also become members on the Committee.<sup>314</sup> CAEP is now another technical committee that reports to the Council and proposes new SARPs in the context of the environment.<sup>315</sup>

##### **4.5.1 Emissions trading regimes – The emergence of CORSIA**

It is pertinent to note the events that led to the adoption of an international regulation at ICAO, the extension of the EU-ETS to international air transport being a primary contributing factor. Regardless of whether it would take such a unilateral act to trigger action on the part of the international space sector, the EU-ETS and CORSIA respectively illustrate how a scheme for an entire global sector could come into fruition.

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<sup>312</sup> Ruwantissa Abeyratne, “Carbon Offsetting as a Trade Related Market Based Measure for Aircraft Engine Emissions,” 51 *Journal of World Trade* 3 at 433.

<sup>313</sup> See ICAO, Committee on Aviation Environment Protection, online: *ICAO* <[www.icao.int/environmental-protection/Pages/Caep.aspx](http://www.icao.int/environmental-protection/Pages/Caep.aspx)>

<sup>314</sup> *Id.*

<sup>315</sup> *Id.*

#### 4.5.1.1 EU-ETS

ICAO began to consider various measures to cope with emissions, particularly the need for a global market based-measure (MBM). The first major step toward this goal was reflected in the 37<sup>th</sup> Assembly, where the Annex to Resolution 19 considered developing “guiding principles for the design and implementation of MBMs for international aviation.”<sup>316</sup> A number of reservations were filed by member States in response to this Resolution with concerns reminiscent of the developing/developed States divide.<sup>317</sup> At the 38<sup>th</sup> Assembly, where States reached a consensus on the need to develop an actual framework for MBMs.<sup>318</sup> While these discussions were underway, the EU decided to unilaterally extend its Emissions Trading Scheme<sup>319</sup> (EU-ETS) to the aviation sector. Amending EU Directive 2003/87,<sup>320</sup> the EU’s application of the scheme would now include both EU carriers and foreign operators that landed in EU territory. Naturally, this created an uproar in the international community. The legality of the scheme was contested before the Court of Justice of the European Union (CJEU).<sup>321</sup> Much to the fury of non-EU States, the CJEU reasoned that the scheme could be validly extended to foreign operators in EU territory as a “manifestation of territoriality.”<sup>322</sup> The EU has since received severe criticism for its actions, although it is interesting to note the political implications of this decision. As Professor Pablo Mendes de Leon has written, “[e]ither the EU has unlimited jurisdiction – which it has not, and certainly not on the basis of the Chicago Convention to which it is not a party – or its jurisdiction is limited by applicable international law.”<sup>323</sup> Piera has raised alternative argument that is hard to ignore, namely, that that the EU should not be condemned for unilaterally applying its laws to foreign

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<sup>316</sup> See Resolution 19 of the 37<sup>th</sup> Assembly, *supra* note 309.

<sup>317</sup> See ICAO, 37<sup>th</sup> Assembly, Reservations to Resolution 19, online: ICAO <[www.icao.int/Meetings/AMC/Assembly37/Documents/ReservationsResolutions/10\\_reservations\\_en.pdf](http://www.icao.int/Meetings/AMC/Assembly37/Documents/ReservationsResolutions/10_reservations_en.pdf)>

<sup>318</sup> See Resolution 18 of the 38<sup>th</sup> Assembly, *supra* note 311.

<sup>319</sup> European Parliament and Council Directive 2003/87, 13 October 2003, *Establishing a System for Greenhouse Gas Emission Allowance Trading within the Community and Amending Council Directive 96/61*, OJ L275 of 25 October 2003.

<sup>320</sup> See European Parliament and Council Directive 2008/101, 19 November 2008, amending *Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community* [2009] OJ L 8 of 13 January 2009.

<sup>321</sup> *Air Transport Association of America and US Airlines v. the UK Secretary of State for Energy and Climate Change*, CJEU, Case 366/10 (2011).

<sup>322</sup> *Id.*

<sup>323</sup> See Pablo Mendes de Leon, “Enforcement of the EU ETS: The EU’s Convulsive Efforts to Export its Environmental Values” 37 *Air & Space Law* (2012) at 295.

operators in its territory, since the US, too, has indulged in similar practices regarding security measures and even gambling or smoking by passengers on airplanes.<sup>324</sup>

This begs the question - why then, did the EU-ETS elicit such strong reactions? Apart from the political strength of both the EU and US, the US had introduced measures in areas which may be defended more easily as falling within the scope of international air transport (i.e. introducing measures for enhanced security and safety of passengers). The fact that safety and security were primary concerns of both the original drafters of the Chicago Convention, coupled with the general intolerance for extraterritorial jurisdiction as regards climate change regulation, may have been a key reason for the poor reception to the extension of the EU-ETS to aviation. Amidst the outrage, the EU called for a “temporary suspension” of the scheme.<sup>325</sup> Regardless of whether one views the extension of the EU-ETS as unlawful, it is telling that States’ reacted poorly to this attempt to regulate emissions from international air transport. A new regulation for the space sector would therefore have to carefully toe the line between emphasising an urgent need to introduce such regulation (while avoiding unilateral measures), and the necessity for all States to be included in the policy-making process.

#### **4.5.1.2 ICAO’s response to the EU-ETS**

As a result of the EU-ETS, the ICAO Secretariat began to deliberate options for an appropriate MBM for international aviation. An Ad Hoc Working Group for MBMs was formed, which considered three options for a suitable regime: (i) offsetting, which operates through creation of emissions units that allow States to quantify the reductions they have achieved in alternative sectors; (ii) offsetting with revenue generation, which would mean that in addition to offsetting, revenue would be generated by applying a fee to each tonne of CO<sub>2</sub>, for instance, through a transaction fee; or (iii) an emissions trading regime (cap and trade).<sup>326</sup> There are two ways in which this last option (iii) would operate - by the imposition of a fixed cap for overall emissions, or by introducing allowances that can be traded with respect to a baseline system.<sup>327</sup>

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<sup>324</sup> Alejandro Piera, *supra* note 284 at 191.

<sup>325</sup> See Decision 377/2013/EU of the European Parliament and Council dated 24 April 2013.

<sup>326</sup> ICAO, “Report of the Assessment of Market-Based Measures, 2013”, online: ICAO <[www.icao.int/Meetings/GLADs-2015/Documents/10018\\_cons\\_en.pdf](http://www.icao.int/Meetings/GLADs-2015/Documents/10018_cons_en.pdf)>

<sup>327</sup> *Id.*

In 2016, ICAO adopted the “Carbon Offsetting and Reduction Scheme for International Aviation” or “CORSIA,” at the 39<sup>th</sup> Assembly. This MBM would be an emissions trading scheme with a baseline implemented in a phased manner, with three phases beginning with 2021 to 2023, then the second from 2024 to 2026 and the third from 2027 to 2035.<sup>328</sup> Notably, the first two phases will apply on a voluntary basis to States that have expressly consented to the measure. Only the last phase will be mandatory and will apply to those States who contribute to more than 0.5% of total international revenue tonne kilometers (RTK).<sup>329</sup> International flights between least developed countries, small island developing States and landlocked developing countries are not bound to commit to offsetting, unless voluntary.<sup>330</sup>

## 4.6 Critiquing CORSIA

### 4.6.1 Legality

The legal character of CORSIA itself is dubious. This is because CORSIA derives its strength from the Annexes to the Chicago Convention and Assembly Resolutions. Neither of these are *de jure* hard law instruments. While there could be a possible argument that Assembly Resolutions reflect the consensus of Member States to ICAO and may reflect growing customary international law,<sup>331</sup> and further that the SARPs are *de facto* (though not *de jure*) hard law,<sup>332</sup> the fact that CORSIA’s strength rests solely on these two sources makes it a weak source of law at the outset. Further, the Annexes do provide States the option to withdraw at any point or simply to notify ICAO of their inability to comply with the SARPs in accordance with Article 38 of the Chicago Convention. The author contends that this voluntary character dilutes the power of the SARPs as the foundation for an international emissions regulation such as CORSIA.

### 4.6.2 Effectiveness

Another key issue surrounding CORSIA is the design for which ICAO has opted, choosing an emissions trading scheme which does not have a fixed cap but involves offsetting with respect to

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<sup>328</sup> ICAO “SARPs, Annex 16, Volume IV”, online: ICAO <[www.icao.int/environmental-protection/CORSIA/Pages/SARPs-Annex-16-Volume-IV.aspx](http://www.icao.int/environmental-protection/CORSIA/Pages/SARPs-Annex-16-Volume-IV.aspx)> [Annex 16, Volume IV]

<sup>329</sup> Id.

<sup>330</sup> Annex 16, Volume IV, *supra* note 328 at 3.3.1.

<sup>331</sup> For a discussion regarding assembly resolutions forming evidence of international custom, see Ian Brownlie, *Principles of Public International Law*, (Oxford University Press, 2008) at 15; Also see argument regarding “instant custom” in Bin Cheng, *Studies in International Space Law* (Oxford Scholarship Online, 2012) (1997) at 147.

<sup>332</sup> See Dempsey, *supra* note 287 at 75; Havel and Sanchez, *supra* note 287 at 180.

a baseline. States can thus continue aviation emissions at the present rate (or even increase the same), so long as they purchase offsets to reduce emissions in a different environmental project or sector. For this reason, there has been increasing criticism that the scheme will hardly constitute a contribution to emissions reductions, as opposed to the EU-ETS which is more effective in terms of reducing emissions.<sup>333</sup> This is based on the key difference between CORSIA and the EU-ETS, in that the latter has an EU-wide cap on emissions which is set centrally.<sup>334</sup>

#### **4.6.3 Merging the goal of emissions reduction and carbon neutral growth**

Carbon Neutral Growth (CNG) and emissions reduction through CORSIA even now continue to be clubbed together as though the two separate methods will have the same result of reducing the impact of emissions from international air transport on climate change. The author refers to Resolution 18 of the recent 40<sup>th</sup> Assembly, which mentions the aspirational goal of maintaining net carbon emissions at the same level from 2020.<sup>335</sup> This goal pertains to achieving carbon neutral growth (CNG). However, achieving CNG is separate and distinct from an actual reduction in aviation emissions. The former will only ensure there is no increase, while the latter seeks an actual reduction. If the two goals are pursued as one, they are unlikely to yield satisfactory results because the aims of each goal differ from one other.<sup>336</sup> This is problematic, for the present stage of climate change is beyond the point where CNG will suffice.<sup>337</sup> It is hence proposed that ICAO should place greater emphasis on reducing emissions, rather than aim for CNG, and disentangle the two goals from each other, since they presently risk being mischaracterised as reaching the same result.

#### **4.6.4 Difficulties in implementation: Monitoring, Reporting and Verification processes**

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<sup>333</sup> See Sven Maertens, Wolfgang Grimme, Janina Scheelhaase and Martin Jung, “Options to Continue the EU-ETS for Aviation in a CORSIA-World,” 11 Sustainability 20 (2019).

<sup>334</sup> See European Commission, “Climate Action, Emissions Cap and Allowances,” online: *European Commission* <[ec.europa.eu/clima/policies/ets/cap\\_en](http://ec.europa.eu/clima/policies/ets/cap_en)>

<sup>335</sup> ICAO, 40<sup>th</sup> Assembly, Resolution 18, “Consolidated statement of continuing ICAO policies and practices related to environmental protection - Climate change” [*Resolution 18 of the 40<sup>th</sup> Assembly*].

<sup>336</sup> See study which concludes that carbon-neutral growth will be insufficient to attain sufficient climate impact. David Lee *et al*, “The impact of the ‘2020 Carbon Neutral Goal’ on aviation CO<sub>2</sub> radiative forcing and temperature response” Centre for Aviation, Transport and Environment, Manchester Metropolitan University, online: *MMU* <<http://www.cate.mmu.ac.uk/docs/climate-impacts-from-aviation-CNG2020.pdf>>

<sup>337</sup> According to the report published by the IPCC, limiting global warming to 1.5°C would require an achievement of net zero carbon dioxide (CO<sub>2</sub>) emissions globally by approximately 2050. See IPCC Report, *supra* note 6.

<sup>337</sup> For example, see WHO Report, *supra* note 7, presenting statistics on how climate change affects human health and the subsequent need for an actual reduction in emissions.

