INTERNATIONAL NEGOTIATIONS OF NATURAL RESOURCES ON THE MOON AND OTHER CELESTIAL BODIES:

FUTURE COOPERATION OR CONFLICT?

TANIA PATRICIA EYMORK

NORWEGIAN UNIVERSITY OF LIFE SCIENCES
Department of International Environment and Development Studies, Noragric
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tania.eymork@student.umb.no

tania.eymork@gmail.com

Noragric
Department of International Environment and Development Studies
P.O. Box 5003
N-1432 Ås
Norway
Tel.: +47 64 96 52 00
Fax: +47 64 96 52 01
Internet: http://www.umb.no/noragric

DECLARATION

I, Tania Patricia Eymork, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Signature.………………………………………

Date…………………………………………….

DEDICATION

Energy is in fact the substance, from which all elementary particles, all atoms and therefore all things are made, and energy is that which moves…..energy can be changed into motion, into heat, into light and into tension,...energy can be called the fundamental cause for all changes in the world (Heisenberg, 1990:51).

In dedication to Dr. Professor Werner Heisenberg, Nobel Prizewinner in Physics 1932.

One could say that space is just simple physics...but cooperation is complex chemistry.

J. J. Dordain speaking at the 44th Congress of the International Astronautical Federation in Graz, Austria (October 1993).

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ABSTRACT

This thesis aims to assess the degree to which one can expect conflict or cooperation over the natural resources on the Moon and other celestial bodies in the future. By describing and exploring how the emerging global space industry may benefit humankind, it covers existing international space treaties and how fairer administration may help to eradicate poverty by, amongst other things, providing a clean source of environmentally friendly energy. This sixty-year young industry is redeploying rapidly from once a total governmental responsibility and concern to a more entrepreneurial, commercialized, and privatized sector, hence leading to competition between major space faring nations. Many of our daily activities today are highly dependent from space activities.

Fossil fuels are becoming increasingly challenging to commercially exploit as new areas rich in oil and gas are found in harsher climates such as the Arctic and deeper waters. Due to expensive exploration and exploitation costs, only developed and rich countries will benefit future access, whereas the Less Developed Countries may be left out and remain in sustainable poverty. The alternative energy sector for renewable energy resources such as bioenergy, solar, wind and hydropower have their limits. Nuclear power is today a much debated.

The Moon and other celestial bodies contain a vast amount of natural resources. One, and in abundance, is helium-3. It is estimated that forty tons can meet twenty five percent of the global energy demand for one year. This clean, non-radioactive and safe source of energy scarcely exists on Earth. Helium-3 derives from the dismantlement of old and outdated nuclear warheads. Helium-3 is used within medicine, scientific research, and well logging operations[1] in the oil and gas industry, and for homeland security. Major space nations such as Russia, China, India, and Japan appear to have integrated within their space programs to commercially exploit the Moon for helium-3 in the future.

The United Nations 1967 Outer Space Treaty (OST) prohibits any commercial exploitation on the Moon and other celestial bodies[2] and permits only scientific research for peaceful uses. The Moon and other celestial bodies including the Antarctica and the deep seas (including the Arctic) belong to the Common Heritage of Mankind (CHM). This raises issues whether or not new treaties will be required, and whether or not a new mandating body to be established. The

[1] Hydrocarbon detection in rock formation
[2] Excluding the planet Earth.

CHM is a principle within international law, which holds that defined areas such as the Moon and other celestial bodies, Antarctica, and the deep seas (including the Arctic) should be held in trust for future generations and be protected from exploitation. However, legal and much debated legal loopholes exist.

The quest for profitable natural resources may often be a basis for conflict, and even wars so-called 'resource wars'. 'Space' is also a resource, for example Low Earth Orbit (LEO) where satellites are positioned. Accordingly, conflicts among some nations are already in tension due to outdated LEO treaties where 'first-in, first use' principle is used. LEO is becoming quite crowded with satellites, and both nation states and private companies want to position themselves in the best *space*. Another debate is the delimitation and demarcation of space; where does space start and even where does space end. Therefore, to which degree can one expect conflict or cooperation on the Moon or other celestial body if we cannot even set rules for something as close as LEO ?

Clean energy is the most important challenge Mankind has to face[3]. Dr. Richard Smalley also fears for the world the shortage of affordable and achievable energy resources, which are a necessity for stability in a global world.

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[3] Dr. Richard E. Smalley, Nobel Prize Winner in Chemistry, 1996. Nobelprize.org. www.nobelprize.org/nobel_prizes/chemistry/laureates/1996/smalley/html

ACRONYMS

BBC	British Broadcasting Corporation
CERN	European Organisation for Nuclear Research
CHM	Common Heritage of Mankind
CIA	Central Intelligence Agency
CNSA	China National Space Agency
COW	Correlates of War
DoE	United States Department of Energy
EFDA	European Fusion Development Agreement
ESA	European Space Agency
EURATOM	European Atomic Energy Community
FAI	Fèdèration Aèronauthique Internationale
FUSNET	European Fusion Education Network
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
IJC	International Court of Justice
ISRO	Indian Space Research Organisation
IOP	Institute of Physics
IPCC	Intergovernmental Panel on Climate Change
ISA	International Seabed Authority
ISS	International Space Station
ITER	International Thermonuclear Experimental Reactor
ITPA	International Tokamak Physics Activity
JAXA	Japan Aerospace Exploration Agency
LAO	Low Altitude Orbit
LEO	Low Earth Orbit
NASA	National Aeronautics Space Agency
NNSA	National Nuclear Security Administration
NRK	Norsk Ringkringkasting
NUPI	Norsk Utenriks Politisk Institutt
OPEC	Organization of the Petroleum Exporting Countries Exporting Countries
OST	The Treaty on and Principles on Outer space including the Moon and Other Celestial Bodies
RASA	Russian Aviation and Space Agency
SCAR	Scientific Committee on Antarctic Research
SIPRI	Stockholm International Peace and Research Center
UN	United Nations
UNCLOS	United Nations Conference on the Law of the Sea
UNCOPUOS	United Nations Committee on the Peaceful Uses of Outer Space
UNCSD	United Nations Conference on Sustainable Development
UNOOSA	United Nations Organisation for Outer Space

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This section consists of personal correspondence and could not be numbered

1.Introduction and Background

In 1938, writing in his book, *The Evolution of Physics*, Albert Einstein confessed his resignation with humankind's confinement to the Earth:

Unfortunately, we cannot place ourselves between the Sun and the Earth….This can only be done in imagination. All our experiments must be performed on the Earth on which we are compelled to live (Pelton et al., 2009:10).

Twenty years later, we orbited in space.

In 1969, human beings were walking the Moon.

A further fifty years on we now forge into an environment that has become international, intercultural, and interdisciplinary within the international space community. A community beginning from merely an assembly of a few nations is now a growing global faculty representing a host of nations. These different nationalities work closely with each other on international space programs solving new challenges collaboratively to discover new rewards for humankind. Mostly natural scientists worked in the space industry before. Today international (space) lawyers, social scientists, economists, insurance brokers, tourism, and other disciplines and sectors have joined this emerging space industry. This community, once governmental-driven, is now becoming more and more privatized and commercialized.

To unify and to prosper: this political imperative reflects the desire of nations to compete for technological superiority; however, this can represent international cooperation to enhance the global commons.

Human history has always favored expansion and development. New prospects yield new perspectives. We now stand on the beach, our small world, dipping our toe into the sea, which is the universe. We stare into this ocean of night and imagine that we are the new Columbus generation. The French author Jules Gabriel Vernes foresaw the Apollo mission some hundred and fifty years earlier in publishing in 1865 *From the Earth to the Moon*[1].

Space exploration and space science has spread to a multitude of activities. We understand more about environmental issues such as global warming. We employ space for many interdisciplinary sciences such as astronomy, astrophysics, cosmology, plasma physics, planetary geology, space archeology and space medicine to mention a few disciplines, however also for

[1] De la Terre à la Lune (original French title)

daily household applications such as telecommunications and broadcasting, navigation, education and medical training, and material developments.

Science spinoffs lead to technology transfer within areas such as Global Positioning Systems (GPS), computers, mobile phones, sportswear and gear, clothing, medical care, transportation, banking, etc. Other spin-offs from space technology are also enjoyed by people living in rural, remote, and isolated areas with the access of broadband communications and the internet due to satellite communication. Today, water purification systems originally developed for use on the Space Shuttle has been adapted to provide clean drinking water for hundreds of villages in Less Developed Countries (The Space Report, 2012).

