FLOATING AWAY: INTEGRATING SUSTAINABILITY INTO INTERNATIONAL LAW TO ADDRESS THE WORLD'S DWINDLING HELIUM SUPPLY

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I. INTRODUCTION

Helium is, for many, an afterthought. Historically, it has been a very affordable gas with, upon first glance, few practical uses. Some of its most famous uses are for party balloons, as well as entertaining effects on the human voice. After further research, however, one would be surprised to discover helium's lesser-known important and diverse uses.[1] After an even deeper search, one would be equally surprised to find that helium supplies, though seemingly plentiful now, risk a serious threat from extreme price hikes and eventual depletion if current usage rates do not quickly change.[2]

There are many solutions to problems like the one helium is currently facing.[3] For example, economic solutions can affect markets, and public initiatives can change practices.[4] Often effective, especially at the international level, are legal-based approaches.[5] Although international law is a tricky instrument to implement, legislation at this level is both necessary and effective when a problem that endangers the entire planet emerges. Increasing helium scarcity is an example of this kind of danger, and drafting an international solution to this impending problem would serve as an effective tool to slow increasing helium scarcity to a much more manageable pace for the benefit of future generations.

1. *See infra* Section II.

2. Rosie Cima, *The Increasing Scarcity of Helium*, PRICEONOMICS (June 16, 2015), *available at* https://priceonomics.com/the-increasing-scarcity-of-helium/ (last visited May 30, 2017).

3. *See* Shahbaz Shaikh, *Solutions to Global Scarcity in 2030: A Way Forward?*, FAIR Observer (Oct. 12, 2013), *available at* https://www.fairobserver.com/region/north_america/solutions-global-scarcity-2030-way-forward/ (last visited Mar. 28, 2017).

4. *See generally id.*

5. *See infra* Section V.

The planet is only so large, but by introducing policies agreed to at the international level, we can ensure security for the future inhabitants of Earth. Helium conservation measures can serve as models of how we might seek to preserve other scarce minerals and resources that have become vital over the past century. This note argues that, to mitigate the extreme scarcity of helium, the best course of action is an international agreement that limits helium usage to its most essential applications by enumerating limitations to the exploitation of helium. In reaching this agreement, predicting whether the largest helium-producing countries in the world would join is paramount, and deserves analysis.

II. HELIUM'S WORLDWIDE IMPORTANCE

While most of the world likely associates helium with balloons, its properties and uses go far beyond filling party decorations. Today, helium assumes a critical role in cryogenics, aerostatics, welding, semiconductors, fiber optics, leak detection, gas chromatography, and various other applications.[6]

As recently as 2013, helium was used primarily for cryogenics in the U.S.[7] Due to the fact that helium can sustain liquid form when it reaches very low temperatures, it is able to take on several important roles within the field of cryogenics.[8] One example is for superconductors, such as those in particle accelerators, which must be able to absorb extremely high voltages in order to enable particles to reach high speeds for nuclear reactions.[9] The application of liquid helium to superconductors is essentially the only way to efficiently transfer heat away from those superconductors.[10]

A further application in the field of cryogenics is helium's use in magnetic resonance imagining (MRI) machines.[11] Similar to helium's cooling effect in particle accelerators, helium also cools copper coils in MRI machines.[12] While the complete depletion of helium is not an

6. *See Applications*, HELIUM SCARCITY, *available at* http://www.heliumscarcity.com/?page_id=28 (last visited Mar. 28, 2017); *Frequently Asked Questions on H.R.527*, H. COMM. ON NAT. RES. (Sept. 25, 2013), *available at* http://naturalresources.house.gov/newsroom/documentsingle.aspx?DocumentID=320460#whyact (last visited Mar. 28, 2017).

7. *See* JOHN E. HAMAK, 2013 MINERALS YEARBOOK: HELIUM 34.1, 34.8 (2015).

8. *See* STEVEN W. VAN SCIVER, HELIUM CRYOGENICS 1 (2nd ed. 2012).

9. *See* TONY R. KUPHALDT, LESSONS IN ELECTRIC CIRCUITS: VOLUME I-DC 434 (5th ed. 2006).

10. *Id.*

11. WHEELER M. SEARS, HELIUM: THE DISAPPEARING ELEMENT 10 (2015).

12. *Id.*

immediate threat, helium could dramatically increase in price to the point that MRI scanning becomes even more expensive.

Helium's second most common use is for its role in controlled atmospheres.[13] Helium is used to create a "protective atmosphere … for growing … crystals such as silicon and germanium," which are critical components "for the production of wafers [adopted within] the semiconductor industry."[14] The wafers are used in a wide variety of electronics ranging from computers to cell phones.[15]

In the field of rocket science, helium also plays a very important role. "The propellant for most [modern] rockets" is a combination of liquid hydrogen and oxygen, which serve "to purge and, pressurize and fill the tanks."[16] "[W]hile the hydrogen and oxygen are being consumed, the purging gas [cannot] freeze at the temperature of liquid fuel."[17] This requires a purging gas that is both inert and has low solubility.[18] Helium is the only substance that fits this role, which is vital to rocket-based space travel.[19] Of helium's total use, annual figures concerning helium as a rocket science component vary from around 17 to 20 percent.[20]

In the field of welding, helium also plays an important role. Shielding gases protect the welding process from oxygen and water vapor.[21] Without protection from these two gases, the process of welding becomes significantly more difficult, and the quality of welds can suffer.[22] Compared to other shielding gases, helium produces "a hotter arc which allows for faster travel speeds and higher productivity" which is particularly advantageous for welding non-ferrous metals such aluminum, magnesium, and copper alloys.[23] Although argon rivals helium as another popular gas and is cheaper, helium still provides a

13. *See* HAMAK, *supra* note 7, at 34.2.

14. Trevor M. Letcher, *Helium, in* MATERIALS FOR A SUSTAINABLE FUTURE 152, 156 (Trevor M Letcher & Janet L Scott eds., 2012).

15. *Electronic Chemicals: Semiconductors, Silicon and IC Process Chemicals*, IHS MARKIT (Dec. 2011), *available at* https://www.ihs.com/products/chemical-electronic-chemicals-scup.html (last visited Mar. 27, 2017).

16. Letcher, *supra* note 14, at 155.

17. *Id.*

18. *Id.* at 156.

19. *Id.*

20. *See id.*; *see* HAMAK, *supra* note 7, at 34.2.

21. *MIG Welding Shielding Basics*, BERNARD, *available at* http://www.bernardwelds.com/mig-welding-shielding-gas-basics-p152080#.VtSfRhhmbkI (last visited Apr. 2, 2017).