#### 4.6.4.1 Costs

A common concern is the costs of implementation of CORSIA. A global MBM clearly has multiple procedures, which are now listed under Volume IV of Annex 16. There are numerous procedures for monitoring, verification and reporting (MRV), which has raised the concern that the costs of implementing CORSIA may exceed the benefits of the scheme.<sup>338</sup> For example, ICAO introduced an Emissions Monitoring Plan under CORSIA, which stipulates the procedure for attribution of flights to aircraft operators.<sup>339</sup> There is also a requirement for submissions of Emissions Reports by aircraft operators to their respective States by April 30 of that year, at the latest by May 31, and in case of non-submission of a report by the operator, the State is required to estimate the operator's annual emissions for that year to form the basis of its offsetting.<sup>340</sup> Volume IV introduces additional MRV procedures for CORSIA-eligible fuels and emissions units by aircraft operators,<sup>341</sup> with a separate "verification body" which must conduct a risk analysis and submit a Verification Report to a State, with review by an "independent reviewer."<sup>342</sup> Upon receiving the Emissions Report that has successfully completed verification, the State will have to obtain flight information for that operator to estimate its emissions, which will be done using the criteria stipulated by the new "CORSIA Estimation and Reporting Tool".<sup>343</sup> The aforementioned data will then be used to create a baseline for the global scheme. As the design of the scheme itself is being questioned for its effectiveness, the amount of expenditure required to implement and fulfil each of these reporting requirements is quite likely to outweigh its benefits.

#### 4.6.4.2 Absence of Penalties

The aforementioned requirements are only some of the major procedures involved in the implementation of CORSIA. These procedures do nonetheless demonstrate that each State is vested with vast discretion regarding MRV procedures.<sup>344</sup> This is a serious concern, as the State

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<sup>338</sup> See Ruwantissa Abeyratne, *Legal Priorities in Air Transport* (Montreal: Springer International, 2019) at 154 [Abeyratne].

<sup>339</sup> Annex 16, Volume IV, *supra* note 328 at 2.2.2.

<sup>340</sup> *Id.*, at 2.3.

<sup>341</sup> Annex 16, Volume IV, *supra* note 328 at 2.3.3.

<sup>342</sup> *Id.* at 2.4.

<sup>343</sup> *Id.* at 2.5.

<sup>344</sup> See criticism levied against Volume IV of Annex 16 for insufficient transparency at International Coalition for Sustainable Aviation, "Report on Understanding the CORSIA Package", online: ICSA <[https://carbonmarketwatch.org/wp-content/uploads/2018/02/ICSA-Report\\_A4.pdf](https://carbonmarketwatch.org/wp-content/uploads/2018/02/ICSA-Report_A4.pdf)>

will inevitably be responsible for the submission of data under CORSIA. Due to the complete lack of transparency in the system, there is a need for some form of penalty to be imposed as a consequence for false reporting. Yet to date, there are no such consequences penalising States for fraudulent MRV procedures. Unless this is rectified, the present state of regulations is likely to result in accusations among States regarding fraudulent reporting. In case of such a hypothetical dispute, it is further unclear as to how such a dispute would be resolved.

#### **4.6.4.3 Double Counting**

MRV procedures additionally have the potential for double-counting, for example where the country hosting the offset project and the airline purchasing the offset count the emissions reduction as their own.<sup>345</sup> Volume IV of Annex 16 of the SARPs as it stands today does not effectively bar a State from submitting a report for the emissions reductions achieved through the offset and the purchase of the same by the State's operator. Again, as asserted above, this only exhibits how much discretion is vested in States for reporting procedures.

The 40<sup>th</sup> Assembly demonstrates that ICAO's response to these issues will be sluggish. Resolution 18 simply introduces general guiding principles for the design and implementation of market-based measures (MBMs) for international aviation, which includes criteria such as "transparent", "administratively simple", "cost-effective" additionally recommends that it "should not be duplicative".<sup>346</sup> Similarly the Assembly recommended "a coordinated approach for national administrative policy actions"<sup>347</sup> in order to achieve effective domestic enforcement by States. Despite this language appearing in the resolution, it is unclear if, and how, these recommendations will be translated into practice under the scheme.

#### **4.6.5 Agreement on alternate fuels**

Sustainable fuels are those which can have a lower life-cycle GHG footprint than conventional fuel, according to the Expert Group at ICAO (named the ICAO SUSTAF Expert Group).<sup>348</sup> The

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<sup>345</sup> Abeyratne, *supra* note 338 at 145.

<sup>346</sup> Resolution 18 of the 40<sup>th</sup> Assembly, *supra* note 311.

<sup>347</sup> *Id.*

<sup>348</sup> See ICAO Sustainable Alternative Fuels (SUSTAF) Expert Group, "The Challenges for the Development and Deployment of Sustainable Alternative Fuels in Aviation: Outcomes of ICAO's SUSTAF Experts Group", online: ICAO <[www.icao.int/environmental-protection/GFAAF/Documents/ICAO%20SUSTAF%20experts%20group%20outcomes\\_release%20May2013.pdf](http://www.icao.int/environmental-protection/GFAAF/Documents/ICAO%20SUSTAF%20experts%20group%20outcomes_release%20May2013.pdf)>

40<sup>th</sup> Assembly acknowledged the importance of the organisation's past work in this area, including the Global Framework for Aviation Alternative Fuels (GFAAF) and its focus on future development of a system to support greener fuels, including the convening of the third CAAF and the need to adopt clear goals for the 2050 ICAO Vision for Sustainable Aviation.<sup>349</sup> It is not only the actual requirement for production of sustainable fuel that is the concern, but the need for sufficient changes to be introduced in the fuel system as well. These changes would have to include a system to facilitate fair pricing and also to ensure supply of that fuel to all markets in an equitable manner. Additionally, criticism has been levied against ICAO's consideration of CORSIA-eligible fuels, because the present sustainability criteria ought to encompass not only emissions reductions of the fuels but their social, economic, and other environmental sustainability attributes as well.<sup>350</sup>

A commitment to sustainable aviation fuels and a supporting framework must therefore be pursued just as aggressively as economic measures, for the latter are only a temporary corrective; MBMs are aimed at reducing emissions, and CORSIA will by no means stop emissions from occurring altogether. Sustainable alternative fuels are thus a long-term measure which must be accorded equal, if not greater, significance.

#### **4.7 The Debate regarding Frequent Flyer Programs**

In addition to the measures pursued by ICAO, it is worth noting other proposals to reduce emissions from the global aviation sector including the debate regarding Frequent Flyer Programs (FFPs). While the commercial space industry is at a nascent stage, this ongoing debate in the aviation context can allow us to gauge whether such measures may be required in the space sector.

FFPs were introduced to “induce and capture the loyalty of travelers”.<sup>351</sup> By providing incentives to fly with an airline, FFPs are considered the most popular and successful marketing strategy devised to build customer loyalty and sell high priced seats.<sup>352</sup> The present state of climate change has led environmentalists to question whether such programs contribute to an increased volume of air traffic. This attitude is most recently reflected in the report published by the UK Committee on Climate Change, an independent body whose purpose is to advise the UK Government on

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<sup>349</sup> Id.

<sup>350</sup> Abeyratne, *supra* note 338 at 144.

<sup>351</sup> Anthony Chin, “Impact of Frequent Flyer Programs on the Demand for Air Travel,” 7 *Journal of Air Transport* 2 (2002) at 1-2.

<sup>352</sup> Id.

emissions targets and to report to Parliament on progress made in reducing greenhouse gas emissions and preparing for climate change.<sup>353</sup>

This report has been controversial, as it urges the government to take stringent action against existing FFPs, stating that “flying is a uniquely high-impact activity” and “the quickest and cheapest way for a consumer to increase their carbon footprint.”<sup>354</sup> This is illustrated by comparing emissions from one return ticket between London and New York, which is roughly equivalent to that of heating a typical home in the UK for a complete year.<sup>355</sup> The most surprising statistic revealed however, is not regarding emissions, but with respect to the actual segment of the population that takes these flights. The report states that an estimated 70% of UK flights are taken by just 15% of the population.<sup>356</sup> The Committee proposed two primary solutions: (i) an escalating “Air Miles Levy” to discourage excessive flying by the 15% of the UK population estimated to be responsible for 70% of flights, or (ii) introducing regulation that banned all frequent flyer reward schemes that stimulate the demand for air travel.<sup>357</sup> This levy does not target the larger population who mostly travel for a yearly vacation. Instead, the proposed levy would encourage shifting from long-haul to short-haul leisure destinations while 3 or 4-year cycles would allow travellers greater flexibility for long-haul travel.<sup>358</sup> Emissions would be estimated differently while accounting for Business and First Class tickets.<sup>359</sup> This distinction between Business and First Class travelers is made on the basis of the argument that more spacious cabins, vacant seats and additional services contribute more to emissions than economy class. The industry backlash to this report has been unsurprising, with the UK’s Board of Airline Representatives arguing that there was no rationale for the recommendations to be implemented.<sup>360</sup> Additionally, the trade body Airlines UK released a public statement that “UK aviation has a robust plan to cut aviation carbon emissions and get to net zero by 2050, without the need to price people out of air travel or put the UK at a competitive disadvantage,” while further emphasising “the many exciting developments around aircraft and

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<sup>353</sup> UK, Committee on Climate Change, online: *UKCCC* <[www.theccc.org.uk/about/](http://www.theccc.org.uk/about/)>

<sup>354</sup> UK, Committee on Climate Change, “Behaviour change, public engagement and net zero: A report for the Committee on Climate Change”, online: *UKCCC* <<https://www.theccc.org.uk/publication/behaviour-change-public-engagement-and-net-zero-imperial-college-london/>> [*Climate Change Study*]

<sup>355</sup> *Id.* at 7.

<sup>356</sup> *Id.* at 8.

<sup>357</sup> *Id.* at 37.

<sup>358</sup> *Id.*

<sup>359</sup> *Id.*

<sup>360</sup> See CNBC, “Airlines slam proposals to ban air mile programs and tax frequent flyers,” online: *CNBC* <[www.cnn.com/2019/10/15/airlines-slam-proposal-to-ban-air-mile-schemes-and-tax-frequent-flyers.html](http://www.cnn.com/2019/10/15/airlines-slam-proposal-to-ban-air-mile-schemes-and-tax-frequent-flyers.html)>

engine technology, sustainable aviation fuels and the new emerging carbon markets.”<sup>361</sup>

The very talk of abolishing frequent flyer programs and consumer incentives is labelled “extreme”. Nevertheless, this is a proposal that merits consideration, particularly since ongoing attempts at limiting emissions from international air transport are slow and still in progress. While these policy measures are being developed and issues with implementation are addressed, a levy on frequent flyer programs may offer temporary relief. With a levy on FFPs, there is a direct price on emissions for the regular traveler who (according to the survey above) can afford to pay an increased fare. Interestingly, as part of its research, the Committee included a survey in the UK to attain the reaction of the public to a levy on FFPs. The survey found that the majority preferred a Frequent Flyer Levy over other potential policy options, and even viewed this levy as a positive action in comparison to no action at all.<sup>362</sup> Obviously, all carriers and not just the UK should ideally be involved in any such proposal, but the proposal itself is encouraging, as it contemplates (i) pricing emissions from an exclusive section society that benefits from these programs; (ii) a direct form of revenue generation that targets the passenger itself and (iii) in targeting the passenger, the levy could result in changing consumer mindset regarding air travel.

Naturally, the very notion raises numerous questions, such as what the definition of a “frequent flyer” would be, whether this levy should be equally imposed on routes where there are no viable alternatives, and who the authority responsible for overseeing and implementing this scheme would be. To impose such a scheme in the space sector would be premature at this stage, given that the space tourism industry is at an early stage of development, but the author contends that there is at the very least, scope for discussion on the imposition of a levy for rocket emissions. This is derived from the rationale that certain commercial space industries, for example, space tourism would (at least initially) be accessible only by a specific part of the population.

#### **4.8 Future considerations for the international aviation sector**

In October 2019, the 40<sup>th</sup> Assembly at ICAO adopted Resolutions 17, 18 and 19 regarding the environmental impact of aviation. The progress made is undeniable, evident from the new CO2

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<sup>361</sup> Id.

<sup>362</sup> The study stated that 56% of the public agreed that a levy on frequent flyers would be fair, while only 26% felt it would be unfair. See Climate Change Study, *supra* note 354 at 34.

standards confirmed to take effect from 1 January 2020 for certain aircraft types in Resolution 17.<sup>363</sup> The Assembly also evidenced ICAO's commitment to ensuring fuel-efficient routing of international flights, including through the Global Air Navigation Plan (GANP) and the continued the pursuit of a framework to support alternative fuels.<sup>364</sup> Still, the Assembly also demonstrates that the inclusion of all States in a global MBM generates extreme attitudes and slow progress in policy-making. It is evident, for instance, that the CBDR versus non-discrimination saga rages on, with both groups relentlessly aiming to incorporate this language.<sup>365</sup> This polarisation of States was further demonstrated through the difficulty in reaching consensus on the introduction of a "collective medium-term global aspirational goal" to maintain global net carbon emissions from international aviation from 2020 at the same level. To avoid an impasse in negotiations, the Assembly finally incorporated SCRC language.<sup>366</sup>

Given this pace of negotiations, some argue that the emissions conundrum can be resolved by a select group of States and does not require collective action.<sup>367</sup> This argument is embedded in the notion that the majority of global greenhouse gas emissions today can be attributed to under 15 States and therefore inclusivity is not an important principle to achieve a reduction in emissions. The data in Chapter 1 of this thesis, however, demonstrates that the Global South is inevitably more vulnerable to the impact of climate change. It is therefore asserted that it is crucial for all nations to be included within any discussion regarding emissions regulation, bearing that disproportionate impact in mind. From this study on the aviation sector, these are valuable lessons that can be applied to a regime for rocket emissions, which will be constructively applied in formulating the principles in Chapter 6 of this study.