Further, lives and ships are saved as meteorological satellites provide warnings of deadly storms for instance. Fisheries and deforestation are better controlled. Wild and threatened animals can be saved from poachers. The United Nations Office for Outer Space Affairs (UNOOSA) applies space tools to offer solutions to numerous areas in their development agenda such as food security, disease monitoring, natural resource management, disaster management and tele-education (UNOOSA, 2012).

Space programs aim to find out more about Earth, the space environment, the solar system and the universe. Medical space science helps people to live longer preventing less cancer and heart disease. Space science helps safeguard the environment and to monitor environmental change and damage. It improves land cultivation. It develops more accurate weather forecasts and creates maps to improve urban planning.

The first *space age* started in 1957 when the former Union of Soviet Socialist Republics (USSR) successfully sent the world's first satellite, Sputnik 1, into Earth's orbit. In 1961, the USSR sent the world's first manned flight into space. This *space race* eventually led to the USA's Moon landing in 1969 (Lutes, 2008).

In 1966, the Soviet Luna 9, 10, 11, 12, 14 un-manned space crafts were launched and subsequently landed on the Moon with one of the aims to determine the information on the characteristics and to determine and analyze chemical composition of soil samples of the Moon's surface. In 1976, the Soviet Luna 24 was launched and returned with samples from the Moon's surface (Burleson, 2005:230-233).

The first ever international and cooperative space mission was in 1975 between the USSR and the USA namely the Apollo-Soyuz test project. This lead to further cooperation on MIR, and the International Space Station (ISS) (Burleson, 2005:241-243).

The state of the global environment depends on a diversity of physical and biological pressures, induced either naturally or by humans. One main environmental pressure caused by human activity is the growing demand of natural energy resources such as the debated depletion of non-renewables such as oil, gas and coal. These resources have considerable, concerning and undesirable effects on the planet Earth and its atmosphere. Technological developments have improved our capability to limit some of these negative effects, however, population growth with the accompanying growth in energy consumption are putting increasing pressure on these nonrenewable natural resources found on Earth.

The Moon and other celestial bodies may hold a rich supply of a natural energy resource, namely helium-3. This natural resource not only can supply Earth with a clean, non-radioactive and safe source of energy, it might increase energy access to all, securing energy demand to meet human needs in the future. In Less Developed Countries (LDCs), access to affordable, reliable and sustainable energy is fundamental to reducing poverty, to improving health, and economic productivity, hence attaining economic growth and stability.

The United Nations Millennium Development Goals (MDGs)[2] actually do not include specific targets in relation to access to electricity for example as one energy resources despite the fact that the United Nations declared 2012 to be the 'International Year of Sustainable Energy for All'[3], officially recognizing the urgent need to put energy at the center of the global development agenda.

Other strategic platforms held to discuss energy access are the International Energy Agency[4] (IEA) held in Oslo, Norway in October 2011 namely 'Energy for All Conference'. In December 2011, another was held in Durban, South Africa namely 'COP17'. These are however pre-meetings which are to be addressed at the United Nations Conference on Sustainable Development (UNCSD) in Rio de Janeiro, Brazil in June 2012. International concern regarding energy and access thereof is a growing issue.

[2] MDGs consists of 8 goals adopted by world leaders in 2000 set to be achieved by 2015, and provide concrete , numerical benchmarks for tackling extreme poverty.
[3] www.un.org/milleniumgoals. Accessed 08.10.2011

Sustainable development is primarily a global goal and the world's population today is approximately seven billion and increasing. According to Weisz (2004:47-52) and Bartlett (2004:35-55) the global energy future lies in meeting the needs of ten to twelve billion people in 2050. Global energy consumption is therefore an accompanying effect on non-renewables such as oil, gas and coal and may lead to conflicts as in the past.

International conflicts among countries seem be on the rise over space, in Low Earth Orbit (LEO) itself regarding satellites positioned in space, and, not to forget space pollution caused by debris from shooting from Earth old and outdated satellites resulting in debris in space as China and the USA have done, and still do. Today there is a main concern regarding this space pollution problem and challenge as it is capsuling the planet Earth, hence may be result obstacles for future space programs (PAX America documentary, 2011). This will be discussed in brief as it is not the initial goal of this thesis, however to describe that international conflicts do exist over space. The questions to ask here are: How is space defined? Where does space begin? Where does outer space start and even end? Where does space end?

Helium-3 may be the new energy resource in the future accompanied with other renewable energy resources such as solar, wind, and hydropower is among others. Helium-3 is considered a clean and safe natural resource, and accordingly, in abundance on the Moon and other celestial bodies. This natural resource, a scarcity on Earth and in high demand for several applications as mentioned above, may cover the global energy demand for several thousands of years. Since September 11, 2001 bombing of the Twin Towers in New York, the demand for helium-3 has exceeded supply.

Other natural resources in high global market demand existing, and in abundance, on the Moon and other celestial bodies, are Rare Earth Elements (REEs). More important to consider these REEs in this thesis is that these elements may be mined and used in various manners to assist in the technical mining of helium-3. REEs can supply the growing global market demand on Earth. China today has the monopoly covering 97% of the global demand of REEs

This thesis not only aims to shed light on this young and advancing space industry to the interested reader, it however aims to explore possible outcomes of future international cooperation to avoid a geopolitical conflict over a future exploitation of helium-3 on the Moon[5] and

[5] This thesis will focus on the Moon due to its proximity to Earth and therefore more economically and technologically viable. Further, the Moon has *mostly* been explored, orbited, and walked upon.

other celestial bodies. Therefore, the question arises as to what are the current available mechanisms to avoid conflict, to cooperate and share this natural resource that may decrease poverty with energy access and energy security increasing living standards of Less Developed Countries (LDCs).

The relevance of this thesis is due to the *second* space race (1991 to present). The *first* space race began during the Cold War from 1957 to 1991 between the former USSR and USA in space exploration and technology, and especially the geostrategic competition between them both to be the first to be in space (Lutes, 2008).

There are two main reasons for returning to the Moon: One, the Moon can be a stepping-stone to other celestial bodies such as planets and asteroids for further exploration and exploitation.

Two, the abundance of the natural resource called helium-3 on the Moon. Helium-3 is a rare isotope used in many civilian applications and for national security purposes today. Helium-3, once mined on the Moon and other celestial bodies could supply Earth with vast amounts of a clean and safe source of energy in the future once fusion technology for helium-3 is accomplished.

Once realized this may help decrease global poverty in Less Developed Countries (LDCs) by helping them gain access to energy. Energy access leads to productivity and sustainability. According to the United Nation's Millennium Development Goal (MDG) number one: To Eradicate Extreme Poverty and Hunger[6] consisting of three objectives:

To halve, between 1990 and 2015, the proportion of people whose income is less than $1 a day; to achieve full and productive employment and decent work for all, including woman and children; to halve, between 1990 and 2015, the proportion of people who suffer from hunger.[7]

One and a half billion of the world's population have no access to electricity at all, and three billion people rely on traditional biomass and coal for just for cooking and heating (Hunt et al., 2010).

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[6] United Nations Summit, 20-22 September 2010, New York. High-Level Plenary Meeting of the General Assembly. www.un.org/millennium goals/pdf/MDG_FS_1_EN.pdf. Accessed 16.08.2011

[7] Ibid

The moon and other celestial bodies contain a vast amount of natural resources. It is estimated that the use of these resources as a source of energy not only will have a huge impact, however will have the capability to solve the energy challenge on Earth in the future. Non-renewable energy resources are running out and organizations such as the US Department of Energy (DoE), Organization for the Petroleum Exporting Countries (OPEC) estimate that fossil fuels deplete within the next half century, or earlier.

The supply of fossil fuels is limited and their extraction and use harms the environment. According to the International Energy Agency's 'World Energy Outlook 2010 Factsheet', the world energy demand will increase by 36 % between 2008 and 2035.

The process of drilling in shale rock for natural gas is called Fracking[8] first commercially used in 1949 at a well in the Hugoton gas field located in Kansas (Britt et al., 2009) estimates that of the existing wells only in the USA fracturing has been performed in more than 70% of them. According to Bloomsberg Businessweek (03.03.2011) the percentage is as high as 90%. The debate that fracking fluids such as diesel oil used in the drilling process and producing wastewater contaminates river basins and potable water according to the New York Times (26.02.2011).

Alternative approaches of generating energy by means of hydro, wind, and solar power, geothermal power, bioenergy to give some examples. These energy-generating technologies may either be alternative and/or supplementary approaches of generating energy in order to challenge both present and future demand and to reduce CO2 emissions according to the Kyoto Agreement. Some of these alternatives are still in their infancy, and at times the sun is not shining and the winds are not blowing.