22. *See id.*

23. *Id.*

valuable contribution to the welding industry.[24] Further, the increasing price could, in turn, cause a shift in reliance to argon, affecting the supply side of that element.[25]

Another application of helium, gas chromatography, is a "technique used to separate volatile compounds or substances that can be vaporized without decomposition."[26] Within the mobile-phase of gas chromatography, helium takes on the role of a carrier gas, which is essential to the entire chromatography process.[27] While gas chromatography may not be a process known to many outside the chemistry community, to those familiar with it, its applications are widely recognized.[28]

As a tool in environmental analysis, gas chromatography is used to detect pharmaceuticals in water and determines the long-term impact of oil spills.[29] In food analysis, gas chromatography provides a picture of food composition, food additives, flavor and aroma components, a variety of transformation products, and contaminants, such as pesticides, fumigants, environmental pollutants, natural toxins, veterinary drugs, and packaging materials.[30] Within forensics, gas chromatography plays a role in drug screening, detecting drugs in oral fluids.[31] Moreover, gas chromatography is also used in pharmaceutical analysis.[32]

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24. Id.

25. *See* Dan Davis, *What's Up With Helium For Welding Applications?*, THE FABRICATOR (Dec. 3, 2012), *available at* http://www.thefabricator.com/article/consumables/whats-up-with-helium-for-welding-applicationsr (last visited Apr. 7, 2017).

26. *What Is Gas Chromatography?*, POLYMER SOLUTIONS (Apr. 16, 2014), *available at* https://www.polymersolutions.com/blog/what-is-gas-chromatography/ (last visited Apr. 7, 2017).

27. Kyaw Thet & Nacy Woo, *Gas Chromatography*, LIBRETEXTS (MAR. 13, 2015), *available at* http://chemwiki.ucdavis.edu/Core/Analytical_Chemistry/Instrumental_Analysis/Chromatography/Gas_Chromatography#Carrier_Gas (last visited Apr. 10, 2017).

28. *See* LCGC Editors, *Chromatography in Real-World Applications: Current Trends in Environmental, Food, Forensic, and Pharmaceutical Analysis*, LCGC (Aug. 2, 2014), *available at* http://www.chromatographyonline.com/chromatography-real-world-applications-current-trends-environmental-food-forensic-and-pharmaceutical?id=&pageID=1&sk=&date= (last visited Apr. 7, 2017).

29. *See id.*

30. Steven J. Lehotay & Jana Hajšlová, *Application of Gas Chromatography in Food Analysis*, 21 TRENDS IN ANALYTICAL CHEMISTRY 686, 686-690 (2002).

31. *Id.*

32. *See* E. Brochmann-Hanssen, *Gas Chromatography and Its Application to Pharmaceutical Analysis*, 51 J. OF PHARM. SCI. 1017, 1017 (Nov. 1962).

III. THE CURRENT STATE OF HELIUM SUPPLIES

It is well established that planet Earth has finite resources. The economic problem of scarcity reflects the fact that mankind has "unlimited wants, scarce means (resources)," and multiple uses for those scarce means.[33] Considering that the demand for scarce resources is very high due to unlimited human wants, and that scarce resources have multiple uses, it is necessary to carefully ascertain "what to produce, how to produce and for whom to produce."[34] Scarcity provides that, in a world of infinite wants and needs, not all of those desires can be met due to the limited quantity of resources that must be shared.

There are two types of scarcity that are relevant in economics terms: absolute scarcity and relative scarcity.[35] Absolute scarcity "exists when there is not enough of a resource in existence to satisfy existing demand for it."[36] On the other hand, relative scarcity exists where "a particular resource is in short supply in one or more areas, because of inadequate or [uneven] distribution."[37] Absolute scarcity refers to the limited existence of resources, whereas relative scarcity factors in how difficult it is to extract those resources. With respect to helium, or any other natural resource, consideration of relative scarcity is more important for purposes of utility to humans than absolute scarcity.[38] This is because no matter how abundant a resource is, if humans do not have access to that resource, or if acquiring access is too expensive, then that resource loses all value.[39]

There are several factors to take into account when measuring relative scarcity, but the most important are proven reserves, price of the resource, cost of extraction and substitutes.[40] As of today, accurate numbers illustrating helium production are hard to find. One of the most reliable sources for information about the current trends of mineral supply

33. Sundaram Ponnusamy, *Scarcity Definition of Economics*, HUBPAGES (May 31, 2014), *available at* http://hubpages.com/education/Scarcity-Definition-of-Economics (last visited Apr. 7, 2017).

34. *See id.*

35. *See* KARPAGAM M., ENVIRONMENTAL ECONOMICS: A TEXTBOOK 42 (1st ed. 1999).

36. *Absolute Scarcity*, OXFORD REFERENCE, *available at* http://www.oxfordreference.com/view/10.1093/oi/authority.20110803095344951 (last visited Apr. 3, 2017).

37. *Relative Scarcity*, OXFORD REFERENCE, *available at* http://www.oxfordreference.com/view/10.1093/oi/authority.20110803100412697 (last visited Apr. 3, 2017).

38. *See* KARPAGAM M., *supra* note 35.

39. *See id* (this is implicit when considering relive scarcity).

40. Darwin C. Hall & Jane V. Hall, *Concepts and Measure of Natural Resource Scarcity with a Summary of Recent Trends*, 11 J. OF ENVTL. ECON. & MGMT. 363, 364-367 (1984).

and demand comes from the United States Geological Survey (USGS), an agency under the Department of the Interior.[41]

The 2015 Mineral Commodity Summaries, an annual USGS publication, addressed several factors influencing the current state of helium supplies. Unfortunately, the most recent available worldwide production figures are from 2006.[42] That year, the total United States helium reserves and resources "were estimated to be 20.6 billion cubic meters" (BCM), while helium resources of the world were expected to be roughly 31.3 BCM, bringing the worldwide total to nearly 52 billion cubic meters.[43] Of this 10-year-old figure, Qatar had 10.1 BCM, Algeria 8.2 BCM, Russia 6.8 BCM, Canada 2.0 BCM, China 1.1 BCM, and the rest of the world approximately 3.1 BCM.[44] Recently, however, state-owned Russian gas utility Gazprom proposed that global reserves are closer to 41 BCM,[45] further illustrating the lack of clarity.

In 2013, the United States consumed 32% of the worldwide total volume, or 56.6 million BCM, which places the entire world's consumption at 178.3 million BCM.[46] As technology has continued to improve, helium demand has mirrored technological advancements, which explains why helium consumption has increased approximately 5% every year since 2000.[47] Predictions, however, have foreseen helium consumption increasing at a rate of 2.5% per year over the next twenty years.[48] Because the Bureau of Land Management, in following helium legislation, has publicly set the price of crude helium through its volume sales process, the helium industry has adopted that price as the primary basis for valuing and pricing liquid helium sales.[49] This causes helium

41. *See About Us*, USGS, *available at* https://www.usgs.gov/about/about-us (last visited Apr. 3, 2017).

42. U.S. GEOLOGICAL SURVEY, MINERAL COMMODITY SUMMARIES 73 (2015).

43. *Id.*

44. *Id.*

45. John Siciliano, *Demand for Helium Rises*, WASH. EXAMINER (Jul. 13, 2015), *available at* http://www.washingtonexaminer.com/demand-for-helium-rises/article/2567976 (last visited Apr. 3, 2017).

46. Maura D. Garvey, *The 2014 Worldwide Helium Market: New Helium Sources Begin to Alleviate Tightness of Supply*, *in* CRYOGAS INTERNATIONAL 36 (June 2014).