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<sup>363</sup> ICAO, 40<sup>th</sup> Assembly, Resolution 17, "Consolidated statement of continuing ICAO policies and practices related to environmental protection - General provisions, noise and local air quality."

<sup>364</sup> *Id.*

<sup>365</sup> See Resolution 18 of the 40<sup>th</sup> Assembly, *supra* note 345, which attempted to appease both groups.

<sup>366</sup> *Id.*

<sup>367</sup> See author Daniel Bodansky who contends that broad participation is not essential to solve the climate change problem and argues that a smaller regime comprising of fewer members can address the problem effectively, in Daniel Bodansky, *The Art and Craft of International Environmental Law*, (Cambridge: Harvard University Press, 2010) at 35.

## **Chapter 5 – A study of emissions regulation in the international maritime sector**

Having conducted a comparative study with the aviation sector, this chapter examines the regulation of emissions in the global maritime sector, focusing on the effectiveness of technical and operational measures.

The Fourth Assessment Report of the IPCC estimated emissions from international shipping to account for approximately 2.7% of global emissions in 2007, which is roughly 870 million tonnes of carbon dioxide.<sup>368</sup> The International Maritime Organisation (IMO) has since studied the role of the maritime sector in GHG emissions, their most recent study estimating that international shipping contributes to 2.2% of global anthropogenic carbon dioxide emissions.<sup>369</sup> These statistics, along with the general perception that maritime transport is the least energy-intensive mode of transport, has done little to muster support for enhanced regulation.<sup>370</sup> Nevertheless, emissions from the global maritime sector include other emissions such as sulphur oxides, nitrogen oxides, particulate matter, and water vapor which all contribute to atmospheric pollution.

Emissions are estimated to grow between 50-250% by the year 2050, if they continue at the present rate.<sup>371</sup> Based on these estimates and the present rate of deterioration of the Earth environment, IMO has undertaken several initiatives to reduce emissions. This chapter begins with the relevant instruments regulating protection of the marine environment.

### **5.1 Relationship between UNCLOS and the IMO conventions**

Two key regulatory systems operate within the maritime sector, namely UNCLOS<sup>372</sup> and the IMO conventions. From the perspective of the UNCLOS framework, only Article 2 contains an express reference to IMO. Other provisions mention “the competent international organisation” in certain contexts, such as safety and pollution.<sup>373</sup> There is however, no doubt that this reference is exclusively meant to be IMO, as IMO was established as a specialised agency under the larger UN

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<sup>368</sup> IPCC, “Fourth Assessment Report, 2007”, online: *IPCC* <[www.ipcc.ch/report/ar4/syr/](http://www.ipcc.ch/report/ar4/syr/)>

<sup>369</sup> IMO, “Third IMO Greenhouse Gas Study 2014”, online: *IMO* <[www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Third%20Greenhouse%20Gas%20Study/GHG3%20Executive%20Summary%20and%20Report.pdf](http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Third%20Greenhouse%20Gas%20Study/GHG3%20Executive%20Summary%20and%20Report.pdf)>

<sup>370</sup> See Beatriz Martínez Romera, *Regime Interaction and Climate Change: The Case of International Aviation and Maritime Transport* (Routledge, 2018) [Beatriz Romera].

<sup>371</sup> *Id.* at 24.

<sup>372</sup> See *United Nations Convention on the Law of the Sea*, 10 December 1982, 1833 UNTS 3 (entered into force 16 November 1994) [*UNCLOS*].

<sup>373</sup> *Id.*, arts 22, 41, 53, 60, 61 and 119.

mechanism for the regulation of international shipping.<sup>374</sup> Provisions of the IMO Convention indicate that there are other “intergovernmental organisations which are not specialised agencies of the United Nations, but whose interests and activities are related to IMO.”<sup>375</sup> These provisions imply that the UNCLOS and IMO systems work parallel to each other, with IMO being the forum for decision-making.

Article 211 of UNCLOS mandates States “acting through the competent international organisation or general diplomatic conference” to establish international rules and standards to prevent, reduce and control pollution of the marine environment from vessels and additionally promote the adoption of appropriate routing systems to minimise the threat of accidents which might cause pollution of the marine environment.<sup>376</sup> This provision also notes that States are entitled to enact their own national regulations regarding marine pollution, in which case the said State is required to make public their specific requirements and also communicate them to IMO.<sup>377</sup> Accordingly, there are two kinds of regulations noted by UNCLOS- the acknowledgement of international rules and standards,<sup>378</sup> in addition to the domestic regulations introduced by States.

Article 212 of UNCLOS is also relevant. This provision mandates States to adopt laws to prevent, reduce and control pollution of the marine environment from or through the atmosphere, applicable to the airspace under their sovereignty and to vessels flying their flag or vessels or aircraft of their registry.<sup>379</sup> Moreover, States “acting especially through competent international organisations or diplomatic conference, shall endeavour to establish global and regional rules, standards and recommended practices and procedures to prevent, reduce and control such pollution.”<sup>380</sup> It is interesting that there is an explicit reference to “standards and recommended practices” as this expression is reminiscent of the process of SARPs being introduced as Annexes to the Chicago Convention. However, the process to introduce regulation in the maritime context is different, as these Annexes become binding on States through a tacit acceptance process unique to IMO (discussed below). An additional provision in UNCLOS reinforces this Article 212, as there is a

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<sup>374</sup> *Convention on the International Maritime Organization*, 6 March 1948, 289 UNTS 3 (entered into force 17 March, 1958) [*IMO Convention*], art 59.

<sup>375</sup> *Id.*, art 60. Also see arts 61-62.

<sup>376</sup> *UNCLOS*, *supra* note 372, art 211.

<sup>377</sup> *Id.*

<sup>378</sup> For example, see *UNCLOS*, *supra* note 372, art 217 regarding “Enforcement by flag States”.

<sup>379</sup> *Id.*, art 212.

<sup>380</sup> *Id.*

specific provision for enforcement, making it mandatory for States to enforce any regulations adopted in pursuance of this provision.<sup>381</sup> This provision also entitles States to take other measures necessary with respect to implementing the international rules and standards introduced through the IMO system, making a specific reference to such measures being “in conformity with all relevant international rules and standards concerning the safety of air navigation.”<sup>382</sup>

Article 237 of UNCLOS specifically addresses the possibility of fragmentation between the two regimes by stating that the provisions of Part XII of UNCLOS are without prejudice to other agreements regarding marine environmental protection, and further that any such specific obligations assumed by States under these agreements, must be carried out in a manner consistent with the general principles and objectives of UNCLOS.<sup>383</sup> Similarly, the IMO conventions also contain such language to the effect that the text of the IMO convention would not “prejudice the codification and development of the law of the sea” in UNCLOS.<sup>384</sup>

From these provisions, it is evident that UNCLOS was drafted with the intent of harmonising regulations in international maritime law, both with the previously established IMO conventions (and corresponding laws and standards), as well as international air law.

Edmund Hughes attributes the regulatory success of the global maritime sector to the formal acceptance of the primary conventions on pollution (i.e. the Convention for Safety of Life at Sea (SOLAS)<sup>385</sup> the International Convention for the Prevention of Pollution from Ships (MARPOL),<sup>386</sup> and the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STWC)<sup>387</sup> respectively), as the ratification rate represents approximately 99% gross tonnage of the world’s merchant fleet.<sup>388</sup> According to Hughes, this is strengthened by the no-more-favourable treatment principle present in these conventions, which

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<sup>381</sup> Id, art 222.

<sup>382</sup> Id.

<sup>383</sup> Id., art 237.

<sup>384</sup> See for example, *MARPOL*, *infra* note 386, art 9.

<sup>385</sup> *International Convention for the Safety of Life at Sea*, 1 November 1974, 1184 UNTS 2 (entered into force 25 May 1980) [SOLAS].

<sup>386</sup> *International Convention for the Prevention of Pollution from Ships*, 2 November 1973, 12 ILM 1319 (entered into force 2 October 1983) [MARPOL].

<sup>387</sup> *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers*, 7 July 1978, 1361 UNTS 2 (entered into force 28 April 1984).

<sup>388</sup> Edmund Hughes, “The IMO: Ship-sourced Emissions, Climate Change, and Global Ocean Governance” in David Attard, Rosalie Balkin and Donald Greig, eds, *The IMLI Treatise On Global Ocean Governance: Volume III: The IMO and Global Ocean Governance* (Oxford University Press, 2015) at 5 [Hughes].

causes said 99% of States to apply the regulations to vessels flying the flag of non-members of IMO as well.<sup>389</sup> Subsequently, an incentive is created, for non-State parties to join the IMO system.<sup>390</sup> This author concurs, as this would result in a wider membership at IMO, given that a non-State party would want to be included in any amendment-making or certification process.

## 5.2 Law-making at IMO

IMO, initially named the Intergovernmental Consultative Maritime Organisation, was formed in 1948. The organisation has since evolved its functions from a mere consultative role to become the central organisation responsible for regulation of international maritime emissions.<sup>391</sup> This responsibility was officially recognised in Article 2 of the Kyoto Protocol, as stated in the preceding chapter. Similar to ICAO, IMO is comprised of an Assembly, elected Council and Secretariat, with additional sub-committees with technical expertise. A further similarity between the two organisations is that IMO too initially focused on safety rather than environmental protection. This is because until the nineteenth century, States took little interest in maritime jurisdiction beyond their immediate coastal areas, and none in respect of environmental matters.<sup>392</sup>

The shift towards environmental law-making at IMO commenced with the prominent oil spill in 1967 from the *Torrey Canyon*. It was this incident that spurred the establishment of the Legal Committee at IMO to address damages arising from the incident and adopt measures against future pollution disasters. IMO's environmental mandate thus centered on pollution resulting from oil spills, which eventually led to the creation of MARPOL in 1973. The focus on environmental concerns led IMO to conclude that there was a necessity for a specialised body within the organisation to focus on these subject areas. Hence, in 1974, after MARPOL was created, IMO constituted the Marine Environment Protection Committee (MEPC). The 1980s then witnessed IMO's involvement in studying emissions from ships, which was a substantial evolution from the organisation's focus on "visible" sources such as oil spills, sewage and dumping. MARPOL has been amended to address these different forms of pollution by introducing Annexes on different subject matters, such as Annex III regarding pollution from packaged substances, Annex IV

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<sup>389</sup> Id.

<sup>390</sup> Id. at 6-7.

<sup>391</sup> *IMO Convention*, *supra* note 374, art I(a).

<sup>392</sup> Jeffrey Smith, "Inspirations from Sustainable Maritime Development", in Armand de Mestral, Paul Fitzgerald and Tanveer Ahmad, eds, *Sustainable Development, International Aviation and Treaty Implementation* (Cambridge University Press, 2018) at 300 [Smith].

regarding sewage from ships, Annex V regarding garbage discharge and in 1997, Annex VI regarding air pollution.

### 5.2.1 Political divisions within IMO

The beginning of law-making at IMO witnessed the emergence of two groups of States with competing interests, i.e. maritime States that possessed significant military and commercial navigation interests, and coastal States, which were shoreline States that sought to regulate the movement and activities of foreign vessels in or near the waters adjacent to their coasts.<sup>393</sup> The two groups asserted different views, the latter seeking to protect their shores by adopting strict environmental controls over their own vessels and those of other States within their waters, and the former, which perceived coastal state regulation to be inimical to the traditional freedom of navigation.<sup>394</sup> However, with growing industries of developing States, particularly the coastal States, this boundary has begun to blur, resulting in overlapping interests. For example, developing States such as Brazil and China are now renowned for their commercial trade through the maritime sector, and would hence be considered maritime States, as would the US. This divide is significantly different from the developed-developing nation grouping as identified in earlier chapters under the UNFCCC framework and at ICAO.

### 5.2.2 Stakeholders

The constitution of IMO is not only comprised of member States, but also encourages other stakeholders, such as intergovernmental and non-governmental organisations to participate in meetings. There is greater potential for acceptance of rules and standards, as the non-State entities which also have an interest in international shipping can express their views, such as the International Chamber of Shipping (ICS), a trade association and NGOs such as the Comité Maritime International (CMI). Nicholas Gaskell elaborates on the role of NGOs in the IMO law-making process, having attended IMO meetings as a representative of the NGO, International Union for the Conservation of Nature and Natural Resources (IUCN).<sup>395</sup> He describes the Legal Committee of IMO as more of a “political forum” as all present must (i) agree to proceed with the

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<sup>393</sup> Alan Khee-Jin Tan, *Vessel-source Marine Pollution: The Law and Politics of International Regulation* (Cambridge University Press: 2006) at 29 [Khee-Jin Tan].