Nuclear power, as another energy source, is under international debate due to nuclear power plants disasters such as Chernobyl in the Ukraine in 1986 and Fukushima in Japan in 2010. This may have led to Japan to re-evaluate the safety of nuclear plants.

For example, 25 years ago the Chernobyl nuclear power plant in the Ukraine exploded releasing large quantities of radioactive contamination into the atmosphere. Again, in February 2010, the Fukushima nuclear plant accident in Japan caused almost the same result of contam-

[8] Also referred to as hydraulic fracturing or hydrofracking.

ination that I assume dangerous for both people and environment. Mayak[9] was one of the worst nuclear accidents in history. The USSR kept this as a secret for 30 years after the explosion in 1957 having released 50 – 100 tons of radioactive waste, contaminating a large region in the eastern Urals. In the past 45 years, as many as 400,000 people have been irradiated in one or more of the accidents[10]

Today, Japan, Germany, Italy, and South Korea have stopped all future plans and programs for new nuclear power plants construction. Germany especially has shut down several of their existing nuclear power plants after the Fukushima accident (NRK, 13.06.2011).

Energy access and economic development are the primary drivers in developing countries, whereas energy supply and environmental concerns are the most important concerns to developed countries. Governments are now turning towards renewable energy sources such as bioenergy, solar energy, geothermal energy, hydropower, ocean energy, and wind energy.

According to the 11th working group III of the Intergovernmental Panel on Climate Change[11] (IPCC) held in Dubai, United Emirates in May 2011 the shares of energy sources in the total global primary energy supply in 2008 was for coal 28,4%, gas 22,1%, oil 34,6%, nuclear energy 2,0 %, and renewable energy 12,9%. Renewable energy sources will play a central role in moving the world to a more secure, reliable and sustainable energy path. The potential is large, but depends on the strength of governments to support technological developments and make renewables competitive with other resources. The World Energy Outlook 2010 Factsheet - IEA (2010) states that:

Renewables are generally more capital intensive than fossil fuels, so the investment needed to provide the extra renewables capacity is very large. Investment is estimated at USD 5.7 trillion[12] over the period 2010 – 2035. Renewables are expected to become increasingly competitive as fossil fuel prices rise and renewable technology matures.

The demand and use of energy is as old as human history. Coal helped fuel the industrial revolution of the 18th and 19th centuries. Oil use formed the basis of the mobility revolution of

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[9] Mayak Production Association is one of the largest nuclear facilities in the Russian Federation built in 1945 – 1948 as part of the USSR's nuclear weapon program. Today the plant specializes in reprocessing spent nuclear fuel from nuclear reactors and from decommissioned weapons producing tritium and radioisotopes. en.wikipedia.org/wiki/Mayak. Accessed 14.06.2011

[10] www.american.edu/projects/mandala/ted/ural.htm.
Accessed 14.06.2011

11 United Nations Environment Programme (UNEP)

[12] 2009 US dollars

the 20th century. All fuel types are used to provide access to electricity, and the global consumers allow energy service to fuel economic growth and social progress. Energy demand will continue to grow to 2030 as economies expand, the world population grows and people's living conditions improve (OPEC, 2010).

Cooperation is as old as human history and so is conflict. One major example is the European settlement of the New World in the Americas from the 15th through 17th centuries represents ways comparable to that of future human settlement of the moon. This case involved the great powers of the time: Portugal, Spain, France, Great Britain, and the Netherlands.

Native people of the New World were defeated by European colonizers as they forced upon them advanced technology and its own type of human organization. However, these countries entered into conflict among themselves. The Treaty of Tordesillas in 1494 divided the Americas into zones for the colonizers, Spain and Portugal. It fell apart due to facts such as sailing and navigation technology enabling to send rival missions, the presence of multiple great powers in the international system and the absence of taboos against the use of weapons and the corresponding acceptance of war as a means of conflict resolution.

Governance of the New World followed the same European regime with the same social and political institutions and related forms of legislation. There were territorial based disputes and economic competition as states wanted to own and occupy the most profitable regions. Power and not cooperative rules and norms dictated the resolution of differences between states over sovereignty as to territory and resources. The criteria for a successful cooperation at the time did not *prefer a more regulated environment*, did not *believe that others share*(d) *the value they place*(d) *on mutual security and cooperation and faced condition in which one or more actors believe*(d) *that security* (was) *best provided for by expansion* (Jervis, 1983:176-177). Under these circumstances, efforts at conflict resolution through regime formation were bound to fail.

The two existing space law treaties do not contain any specific details dealing with the use of natural resources in outer space. In this regard, analysis will focus on these two United Nations documents: The 1967 Outer Space Treaty[13] and the 1979 Moon Agreement.[14]

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[13] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including The Moon and Other Celestial Bodies

[14] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies

This may well be that a major reason for the fact that the exploitation of natural resources in outer space has not yet begun could be due to the absence of specific rules establishing how this exploitation has to take place and the rights and duties of the parties involved. Due to this uncertainty, both nations and private entities interested in these resources might well have doubts over investing capital and technologies in these activities. A legal regime to manage and regulate the exploitation of the natural resources of the Moon and other celestial bodies is the key. This thesis will also explore the existing legal regime, and whether there is a need for a complete new international organization including new legislation for the exploitation of natural resources on this new frontier.

Nations of this planet have three main undisturbed resources areas yet to tap: the deep ocean floors including the Arctic, Antarctica, the Moon other celestial bodies, and beyond. What is unique to these areas is that no nation can claim them exclusively as their own. This situation results in international questions especially when it comes to exploration and exploitation of natural resources within these areas. The quest for profitable natural resources such as oil, minerals, metals, gems, timber, fisheries, water, etc. may often be a basis for conflict, and even wars, according to International Relations scholars such as H. Morgenthau, K. Waltz, J. Mearsheimer, and S. Huntington (Sharp, 2007:323). Therefore, a legal regime for outer space governance is important as non-cooperative international relations regarding the Moon and its natural resources may lead to future conflicts. Such patterns regarding have plagued human-kind for centuries. Despite hopes for cooperation, territories with scarce and profitable natural resources have been are sources of conflict.

Typically and consistent with realist predictions about international politics, states have had a built-in penchant to pursue relative gains over their rivals and therefore have sought to seize and defend new resources to their own advantage. On the other hand, successful formation of a stable, transnational governance system – a mechanism for sharing or otherwise peacefully allocating the Moon's resources – could open the possibility for mutually beneficial and self-sustaining lunar commerce and settlement, consistent with neo-liberal institutionalist predictions (Motlz, 2008:82).

Major findings in conflict studies are that territory disputes have a greater probability of ending up in a conflict: *Territorial disputes are not necessary a condition of war, but only increase the probability of war when they are present* (Vasquez and Henehan, 2001:123-138).

Further, according to the Central Intelligence Agency (CIA) more than 200 disputes[15] are ongoing at present over terrestrial and maritime territories, boundaries, and natural resources all over the world (CIA Fact Book, 2009).

Links between resources and conflicts are often popularized through the concept of 'resource wars' mediated in the late 1970s as a metaphor describing renewed tensions between the Cold War between the USA and the USSR over the control of fossil fuels and minerals in disputed peripheries such as the Middle East and Southern Africa (Russett, 1981:42-58). The term 'resource war' refers to conflicts revolving over the *pursuit or possession of critical materials* (Klare, 2001:25).

The status of the Moon has changed after the competition between the USA and USSR. Today, with the beginning of the twenty-first century, marked by the end of this bipolar competition between the East and the West, by the globalization of the international economy, and by a renewed spirit of cooperation among states, the Moon has become a great opportunity for all humankind due to great technological developments and advancements, a new hope for the betterment of conditions of life of the people on Earth. New space nations have emerged and China has captured most of the attention, Japan, and India, are expanding their space programs. (Moltz, 2011:171).

As space exploration missions become increasingly complex and expensive, space agencies turn to partnerships to realize their goals and objectives such as the International Space Station (IIS). These partnerships are increasingly putting partners on the critical path to the success of the overall effort. Human exploration missions will benefit from the interdependency at the architecture, mission and capability level.

Therefore, there is a clear need for an appropriate legal regime organizing the future exploitation on the Moon and other celestial bodies, excluding Earth, in an orderly and safe manner, which – to the extent to cooperate internationally and avoid any future conflict for the purpose of human kind.