47. *Inflation Warning: America's Dominance of the Global Helium Market is Ending*, ECONOMIST (Sep. 28, 2013), *available at* http://www.economist.com/news/finance-and-economics/21586840-americas-dominance-global-helium-market-ending-inflation-warning (last visited Apr. 3, 2017).

48. *Id.*; Garvey, *supra* note 46.

49. Garvey, *supra* note 46.

prices to increase, which in turn causes some uses of helium to become less popular, leading to more conservation, recovery, and recycling.[50]

Pricing is, of course, dependent on supply and demand, but serves as another good tool for assessing scarcity. If a product is consistently increasing in price, then chances are that it is becoming increasingly relatively scarce as well. In 2012, helium prices rose to $6.13 per cubic meter, the highest price since 1995,[51] a possible indication of increasing relative scarcity. Providing further detail for the determination of relative scarcity is the identification of substitutes. Helium can be replaced in some of its applications.[52] For example, argon can replace helium as a shielding gas in welding processes.[53]

Given the absence of any substantial increase in helium reserves, as well as the fact that the price of helium has steadily increased, and helium consumption is projected to increase as it has, a strong case can be made that helium is becoming increasingly relatively scarce.[54] Considering these circumstances, action must be taken to prevent a dramatic increase in price that renders helium too costly for its several valuable uses.

IV. EFFORTS TO ADDRESS THIS PROBLEM

A. Non-law-related

Although this paper aims to recommend solutions, or at the very least address how to protect the world's helium supply through legislation, there are other alternatives that can supplement the legislative process. The problem of helium scarcity is one that encompasses the areas of science, economics, and law. While I would submit that law and sustainable policy approaches are the most effective measures to address worldwide problems, measures outside the legislative process have been known to solve issues, and efforts to address helium scarcity outside the law are worth introducing.

Air Products, an international corporation whose principal business is selling gases and chemicals for industrial uses, recently opened the Doe Canyon helium plant, the only plant in the world that extracts helium

50. *Id.*

51. Jacob Adelman, *Helium Rises to Highest Since 1995 in Fallout From Shale Boom*, BLOOMBERG (Jan. 30, 2013), *available at* http://www.bloomberg.com/news/articles/2013-01-31/helium-rises-to-highest-since-1995-in-fallout-from-shale-boom (last visited Apr. 13, 2017).

52. U.S. GEOLOGICAL SURVEY, *supra* note 42.

53. *Id.*

54. *Id.* at 72-73.

from a gas stream primarily composed of carbon dioxide.[55] The new plant is expected to produce up to 6.5 million BCM of helium per year, which would replace more than 15% of the federal helium reserve.[56]

Another solution to the worldwide helium shortage is to research and discover new technologies that can recycle helium, and by extension our dependence on helium. For example, GE Healthcare recently spent $17 million on a facility in Florence, South Carolina that captures and recycles much of the helium used in the production of its MRI equipment.[57] The facility "use[s] . . . innovative technolog[y] to capture pure helium gas and compress it into an extremely cold … liquid form."[58]

In a similar realm, two other common elements, nitrogen and hydrogen, are being explored as alternatives to helium.[59] In the coming years, helium use is expected to increase, specifically in the Asia Pacific region.[60] As a response, researchers have begun testing nitrogen and hydrogen as alternatives to helium for chromatography processes.[61] While promising for the future of helium-dependent scientific and medical practices, hydrogen and nitrogen are still far away from entirely replacing helium.[62]

B. Effort at the National Level – The Responsible Helium Administration and Stewardship Act

Although the world lacks a strong international framework to address the increasing scarcity of helium, there have been efforts made at the national level. While these efforts are a step in the right direction and illustrate that some response to the helium crisis has been made through

55. Gerald Ondrey, *Air Products Opens Doe Canyon Helium Plant*, CHEM. ENGINEERING ONLINE (Aug. 19, 2015), *available at* http://www.chemengonline.com/air-products-opens-doe-canyon-helium-plant/?printmode=1 (last visited Apr. 3, 2017).

56. *Id.*

57. *Outliers: MRI Industry Keeps Hope Afloat for Helium Industry*, MODERN HEALTHCARE (May 25, 2013), *available at* http://www.modernhealthcare.com/article/20130525/magazine/305259967 (last visited Apr. 3, 2017).

58. *South Carolina a Magnet for Jobs & Investment: GE Breaks Ground in Florence*, GE HEALTHCARE (May 20, 2013), *available at* http://newsroom.gehealthcare.com/south-carolina-a-magnet-for-jobs-investment-ge-breaks-ground-in-floren/ (last visited Apr. 3, 2017).

59. Amit Pratap, *Helium Shortage Opens the Door to Alternatives*, LAB. EQUIP. (Apr. 13, 2015), *available at* http://www.laboratoryequipment.com/articles/2015/04/helium-shortage-opens-door-alternatives (last visited Apr. 3, 2017).

60. *Id.*

61. *Id.*

62. *Id.*

legislation, they simply do not have the capability to tackle a worldwide problem of this magnitude, at least not when it comes to helium.

The Bureau of Land Management-operated Federal Helium Reserve holds, as of 2013, 30% of the world's helium supply.[63] The Federal Reserve was originally created in 1926 as a means to assist the U.S. in keeping up "with advancements in military technology, such as blimps."[64] Unfortunately for the U.S., blimps failed to ever gain considerable importance in military operations.[65] As a result, the U.S. was left with a large reserve of helium that continued to accrue debt, until Congress passed legislation in 1996 to privatize the reserve and relieve the government of the burden of the Reserve by 2015.[66]

The Helium Stewardship Act was passed in 2013 for the two main purposes of "preventing impending helium shortages [and] ensuring [that] taxpayers get a fair return for [helium].[67] The Act consisted of three phases, the most crucial of which was the third, which ends the commercial sale of helium when there are 84.9 BCM of helium remaining in the Reserve, and allocates that amount for national security and scientific needs.[68] The third phase is important because it is representative of a commitment by the U.S., the world's leading supplier of helium, to preserve helium for important future needs, rather than let it be traded away and used wastefully.

While the Helium Stewardship Act of 2013 was an important step by the U.S. to ensure the security of helium, the Federal Helium Reserve still contributes only 30% of the world's helium.[69] Although the U.S. dominates the world's helium market, helium production and consumption is far from only a domestic concern. For this reason, initiatives such as the Helium Stewardship Act, which seek to bring stability to the world's increasingly scarce helium supply should not be adopted by individual countries. Given how widespread helium is throughout the world, it is important that countries work together towards sustainability-based goals.

63. *Frequently Asked Questions on H.R.527, supra* note 6.

64. *Id.*

65. *Id.*

66. *Id.*

67. *Id.*

68. *Frequently Asked Questions on H.R.527, supra* note 6.

69. Andrea Widener, *Helium Headache*, CHEM. & ENG'G NEWS (Sept. 16, 2013), *available at* http://cen.acs.org/articles/91/i37/Helium-Headache.html (last visited Mar. 31, 2017).