<sup>394</sup> Id.

<sup>395</sup> Nicholas Gaskell, “Decision-making and the Legal Committee of the International Maritime Organization”, (2003)18 *International Journal of Marine and Coastal Law*, Kluwer Law at 162 [Gaskell].

consideration of a particular subject, (ii) set priorities within this subject, (iii) decide on the appropriate structure of an instrument, (iv) decide on the principles to be covered, and (v) decide on particular wordings, all of which finally culminates in a stage where the Legal Committee has a “ripe” draft.<sup>396</sup> It appears that this form of law-making provides greater scope for participation of non-governmental entities within this forum.

Regarding the political powers of States within IMO, Gaskell employs an Orwellian phrase to describe how member States have the right to an equal vote at IMO, yet how, “some States are more equal than others.”<sup>397</sup> One example would be the US, not only due to its commercial interests in international shipping, but also as a key player in the global tussle for control of oil resources. With production power and sizable imports, the US has been said to be “possibly the only country which can afford to impose unilateral laws on ships visiting its ports or even laws with extra-territorial effect without substantially hurting its own interests.”<sup>398</sup> The domestic enactment of several US laws in this area substantiate this argument, an example being the Oil Pollution Act which was a direct response to the *Exxon Valdez* oil spill, and apparently prevented the US from staying out of the international regime for compensation for oil pollution victims.<sup>399</sup> The counter-argument to this claim would be that, in the 1970s, the IMO system had no legislation for environmental issues such as oil spills, and the US therefore responded by adopting national measures to handle the issue. The lobbying for national US legislation in this area primarily came from the coastal states of the US, which felt that a uniform international regime inhibited them from enacting their own domestic regulations for visiting ships in their ports.<sup>400</sup>

It is also worth noting the fact that the contributions of member States to the organisation’s budget are based on the tonnage of their merchant fleet.<sup>401</sup> This criterion differs significantly from other UN agencies, where contributions are usually made on the basis of GDP.<sup>402</sup>

### 5.2.3 Tacit Acceptance Process

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<sup>396</sup> Id.

<sup>397</sup> Id.

<sup>398</sup> Khee-Jin Tan, *supra* note 393 at 65.

<sup>399</sup> Id.

<sup>400</sup> Id.

<sup>401</sup> Beatriz Romera, *supra* note 370 at 95.

<sup>402</sup> Id.

IMO has a unique process for introduction of amendments in MARPOL, i.e. the tacit acceptance procedure.<sup>403</sup> When a technical rule or standard requires updating under this convention, the tacit acceptance procedure enables the amended rule to become effective on a specific date, based on how said amendment is perceived by State parties. Therefore, unless the proposed amendment is expressly rejected by certain States (being States that contribute to 50% percentage of the gross tonnage of the world's merchant fleet), then the amendment is automatically deemed effective after 10 months have passed without any such rejection.<sup>404</sup> This characterises law-making within IMO as more enforceable with stronger commitments, as the Annexes become binding upon sufficient ratification. This author compares the tacit acceptance process to the adoption of SARPs at ICAO as observed in Chapter 4, and notes that there is a clear difference as the latter continue to be branded with the status of *de jure* soft law, while Annexes to MARPOL are hard law.

IMO supports hard law measures with a mix of soft law instruments, which is viewed as a contributing factor to a more successful regime in the maritime context. IMO has acknowledged the different capacity levels of States as regards implementation of standards, and this has resulted in soft law instruments such as “goal-based standards.” These are high-level standards comprised of at least one goal, functional requirement(s) associated with that goal, and verification of conformity that rules/regulations meet said functional requirements as well as the goal.<sup>405</sup> Since IMO prioritises the development of such instruments, there is more potential for the development of customary international law in the maritime context, with the emergence of such standards and guidelines which States feel compelled to adhere to.

### **5.3 Environmental initiatives at IMO**

#### **5.3.1 Annex VI of MARPOL**

The contribution of ships to emissions and climate change cannot be categorised as marine pollution in the narrower sense, because it does not have the equivalent discernible effect of, say, oil spills or sewage from vessels. Despite this, Article 2 of the MARPOL convention defines “discharge” in relation to harmful substances or effluents containing such substances, as “any

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<sup>403</sup> See *MARPOL*, *supra* note 386, art 16.

<sup>404</sup> *Id.*

<sup>405</sup> See IMO Safety, “IMO Goal-Based Standards”, online:  
<[www.imo.org/en/OurWork/Safety/SafetyTopics/Pages/Goal-BasedStandards.aspx](http://www.imo.org/en/OurWork/Safety/SafetyTopics/Pages/Goal-BasedStandards.aspx)>

release howsoever caused from a ship and includes any escape, disposal, spilling, leaking, pumping, emitting or empty ships.”<sup>406</sup> A majority of States at the MEPC hence concluded that a new annex should be introduced to MARPOL, which culminated in the introduction of Annex VI exclusively dedicated to air pollution from ships. Through Annex VI, IMO has been able to navigate an extreme division of views which emerged under the UNFCCC climate model and move beyond its original mandate of safety in international shipping to include the effects of GHG emissions and climate change within its purview.

Annex VI introduced a new set of regulations titled “the Prevention of Air Pollution from Ships.” In 2005, IMO concluded that GHG gases should be included within Annex VI. This resulted in a newly amended Annex VI, as well as a revised Technical Code for Nitrogen (NO) Emissions, which became effective in 2010. The regulations under Annex VI identify emission control areas (ECAs) that require the introduction of regulation for emissions of sulphur oxide, beginning with the Baltic Sea, North Sea and English Channel.<sup>407</sup> IMO also permits new ECAs to be identified and demarcated by further amendments to Annex VI. This demarcation of ECAs thus imposed a new mandate on vessels, requiring them to shift to fuel oil that complies with a lower rate of sulphur oxide emission before said vessel would enter the ECA. Similarly, the Annex also introduced an emissions target for nitrogen oxides under Regulation 13.<sup>408</sup> As per this regulation, vessels are required to provide proof of compliance in order to be certified.

Through Regulation 14, the MEPC resolved to implement a new fuel oil standard of a lower limit of 0.50% sulphur content which would enter into force and apply to all vessels on 1 January, 2020.<sup>409</sup> To facilitate a smooth transition to this new standard, at the 74<sup>th</sup> Session of the MEPC, IMO adopted a new set of guidelines titled “Guidelines for Consistent Implementation of the 0.5 percent Sulphur Limit under MARPOL Annex VI.”<sup>410</sup> These guidelines provide additional information and recommendations for ship-owners, State administration and fuel oil suppliers

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<sup>406</sup> MARPOL, *supra* note 386, art 2.

<sup>407</sup> MARPOL, *supra* note 386, Annex VI, Regulation 14.

<sup>408</sup> *Id.*, Regulation 13.

<sup>409</sup> MEPC, 73<sup>rd</sup> Session, Resolution 305(73), “Amendments to the Annex of the Protocol of 1997 to Amend the International Convention for the Prevention of Pollution from Ships, 1973, as Modified by the Protocol of 1978 relating thereto.”

<sup>410</sup> MEPC, 74<sup>th</sup> Session, Resolution 320(74), “2019 Guidelines for Consistent Implementation of the 0.50% Sulphur Limit under MARPOL Annex VI.”

alike, on the recommended composition of types of fuels, as well as verification and control mechanisms.<sup>411</sup>

### 5.3.2 Technical and operational measures

When ICAO began to debate policy measures appropriate for the regulation of aircraft emissions, the IMO Assembly too commenced an evaluation of suitable measures for international shipping. The first major step towards a global mechanism was IMO Assembly Resolution A.963(23) in 2003. The IMO member States collectively urged the MEPC to identify and develop mechanisms to limit or reduce greenhouse gas emissions from international shipping, while prioritising (i) the establishment of an emission baseline, (ii) the development of a methodology to describe the efficiency of a ship in terms of an emission index for that ship and (iii) further develop guidelines by which the emission indexing scheme may be applied in practice.<sup>412</sup> The IMO Assembly directed this request to the MEPC and also incorporated the instruction that the IMO Secretariat should continue co-operating with the UNFCCC Secretariat of UNFCCC as well as the ICAO Secretariat in this subject area.<sup>413</sup> Despite the lack of any specific reference to IMO (or ICAO) under the Paris Agreement, IMO has nevertheless continued to regularly report progress on developing emissions regulation to the Subsidiary Body for Scientific and Technological Advice under the UNFCCC framework to ensure a coordinated and informed approach to the problem.

In 2011, the 62<sup>nd</sup> IMO Assembly adopted Resolution MEPC 203(62) to incorporate an additional chapter to Annex VI regarding energy efficiency, and introduced two initiatives, the first being the Energy Efficiency Design Index (EEDI). IMO described the EEDI as a “non-prescriptive, performance-based mechanism” that applies to newly manufactured vessels.<sup>414</sup> The EEDI will be implemented across a ten year period, with 2025 being the year-end mark where ships must be 30% more energy efficient as compared to 2014.<sup>415</sup> IMO distinguished three different periods to phase-in improvements in efficiency, being 10% in the first stage from 2015 to 2019, 20% in the second stage from 2020 to 2024 and 30% which would be effective after 2024 (i.e., 1 January,

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<sup>411</sup> Id.

<sup>412</sup> IMO, 23<sup>rd</sup> Assembly, Resolution A.963(23), “IMO Policies and Practices related to the Reduction of Greenhouse Gas Emissions from Ships” (5 December 2003) [*IMO 23<sup>rd</sup> Assembly Resolution*].

<sup>413</sup> Id.

<sup>414</sup> See IMO, “Energy Efficiency Measures”, online: *IMO* <[www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Technical-and-Operational-Measures.aspx](http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Technical-and-Operational-Measures.aspx)>

<sup>415</sup> MARPOL, *supra* note 386, Annex VI, Regulation 21.

2025).<sup>416</sup> To facilitate compliance, every vessel is required to obtain an International Energy Efficiency Certificate, provide evidence that the ship has regularly conducted checks on its efficiency levels and further provide proof of approval by the national laws of its port State.<sup>417</sup> The EEDI is thus voluntary as it vests ship owners with the power to decide which technology to apply in order to achieve the appropriate energy level. This means that manufacturers have the option to employ the technology or design most beneficial to them- a method that IMO hoped would also contribute to innovation and discovery of cleaner international shipping. For this reason, the EEDI can be considered as a long-term measure that can shift industry practice and facilitate the migration towards sustainable shipping practices.

The second measure introduced to Annex VI was an operational measure entitled the Ship Energy Efficiency Management Plan (SEEMP) which would be applicable to all ships, regardless of when they were manufactured. The SEEMP establishes a mechanism for operators to improve the energy efficiency of existing ships against business-as-usual operations, in a cost-effective manner and also provide an approach for monitoring ship and fleet efficiency performance over time.<sup>418</sup> All ships of 400 gross tonnes and above engaged in international trade are required to implement and maintain a SEEMP, which establishes a mechanism for operators to improve the energy efficiency of ships.<sup>419</sup>

The two instruments can therefore be distinguished on the basis of scope of application and enforceability. EEDI is a technical measure that applies to new ships only, while SEEMP is an operational measure imposed on all vessels. The introduction of SEEMP was supported by a set of voluntary guidelines which elaborate on the four stages SEEMP, i.e. planning, implementation, monitoring, and self-evaluation and improvement.<sup>420</sup> The first stage of planning involves identifying the present energy usage of the vessel and how this could be improved. The implementation step facilitates this improvement by developing the procedures for energy management, defining tasks and assigning them to qualified personnel.<sup>421</sup> The Guidelines

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<sup>416</sup> Id.

<sup>417</sup> Id., Regulation 21.

<sup>418</sup> MARPOL, *supra* note 386, Annex VI, Regulation 22 [*SEEMP Regulation*].

<sup>419</sup> Id.

<sup>420</sup> MEPC, 63<sup>rd</sup> Session, Resolution 213(63), “2012 Guidelines for the Development of a Ship Energy Efficiency management Plan (SEEMP)”. [*2012 SEEMP Guidelines*].

<sup>421</sup> *SEEMP Regulation*, *supra* note 418.

recommend that ship owners continuously monitor the energy efficiency of their vessels using a reliable international standard to quantify the energy levels.<sup>422</sup> The data obtained from monitoring using the EEDI is then recommended using the self-evaluation system in said guidelines.<sup>423</sup>

The author notes that the introduction of the EEDI and SEEMP were questioned by several States, particularly developing States. At the 62<sup>nd</sup> Session of the MEPC, China, Saudi Arabia and South Africa contended that both the EEDI and SEEMP require implementation in consonance with the CBDR principle under UNFCCC.<sup>424</sup> However, the opposition of these States did not impede the introduction of the EEDI or SEEMP, as the amendments to Annex VI received enough ratifications to become binding. The divided views did lead to the development of another category of policy measures at IMO, namely technology transfers between developed and developing States.