International treaties of outer space, the sea, Antarctica and the Arctic are branches of international law regulating activities in areas that do not fall, or only partially, under national sover-

[15] Definition of 'Dispute' is not covered in the CIA fact book.

eignty. The two principle sources of the vast body of international law are custom and treaty[16] (Brownlie, 1990:3).

Of the latter category, the most important instruments are the Treaty on Principles Governing the Activities of States in the Exploration and the Use of Outer Space Including the Moon and Celestial Bodies (OST) and the 1982 United Nations Convention of the Law of the Sea (UNCLOS).

According to Article II of the OST, space remains totally beyond the scope of any national sovereignty. Seas are only partly beyond sovereignty of states[17]. However, the seas and the deep seabed fall entirely outside such sovereignty (UNCLOS Articles 87, 89, 137). Hence, outer space and the deep seabed are very similar in legal status.

Furthermore, how is natural resource exploitation of helium-3 (or other scarce and profitable minerals and metals e.g. Rare Earth Elements (REEs) also thought to exist on the Moon and other celestial bodies[18]) on the Moon to be solved in the future? As per today, the only sovereign entity entitled to manage this issue in the whole space community is the UN. Should Moon-related issues continue to be managed by the UNOOSA, the sole entity responsible for international cooperation in the peaceful uses of outer space? This body serves as the secretariat for the General Assembly's only committee dealing exclusively with international cooperation in the peaceful uses of outer space: the United Nations Committee on the Peaceful purposes in Outer Space (COPUOS). Or, should a new legal regime be put in its place altogether as in OST, article I states that nations may only *use* the Moon for peaceful and scientific purposes.

Keeping in mind such importance of the Moon and other celestial bodies' resources, their exploitation may generate a large amount of benefits and may contribute to improve the quality of sustainable life and for the most unfortunate people and their livelihoods on Earth.

[16] Article 38 (1) (a-b) of the statute of the International Court of Justice (IJC)

[17] There is national sovereignty in the territorial sea and quasi-national sovereignty, limited mainly to exploration and exploitation of natural resources in the exclusive economic zone and the continental shelves. UNCLOS Articles 2, 56, 77.

[18] Today China holds close to 100% of the REE market in the world.

1.1. Purpose

This thesis aims to assess the degree to which one can expect conflict or cooperation and if the latter, what are the current mechanisms to avoid conflict and share the natural resources of the Moon and other celestial bodies.

1.2. Objectives

- To investigate space developments and international treaties due to that major space faring nations suggest in their programs to explore and exploit natural resources on the Moon and other celestial bodies in the future.

- To explore the geopolitical dynamics in an highly unequal world with huge disparities in energy consumption and energy access to fight poverty. Ensuring energy access is one of the major challenges the world faces today in LDCs. The lack thereof affects and undermines health, limits opportunities both for education and sustainable development for those living under extreme poverty.

1.3. Methodology

1.3.1. Data Collection Method

The data collection method for this thesis is using the technique that Bryman describes as unstructured interviews for collecting data, which I find the most relevant method for gathering applicable qualitative data (Bryman, 2008:48, 184-185, 699). The main advantage with this approach is the flexibility the method offers as it allows going into depth on particular issues instead of going through a fixed list of questions.

1.3.2. Informants and Respondents

The informants are authorities within international space law, fusion technology and helium-3 science, lunar geology, various authorities within the space industry and specialists within the oil and gas industry. Since the main goal was to gain a deeper understanding of my topic and acquire knowledge, qualitative interviews by correspondence seem to be the best-suited method of data collection.

The informants I had personal connect with are based on the 'Snowball' sampling approach (Bryman, 2008:184*) where the researcher will make initial contact with a small group of* *people who are relevant to the research topic and then uses these to establish contact with others.*

During my research work however, I was in for a surprise. On a ‘ad-hoc’ basis (neither part of the planned data collection method nor part of this thesis) I talked to approximately sixty to seventy people about their knowledge regarding the subject *outer space*. These respondents gave similar answers e.g. the landing of the Moon, NASA, the American astronaut Neil Armstrong, a few answered the European Space Agency (ESA) and the first manned sputnik. Not *one* person mentioned the word *satellite.* This could be to the fact that at present outer space does not have much immediate bearing on the daily lives of the vast majority of people despite their relevance to people is considerable, however for the time being this relevance is largely indirect. Another factor contributing to this situation is that outer space is mostly technical, involving information attained by specialists and discussed amongst themselves. There was a deviation between those around forty years old and older and those of a younger age. The older were more specific as to the year of the Moon landing in 1969 and the first manned Sputnik of the former USSR that went into orbit. The ones under forty had a limited amount of knowledge of outer space, however knew several science fiction movies and computer games.

1.3.3. Secondary Literature

The use of secondary literature sources, and especially on the internet, is invaluable. Space development and technology advances at the speed of light. However, due to peoples’ admiration and fascination for space, literature available on the internet had to be carefully evaluated and analyzed due to the vast amount of science fiction and controversies. Journals within Conflict and Development, Space, Astronomy, International Space Law, Chemistry and physics, geology were highly valuable. Reports and articles were also prized for covering specific aspects and courses of events. Newspapers gave little coverage on space matters.

1.3.4. Limitations

Secondary literature resources from India, and China especially are difficult to acquire. Much is written is their respective languages with little, poor or no English translation to offer a foreign and interested researcher. Their internet sites are deprived from maintenance. Therefor I had to rely on either English or French information.

The United Nations Office for Outer Space Affairs (UNOOSA), responsible for promoting international cooperation in the peaceful uses of outer space, were to be a vital information resource during my research. After numerous efforts in trying to initiate contact with the UNOOSA office, a meeting was eventually agreed upon with one of the UNOOSA members. Three days before departure to Vienna, the person dropped this important meeting. I have numerous times, tried to contact this office in order to enhance my understanding of certain issues regarding international space law agreements. However to no avail despite that their website[19] clearly states the following: *.....the Office provides information and advice, upon request, to governments, non-governmental organizations and the general public on space law in order to promote understanding, acceptance and implementation of the international space law agreements.....* An interesting observation from my part!

However, using the Snowball sampling approach I came in contact with another UNOOSA member with observer status via the international space law specialist Franz G. von der Dunk.

Despite the space industry becoming more and more privatized, there still seems to be some red-tape among the space agencies as to releasing information beyond the public eye.

Further, I have little background in International Law, and even less in International Space Law that has become a science in itself due the increase in space activities. The success was that I learnt a lot and hopefully this will mirror in this thesis.

Lastly, the constraints of time and finances.

2. SPACE

2.1. Definition of Space and Outer Space

Outer space is the space upwards from the airspace (atmosphere) surrounding the Earth. As the composition of the atmosphere does not change dramatically at a certain height, it is impossible to physically determine exactly where the airspace ends and outer space begins. Consequently, the problem of limitation is more a political and legal issue than a straightforward technical one. Some kind of a fixed limit would be of great importance, however, because airspace partly falls under national sovereignty[20] Airspace comes under national jurisdiction

[19] www.unoosa.org/oosa/en/SpaceLaw/index.html
[20] Airspace comes under national jurisdiction and sovereignty where it lies over national territory and territorial

and sovereignty where it lies over national territory and territorial waters. Otherwise, outer space is not subject to national sovereignty e.g. over the high seas. They both belong to the Global Commons[21] (Kegley et al., 1999:316).

2.2. Space Industry, Development and Infrastructure

The space sector originates from World War II after the successful launch of the Soviet's Sputnik in 1957. The first considerations for the space sector were political and military between the Soviet and western blocs during the cold war (Logsdon, 2010:7-8).

Today, the space industry structure is changes and is commonly divided into three sectors today: defense, intelligence, civil, and commercial. Although largely independent of one another, these sectors share an industrial base, a workforce, and infrastructure. The defense and intelligence sectors are referred to as 'national security space'. Civil space includes all non-defense government space activities such as USA's National Aeronautics and Space Administration (NASA). Commercial space consists of private entities and segmented into satellite manufacturing, launch vehicle manufacturing and service, and satellite operations and services. The expanding commercial sector includes entrepreneurial space companies and emerging markets for space capabilities (The Space Foundation, 2011:4).