C. International Mineral Resources Law

Generally speaking, "international law has taken a 'hands-off' approach to mining."[70] This is exemplified by Principle 21 of the Stockholm Declaration,[71] which states:

> States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and 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.[72]

Still, states relinquish some power when agreeing to treaties, which comprise the international law from which mineral resource law is born.[73] Although there is no all-encompassing source of international mining law, a number of related treaties and conventions do exist.[74] However, these contain very general language, lack specificity, and focus only on individual phases of mineral marketing and development, rather than the process as a whole.[75]

Furthermore, the majority of "hard" or binding international law pertaining to mining exists only to address direct, immediate threats to public health and environmental protection.[76] For these reasons, the scant body of international law that regulates mining, as it stands, would do little to justify a limitation on helium mining – at least not as a response to scarcity.

There has, however, been a recent "paradigm shift," not as a response to scarcity, but due to environmental considerations.[77] A concern for the increasing scarcity of natural resources shares some common ground with environmental problems. Both theories are born

70. George W. Pring, *International Law and Mineral Resources*, *in* Mining, Environment, and Development: A series of papers prepared for the United Nations Conference on Trade and Development (UNCTAD) 1, 9 (2008).

71. Report of the United Nations Conference on Human Environment, *Stockholm Declaration on Human Environment*, principle 21, U.N. Doc. A/CONF. 48/14 (1972) *revised by* U.N. Doc. A/CONF.48/14/Corr.1 (1973) *reprinted* in 11 I.L.M. 1416, 1420 (1972) [hereinafter Stockholm Declaration].

72. *Id.*

73. Pring, *supra* note 70.

74. *See id.*

75. *Id.* at 10; RODERICK G. EGGERT, MINING AND THE ENVIRONMENT: INTERNATIONAL PERSPECTIVES ON PUBLIC POLICY 4-11 (Roderick G. Eggert ed., 1994).

76. Pring, *supra* note 70, at 10-21.

77. *Id.* at 18.

out of a basic respect for the fact that Earth is a living organism with finite resources, and can consequently be depleted of those resources and irreversibly damaged.[78] However, the basis for international legislation controlling mining practices for environmental reasons is not quite the same as a scarcity-based rationale. That being said, measures such as the Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol) are illustrative of the fact that "trade and economic sanctions" can be levied "against states violating the provisions of the treaty or against non-parties."[79]

The Montreal Protocol was designed to protect the ozone layer by establishing "precautionary measures to control equitably total global emissions of substances that deplete it, with the ultimate objective of their elimination on the basis of developments in scientific knowledge."[80] To achieve that objective, the Protocol incorporated restrictions on trade, a rare measure at the international level used to meet environmental goals.[81] Examples contained within the Protocol include the prohibition of parties from importing controlled substances from non-party states, and requiring consideration of banning or restricting trade with non-party states for products made with, but not containing, controlled substances.[82] Furthermore, "[p]arties operating under Article 5 are prohibited from exporting any controlled substance to a non-party" state, which was then expanded to all parties after an amendment in 1990.[83]

While the Montreal Protocol is considered a successful piece of international legislation by many,[84] it has still generated a notable amount of controversy due to its stark confliction with the General Agreement on Tariffs and Trade (GATT), as well as the North American Free Trade Agreement (NAFTA).[85] With respect to helium and other scarce resources, however, consider Article XX of the GATT, which states that

78. *See generally* THOMAS F. HOMER-DIXON, ENVIRONMENT, SCARCITY, AND VIOLENCE (2001).

79. Pring, *supra* note 70, at 19.

80. Donald L. Goldberg et al., *Effectiveness of Trade & Positive Measures in Multilateral Environmental Agreements: Lessons from the Montreal Protocol*, THE CTR. FOR INT'L ENV'T LAW 2 (1997), *citing* Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, 26 I.L.M. 1541 (entered into force Jan. 1, 1989) [hereinafter Montreal Protocol].

81. *Id.*

82. DONALD M. GOLDBERG, PROVISIONS OF THE MONTREAL PROTOCOL AFFECTING TRADE 2 (1992); Montreal Protocol, *supra* note 80, art. 4 ¶ 1.

83. Goldberg, *supra* note 82, at 3; Montreal Protocol, *supra* note 80, art. 4, ¶ 2, art. 5.

84. *See generally* UNEP, *A Success in the Making: The Montreal Protocol on Substances that Deplete the Ozone Layer* 1 (2007).

85. Pring, *supra* note 70, at 19; Goldberg, *supra* note 80, at 3.

"nothing in [it] shall be construed to prevent the adoption or enforcement by any contracting party of measures . . . necessary to protect human, animal, or plant life, or health," or "relating to the conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production or consumption."[86]

While these provisions do little to support environmental protection, they do perhaps speak to natural resources conservation. When compared to the other exceptions of Article XX, paragraph (g) stands out because it only requires measures be effective, rather than necessary.[87] The inclusion of paragraph (g) speaks to the importance of conserving exhaustible natural resources, and its less restrictive wording further supports that importance.

V. FRAMEWORKS THAT HAVE ADDRESSED SIMILAR PROBLEMS

A. Water

While helium is more dispensable to humans than water, international efforts to preserve the world's water supply and curb wasteful practices may, at the very least, serve as a model or blueprint for how to go about using our rare minerals sustainably. Much like water, helium and similar minerals are not necessarily in low abundance, rather they are used wastefully and managed poorly.[88] Also, much like water, helium can be preserved and used more efficiently for the benefit of the entire world, rather than just wealthier nations.

The United Nations adopted the Convention on the Law of Non-Navigational Uses of International Watercourses (U.N. Watercourse Convention) in 1997.[89] The treaty was not implemented into force, however, until August 17th, 2014.[90] The treaty establishes a framework for the "utilization, development, conservation, management, and protection of international watercourses, while promoting optimal and

86. General Agreement on Tariffs and Trade, art. XX, Oct. 30, 1947, 61 Stat. A-11, 55 U.N.T.S. 194 [hereinafter GATT].

87. *Id.*; WTO, ANALYTICAL INDEX OF THE GATT 584 (2012).

88. *See* Brad Plumer, *Good News! Congress Just Averted a Global Helium Crisis*, WASH. POST (Sept. 27, 2013), *available at* https://www.washingtonpost.com/news/wonk/wp/2013/09/27/good-news-congress-just-averted-a-global-helium-crisis/ (last visited Apr. 2, 2017).

89. U.N. Convention on the Law of the Non-Navigational Uses of International Watercourses, May 21, 1997, 36 I.L.M. 700 [hereinafter U.N. Watercourses Convention].

90. *See Water for Peace*, GREEN CROSS INT'L, *available at* http://www.gcint.org/water-for-life-and-peace/water-for-peace/ (last visited Apr. 2, 2017).

sustainable utilization thereof for present and future generations."[91] Moreover, the treaty does all of this while accounting for the special situations and needs of developing countries.[92] Given that water scarcity affects roughly 20% of the planet's population, the U.N. established an international framework that addresses this critical resource.[93]

While the U.N. Watercourses Convention mirrors potential legislation to protect scarce natural resources, it also significantly differs in that it pertains to watercourses that are international. Contrast from helium reserves, which are typically intra-national.[94] Still, the U.N. Watercourses Convention illustrates that resource scarcity is a problem that deserves international attention and collaboration.