Regulation 23 of Annex VI pertains to “Technical co-operation and transfer of technology.” Construed by some scholars as a regulation that incorporates a relatively more passive form of CBDR,<sup>425</sup> the language encourages the promotion of support to “developing States that request technical assistance.”<sup>426</sup> This would include the development and transfer of technology and exchange of information from developed to developing States.<sup>427</sup> At its 65<sup>th</sup> session, the MEPC adopted resolution MEPC.229(65) to further this objective, and requested IMO to facilitate cooperation in this regard, while also sourcing funds for capacity building to the developing States which have requested technology transfers.<sup>428</sup>

The MEPC then established an Ad Hoc Expert Working Group on Facilitation of Transfer of Technology for Ships and initiated two projects through this group, the first being the Global Maritime Energy Efficiency Partnerships Project (GloMEEP). GloMEEP takes a “fast-track approach to pursuing relevant legal, policy and institutional reforms,” so as to drive innovation to support the effective implementation of IMO energy efficiency requirements in developing

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<sup>422</sup> See 2012 SEEMP Guidelines, *supra* note 420.

<sup>423</sup> *Id.*

<sup>424</sup> See MEPC, 62<sup>nd</sup> Session, “Comments on the proposed mandatory energy efficiency regulations, Submitted by China, Saudi Arabia and South Africa”.

<sup>425</sup> See Md. Saiful Karim, *Prevention of Pollution of the Marine Environment from Vessels: The Potential and Limits of the International Maritime Organization* (Springer Publishing, 2014) at 119.

<sup>426</sup> MARPOL, *supra* note 386, Annex VI, Regulation 23.

<sup>427</sup> *Id.*

<sup>428</sup> MEPC, 65<sup>th</sup> Session, Resolution 229(65), “Promotion of Technical Co-operation and Transfer of Technology relating to the Improvement of Energy Efficiency of Ships.”

States.<sup>429</sup> As a collective effort of IMO, UNEP and Global Environment, the project presently focuses on ten countries, namely India, China, the Philippines, Malaysia, Morocco, Georgia, South Africa, Jamaica, Panama and Argentina.<sup>430</sup>

The second initiative is the introduction of Maritime Technology Cooperation Centres (MTCCs), an initiative funded by the European Union and implemented by IMO.<sup>431</sup> The project aims to unite these MTCCs in specific regions into a global network, while focusing on developing countries, in particular, least developed countries and small island developing States.<sup>432</sup>

### 5.3.3 MBMs in Shipping

In 2003, the IMO Assembly adopted Resolution 23 which acknowledged the need for market-based measures to regulate emissions in international shipping.”<sup>433</sup> As was the case with the EEDI and SEEMP, the question of whether an MBM for international shipping should incorporate the CBDR principle continued to be raised by developing States. India was particularly vocal on this issue, expressing that developing countries would suffer both economic and social disadvantage if MBMs were to be implemented without reference to CBDR.<sup>434</sup>

In a parallel sector, ICAO was already exploring forms of MBMs that could be applied in the aviation context. Still, in IMO, States were unable to reach a consensus on the need to introduce MBMs to begin with. This is because the aforementioned States who had opposed the EEDI and SEEMP on grounds of violating CBDR, had further argued that MBMs should be preceded by commitments from developed States on “financial, technological and capacity-building support” for the implementation of regulations on energy-efficiency for ships by developing countries”.<sup>435</sup> The discussion on MBMs was thus suspended at the 65<sup>th</sup> Session of the MEPC while developing States sought to strengthen commitments to technology transfers and technical assistance.<sup>436</sup>

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<sup>429</sup> GloMEEP, Global Maritime Energy Efficient Partnerships, online: [Glomeep <glomeep.imo.org/about/about-the-project/>](http://glomeep.imo.org/about/about-the-project/)

<sup>430</sup> Id.

<sup>431</sup> The Global MTCC Network, About GMN, online: [GMTCC <gm.imo.org/about-gmn/>](http://gmtcc.imo.org/about-gmn/)

<sup>432</sup> Id.

<sup>433</sup> *IMO 23<sup>rd</sup> Assembly Resolution*, *supra* note 412.

<sup>434</sup> See MEPC, 61<sup>st</sup> Session, *Market-Based Measures – inequitable burden on developing countries*, Submitted by India (2 August 2010).

<sup>435</sup> See MEPC, *Report of the Marine Environment Protection Committee on its 65<sup>th</sup> Session* (24 May 2013).

<sup>436</sup> Id.

### 5.3.4 Alternative fuels

The maritime community has been exploring the option of use of gas as a fuel for international shipping, as the combustion process would result in less harmful pollutants being emitted due to reduced NO levels, which would also be virtually sulphur-free.<sup>437</sup> In 2015, the International Code of Safety for Ships using Gases or other Low-flashpoint Fuels (IGF Code) was introduced. Although titled a “code”, IMO introduced an amendment in the SOLAS convention which made the code mandatory.<sup>438</sup> IMO has introduced this code with the objective of providing criteria to install machinery, equipment and systems in such vessels, so as to minimise risk to the ship, crew as well as environment.<sup>439</sup> The IGF too, employs a goal-based approach as mentioned above, and specifies functional requirements in the areas of design, construction and operation.<sup>440</sup>

Similar to ICAO, IMO has demonstrated a commitment to pursuing sustainable alternatives in shipping. This indicates that both organisations have not restricted themselves to only one form of measures to resolve the emissions problem, but are addressing regulation through multiple forms. Indeed, as asserted in the previous chapter, measures such market-based mechanisms can be interpreted as short-term measures that reduce emissions, while alternative less-polluting fuels are identified as a long-term measure. The author contends that approaching rocket emissions in the global space sector demands a similar approach.<sup>441</sup>

## 5.4 Critiquing IMO initiatives

### 5.4.1 Lack of transparency and discretion in reporting

The 69th Session of the MEPC reiterated IMO’s approach to documenting these developments and agreed to follow a “three step approach: data collection, data analysis, followed by decision-making on what further measures, if any, are required.”<sup>442</sup> In this regard, it is important to note that the 68<sup>th</sup> Session of the MEPC emphasised the need to keep all data obtained confidential, on

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<sup>437</sup> Hughes, *supra* note 388, at 220.

<sup>438</sup> SOLAS, *supra* note 385, regulations II-1/56, II-1/57.

<sup>439</sup> IMO, “International Code of Safety for Ship Using Gases or Other Low-flashpoint Fuels (IGF Code)”, online: *IMO* <[www.imo.org/en/OurWork/Safety/SafetyTopics/Pages/IGF-Code.aspx](http://www.imo.org/en/OurWork/Safety/SafetyTopics/Pages/IGF-Code.aspx)>

<sup>440</sup> *Id.*

<sup>441</sup> See Chapter 6, Principle IV.

<sup>442</sup> See MEPC, *Report of the Marine Environment Protection Committee on its 69<sup>th</sup> Session* (13 May 2016).

the basis that “there is a need to address resulting administrative burdens, impact on industry and the variables that influence energy efficiency”<sup>443</sup> thereby prohibiting any third parties from access.

A similarity emerges between Volume IV of Annex 16 to the Chicago Convention, and the new provisions under Annex VI of MARPOL, in the amount of discretion vested in the State. Under Annex VI of MARPOL, the flag State is responsible for ensuring that data has been accurately reported, pursuant to which the flag State will then issue a Statement of Compliance to that ship.<sup>444</sup> As per the views expressed at the IMO Assembly, the lack of transparency, or “confidentiality” is directly linked to the ease of administration. According to Jeffrey Smith, the regulation of maritime emissions has been more successful because of these elements. He posits that the organisational structure, with the Secretariat ensuring “administrative continuity of complex matters” encourages greater clarity on environmental statistics.<sup>445</sup> He argues that IMO has a concise record of detailed technical rules for environmental regulation and governance is captured in detailed rules prescribed in treaty regulation form, in distinction to “more ethereal operating principles, human factors governance, and economic standards.”<sup>446</sup> Whether this has contributed to IMO’s success is yet to be verified, but this author contends that prospective regulation for the global space sector requires transparency due to the sensitivity of outer space activities and the corresponding link with space security.<sup>447</sup>

#### **5.4.2 Failure to adopt MBMs**

Due to the pursuit of technology transfers between developed and developing States, IMO has failed to prioritise the importance of economic measures, such as MBMs, among IMO States. This will be debated at the upcoming session of the MEPC in December, 2019. At the same time, given that the effectiveness of CORSIA itself is questionable, this raises the question of whether IMO’s prioritisation of technical and operational measures (over market-based measures) are more suitable as long-term measures to regulate emissions. Furthermore, the EEDI and SEEMP being introduced in 2013, as against any consensus on CORSIA having been achieved only in 2016, may

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<sup>443</sup> See MEPC, *Report of the Marine Environment Protection Committee on its 68<sup>th</sup> Session* (29 May 2015).

<sup>444</sup> See *MARPOL*, *supra* note 386, Regulation 5.

<sup>445</sup> Jeffrey Smith, *supra* note 392 at 305.

<sup>446</sup> *Id.*

<sup>447</sup> See Chapter 6, Principle III.

indicate that States in IMO view offsetting as an approach that should be avoided in the maritime context.

#### **5.4.3 Moving away from polarisation of States under the UN climate model**

Although the debate on MBMs and subsequently, the resolution on technology transfers has arguably erected this boundary again, the fact that IMO was able to successfully introduce parallel measures without reaching an impasse between States is highly commendable. This reflects a more inclusive and less hostile approach to environmental regulation. It can be concluded that IMO has produced more tangible sources of environmental law due to the confidence of States in the law-making process. This is reflected in both the clear enforceability of Annexes in the IMO framework, as well as reduced focus on the developing/developing States divide.

#### **5.4.4 Prioritising “complete decarbonisation” over “carbon-neutral growth”**

A comparison of goals between ICAO and IMO further shows that IMO, through the MEPC, has not only intended to “reduce” GHG emissions, but “phase [them] out entirely” by 2050.<sup>448</sup> The very incorporation of this goal would mean that IMO has pursued long-term measures. IMO has therefore evidently disentangled carbon neutral growth from complete decarbonisation, and instead identified the need to achieve sustainable shipping practices in the long run. This would involve not only reducing the dependence of the maritime industry on polluting fuels, but also implementing efficiency measures on its vessels, while encouraging the use of innovative technologies within the industry.

### **5.5 Future considerations for the international maritime sector**

IMO shares similar organisational features with ICAO, yet it appears that the maritime sector has enjoyed greater success in introducing measures to reduce emissions. This can be attributed to IMO’s approach to law-making and the difference in political divisions between the organisations. The issue of CBDR appeared when IMO was deliberating technical and operational measures, but has not escalated to point of impeding progress, due to the tacit acceptance procedure. The author concludes that this is a notable advantage at IMO. However, the suspension of further discussion

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<sup>448</sup> See MEPC’s initial strategy publicly announced in 2018, to reduce total annual GHG emissions by at least 50% by 2050 while simultaneously pursuing efforts towards phasing them out entirely, at IMO, Media, online: *IMO* <[www.imo.org/en/MediaCentre/HotTopics/GHG/Pages/default.aspx](http://www.imo.org/en/MediaCentre/HotTopics/GHG/Pages/default.aspx)>.

on market-based measures is disappointing, given that ICAO has adopted a complete global mechanism. At the time of this writing, the issue will be revisited by IMO at its next assembly in December, 2019.

In the next chapter, the author will use these components from both Chapters 4 and 5 to evolve a set of principles applicable exclusively to the regulation of rocket emissions.

## **Chapter 6 – A series of principles for the regulation of rocket emissions**

The previous chapters illustrated the need for new regulation on rocket emissions and analysed the international aviation and maritime sectors respectively, to identify practices that can be applied to the global space sector. As established in Chapter 3, the form of the most appropriate mechanism to curb emissions is highly debatable. This author therefore proposes the following principles which can serve as the basis for a new regulation, regardless of form.

### **6.1 Principle I – Self-regulation**

The key characteristics of any regulatory instrument or approach have been identified as fourfold: target, regulator, command, and consequences.<sup>449</sup> The principle of self-regulation refers to any system of regulation in which the regulatory target – either at the individual-firm level or sometimes through a representative industry association – imposes commands and consequences upon itself.<sup>450</sup> Chapter 1 proves that it is private, non-governmental entities that are presently leading the growth of the commercial space industry. These companies are major stakeholders in the international space sector and should therefore be given the opportunity to participate in the policy-making process. To take this participation one step further would be to grant these non-governmental entities the ability to adopt and impose emissions regulation on a State-specific industry basis. This would be beneficial for the following reasons.