2.3. Space Market and Economy

The global space economy continues to grow and increased by 7.7% in 2010. The economy increased by nearly USD 20 billion during 2010 reaching an estimated total of USD 276.52 billion. Some came from increases in government spending, however the vast majority occurred from the commercial sector. Revenue from commercial infrastructure and support industries increased by 13% in the same year, reaching a total of USD 87.39 billion. Commercial space products and services increased by 9% adding USD 8.55 billion in revenue for a total of USD 102 billion. One area of concern is the commercial space transportation service sector, which declined by 88% in 2010 as there were no seats available for purchase by private individuals wishing to travel into orbit (The Space Report, 2011:6). This may be due to two reasons: Technology security, and to the legal space regime as this sector is obliged to adhere to both national and international space law as many nations have their own definition

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waters. Otherwise, it is not subject to national sovereignty, e.g. over the high seas. Convention on International Aviation, Articles 1, 2.. UNCLOS articles 2, 58, 78, 87. Airspace over a stat's exclusive economic zone and the continental shelf is comparable in status to airspace over the high sea (Haanappel, 1986:145-148).

[21] The 'Global Commons' are Antarctic

of where space stops and outer space starts, or in other words: Sovereignty and the jurisdiction of airspace and outer space – a legal criteria for airspace delimitation.

Figure 1 below depicts the global space activity for 2010 where it clearly shows the commercial market has a superior market share of nearly 70%, and not to forget that this was not so long ago a purely governmental affair.

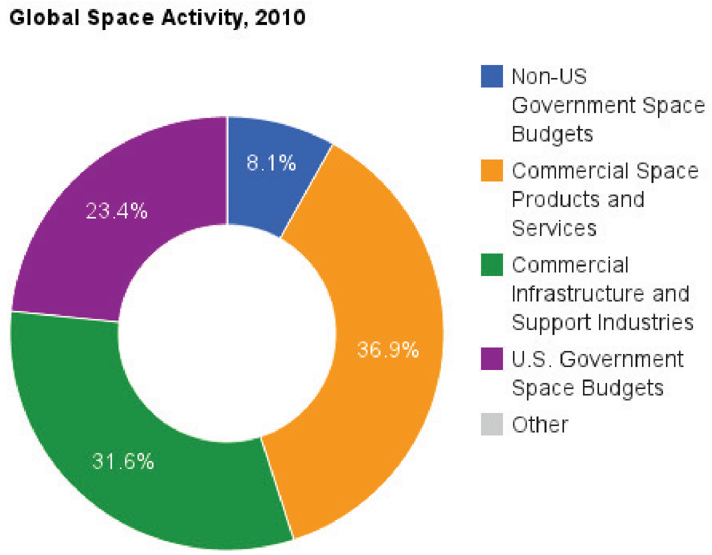

Figure 1 Global Space Activity in 2010, Space Report 2011

2.4. Space Insurance

The global space insurance market is in good shape. In 2008 was a profitable year for space insurers (gross premiums of USD 930 million compared with estimated claims of less than USD 320 million). Space insurance is the third largest expense in a satellite project. Since 2000, the market has been profitable as broadcast and telecommunications services are expected to grow in the future. The space insurance market in China has excelled. Whilst China's space history began in 1970 with their first satellite launch, only one insurance company existed in China namely the People's Insurance Company of China (PICC). Today, there are

19 insurance companies offering an underwriting capacity in excess of USD 200 million per launch into space (Risk Management, 2009:4).

2.5. Space Education

The US space industry is facing demographic challenges as a significant number of employees are approaching retirement in the workforce. There are questions whether the supply of graduates is sufficient to fill the gap with a specialized workforce in this expanding sector. The European space industry increased its workforce by 3% in 2009, and now reaches a total of 31,000 jobs. In Japan, the workforce increased by 22% the same year and has 6,300 workers. China doubled its number of first-degree Science and Engineering graduates from 325,000 to 777,000 from 2002 to 2006 (The Space Report, 2011:8).

The American civil space workforce declined for the fourth year in a row, dropping 3% from 259,996 in 2009 to 252,315 in 2010. Both Europe and Japan saw increases in their civil space work force (The Space Report, 2012).

2.6. Space Launch Industry

The global launch industry carried out 74 orbital launches in 2010. Russia remains the global leader conducting 31 launches compared to China and the USA, each with 15. It is estimated that there are nearly 1000 active satellites in orbit around Earth. One of the recent growth areas is satellite-based broadband internet connectivity. Commercial operators are seeking to provide consumers in underserved and remote areas. There is a rapid expansion in the number of devices that use satellite-based positioning, navigation, and timing services has provided additional impetus for countries to field their own satellite navigation systems. The coordination of these systems, as well as infrastructure to improve the accuracy of navigation systems used by the aviation and transportation industries, has emerged as an important area for international cooperation (The Space Report, 2010:7).

In 2011, there were a total of 84 launches into space, 14% more than in 2011. Russia led with 331, China had 19 and the USA had 18, making the first time that the Chinese launches exceeded those of the USA (The Space Report, 2012).

2.7. Major Space Faring Nations

The definition of a space faring nation is *a nation with the ability to access space capabilities using their indigenous space systems* (Dictionary of Military and Associated Terms, 2012).

Space faring nations have space programs. *It is frequently a government-controlled entity assigned to perform activities such as space exploration research. It can also refer to a nation's commercialization and development of space technology. Space programs can either be manned or unmanned* (Burleson 2005).

The major space faring nations: USA, Russia, India, and China have each announced to establish a base on the Moon, in part with the purpose to mine and bring to Earth helium-3, rarely found on Earth but believed to be in abundance on the Moon. These space nations plan to launch industrial mining helium-3 by 2020 (Bilder, 2009:243).

The European Space Agency (ESA) with its nineteen member states[22] is intently left out as ESA does not plan to either go to the Moon, nor mine helium-3, and therefore not relevant to this thesis. However, according to the European Commission's communication of 4th of April 2011 to the European Parliament that their space policy focuses on security, innovation and job growth, and political independence. It must be understood that not all member countries of the European Union (EU) are members of ESA and not all ESA member states are members of the EU. ESA is a completely independent organization although it maintains close ties with the EU through the ESA/EC[23] Framework Agreement. The two organizations share a joint European strategy for Space and have together developed the European Space Policy (ESA, 2012). However, ESA has successfully ended the following achievement:

Mars500 is the first realistic full-duration simulation of a human mission to Mars performed by ESA. This interplanetary voyage began on 3 June 2010 and ended 4 November 2011 from a 520-day interplanetary spaceflight. This was an international project with a crew from France, Russia, Italy, including China. The mission was conducted by Russia's institute of Biomedical Problems (IBMP), with participation by ESA as part of its European Program for Life and Physical Sciences (ELIPS) to prepare for future human missions to the Moon and Mars (ESA, 2011).

2.7.1. New Emerging Space Nations – An example

In 2009 within a year of similar communication from Germany, the UK, Denmark and Brazil another space-active nation wrote to the COPUOS stating its intentions to continue its investment and involvement in outer space. It was stated that this country:

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[22] Austria, Belgium, Czech Republic, Denmark, Finland, France Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Norway, Portugal, Romania, Spain, Sweden, Switzerland, and the United Kingdom

[23] European Commission

Has been utilizing both air- and space-based platforms for information and communications, and has developed air-based surveys using sophisticated aircraft equipped with the necessary imaging instruments. Moreover (...) prospectively plans to launch a multi-mission geostationary satellite for telecommunications, telebroadcasting, information technology-based functioning and microwave remote sensing devices, in addition to telecommunications instruments. The geostationary satellite data will be used for meteorological applications such as monitoring cyclones, rainfall, floods and cold waves, which are regularly occurring phenomena in (...). The development of air-based survey system, polar orbiting and geostationary satellites is very important for (...)[24].

That country was Bangladesh. According to the World Bank (2009) 40% of its population lives below the national poverty line. According to UNCTAD (2009) Bangladesh is one of 49 countries designated by the UN as a Least Developed Countries (LDC). Yet its concern regarding outer space exploration and utilization is both commendable and indeed imperative if it is to emerge from underdevelopment. This underscores the importance and reality of outer space exploration to all modern states and the need for international treaties to catch up with technological developments and accelerating advancements in outer space exploration (Oduntan, 2012:2).

2.8. Space Privatization and Commercialization

Google's chief executive Larry Page and film director and James Cameron are now planning within five to ten years to explore and commercially mine natural resources from another celestial body in space: asteroids. Asteroids, as the Moon, may contain natural resources such as iron, platinum, gold, and diamonds. This private company, Planetary Resources founded in 2009, is also backed by space tourism pioneer Eric Anderson, X-Prize founder Peter Diamandis, Ross Perot, and veteran astronaut Tom Jones (BBC, 24.04.2012).

2.8.1. Space Tourism

One of the most special international collaborations within space tourism is the Commercial Spaceflight Federation[25] with members such as Sir Richard Brandson, head of the Virgin brand, Elon Musk who started Paypal, Paul Allen, co-founder of Microsoft along with Bill Gates, Robert Bigelow, the creator of Amazon.com (Pelton et al., 2010:110-113).