B. International Tropical Timber Agreement

Past international agreements have illustrated that multiple states can work together to achieve sustainable outcomes. The International Tropical Tree Agreement of 2006 is an example of this willingness to achieve sustainable goals and serves as a strong indicator that sustainable helium regulation is an attainable goal. The agreement, which has been signed by 73 nations,[95] sets objectives that aim to promote sustainable harvest practices, improve understanding of the structural conditions in international markets, and encourage members to develop national policies aimed at sustainable utilization and conservation of timber producing forests.[96] While the timber and mineral industries have some differences, they are also very similar. Both commodities are natural resources, both are harvested in multiple countries, and both are widely used across the planet.

VI. THEORIES OF INTERNATIONAL MINERAL LAW

One problem facing a balanced, sustainable future for helium mining is the fact that helium is naturally scattered across the world. Different countries implement different regulatory structures with respect to mineral rights, and these varying structures complicate the process of

91. U.N. Watercourses Convention, *supra* note 89, preamble.

92. *Id.*

93. *See Water Scarcity*, U.N. DEP'T OF ECON. & SOC. AFF. (Nov. 24, 2014), *available at* http://www.un.org/waterforlifedecade/scarcity.shtml (last visited Apr. 2, 2017).

94. *See* U.N. Watercourses Convention, *supra* note 89.

95. *See ITTO Members Under ITTA, 2006*, ITTO, *available at* http://www.itto.int/itto_members/ (last visited Apr. 2, 2017).

96. *See* International Tropical Timber Agreement, art. 1, Jan. 26, 1994, 1955 U.N.T.S. 81 [hereinafter ITTA].

creating an agreement that addresses how helium should be extracted and used. For example, consider a country where mineral rights are entirely owned by the government, compared to a country where mineral rights are entirely owned by private parties. As is the case with nearly any law, there can be winners and losers. Should a country be compelled to regulate helium extraction when said helium is in private hands, there could be considerable backlash for those private mineral rights owners. However, it is still up to the countries that sit on helium-rich reserves to weigh future needs against contemporary property (mineral) rights, even amid backlash.

Mineral rights ownership can be divided into three fundamental regulatory approaches: the land ownership scheme, the concession scheme, and the claim system.[97] Under the land ownership model, "the right to use and exploit minerals runs with the ownership of the land," while under the other two models the government grants the right to use or exploit minerals.[98] The land ownership model is arguably the most common, at least in the most helium-rich countries.[99] Under the land ownership model, the minerals contained under land owned by a party are considered part of the land, and it is from that approach that ownership of the minerals is granted.[100]

Under a concession system, a party may be granted rights under land owned by that party, but only after approval from the state.[101] Under a claim system, a party can acquire sole right of exploitation of minerals, subject to certain formalities that may vary by state.[102] The claim system is synonymous to a finders-keepers approach to conferring mineral rights. This system is justified by the belief that it encourages exploration and perpetuates the discovery of new mineral deposits.[103]

These three approaches to granting mineral rights create a conflict. While concession or claim systems are more advantageous for discovering new mineral deposits, they also impinge on traditional property rights.[104] Regardless of which approach a country implements in granting mineral rights, the ultimate issue here is which system might

97. EVA LIEDHOLM JOHNSON, MINERAL RIGHTS: LEGAL SYSTEMS GOVERNING EXPLORATION AND EXPLOITATION 13 (2010).

98. *Id.*

99. *See infra* Section VIII.

100. *See* JOHNSON, *supra* note 97, at 13-14.

101. *See id.* at 14-15.

102. *See id.* at 15.

103. *See id.* at 15.

104. *See id.* at 13-15.

be most sustainable, or rather, which system will promote the most efficient use of helium.

VII. WHY AN INTERNATIONAL FRAMEWORK IS APPROPRIATE

Security can be defined as "the condition of being protected against, or not exposed to, a danger."[105] The word "collective" serves to distinguish the security of multiple states from individual states.[106] While collective security is an old concept, it is still very relevant in international relations. Immanuel Kant argued in favor of sovereignty while simultaneously acknowledging that the world's population and autonomous nations share common goals essential to survival.[107] The U.N., both in its creation and its modern operation, still practices in line with Kant's philosophy.[108] While the concept of collective security and the U.N.'s inception primarily serve to prevent international conflict, collective security applies to organized efforts to avoid harm or destruction from other causes as well.[109]

Today, technological advancements, globalization, and the ever-expanding complexity of economic interactions have seen human innovation reach new heights.[110] With the growth and advancement of mankind, as well as the "decline of U.S. economic hegemony and . . . uncertaint[y] in the industrialized world" with respect to "uninterrupted economic growth," interventionist policies at the economic stage can only be expected to increase.[111] As applied to minerals and resources, consider the U.S.-N.A.T.O. invasion of Afghanistan in the wake of September 11th, 2011. Several positions vary in opinion about the legitimacy of U.S. involvement in Afghanistan as a response to terrorism, but one common viewpoint is that U.S. involvement was primarily based on a desire to fortify oil production in Afghanistan and the surrounding Middle Eastern countries.[112] That nations are willing to go to war over natural resources,

105. HANS KELSEN, COLLECTIVE SECURITY UNDER INTERNATIONAL LAW 1 (1954).

106. *Id.*

107. *See generally* IMMANUEL KANT, ON PERPETUAL PEACE: A PHILOSOPHICAL SKETCH 53-101 (Brian Orend ed., Ian Johnston trans., Broadview Press 2015) (1795).

108. Carl J. Friedrich, *The Ideology of the United Nations Charter and the Philosophy of Peace of Immanuel Kant 1795-1945*, 9 THE J. OF POL. 10, 10-30 (1947).

109. *Id.*

110. *See* Mohammed Ayoob, *Squaring the Circle: Collective Security in a System of States*, *in* COLLECTIVE SECURITY IN A CHANGING WORLD 45, 46 (Thomas G. Weiss ed., 1993).

111. *See id.* at 47.

112. *See* PETER DALE SCOTT, DRUGS, OIL, AND WAR: THE UNITED STATES IN AFGHANISTAN, COLOMBIA, AND INDOCHINA xiv (2003) (quoting Frank Viviano, *Energy*

illustrates the importance and value of those resources to the world. Fortifying scarce resources like helium will effectively prevent future drastic measures, such as the invasion of resource-rich countries.

Geographically speaking, helium is not divided like resources such as water or oil. The uses of helium are not particular to any one nation nor a small specific group of nations; helium has universal applicability. For that reason, it seems natural that helium scarcity is addressed through a law that is international in nature.

VIII. RECOMMENDATIONS FOR SUSTAINABILITY

To recommend international legislation that focuses solely on helium is an admirable goal, but not a realistic one. While this paper aims to stress the importance of helium and introduce the economic and scientific evidence demonstrating helium's increasing scarcity, helium is not the only scarce mineral that would benefit from protective international measures. The best step for countries to take is to form an international agreement that restricts trade, imports, and exports on scarce minerals. Helium is merely an example of the principle that Earth's resources must be carefully managed and utilized.