#### **6.1.1 Acceptability**

Environmental regulation is viewed warily by industry stakeholders due to the general belief that such regulation will hinder industry growth and progress.<sup>451</sup> By incorporating the principle of self-regulation into a rocket emissions mechanism, the space industry of a State would be far more receptive to a regulation regarding rocket emissions if the discretion to impose and enforce this regulation is vested in the industry itself. As stated above, this principle could be introduced through an association that represents a State's space industry. Under this principle, States could first commit to binding targets on rocket emissions (with industry stakeholders present for such negotiations) and thereafter direct the means of achieving this target to the industry stakeholders.

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<sup>449</sup> Cary Coglianese and Evan Mendelson, "Meta-Regulation and Self-Regulation," in Coglianese (ed) *Oxford Handbook of Regulation*, (Oxford Scholarship Online, 2010) at 23.

<sup>450</sup> Id.

<sup>451</sup> See Chapter 4, Section 4.2.1.

This approach is largely derived from the regulation of the maritime sector examined in the previous chapter. In particular, this principle is derived from the success of the Energy Efficiency Design Index (EEDI) and Ship Energy Efficiency Management Plan (SEEMP) respectively.<sup>452</sup> Drawing elements from the EEDI, this author proposes that the principle of self-regulation could ultimately result in a similar technical or operational measure which has a target that the State has committed to, but which leaves the method of achieving this target entirely to the industry.

### **6.1.2 Enhancing compliance with the Outer Space Treaty**

The second reason why this would be beneficial for the space sector is the existence of specific language in the Outer Space Treaty pertaining to the international responsibility of a State.<sup>453</sup> Article VI of the Outer Space Treaty further requires continuous supervision by the State, and provides that “[t]he activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorisation and continuing supervision by the appropriate State Party to the Treaty.”<sup>454</sup> Indeed, the application of the author’s proposal for self-regulation for the space sector finds increasing support from the international community, such as Professors Lyall and Larsen who contend that, “[t]o be effective, space law has to be made by those who understand the technologies and technicalities that it has to regulate.”<sup>455</sup>

A key advantage to this principle is the subsequent obligation for the national government to ensure that no breach or violation of international law occurs on the part of its commercial space sector stakeholders. At the same time, the principle would grant freedom to such entities to adopt the measures and means that they deem most appropriate and convenient. While this author notes that self-regulation is not without disadvantages, such as the potential for excessive self-interest, this principle could possibly be adopted in a manner similar to IMO’s EEDI, such that it enables participants who are informed of the function and impact of technologies to be included in the process of decision-making.<sup>456</sup>

## **6.2 Principle II – Non-prescriptiveness**

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<sup>452</sup> See Chapter 5, Section 5.4.2.

<sup>453</sup> *Outer Space Treaty*, *supra* note 83, art VI.

<sup>454</sup> *Id.*

<sup>455</sup> Lyall and Larsen, *supra* note 75 at 48.

<sup>456</sup> *Id.*

In Chapter 2, it was observed that the character of space law-making has undergone a transformation since the enactment of the four international space treaties in the 1960s – 1970s.<sup>457</sup> New trends in space law reflect (i) that the process is no longer purely “international”<sup>458</sup> and (ii) that new commitments are rarely expressed in the treaties or conventions, but in instruments that have a more “voluntary” character.<sup>459</sup>

From the analysis in Chapter 4, the author deduces that the non-prescriptive character of an instrument increases the likelihood of acceptability, even if introduced in a phased manner as demonstrated by the Carbon Offsetting and Reduction Scheme for International Aviation (CORSA). This is additionally applied in instruments in the maritime sector, as the EEDI is a non-prescriptive technical measure that was successfully introduced as being applicable to newly manufactured vessels.<sup>460</sup> It can therefore be concluded that (at least initially) an instrument that is voluntary can be well received in the space sector.

This latter point has been demonstrated most recently by the adoption of the UNCOPUOS Long-Term Sustainability Guidelines in 2019, as observed in Chapter 2. These guidelines may not be enforceable, but represent an international consensus regarding the sustainable use of outer space. This feat cannot be underscored enough, as this is the first time that States are all unanimously in agreement on positions regarding outer space since the space treaties came into force. Consequently, this instrument has the potential to become a starting point for the crystallisation of customary international law in the future. Indeed, past recommendations for a Code of Conduct to encourage practices that contribute towards environmental protection and the sustainable use of outer space have been proposed based on this very reasoning,<sup>461</sup> but have not been developed on the subject of rocket emissions specifically.

Having established a lacuna regarding rocket emissions in international space law in Chapter 2, this author emphasises that discussions for a new mechanism can thus, at the very least commence on a voluntary basis. By proposing dedicated emissions regulation in a voluntary form, this would

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<sup>457</sup> See Chapter 2, Section 2.1.

<sup>458</sup> See Ram Jakhu, Steven Freeland, Kuan-Wei Chen, “The Sources of International Space Law: Revisited,” 67 *German Journal of Air and Space Law*, (2018) 606-667; Also see Julian Hermida, *Legal Basis for a National Space Legislation*, (Dordrecht, Kluwer Academic, 2004).

<sup>459</sup> See Chapter 2, Section 2.1.

<sup>460</sup> See Chapter 5, Section 5.4.

<sup>461</sup> See GSG Study, *supra* note 39 at 472.

encourage States to conduct to such practices in outer space. As stated in Chapter 2, if there is sufficient evidence of State practice and corresponding *opinio juris*, for instance beginning with the use of the least-polluting liquid rocket fuels as an industry practice, the same could eventually be considered a traditional and effective source of law under Article 38.

### **6.3 Principle III – Transparency**

In Chapter 4, this author notes the difficulties posed by implementation of CORSIA, in particular the Monitoring, Reporting and Verification (MRV) mechanisms.<sup>462</sup> The lack of transparency, especially the vast amount of discretion vested in the State, in addition to the subsequent potential for double-counting, were highlighted as major disadvantages of the scheme. If the principle of self-regulation (See Principle I above) is adopted, the following measures for transparency would be advisable, as disclosure of information is critical to effective regulation.

#### **6.3.1 Continuous monitoring**

Under Article VI of the Outer Space Treaty, a State is obligated to continuously supervise the activities of both governmental and non-governmental entities.<sup>463</sup> A monitoring function for emissions from the national space industry would align with the sentiment of this provision and ensure that the State achieves the committed target.

A report was released by the UN Conference on Trade and Development<sup>464</sup> in 1999, which recommended provisions for a mechanism under the Kyoto Protocol. This report lists an additional advantage of increased transparency in an emissions trading mechanism, specifically that continuous monitoring “provides a basis for deciding whether stronger international actions would be necessary.”<sup>465</sup> If an emissions trading scheme is adopted for rocket emissions, the report further argues that monitoring will facilitate corrective adjustments in the scheme for assigned amounts.<sup>466</sup>

#### **6.3.2 Self-reporting**

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<sup>462</sup> Chapter 4, Section 4.6.

<sup>463</sup> *Outer Space Treaty*, *supra* note 83, art VI.

<sup>464</sup> UNCTAD, International Rules for Greenhouse Gas Emissions Trading, online: <https://unctad.org/en/Docs/pogdsgfsbm6.en.pdf> [UNCTAD Report]

<sup>465</sup> *Id.*

<sup>466</sup> UNCTAD Report, *supra* note 464.

As per Principle I, entities engaged in space activities should additionally be entitled to report their statistics to the State themselves. The benefits of self-reporting are twofold: first, this saves on State expenditure towards establishing a separate process and governmental department or entity responsible for collecting reports. Second, because self-reporting is another form of self-regulation, this further strengthens the attraction of an overall regulation for rocket emissions by providing commercial entities with the incentive to accept the adoption of such a measure.

### **6.3.3 Verification by an independent international authority**

If a mechanism proceeds to be developed on this basis, the collection and monitoring functions would be conducted within the State. It is essential that the subsequent verification procedure be conducted by an independent international authority to ensure that the information received is accurate. This author accordingly proposes that the body is international, to prevent national or regional biases in reporting. Further, verification conducted in this manner will ensure that States are not double counting – a concern under CORSIA addressed in Chapter 4.

Verification is necessary to assure the global community at large that the entire scheme is facilitating, and not impeding, the attainment of global warming goals.<sup>467</sup> The creation of this body would of course require financing, and one option in the space context could be a levy of fees on allowances (if an emissions trading mechanism is adopted) or a charge that is included in a tax, which contributes to the funding of this body. This author acknowledges the complexity of this process, but contends that enforcement is likely to be ineffective if the instrument is both voluntary and reliance solely domestic. An independent authority is therefore necessary to ensure effective implementation of the regulation. The authority could be assisted by existing organisations and NGOs in the space sector, to ensure that the data being verified is objective and accurate.

## **6.4 Principle IV – Prioritisation and multidimensionality**

### **6.4.1 Prioritising emissions in space environmental regulation**

Chapter 1 presented the harmful effects of rocket emissions and tied the same to both ozone depletion and climate change. It has also been established that there is little research dedicated to the full extent of the environmental impact caused by emissions. It is argued that if the issue of

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<sup>467</sup> Id.

rocket emissions continues to be clubbed with space debris and other environmental hazards, there will be little to no enthusiasm for regulation for rocket emissions whatsoever, as there is insufficient focus on the problem. This conclusion is supported by the author's study of emissions in the aviation and maritime sectors. The regulation of aviation and maritime emissions respectively have been identified as separate issues within both the aviation and maritime sectors, resulting in CORSIA under Annex 16 to the Chicago Convention and Annex VI of the MARPOL pertaining to air pollution from ships.<sup>468</sup> ICAO in particular should be commended for pursuing MBMs to regulate aircraft emissions at an open forum allowing all States to be included in deliberation, a process that began with the 38<sup>th</sup> Assembly.<sup>469</sup> In the maritime context, discussions for an MBM were suspended in 2012 as discussed in Chapter 5,<sup>470</sup> but IMO has vigorously pursued technical and operational measures in the form of both the SEEMP and EEDI.<sup>471</sup> IMO has also focused on the promotion of technology transfers from developed to developing States.<sup>472</sup> Similarly, ICAO has pursued CORSIA, but simultaneously continues to explore long-term options in the form of appropriate fuels.<sup>473</sup> Both organisations have displayed a committed focus to emissions as a singular policy issue. In addition, both organisations have established environmental committees to oversee and implement regulations, being the Committee on Aviation Environmental Protection (CAEP) and Marine Environment Protection Committee (MEPC). It is therefore evident that a singular mechanism is required to specifically focus on the intricacies of rocket emissions, as there will be numerous questions regarding possible technical, operational and economic measures to regulate rocket emissions.

#### **6.4.2 A multidimensional approach**

Chapters 4 and 5 additionally reveal that both ICAO and IMO not only targeted emissions as a separate policy issue in each sector, but aimed to adopt a comprehensive approach to regulating the issue. This is evidenced by each organisation's employment of strategies that targeted different aspects of the problem. For example, ICAO's focus on sustainable fuels is distinct from the organisation's development of a market-based mechanism, which reflects the use of different tools

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<sup>468</sup> See Chapter 4, Section 4.6 and Chapter 5, Section 5.4.

<sup>469</sup> IMO, *Report of the Marine Environment Protection Committee on its 65<sup>th</sup> Session*, (24 May 2013).

<sup>470</sup> See Chapter 5, Section 5.4.

<sup>471</sup> *Id.*

<sup>472</sup> *Id.*

<sup>473</sup> See Chapter 4, Section 4.6.5.

to address emissions from aviation. Similarly IMO has employed both technical and operational measures while also deliberating whether to introduce economic measures for emissions from shipping.

By focusing on research initiatives to examine the extent of the pollution, the result would be to (i) gauge a more suitable estimate regarding the impact caused by each fuel type; (ii) facilitate more efficient policy-making, in that there would be definitive targets that States could establish and work toward and (iii) raise awareness regarding the use of cleaner fuels. These outcomes would in turn allow space policy to develop various methods and approaches to target emissions—not only focusing on a market-based mechanism or economic solutions such as command-and-control or taxes, but also developing parallel initiatives for sustainable fuels.