[24] Bangladesh communication to UNCOPUOUS , 27.10.2009
[25] Formerly named the 'Private Spaceflight Federation'

The space tourism industry has rocketed during the last decade.

As with market economics, the more the competition, the lower the price. These companies, mostly from the USA but also Australia, Denmark, and the United Kingdom and will accommodate services such as orbit flights, IIS tourism, and taxis. These are: Rocketship Tours, Space Adventures, Virgin Galactic, Blue Origin, Armadillo Aerospace, Xcor, Copenhagen Suborbitals, and Bigelow Aerospace to mention a few.

3. THE INTERNATIONAL REGIME AND TREATIES FOR OUTER SPACE

3.1. United Nations Office for Outer Space Affairs (UNOOSA)

The UNOOSA is the UN office responsible for international cooperation in the peaceful uses of outer space and serves as the secretariat for the General Assembly's only committee dealing exclusively with international cooperation in the peaceful uses of outer space: the United Nations Committee on the Peaceful uses of Outer Space (COPUOS).

The beginning of COPUOS started in 1958 after the first artificial satellite, Sputnik, was launched into space by the former USSR in 1957, as an ad-hoc committee. In 1959, a permanent committee was established by the General Assembly consisting of 24 member states. As per 2011, the Committee consists of 71 member states[26] and is one of the largest Committees in the United Nations[27] (UNOOSA, 2012).

3.2. The Outer Space Treaty (OST) of 1967 and the Moon Treaty (MT) of 1979

The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies is the framework for the exploration and use of outer space. However, the OST has been much debated due to its wording and hence (mis)interpretation. This treaty states that state members may *use* the Moon for peaceful purposes (art. I). The wording has been much debated as it can mean all activities and not only for scientific activities. Art. II prohibits any *national* appropriation by claim of sovereignty. Again, the wording could be misinterpreted. It could mean that a private entity or person could claim sovereignty over the Moon. Art. IV states that parties have the right to exploration and use of the Moon without discrimination of any kind on the basis of equality and

[26] For list of member states, go to www.unoosa.org/oosa/en/COPUOS/members.html
[27] For an overview, go to www.unoosa.org/oosa/COPUOS/cop_overview.html

benefit mankind. This could mean that mining helium-3 on the Moon to generate a clean, safe and non-radioactive energy resource, for all, and especially LDCs to alleviate poverty and to increase access to energy for sustainable development.

The OST made much confusion as to how to interpret the Treaty among its 100 member states. As there were many interpretations of the Treaty, few states wanted to invest in further exploration. It went so far that Dennis Hope claimed the Moon as his own as he was a private person and not a nation. He established the Lunar Embassy and sold real estate on the Moon to the general public, and still does (Lunar Embassy, 2012).

The United Nations COPUOS deliberated and developed from 1972 to 1979 the Moon Treaty (MT) and was in force in 1984. However, the MT has been ratified and or signed by ten countries, none are space faring nations[28] The USA, Russia, and China have neither signed, nor ratified the MT, which has lead to the conclusion that the MT is a complete failure from the stand point of International Space Law (The Space Review, 2011).

4. ENERGY RESOURCES AND OUTLOOK ON EARTH

Below are given examples on energy demand, supply, usage, few statistics regarding non-renewable energy resources[29]:

China's energy demand was only half of the USA in 2000, however, it proceeded to grow at a pace four times faster than in the previous decade according to the IEA[30]. The IEA projects China's demand will increase by 75% by 2035.

Russia has the largest energy usage per capita due to a harsh climate, a declining population, dependence on heavy industry, and inefficient production and distribution systems put into place during the Soviet Union era.

Ethanol fuels about half the passenger vehicle travel in Brazil. All gasoline sold has at least 20 percent ethanol blended in. Drivers also have a choice to 100% ethanol. When oil prices are low, customers heavily favor petroleum.

[28] Denmark, Zimbabwe, Guinea-Bissau, Latvia, Baharain, Sri Lanca, Nicaragua, Tunisia, Grenada, and ESA with status Non-Party.
[29] Unfortunately, the reference has been misplaced or lost.
[30] World Energy Outlook 2010.

Australia depends heavily on the most carbon-intensive fuel to generate electricity accounting for its high greenhouse emissions per capita. However, Australia sends 66% of its coal abroad and mainly to Asia.

Drought has caused critical shortages of hydroelectricity in many Asian, African and South American countries. Climate changes that reduce rainfall may make it difficult for some countries to rely on this form of renewable power.

Pakistan leads the world with 2.3 million natural gas vehicles with 1.8 million in Iran and 1.6 in Brazil. The nation with the largest proven natural reserves, Russia, has only approximately 100,000 vehicles running on the cleaner-burning fuel.

The large fifty-year old geothermal plant in California, The Geysers, helps the USA generate more energy from underground heat than any other country. However, it adds up to only a fraction of the nation's electricity consumption.

Iceland and Costa Rica derive more than 90 percent of their power. El Salvador is supplied with about 40%.

Burning of biomass, in the form of wood, coal, crop waste, and dung, provides the vast majority of energy consumed in Sub-Saharan Africa. Cooking smoke is a major health risk where less than two percent of the population has access to electricity.

Norway exports more natural gas than any other country except for Russia, and provides much of Europe's crude oil due to its access to North Sea resources (Insert projected Barents Sea and Arctic reserves). However, Norway derives its own electricity mainly from hydroelectric power.

The International Energy Agency (IEA) projects that 93% of the growth in energy demands over the next 25 years will come from today's developing countries.

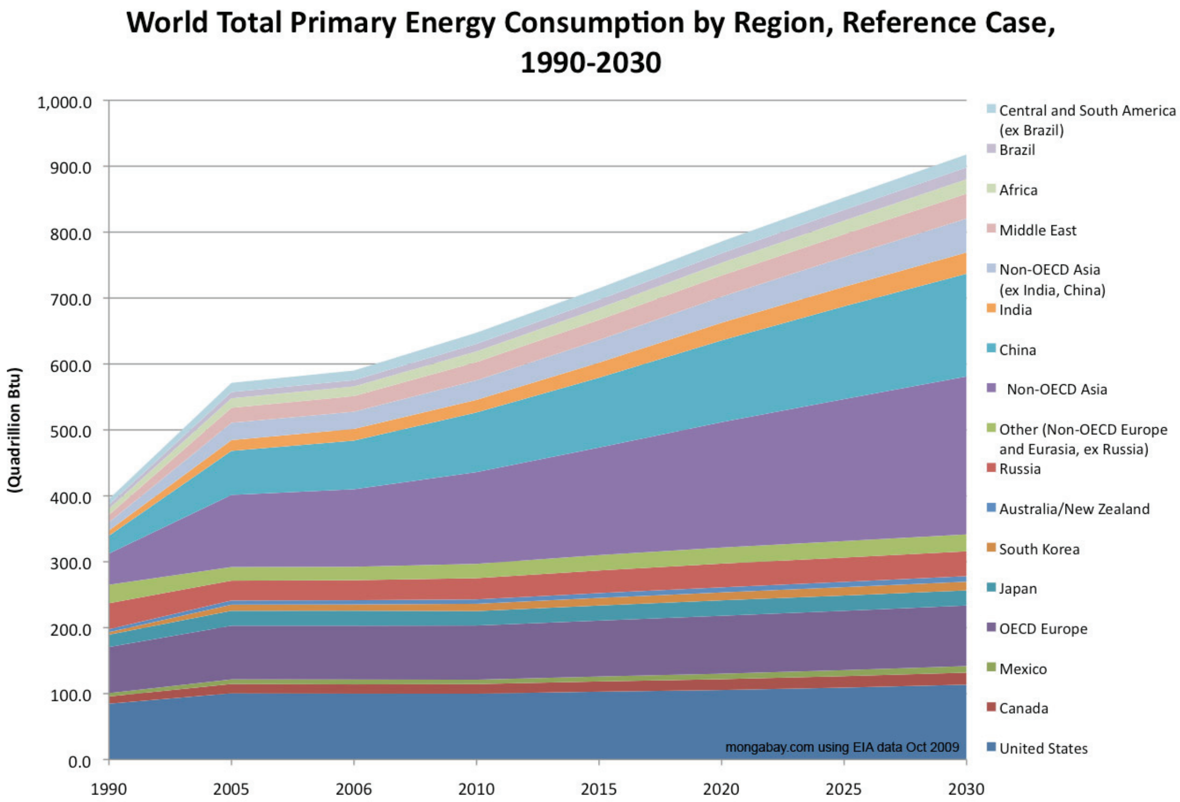

Figure 2 Source DoE, 2009

5. NATURAL 'OUT OF THE BOX' ENERGY RESOURCES

We are continuously confronted with a rising world energy demand as the global population is growing. The energy future depends on matters such as uncertainties of environmental, political issues and technological developments. Most of the global energy produced is by burning fossil fuels. Negative side effects for the environment and depletion of these non-renewable resources may force us to think us to use alternative energy resources.