A. Country Analysis

While the sustainable use of helium would best be served by the involvement of as many nations as possible in a conservation treaty, there are a few countries that possess the majority of helium reserves and contribute to the majority of helium production. Although helium is located in several countries across the world, six countries[113] currently hold roughly 48.8 BCM of the world total of 51.9 BCM.[114] For that reason, while the inclusion of as many countries as possible is more than welcome, the involvement of these six countries is essential to the viability of potential international helium legislation. Due to the importance of those few countries, the parameters set by the helium legislation are directly related to what those six countries would or would not agree to. For that reason, an assessment of the current state of mining, as well as the central motivations of these six countries is necessary before any discussion of the actual proposed legislation.

Future Rides on U.S. War / Conflict Centered in World's Oil Patch, S.F. CHRONICLE, Sept. 26, 2001).

113. Those countries are the United States, Qatar, Algeria, Russia, Canada, and China.

114. *See* U.S. GEOLOGICAL SURVEY, *supra* note 42, at 73.

1. Qatar

Qatar is a country located in the Middle East with a unitary parliamentary constitutional monarchy.[115] Qatar is rich in petroleum and natural gas, both of which account for 55% of the country's gross domestic product.[116] Most important though, Qatar is very rich in helium.[117] As it stands, all natural resources are state property under Qatari natural resource law.[118] Qatar Petroleum, a state-owned petroleum company, has been granted the exclusive rights of helium exploration, production, refining, transport, and storage within Qatar's borders.[119]

As a matter of policy, Qatar has acknowledged the importance of a cost-effective, sustainable approach that bears in mind the needs of future generations, as detailed in The Qatar National Development Strategy 2011-2016 (National Development Strategy).[120] Unfortunately, this part of the development strategy only touches on a pledge to protect the environment for the sake of future generations, rather than mineral conservation.[121] Outside of the National Development Strategy, Qatar also adheres to the Pillars of Qatar National Vision 2030, of which the National Development Strategy was born.[122] The National Vision consists of four pillars: economic, social, human, and environmental development.[123] It serves to address the broad goals Qatar wishes to achieve, rather than the specific actions the country will take to achieve those goals.[124] The environmental development section of the National Vision speaks to the exhaustion of natural resources by stipulating that future generations are threatened by the depletion of non-renewable

115. *See 2008 Country Reports on Human Rights Practices: Qatar*, U.S. DEP'T OF STATE (FEB. 25, 2009), *available at* https://www.state.gov/j/drl/rls/hrrpt/2008/nea/119125.htm (last visited Apr. 3, 2017).

116. *Id.*

117. U.S. GEOLOGICAL SURVEY, *supra* note 42.

118. *See* Maria Valdez et al., *Oil and Gas Regulation in Qatar: Overview*, PRAC. L. (JUNE 1, 2014), *available at* http://us.practicallaw.com/5-525-5499?source=relatedcontent#a678474 (last visited Apr. 3, 2017); Law No. 3 of 2007 (Law on the Exploitation of Natural Resources and its Sources) (Qatar)*; see generally* QATAR GEN. SECRETARIAT FOR DEV. PLANNING, QATAR NATIONAL DEVELOPMENT STRATEGY 2011-2016 7, 48 (2011) [hereinafter QATAR NATIONAL DEVELOPMENT STRATEGY].

119. Valdez et al., *supra* note 118.

120. *See* QATAR NATIONAL DEVELOPMENT STRATEGY, *supra* note 118, at 213-236.

121. *See id.* at 214.

122. *See* QATAR GEN. SECRETARIAT FOR DEV. PLANNING, QATAR NATIONAL VISION 2030 (July 2008).

123. *See id.*

124. *See id.*

resources not compensated for by the creation of new sources of renewable wealth.[125]

While it is encouraging that Qatar stresses the importance of protecting the prosperity of future generations, Qatar's focus on wealth with regard to natural resources, compared to the practical uses of those resources may be cause for some alarm. It is clear that Qatar is a very resource-rich country whose exports greatly outnumber imports,[126] possibly explaining why Qatari legislation illustrates a concern for wealth rather than conservation. At any rate, Qatar's large stake in the helium industry places great urgency in constructing an agreement that Qatar would agree to. As such a large exporter, profit is of great importance to Qatar. However, profitability and conservation of helium are not necessarily conflicting ideas, which would hopefully entice Qatar to join in a treaty.

2. Algeria

Algeria is a semi-presidential republic located in Northern Africa.[127] In addition to helium, which Algeria was the third-most producer of in 2013, the country also exports crude oil and natural gas.[128] In Algeria, the mining industry is regulated by the Ministère de l'energie et des Mines [Ministry of Energy and Mining] (MeM), through its numerous agencies.[129] Among the agencies, duties are separated into an office for geological and mining research, two agencies that regulate the mining industry, and one industry that awards permits and licensing for mining.[130] As far as actual helium ownership goes, exact figures are unclear, but there appears to be a split between private and public ownership for all minerals in Algeria, including helium.[131]

When considering the likelihood that Algeria would join in an international agreement to preserve helium supplies for generations, it is important to consider the Algerian "Golden Share" policy. The policy, which was introduced in 2010, gives the Algerian government a majority

125. *Id.* at 4.

126. *Qatar*, OBSERVATORY OF ECON. COMPLEXITY, *available at* http://atlas.media.mit.edu/en/profile/country/qat/ (last visited Mar. 27, 2017).

127. *Algeria: Government*, GLOBAL EDGE, *available at* http://globaledge.msu.edu/countries/algeria/government (last visited Apr. 13, 2017).

128. Mowafa Taib, *The Mineral Industry of Algeria*, 2013 MINERALS Y.B. 2.1 (June 2015), *available at* http://minerals.usgs.gov/minerals/pubs/country/2013/myb3-2013-ag.pdf (last visited Apr. 13, 2017).

129. *Id.* at 2.2.

130. *Id.*

131. *Id.*

share in the local operations of new companies operating in Algeria, as well as a seat on the company's board of directors (but not voting rights).[132] This policy, which applies to all sectors of the Algerian economy, serves to prevent foreign ownership from overtaking the industry.[133] The Golden Share Policy illustrates Algeria's willingness to cooperate with foreign entities, while also demonstrating Algeria's grip on the mining industry.

The public nature of Algeria's mining industry, coupled with the fact the country's economy is relatively stable and continuing to grow,[134] bodes well for the chances Algeria would be willing to join in an international helium preservation agreement. Furthermore, Algeria has several environmental laws in place to restrict the impact of the mining industry,[135] which demonstrates the country has a commitment to protecting future generations, the strongest factor pushing a helium-sustainability initiative.

3. Russia

Russia is a federal presidential republic located in northeastern Europe and part of North Asia.[136] Widely respected as a world power, the country would serve as an important ally in preventing helium scarcity both because of its own helium supply, but also because of the potential influence on other countries.[137]

In Russia, all minerals are owned by the state, but a licensing regime allows private companies the opportunity to mine under limited constraints, dependent upon the type of license being issued.[138] Russia currently offers three types of licenses for mineral exploitation: an

132. *Id.* at 2.1.