### **6.5 Principle V – Regional and international cooperation**

Both ICAO and IMO have achieved cooperation in each sector, which this author attributes to the enforcement of technical standards in both cases.<sup>474</sup> Space is a unique arena in this aspect. The complexity of venturing into outer space, of keeping humans alive in a hostile environment or of reaching distant places in the solar system translates into the need for the development of advanced technologies; and this, in turn, translates into cost.<sup>475</sup> Cooperation between States has thus always played an important role in the exploration and use of outer space, as cooperation has allowed States to distribute costs and resources among several partners.<sup>476</sup> Certainly, the ISS-IGA<sup>477</sup> is a testament to the benefits of cooperation and how this principle can form the backbone of an international arrangement. However, the involvement of numerous participants has resulted in the need for additional regulation. The result is the emergence of numerous bodies and initiatives regarding space activities, such as the European Space Agency, African Space Agency and Asia-Pacific Space Cooperation Organisation (APSCO). Xavier Li-Wen Liao has criticised these regional initiatives, contending that the regional approach reflected in these organisations only contributes to the fragmentation of international regulation.<sup>478</sup> Whether or not Liao's prediction of

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<sup>474</sup> See Chapter 4, Section 4.2 regarding “SARPs” and Chapter 5, Section 5.4 regarding Annexes to the MARPOL.

<sup>475</sup> Simonetta Cheli, “Cooperation in Space” in Christian Brunner and Alexander Soucek (eds), *Outer Space in Society, Politics and Law* (Springer: New York, 2011) at 178.

<sup>476</sup> *Id.*

<sup>477</sup> *Agreement Between the United State of America and Other Governments*, 8 July 1966, 80 Stat 271; 1 USC 113 (entered into force 29 January 1998) [ISS IGA].

<sup>478</sup> Xavier Li-Wen Liao. “The Growing Space Regionalisation of the Global Space Regime Complex” (2015) 14 *Journal of Air and Space Law* at 23.

fragmentation will become a reality, these organisations must cooperate in order to achieve a cohesive regime for rocket emissions.

These are not the only institutions which must engage with each other; UNOOSA too has been held accountable for the need to improve coordination with other agencies such as the Office for Disarmament Affairs in the context of space security.<sup>479</sup> Still, cooperation of UNOOSA with other bodies is promising, as evidenced by meetings with ICAO regarding overlapping air and space regimes in addition to suborbital technologies.<sup>480</sup> Furthermore, the Inter-Agency Space Debris Coordination Committee cooperates by submitting their findings to the Scientific and Technical Sub-committee of UNCOPUOS.<sup>481</sup> Cooperation between each of these organisations is indispensable to the regulation of rocket emissions, as this will facilitate the exchange of information, as well as prevent duplication of regulation. Liao's argument regarding fragmentation by way of space regionalisation has been rejected by certain scholars who argue that regional organisations encourage and support the creation of many small-scale and medium-scale institutions.<sup>482</sup> The author therefore proposes that the principle of regional and international cooperation of such entities can contribute to more efficient governance in the space sector.

## 6.6 Principle VI – Adaptability

In Chapter 2, it was observed that space law-making is in transition, where States would prefer to avoid a commitment to multilateral treaties and instead develop space law through national regulation and non-binding instruments.<sup>483</sup> This trend is significant for the proposal of any new legislative mechanism for outer space, particularly because several space-related ventures were not previously foreseen by the drafters of the original treaties, such as space tourism.<sup>484</sup> This indicates that a new regulation for space activities should be adopted in accordance with the original space treaties, but with a degree of adaptability that accommodates future developments

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<sup>479</sup> See recommendations of the Group of Governmental Experts for enhanced space security, *Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities*, UNGA Res 68/189, 68<sup>th</sup> Sess, UN Doc A/ 68/189 (2013).

<sup>480</sup> To discuss emerging issues in space, ICAO and UNOOSA held a symposium in 2017, which specifically focused on air and space traffic management. See ICAO, News Releases, ICAO/UNOOSA Aerospace Symposium (SPACE 2017), online: ICAO <[www.icao.int/meetings/space2017/Pages/default.aspx](http://www.icao.int/meetings/space2017/Pages/default.aspx)>.

<sup>481</sup> See GSG Study, *supra* note 39 at 38.

<sup>482</sup> *Id.*

<sup>483</sup> See Chapter 2, Section 2.1.

<sup>484</sup> For example, the “Dear Moon” lunar tourism mission and art project proposed by billionaire Yusaku Maezawa, online: *Dear Moon* <<https://dearmoon.earth/>>

in the industry. In this regard, soft law instruments, such as non-binding standards and memoranda of understanding, can provide scope for adaptability where hard law instruments (such as conventions and treaties) cannot. Professors Lyall and Larsen too note this advantage of soft law, christening soft law “a flexible process” that allows its content to adapt to new requirements and changing technologies in a way that a treaty finds difficult.<sup>485</sup> Indeed, soft law instruments have been described as particularly useful in this regard.<sup>486</sup>

The feature of adaptability in space law-making is visible in the International Telecommunications Union (ITU). The ITU was founded in 1865 and is presently comprised of 193 Member States in addition to over 900 non-governmental entities which range from companies to universities and regional organisations.<sup>487</sup> The ITU has been lauded for its adaptable character, expressed through a constant revision and update of its mandate, organisational structure, and working methods, so as to include new actors in global telecommunications and accommodate changing technologies.<sup>488</sup> From Chapters 4 and 5, it is apparent that ICAO and IMO share similar organisational structures, and that this flexibility is palpably absent. In the case of IMO for instance, the criteria of “registered tonnage” to determine the largest ship-owning nations has not been revisited since the Advisory Opinion rendered by the International Court of Justice in 1960.<sup>489</sup> As a result, both institutions have retained rigid organisational structures.

Adaptability is a feature required for the effective regulation of rocket emissions, as the regulation itself would have to accommodate new findings of atmospheric science and associated technologies which are constantly evolving. Further, if there is an element of adaptability established for the international independent authority proposed above, this would reassure States that a commitment to this mechanism is subject to change if States feel dissatisfied with the structure. The principle of adaptability specifically for rocket emissions has been recognised in the Global Governance Study as well, in which the authors contend that a flexible legal framework should have the ability to incorporate future developments in launch systems and that such

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<sup>485</sup> Lyall and Larsen, *supra* note 75 at 48.

<sup>486</sup> *Id.*

<sup>487</sup> See International Telecommunications Union, About, online: *ITU* <[www.itu.int/en/about/Pages/default.aspx](http://www.itu.int/en/about/Pages/default.aspx)>

<sup>488</sup> See GSG Study, *supra* note 39 at 147.

<sup>489</sup> See advisory opinion rendered by the ICJ, regarding membership of Liberia and Panama on the Maritime Safety Committee of the IMO, *Constitution of the Maritime Safety Committee of the Intergovernmental Maritime Consultative Organization*, Advisory Opinion [1960] ICJ Rep 150

flexibility would incentivise the development of fuel systems that are not environmentally harmful.<sup>490</sup> If the corresponding governing regulation is adaptable, it can further encourage the development of alternative sustainable technologies.

## **6.7 Principle VII – Interdisciplinarity**

Law as a lone discipline, cannot by itself sufficiently resolve the rocket emissions issue. This argument is two-pronged. Firstly, Chapter 2 has demonstrated that rocket emissions do not strictly fall within the regulation of the existing space treaties. Furthermore, the fragmentation of international environmental law reveals a patchwork system of overlapping instruments that may or may not include rocket emissions within their scope.

In Chapter 4, this author presented the politicised nature of emissions regulation at ICAO, evident from the development of CORSIA triggered by the EU-ETS, and from ongoing discussions at the 40<sup>th</sup> Assembly regarding the implementation of CORSIA and future sustainable aviation goals.<sup>491</sup> In a similar manner, Chapter 5 has demonstrated a parallel politicisation at IMO on the basis of States which experience the largest amount of international traffic, resulting in unequal decision-making between States.<sup>492</sup> Admittedly, this observation regarding political power dynamics alone does little to advance a fruitful discussion on regulation. It is therefore this author's proposal that a first step beyond mere acknowledgment of the risk of politicisation in international law, is to insist that law-making on rocket emissions be imbued with parallel disciplines and corresponding expertise – in effect, a broader “epistemic community”<sup>493</sup> within the emissions regulation conversation. These will include, but are not limited to, economists, scientists, entrepreneurs and activists. The inclusion of these other perspectives have the potential to lead to new considerations in policy-making, as demonstrated by the “Flight Shame” movement and proposed levies on frequent flyer programs in the UK.<sup>494</sup> These examples are a testament to the power of activism and innovative thinking in a global sector. The translation of these movements into concrete policy is

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<sup>490</sup> See GSG Study, *supra* note 39 at 147.

<sup>491</sup> See Chapter 4, Section 4.5.

<sup>492</sup> See Chapter 5, Section 5.4.

<sup>493</sup> See scholars Braithwaite and Drahos, who argue that non-State actors such as international institutions, NGOs and individuals have the means to positively influence global decision-making. See John Braithwaite, Peter Drahos, *Global Business Regulation* (Cambridge University Press: New York, 2000).

<sup>494</sup> See Chapter 4, Section 4.2

a process that can keep policy-makers informed of innovative proposals that could shape the development and enforcement of law.

## **6.8 Principle VIII – Inclusivity**

It has been estimated that approximately 60 States have some form of direct space capability, although the extent that they are able to utilise space for their own development (and other) purposes varies quite significantly.<sup>495</sup> Naturally, this indicates that perhaps up to 140 States thus far have not realistically acquired any independent capability to directly access space themselves, and are instead totally dependent on other States for their space access.<sup>496</sup> The underpinnings of this principle lie in the need for inclusion of these non-spacefaring States in discussions regarding proposals for rocket emissions regulation. Inclusivity is crucial to the development of international space law, as the representation of each perspective, including those of States which do not have their own space capabilities, increases the likelihood of acceptability of the instrument. As stated above, this could contribute towards the crystallisation of customary international law if a sufficient number of States adopt the practice and regard the same as a legal obligation.<sup>497</sup>

In addition, this principle can not only be extended toward States, but also private entities, as non-governmental entities in the space sector have unique perspectives and should also be included in regulatory process. Given that these are the entities that may be directly affected by emissions regulation by bearing the cost of emissions, it would be highly beneficial to the process to include their perspectives.

In the international space law-making context, the UNCOPUOS is renowned for the slow pace of decision-making due to the consensus technique.<sup>498</sup> While inclusivity may not necessarily accelerate the pace of decision-making, the inclusion of other entities, such as companies and even NGOs, has the potential to prove effective in the long-term, by providing a forum for all parties to

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<sup>495</sup> Steven Freeland, “A Delicate Balance: Regulating Micro Satellite Technology in a Big Satellite World” (2015) 18 *University of Western Sydney Law Review* 1.

<sup>496</sup> *Id.*

<sup>497</sup> The International Law Commission has analysed this attribute of customary international law and concluded that the practice in question must be “general.” See Draft Conclusion 8, “Draft conclusions on identification of customary international law with commentaries”, *Yearbook of International Law Commission* 2018, vol. 2, UN Doc A/73/10.

<sup>498</sup> See generally Kai-Uwe Schrogl, “The New Debate on the Working Methods of the UNCOPUOS Legal Subcommittee” (2014) 105 *Acta Astronautica* 1; Also see Gennady Danilenko, “Outer Space and the Multilateral Treaty-Making Process” (1989) 4 *High Technology Law Journal* 217.

collectively deliberate. The inclusion of all such entities is not presently envisioned at COPUOS, with only three organisations (apart from the EU) having been granted “observer” status.<sup>499</sup>

As an example of the untapped potential of such non-governmental entities in the space sector, this author refers to Andrea Harrington’s proposal for insurers to set standards for space debris mitigation.<sup>500</sup> She contends that insurers are in a unique position, as they can take advantage of their technical expertise and transboundary reach to provide guidance and support to their insureds, for instance by setting appropriate minimum standards for the insurance that they underwrite.<sup>501</sup>

By adopting novel approaches that incorporate Principle I (Self-Regulation) and this Principle VIII, we could abandon the traditional notion of proposing new treaties between States and instead focus on strengthening international space law through the entities that it directly affects. From a rocket emissions perspective, this process could be initiated under Article III of the Outer Space Treaty. As stated in Chapter 2, Article III by itself is insufficient to trigger regulatory action alone, but can nonetheless provide the gateway to applying principles of international environmental law.<sup>502</sup> On this basis, a set of informal guidelines can urge States to consider international regulation of emissions from the space sector. As the scholars of the GSG Study state, “[a] better governance system should not exclusively aim at increasing the number of treaties; rather, the aim should also be to amend the existing regimes to make them more inclusive and encourage greater membership.”<sup>503</sup>

## 6.9 Principle IX – Innovation: Beyond CBDR

In international space law, it has been observed that the existing space treaties are the result of a careful balancing act between space haves and space have-nots that aimed to reconcile the need to facilitate spacefaring activities with their sustainability.<sup>504</sup> Imposing a new mechanism for rocket emissions will therefore require an approach that maintains the interest of both factions. In Chapter

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<sup>499</sup> Committee on the Peaceful Uses of Outer Space: Observer Organizations, online: [UNOOSA <www.unoosa.org/oosa/en/ourwork/copuos/members/copuos-observers.html>](http://www.unoosa.org/oosa/en/ourwork/copuos/members/copuos-observers.html)

<sup>500</sup> Andrea Harrington, “Governing Activities in Outer Space: Responsibility, Liability, Regulation and the Role of Insurers” (DCL Thesis, McGill University Institute of Air and Space Law, 2017).