5.1. Nuclear Fusion

Nuclear Fusion, as an energy source, is one of the most complex scientific and technical tasks ever undertaken for non-military purposes and will span several generations. There exist two approaches to realize nuclear fusion on Earth: Inertial and Magnetic fusion. Inertial fusion consists of micro explosions of small fuel pellets be means of powerful lasers or particle beams. Confinement of the fuel is based on the inertia of the pellet fuel mass, which resists the natural expansion when it is heated to thermonuclear fusion temperatures. Magnetic fusion uses magnetic fields to confine the fuel (Onegena et al., 2001:5).

Nuclear fusion is the reaction in which light elements such as those of hydrogen and deuterium combine and form heavier elements e.g., helium-3, releasing a great amount of energy, which primarily manifests itself in the form of heat (Physics.about.com, 2012).

Nuclear fusion power is commonly referred to potential commercial production of net usable power from a fusion source, similar to the use of the term 'steam power'. One leading design for fusion research use is the 'Tokamak' concept of magnetic confinement in which the plasma is contained in a doughnut-shaped vacuum vessel (ITER, 2011). There are approximately 200 Tokamak research projects ongoing around the world and is based a Deuterium - Tritium cycle (D-T).

5.2. International Thermonuclear Experimental Reactor

The largest experiment by means of magnetic confinement such as the Tokamak nuclear fusion reactor by the International Thermonuclear Experimental Reactor (ITER) situated in France and in collaboration with funding partners: USA, EU, Russia, Japan, South Korea, and China. In June 2005, ITER announced that they could produce ten times more fusion power than the power put into the plasma[31] over many minutes. For example, 50 Megawatts of input power can produce 500 Megawatts output power for at least 500 seconds. ITER's next generation of research is DEMOnstration Power Plant (DEMO) and is to be the first reactor to demonstrate sustained net energy-producing fusion on a commercial scale. Its aim is to produce 25 times as much power as the ITER Tokamak. However, DEMO is proposed to begin construction in 2024. PROTO is beyond the DEMO experiment and part of the European Commission long-term strategy for research of fusion energy. Proto will act as a prototype power station, taking in any remaining technology refinements, and demonstrating electricity generation on a commercial basis. It is only expected after DEMO, meaning after 2050. This might make PROTO the first commercial nuclear fusion power plant in the world (Campbell, 2011[32]).

5.3. Helium-3 Fusion

Another and the only nuclear fusion power research project is conducted at the University of Wisconsin-Madison in the USA and is based on experimenting with the fusion of two helium-

[31] In physics and chemistry sciences, Plasma is a state of matter unlike matters: solids, liquids, and gases. Plasma is the most common form in the universe (99%) and often called the 4th matter (UiT.no).

[32] Director of Plasma Operation, ITER. Personal contact 08.05.2011.

3 isotopes (He3-He3). According to Professor Gerald Kulchinski[33] the reaction does not produce radioactivity. It creates nuclear energy without nuclear waste. This fusion technology is not new however, and was invented by Philio Farnsworth who also invested the television.(Wisconsin Engineer, 2011).

According to Professor Kulchinski, other countries (except Russia) may have even more severe problems. Major research on finding an alternative for helium-3 is now underway any alleviate the problem in a few years. As helium-3 now allocated mostly to homeland security missions, the He3-He3 fusion research will be left out. However, and I quote when I asked Kulchinski regarding his view towards the sudden race of space nations going to the Moon and the demand for helium-3 connection: 'We have not been successful in interesting NASA in the in-situ resources like helium-3. Once we show significant progress in helium-3 fusion that will change. From Nasa we get 'yes, we can get helium-3 but you will never make it work'. From the Department of Energy, we get 'Yes, we can make fusion work but you will never get back to the Moon' (personal correspondence, 16.05.2011.

Helium-3 is so rare and in such a demand that the U.S. Secretary of State on the 13th of January 2010 communicated through the International Atomic Energy Agency (IAEA) and the American embassy in Moscow to ask the Russian helium-3 supplier Rosatom to supply the U.S. with helium-3 to support international nuclear safeguard efforts. Some of the work of the IAEA is to ensure safeguards in nuclear facilities and to strengthen international inspections in order to prevent misuse of nuclear materials has been dependent on the use of helium-3 for safeguard instrumentation. Helium-3 is a critical component for such measurements (Clinton, 2010).

5. 2. Helium-3

Helium-3 is an isotope[34] and scarce on Earth, but abundant on the Moon. It is a nontoxic, non-radioactive gas, used in medicine for Magnetic Resonance Imaging (MRI), within the oil and gas industry for well logging[35], and science. Neutron detection applications in national and homeland security are the largest users for detection of smuggled radiological and other spe-

[33] Nuclear Engineer and Director of the Fusion Technology Institute at UW-Madison

[34] An isotope is a chemical element forms that holds a different number of neutrons in its nucleus than other isotopes of the element and therefor carries a different atomic mass but retains its atomic number. See e.g., The Artemis Project, Lunar Helium-3 as an Energy Source, in a Nutshell..

[35] Well logging is the measurement of geological formations penetrated by a borehole. The use of neutron sources and detectors can indicate properties such as rock porosity and the presence of hyrocarbons.

cial nuclear materials such as plutonium and uranium Not only is helium-3 a clean and safe gas, but it may in certain applications also be recycled (Shea et al., 2010:6-21).

Due to its detection performance, nontoxicity, and ease of use, helium-3 is the material of choice. Alternative technologies have shown drawbacks relative to helium-3, such as toxicity and reduced sensitivity, and a replacement for helium-3 technology does not currently exist (Anderson, 2010).

The natural abundance of helium-3, as a fraction of all helium-3 is minimal and scarce on Earth: only about 1.37 parts per million (CRC Handbook of Chemistry and Physics, 2010 – 2011). Helium-3 is produced through nuclear decay of tritium, which is a radioactive isotope of hydrogen. The most common source of helium-3 for example in the USA is the nuclear weapons program, of which helium-3 is a byproduct. The U.S. government produces tritium for use in nuclear warheads. Tritium decays into helium-3 and takes approximately 12.3 years for tritium to decay into helium-3 (CRC Handbook of Chemistry and Physics, 2010 – 2011).

Helium-3 demand has increased dramatically in the USA since 2001 for national and homeland security for neutron detection. Prior to the bombing of the Twin Towers 09.11.2001 in New York, the demand for helium-3 was 8,000 liters per year and the USA was self-contained and had an ample supply (see fig.3).

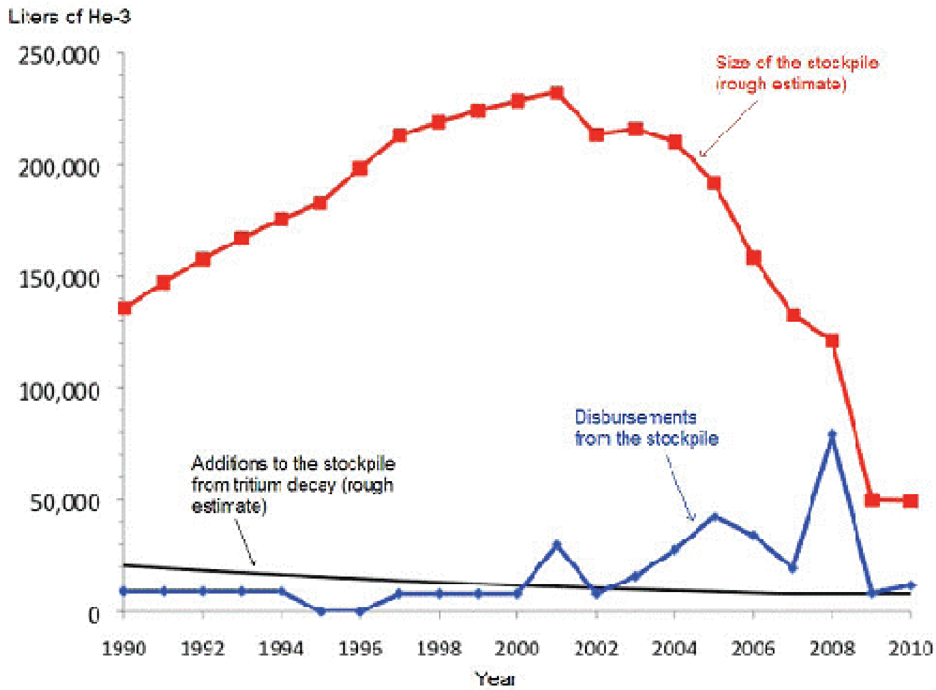

Figure 3 Size of the Helium-3 Stockpile, 1990-2010 (Fetter, 2010)