133. *See* Taib, *supra* note 128, at 2.1.

134. *See id.*

135. *See generally* Law 01-10 [*Mining* Act] July 3rd, 2001, *available at* http://www.mem-algeria.org/fr/legis/mining_act_2001.pdf (Alg.) (last visited Mar. 28, 2017).

136. *Basic Facts About Russia: Political System*, RUSSIAPEDIA (2017), *available at* http://russiapedia.rt.com/basic-facts-about-russia/political-system/ (last visited Mar. 28, 2017).

137. Jonathan Adelman, *Surprise, Surprise, Russia is a World Power Again*, FOX NEWS (Sept. 28, 2015), *available at* http://www.foxnews.com/opinion/2015/09/28/surprise-surprise-russia-is-world-power-again.html (last visited Mar. 28, 2017).

138. Grigoriy Malykhin, *Russian Mining Law, CRIRSCO, and the New Russian Reporting Standard*, CRIRSCO (Nov. 3, 2011), *available at* http://www.crirsco.com/news_items/8_russian_mining_law.pdf (last visited Feb. 20, 2017); *Overview: Russian Mining Regulation*, KING & SPALDING (May 2012), *available at* http://www.kslaw.com/imageserver/kspublic/library/publication/russianmining.pdf (last visited Mar. 28, 2017).

exploration license, which lasts for five years; a production license that lasts based on a feasibility study, but generally lasts for around twenty-five years; and a combined exploration/production license.[139] "[L]icenses are awarded by tender or auction conducted by the Federal Agency for Subsoil Use."[140] While licenses at auctions go to the highest bidder, tender licenses go to the "participant that submits the most technically competent, financially attractive, and environmentally sound proposal."[141]

At the legislative level, conservation is considered important enough that the concept has made its way into the Constitution of the Russian Federation.[142] The first part of the constitution declares that land and other natural resources shall be utilized and protected in the Russian Federation as the basis of life and activity of the people living in corresponding territories, while the second part states that land and other natural resources may be in private, state, and municipal ownership, as well as other forms.[143] Environmental protection has been further addressed through numerous Russian laws, but a consistent commitment to sustainable development has yet to be seen.[144]

Still, at the international stage, Russia has been a strong contributor to issues such as food security, climate change, and environmental protection.[145] While there is little evidence Russia possesses the requisite concern for helium that would suggest whether or not the nation would join in an international helium conservation agreement, it appears that Russia is no stranger to promoting the furtherance of sustainability as a general matter.[146] This bodes well for the chance Russia would join in a treaty, but economics and profitability could largely come into play seeing as how helium has such a large market in Russia.

4. Canada

In Canada, "mineral rights are owned by either government entities (referred to as Crown) or private individuals/corporations (referred to as

139. *See Overview: Russian Mining Regulation*, *supra* note 138.

140. *Id.*

141. *Id.*

142. Konstitutsiia Rossiiskoi Federatsii [Konst. RF] [Constitution] art. 9 (Russ.).

143. *Id.*

144. *See* SERGEI BOBYLEV & RENAT PERELET, SUSTAINABLE DEVELOPMENT IN RUSSIA 20-23 (2013).

145. *See id.* at 167-181.

146. Konstitutsiia Rossiiskoi Federatsii [Konst. RF] [Constitution] art. 9 (Russ.).

freehold)."[147] As a result, "across all of Canada, approximately 89 per cent of land is Crown and the remaining 11 per cent is freehold."[148] Furthermore, the Constitution of Canada states that the regulation of mining activities on publicly owned mineral leases falls under provincial/territorial government jurisdiction.[149]

Although Canada has taken little action promoting sustainable mining as it relates to scarcity, Canada has a number of notable environmental initiatives and laws in place to protect the environment and support sustainable mining practices. Among those initiatives and laws are the Green Mining Initiative, which seeks to address northern mineral development, strategic and critical metals processing, energy efficiency in mining and milling, best practices in mining environmental management, and clean water protection.[150] Furthermore, Canada has enacted the Canadian Environmental Protection Act, the Canadian Environmental Assessment Act, and Metal Mining Effluent Regulations.[151] Although no Canadian law speaks to conservative mining practices, if Canada's past initiatives and programs for sustainable mining are any indictor, Canada may be one of the most likely potential countries to join in international helium legislation.

5. China

Although China only possesses roughly 2% of the world's helium supply,[152] if the nation were to join in a helium conservation agreement there could be a tremendous influence on other countries considering joining, given China's status as a world power.[153] China is also a valuable potential member because of the degree to which helium is consumed there.

147. Cameron Wyatt, *Mineral Rights in Canada*, PIPELINE NEWS (Nov. 10, 2015), *available at* http://www.pipelinenews.ca/opinion/columnists/mineral-rights-in-canada-1.2102451 (last visited May 29, 2017).

148. *Id.*

149. Constitution Act, 1867, 30 & 31 Vict., c. 92A (U.K),

150. Jennifer Hollington & Gavin Lemieux, *Evaluation Report: Green Mining Initiative*, NAT. RES. CAN. (Sept., 2014), *available at* http://www.nrcan.gc.ca/evaluation/reports/2015/17190 (last visited May 29, 2017).

151. Chris Baldwin & Johanna Fipke, *Canadian Mining Law*, FASKEN 12-13 (2010).

152. U.S. GEOLOGICAL SURVEY, *supra* note 42.

153. *See* James Petras, *China: Rise, Fall and Re-Emergence as a Global World Power*, CENTRE FOR RESEARCH ON GLOBALIZATION (Mar. 7, 2012), *available at* http://www.globalresearch.ca/china-rise-fall-and-re-emergence-as-a-global-power/29644 (last visited Mar. 28, 2017).

Under the Mineral Resources Law of 1986, all mineral resources are owned by the state.[154] The Mineral Resources Law of 1986 also serves as the most influential piece of Chinese legislation with regard to mining law.[155] Article one of the law states that a goal of the act is the "protection of mineral resources and ensuring the present and long-term needs of the socialist modernization programme."[156] The act further provides that "[t]he State practices a system wherein the exploration right and mining right shall be obtained with compensation; however, the State may, in light of specific conditions, prescribe reduction of or exemption from the compensation for acquiring the exploration right and mining right."[157] In short, these two provisions demonstrate that the Chinese government has a consideration for sustainable mining, and also a great degree of latitude to confer and take away mining rights. Whether China would cooperate in related legislation at the international level is unclear, but these two provisions in China's primary piece of mineral rights legislation serve as an encouraging glimpse at the potential willingness of China to address helium scarcity and take action in importing and exporting helium.

B. Consumption and Essential vs. Non-essential Uses

Like production, consumption of helium must be closely monitored and controlled. If production can be controlled, then consumption will be directly affected. Nevertheless, countries must be willing to use helium efficiently and at a sensible rate.

Within law related to limiting environmental harm or promoting conservation, distinctions between "essential" and "non-essential" uses are common. For instance, consider a law that might place certain restrictions on water use during droughts,[158] or the Montreal Protocol restrictions on CFC's.[159] Restricting helium consumption to only its most

154. Mineral Resources Law of the People's Republic of China (promulgated by Order No. 36 of the President of the People's Republic of China, March 19, 1986, effective October 1, 1986), art. 3, *amended* Aug. 29, 1996 [hereinafter Mineral Resources Law of 1986].