<sup>501</sup> *Id.*

<sup>502</sup> See Chapter 2, Section 2.5.

<sup>503</sup> GSG Study, *supra* note 39 at 37.

<sup>504</sup> See Philip de Man, “Interpreting the UN Space Treaties as the Basis for a Sustainable Regime of Space Resource Exploitation” in George Kyriakopoulos and Maria Manoli, *The Space Treaties at Crossroads: Considerations de lege Ferenda* (Springer, 2018) at 15.

5, it was concluded that IMO has been relatively more successful as regards adopting effective measures to reduce maritime pollution. In contrast, Chapters 2 and 5 exhibit the inevitable impasse that appears when the CBDR principle is introduced to regulate emissions in either the UNFCCC system or through ICAO. On this basis, this author attempts to circumvent a similar result in the space scenario by proposing that a novel principle be created in the rocket emissions context.

Article I of the Outer Space Treaty states that the exploration and use of outer space shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.<sup>505</sup> The preamble of the Outer Space Treaty also refers to similar language, “...benefit of all peoples irrespective of the degree of their economic or scientific development.”<sup>506</sup> Further, Article I states that “[o]uter space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and that there shall be free access to all areas of celestial bodies.”<sup>507</sup> This provision could indicate that non-discrimination is a cornerstone of international space law as well; however, other instruments have specifically acknowledged the need to further interests of developing nations in outer space.

For example, Article 11(7) of the Moon Agreement (though ratified by only 18 States<sup>508</sup> as of 2019) regarding resource exploitation, states that “[a]n equitable sharing by all States Parties in the benefits derived from those resources, whereby the interests and needs of the developing countries, as well as the efforts of those countries which have contributed either directly or indirectly to the exploration of the Moon, shall be given special consideration.”<sup>509</sup>

Further, the Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting<sup>510</sup> state that activities in the field of international direct television broadcasting by satellites should assist in educational, social and economic development, particularly in the developing countries and give the latter special consideration.<sup>511</sup> Similarly, the

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<sup>505</sup> *Outer Space Treaty*, *supra* note 83, art 1.

<sup>506</sup> *Id.*, preamble.

<sup>507</sup> *Outer Space Treaty*, *supra* note 83, art 1.

<sup>508</sup> UNCOPUOS, *Status of International Agreements relating to Activities in Outer Space as at 1 January, 2019*, 58<sup>th</sup> Sess, UN Doc. A/AC.105/C.2/2019/CRP.3 (2019).

<sup>509</sup> *Moon Agreement*, *supra* note 83, art 11.

<sup>510</sup> *Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting*, GA Res 37/92, UNGAOR, 37<sup>th</sup> Sess, UN Doc A/RES/37/92 (1982)

<sup>511</sup> *Id.*, annex D.

Principles Relating to Remote Sensing of the Earth from Outer Space<sup>512</sup> also make a reference in several principles.<sup>513</sup>

It would thus appear that the difference in development capacities has been expressly recognised in the space sector due to the acknowledgment of this special status in various instruments. Indeed, in 1996, the Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries<sup>514</sup> was adopted with the objective of increasing access to outer space by non-spacefaring nations. This would imply that the existing body of international space law does not conflict with the CBDR principle. Nevertheless, this author argues that the proposal to introduce emissions regulation in space on the basis of CBDR would only lead to its immediate rejection by developed States.

We have seen from Chapter 4 that the 40<sup>th</sup> Assembly at ICAO was receptive to the newly developed SCRC principle, i.e. Special Circumstances and Respective Capabilities, as this gives leeway to both developing and developed States to invoke the principle. The development of a new concept may therefore be a fruitful basis upon which to begin negotiations. Given that developing States such as India and China have substantial spacefaring capabilities, there is scope to propose a new concept that reflects not the divide between developed and developing nations, but classifies spacefaring and non-spacefaring nations into various degrees. By making this distinction, one could also apply the methods of IMO as presented in the previous chapter, and propose technology transfers between spacefaring and non-spacefaring nations on this basis. The exchange of information and sharing of technology, specifically as regards cleaner rocket fuels and sustainable launch practices, will not only give non-spacefaring nations the ability to participate in a mechanism for rocket emissions, but also increase their confidence in engaging in forums which discuss the regulation of such practices. In this manner, the language pertaining to “equity” and “fairness” need not be replicated in a new instrument. However, in suggesting that a new principle be developed, this author asserts that the shape and form of the new principle can

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<sup>512</sup> *Principles relating to Remote Sensing of the Earth from Space*, GA Res 41/65, UNGAOR, 41st Sess, UN Doc A/RES/41/65 (1986).

<sup>513</sup> *Id.*, principles II, IX, XII and XIII.

<sup>514</sup> *Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries*, GA Res 51/122, UNGAOR, 51st Sess, UN Doc A/RES/51/122 (1996).

only be determined upon rethinking our engagement with international law itself (see Principle X below).

#### **6.10 Principle X – Reconceptualising international law**

If the CBDR principle is dispensed with, non-spacefaring States, as well as developing States that have spacefaring capabilities, are likely to reject further forms of negotiations on this basis. Indeed, this debate is so controversial that the idea that developing nations ought to bear responsibility for emissions has been termed “environmental colonialism.”<sup>515</sup> Agarwal and Narain even question the politicisation of the scientific reports on global emissions, arguing that there is a failure to account for a comparative criteria that distinguishes between “the carbon dioxide contributions of gas guzzling automobiles in Europe and North America or even the Third world” and “methane emissions of water buffalo and rice fields of subsistence farmers in India and Thailand.”<sup>516</sup>

Developing a novel principle that is suitable for international space law would require a theoretical inquiry into the foundations of international law itself. Critical legal scholars have argued that international environmental law in and of itself reinforces hierarchies of power and allows countries of the Global North to maintain their privileged positions.<sup>517</sup> Like law generally, international environmental law (such critics argue), is used to represent the interests of the wealthy and powerful, and often fails to provide freedom and order while protecting the individual liberty it seeks to embrace.<sup>518</sup> Professor Antony Anghie substantiates this argument by contending that international law has consistently advanced imperialism, particularly contributing to the fundamentals of State sovereignty.<sup>519</sup> However, this author does not advocate for a total desertion of “received” public international law. A new principle can be developed in a manner that follows the evolving trends in international space law presented in Chapter 2. Instead, these critiques of international law indicate that there is scope to explore new critical thinking from developing States themselves. Southern countries often contend that they did not participate in the creation of

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<sup>515</sup> See Sunita Narain and Anil Agarwal, “Global Warming in an Unequal World: A Case of Environmental Colonialism” (1991) Centre for Science and Environment, New Delhi. These authors draw a distinction between “survival emissions”, i.e. the bare minimum amount of emissions required for daily living, with “luxury emissions”, i.e. emissions over and above this minimum level.

<sup>516</sup> Id.

<sup>517</sup> Martin Adamian, “Environmental (In)justice in Climate Change” in Steve Vanderheiden (ed) *Political Theory and Global Climate Change* (MIT Scholarship Online, 2013) at 11.

<sup>518</sup> Id.

<sup>519</sup> See Anthony Anghie, *Imperialism, Sovereignty and International Law* (Cambridge University Press, 2004).

international law principles by positing that they were not, at the time, fully-fledged members of the international community.<sup>520</sup>

These critiques of international law lead this author to two conclusions: first, the pessimistic view that the divide between developed and developing States is unlikely to be bridged in the near future, but secondly, that this divide can be navigated differently by considering different approaches to international law-making that are preferred by developing States. Abandoning the letter of CBDR as proposed above would quell the fears of developed States, while simultaneously allowing a new mechanism to be built on a foundation that is in the interest and supported by developing States.

One such proposal by Professor B. S. Chimni is the application of Third World Approaches to International Law (TWAIL) that involve a reevaluation of the responsibility and practices of powerful international institutions such as the IMF and World Bank.<sup>521</sup> He additionally argues that there is a need to ensure that the burden of realising the goal of sustainable development is not shifted to poor countries or used as a tool of protection by the Global North.<sup>522</sup> This is of course one possible approach and the process of developing a new principle is not without controversy either. Yet by rethinking engagement with international law, the author contends that there is potential for more effective regulation in international space law by appealing to all States.

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<sup>520</sup> See Sumudu Atapattu, “The Significance of International Environmental Law Principles in Reinforcing or Dismantling the North-South Divide” in S. Alam, S. Atapattu, C. Gonzalez and J. Razzaque (eds) *International Environmental Law and the Global South* (Cambridge University Press, 2015) at 74; Also see Karin Mickelson, “Rhetoric and Rage: Third World Voices in International Legal Discourse” (1998) 16 *Wisconsin International Law Journal* 353.

<sup>521</sup> See B. S. Chimni, “Third World Approaches to International Law: A Manifesto” (2006) 8 *International Community Law Review* 3.

<sup>522</sup> *Id.*

## CONCLUSION

The objective of this thesis has been to demonstrate the need for new regulation on rocket emissions and propose a set of accompanying principles to begin legislative discussion.

The author substantiates the need for such regulation by presenting statistics that demonstrate the surge in launches over the last decade, which are estimated to increase with the dawn of industries such as space mining and space tourism. The study cites data that exhibits the impact of rocket emissions, revealing that chemicals discharged from rockets are released directly into the stratosphere which is particularly vulnerable to pollution. From this analysis, it is concluded that there is scientific evidence supporting foreseeable environmental damage by rocket emissions, although the exact extent of this damage is not presently ascertainable. The thesis then justifies the necessity of new regulation for rocket emissions, in determining how the issue evades regulation under the space treaties. The potential for application of principles of international environmental law is acknowledged, yet the author proves that none of the international conventions and protocols specifically include the international space sector. The author highlights the UNFCCC framework and controversial CBDR principle as an obstacle to global consensus.

The author contends that the shape and form of the regulation is not a starting point for discussion. This is substantiated by the analysis in Chapter 3. In describing different regulatory mechanisms, the author observes advantages in each mechanism, on the basis of qualities such as concentration of power, extent of flexibility, ease of administration and pricing. While command-and-control measures, a blanket tax or an emissions trading scheme may be viable for the international space sector, this study posits that a more fruitful discussion could begin instead by determining the substance of the regulation, rather than form.

The regulation of emissions in international air transport is then examined to identify principles that may be applied to the global space sector. Notably, environmental regulation in aviation has had to be balanced with industry growth under the Chicago Convention. The thesis studies how regulation has been introduced in the aviation sector, considering the question of possible conflict between the UNFCCC and the Chicago Convention. The author observes that the Legal Bureau of ICAO determined that CBDR was not a legal obligation, as this principle polarised States without any progress on commitments. The development of the new concept of SCRC is also considered. From the analysis on CORSIA, it is concluded that the mechanism may indicate progress for

environmental protection, yet its ability to tangibly reduce emissions is questionable. This conclusion is based on dubious legality and practical impediments arising from MRV procedures under CORSIA. The ongoing debate regarding Frequent Flyer Programs is also assessed, wherein the author notes the ability of activism and social movements to impact policy-making.

A similar study is conducted for the international maritime sector. It is evident that the UNCLOS and IMO conventions have been drafted in a manner that promotes harmonisation and centralises IMO as the key specialised agency for the maritime sector. Specifically, the tacit acceptance process at IMO is highlighted, after which the author analyses IMO's technical, operational and economic measures, including the EEDI and SEEMP. It is concluded that the success of the EEDI in particular can be attributed to its non-prescriptive character. The author further notes that moving away from CBDR has resulted in greater success in adopting new measures at IMO, as opposed to the constant reappearance of the debate at ICAO. Based on the comparative analyses, a set of ten principles for the international space sector is proposed in the final chapter.

This series of principles is comprised of the principle of self-regulation, non-prescriptiveness, transparency, prioritisation, multidimensionality, cooperation, adaptability, interdisciplinarity and inclusivity. In the final two principles, it is concluded that a new principle should be devised for the space sector, rather than relying on CBDR. However, this author contends that articulating a such a principle requires rethinking engagement with the very structures of international law. Elucidated in Principles IX and X, abandoning CBDR is recommended as the first step to begin dissolving the current political divide, which simultaneously requires a solution that is also in the interest of developing States. It is therefore suggested that policy-makers consider approaches to international law-making, such as "TWAIL", which are preferred by developing States themselves.

This thesis concludes having justified the need for a new regulation on rocket emissions. The study further suggests that the series of proposed principles act as a precursor to the legislative debate on rocket emissions. These principles can help provide a level playing field for stakeholders to initiate discussion, with the aim that productive conversation commences to reduce the environmental impact caused by rocket emissions.

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