155. *See generally* William L MacBride Jr & Wang Bei, *Chinese Mining Law Overview*, 19 J. OF ENERGY & NAT. RES. L. 220 (2001).

156. Mineral Resources Law of 1986, *supra* note 154, art. 1.

157. *Id.* art. 5.

158. *Mandatory Non-Essential Water Use Restrictions*, VA. DEP'T OF ENVTL. QUALITY, *available at* http://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/Drought/DroughtResponses/DroughtEmergency/MandatoryWaterUseRestrictions.aspx (last visited Mar. 31, 2017).

159. TRANSBOUNDARY AIR POLLUTION: INTERNATIONAL LEGAL ASPECTS OF THE CO-OPERATION OF STATES 274 (Cess Flinterman et al. eds., 1986).

necessary uses is a measure that would preserve helium supplies, and appear more attractive to potential signatories than trade restrictions.

While helium is famous for balloon inflation, that particular use is not actually as common as one might presume.[160] Helium's most common uses are much less obvious, and more important. Looking at Helium's primary applications, covered in section II, a brief discussion is appropriate to discern which uses should or should not be considered essential, and why. Further, as helium becomes scarcer, it also tends to become more expensive, which in turn makes its applications more expensive. In addition to preserving helium itself, if alternatives or replacements are identified, we might begin to discern whether or not a certain use for helium is essential or not.

Helium's primary use is in cryogenics (26% of U.S. usage in 2013).[161] Currently, cryogenics as a field can and should be considered essential. MRI Machines have become a fixture of modern medicine, and other cryogenic applications such as electric power transmission[162] play a large, indispensable role in the world today. Although there may be some avoidable cryogenic applications, the majority could easily be considered essential.

What may be non-essential, or at least less essential, is the actual use of helium in cryogenic processes. While today cryogenics rely on helium,[163] this reliance may not be essential. For example, a company named Cryogenic has recently developed a technique to cool magnets in MRI machines with a fraction of the helium currently used.[164] Ultimately, a full-scale analysis of how pertinent helium is to cryogenic processes would best be left to scientists and economists who can delve deeper into the intricacies of current helium usage and the viability of alternatives.

Like in cryogenics, alternatives also seem to be around the corner in the controlled atmosphere/crystal wafer industry,[165] as well as the gas

160. HAMAK, *supra* note 7.

161. *Id.*

162. *See generally* S.H. Minnich & G.R. Fox, *Cryogenic Power Transmission*, 9 CRYOGENICS 165 (1969).

163. HAMAK, *supra* note 7.

164. *New Cooling Technology Offers Helium Alternative*, ELECTRONICS COOLING (Sept. 20, 2013), *available at* http://www.electronics-cooling.com/2013/09/new-cooling-technology-offers-helium-alternative/ (last visited Apr. 3, 2017).

165. *See* Marcia Faye, *Crystal Wafer May Foretell a Safer Future*, IIT MAGAZINE, *available at* https://magazine.iit.edu/winter-2012/crystal-wafer-may-foretell-safer-future (last visited Apr. 3, 2017).

chromatography industry.[166] Exactly how essential these uses are is up for debate. Countries would be expected to consider the cost, amount of helium used compared to how many people the use impacts, as well as various other factors depending on the particular application. Assigning a label of essential or non-essential is no easy matter when it comes to helium, which further emphasizes the importance of this rapidly disappearing element.

C. Further Proposals

What actual international helium legislation would look like is hard to gauge. There are several provisions that could or could not make their way into the agreement, but there are some suggestions that may attract all prospective parties. Any legislation is better than none, which is why the number one consideration in drafting a helium agreement would be convincing all six of the major helium producing nations to reach an agreement. That being said, below are some recommendations that could serve as potential provisions in the framework.

If one looks to the Montreal Ozone Protocol as an example, it is clear that while restrictions on trade are unusual, they are tenable.[167] For that reason, it is advisable that a discussion on potential trade restriction be offered. A trade restriction could be implemented by setting prices to make the helium market more predictable, which would prevent serious fluctuations in price, which lead to dramatic increases (or decreases) in demand, and consequently, impact production. Further, trade restrictions could be combined with lists of essential and non-essential uses to control the price of helium based on where it is being sold. For example, helium sold for party balloons would be more expensive, or taxed more, than helium used for gas chromatography. The whole idea behind conservation is to use helium for only its most important uses, which means production and consumption would ideally be limited to only those uses.

Another recommendation is to set up a transition of helium from private to public hands for countries that have not already done so. Public entities tend to better serve the public and future generations than private

166. *See* William Goodman et al., *Nitrogen and Hydrogen as Alternate Carrier Gases for GC/MS*, PERKINELMER, *available at* https://shop.perkinelmer.com/Content/RelatedMaterials/ScientificPosters/SPS_Pittcon09-Alternate-Carrier-GCMS-Poster.pdf (last visited Apr. 3, 2017).

167. *See* Montreal Protocol, *supra* note 80.

entities, which focus more on profitability.[168] If a country bound by an international helium conservation agreement owns the helium, there is a greater likelihood that production, consumption, and pricing will be brought to sustainable rates, rather than when the market generates more profit for wasteful applications. This recommendation is already partially achieved as the mineral commodity markets in countries such as Russia and Qatar are heavily owned and regulated by the government, rather than private entities.

IX. CONCLUSION

Overwhelming evidence suggests that helium is becoming increasingly scarce as time passes by, which suggests a new approach is appropriate given the international usage rates of helium and location of helium reserves. An international, legal-based solution to helium scarcity is one method of addressing this problem.

Due to the fact 94% of the world's helium is located in six countries,[169] it is essential that most, if not all of the six largest helium producing countries of the world join in a potential agreement to curb the wasteful use of helium and implement policies that ensure the element's existence for future generations. While it is difficult to predict whether or not a country might be inclined to join in such an agreement, we can look to other policy considerations and agreements adopted by those countries to assess their attitudes and concerns. Further, it is vital that the potential agreement include as many of the six countries as possible. Even if the potential agreement does not give the maximum credence to sustainable helium use, it remains clear that the agreement must be realistic and appeal to all potential member nations.

In the past the world has seen several examples of efforts from nations coming together to address the scarcity of natural resources such as the Montreal Protocol, the Convention on the Law of Non-Navigational Uses of International Watercourses, and the International Tropical Timber Agreement.[170] Although it is far from likely helium scarcity would garner the popularity and respect of an international treaty by itself, there are several other scarce minerals that, when included with

168. *See* ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, REGULATORY POLICY AND GOVERNANCE SUPPORTING ECONOMIC GROWTH AND SERVING THE PUBLIC INTEREST 17-59 (2011).

169. U.S. GEOLOGICAL SURVEY, *supra* note 42.

170. Montreal Protocol, *supra* note 80; U.N. Watercourses Convention, *supra* note 89; ITTA, *supra* note 96.

helium, could establish a strong piece of legislation protecting multiple minerals with worldwide applications.