USA's projected helium-3 demand according to Shea et al., 2010 is as follows:

Year	Helium-3 Demand (liters)	Year	Helium-3 (liters)
2010	68,000	2015	50,000
2011	60,000	2016	43,000
2012	73,000	2017	36,000
2013	80,000	2018	100,000[36]
2014	65,000		

Helium-3 does not trade in the market place as other commodities do. It is produced as a by-product of nuclear weapons maintenance and in the USA, is then accumulated in the stockpile from which suppliers are either transferred directly to other agencies or sold publicly at auction. The U.S. producer of helium-3 is the National Nuclear Security Administration (NNSA) of the Department of Energy (DoE). The seller for the public auctions is the DoE Office of Isotope Production and Research (Shea et al., (2010:2).

Before 2001, production of helium-3 exceeded consumption and in the last decade and especially after the terrorist bombing in New York September the 9th 2001, demand has risen rapidly due to the increased deployment of neutron detectors using helium-3 at borders to help security against smuggled nuclear and radiological materials. Thus starting in 2001, and more rapidly since 2005, the stockpile has declined. By 2009, governments have recognized that ongoing demand would soon exceed the remaining supply.

According to the U.S. Geological Survey, Rare Earth Elements (REEs) are part of the Lanthanide family on the periodic table with atomic numbers 57-71, Scandium (atomic number 21) and Yttrium (atomic number 39). They are grouped to this family due to their similar properties such as inertness (they do not react easily with other elements, which for example means they do not erode easily) and conductivity (Hedrick, 1997:471).

According to Cindy Hurst[37], REE is actually a misnomer and are not rare at all. They are found in low concentrations throughout the Earth's crust and in higher concentrations in numerous minerals. These elements are found in almost all rock formations. However, their

[36] This sudden increase in projected demand has not been available to me. I asked Professor Kulchinski where he said that the USA will not be able to satisfy even the modest demands in the next 5 to 10 years (personal correspondence 14.05.2011).

[37] Analyst for the U.S. Army's Foreign Military Studies Office, Fort Leaverworth, KS

concentrations range from ten to a few hundred parts per million by weight. Therefore, finding elements where they can be economically mined and processed presents a great challenge.

China is the dominant player globally with 95% of REEs production leading to uncertainties and worries for the USA, Japan and the EU. In 1990, China accounted for 27% of REE's. In 2009, world production was 132,000 metric tons and China produced 129,000 of those tons. In the 1990's, China introduced tight controls and restrictions of these elements as the government declared that these were to be protected as strategic elements. Due to domestic demand, exports declined. Further, in 2006, China permitted 47 local REE producers and traders and 12 Sino-foreign REE producers to export. By 2011, there were only 22 local REE producers and traders and 9 Sino-foreign REE traders with authorization to export these elements (Wihbey, 2011).

In the 1980's, the USA was one of the main producers of these REEs. However, the problem with mining for these elements is that it is expensive, spread over a wide area, rather than heavily concentrated and often found alongside radioactive elements and therefore extraction can be environmentally damaging. To successfully mine REEs, requires cheap labor costs and a relaxed attitude towards, health, safety and the environment (Stepek, 2010).

Without REEs, much of the world's contemporary technology would be either vastly different. Without REEs, mobiles, laptop computers would be larger. Further, REEs are essential for the defense industry and therefore strategically significant. They are used for cruise missiles, precision guided munitions, radar systems and reactive armor. Also, key to the emergence of clean energy sectors such as wind-powered turbines, electrical vehicles, as well as to oil refineries.

The reason for highlighting the issue of REE's is that this issue may *also* be a good reason to mine on the Moon.

Those most dependent on the space industry would be the most threatened, the most dependent are the major space nations i.e. USA, Russia, China, India, Japan This argument, Lutes, 2008, suggests cooperation among these:

Cooperation in a globalized society encourages peace and stability, and the space industry is highly globalized. Cooperation leads to technological developments and advancements, political stability and socio-economic strength especially in Less Developed Countries (Lutes, 2008).

6. International Treaties with Analogues

In attempting to establish a (new) legal regime for mining on the Moon and other celestial bodies, it is useful to look to analogous situations in international law to consider the issues discussed and how they were resolved. Whilst the Moon may be the most exciting area within the international mining debate, international mining treaties have been concluded regarding the deep oceans including the Arctic, and the continent Antarctica. These areas have much in common with the Moon and other celestial bodies. Geographically both areas are situated in harsh environments, are difficult to reach to extract natural resources, and difficult to live in. Further, they are also designated international areas in which no nation has a sovereign claim.

After World War II in 1945, the establishment of permanent settlement on Antarctica seems to follow the same pattern as the colonization of the New World as mentioned above. Conflicting territorial claims by countries such as Argentina, Australia, Great Britain, Chile, France, New Zealand and Norway were leading towards conflict. The Antarctic Treaty from 1959 postponed territorial claims and established a legal regime that came into force in 1961 banning any military activity and exploitation as the OST. Until 1991 the continent was peacefully studied until technological advancements within oil and minerals extraction developed. Governments and corporations wanted to open up for exploitation purposes of oil and gas. However, today it is a protected area with successful conflict prevention.

Since the second half of the twentieth century, technological advancements of especially floating oil and gas platforms able to reach the sea bottom for the exploitation of natural resources were commercialized. However, the question in terms of governance was by whom and under whose control. The United Nations became the main body to address these issues and to prevent conflicts where upon the 1982 Convention on the Law of the Sea (UNCLOS) was established. Rules and guidelines were agreed upon that expanded national control over coastal regions including the oversight of any commercial activity on the ocean floor, which would be excluded from possible national territorial appropriation. The USA refused to sign due to its opposition to the extension of exclusionary territorial waters and the United Nations treatment of the seabed as the Common Heritage of Mankind. Hence, the UNCLOS established the International Seabed Authority (ISA), which carries requirements to any prospecting for natural resources on the seabed to have international approval and license to ensure compliance with the UNCLOS clause regarding the Common Heritage of Mankind[38].

The USA remains outside the UNCLOS regime today as it does with the Moon Treaty of 1979. As per today, China, France, India, Japan, Russia and South Korea have registered with the ISA[39], thereby retaining exploratory, but not yet exploitive rights, to certain identified regions of the seabed. However, no commercial mining has yet been carried out and as per today The Mining Code[40] has yet to be completed.

No nation owns the North Pole or the region of the Arctic oceans surrounding it. Russia, Norway, the USA, Canada, and Denmark (Via Greenland) are Arctic states bordering the Arctic Ocean and are limited to a 370 km[41] economic zone around their coasts.

The Arctic is warming. Surface air temperatures in the Arctic since 2005 have been higher than for any five-year period since measurements began around 1880. The increase in annual average temperature since 1980 has been twice as high over the Arctic as it has been over the rest over the world. Nearly all glaciers and ice caps have shrunk and the Arctic sea-ice decline has been faster during the past ten years than in the previous 20 years (Arctic Monitoring and Assessment Program, 2011[42]).

According to the Stockholm International Peace and Research Institute (SIPRI), ice-melting increasing may become one of the geopolitical debates in our time as a result to gain access to the region's most important natural resources and transport routes. Countries have announced new military strategies in this region such as Canada[43] and the USA, Russia[44] and China. Tensions may emerge over who will determine the future of this region. Will it be the five littoral Arctic states[45], or will it be the eight Arctic Council states[46], or will a wide variety of countries be able to develop the region?

Accordingly, there are challenges emerging in respect in the Arctic and in the management through cooperation based on international law and multilateral agreements. The Arctic

38 UN Convention of the Law of the Sea, part XI, section 4, article 173
39 UN Convention of the Law of the Sea, an historical perspective
40 Rules, regulations and procedures issued by the Authority to regulate protecting, exploration and exploitation of marine minerals in the international seabed area.
41 200 nautical miles
42 'Snow, Water, Ice and Permafrost in the Arctic' report
43 Klassekampen, 13.05.2011
44 Aftenposten 01.04.2011
45 Russia, Norway, USA, Canada, and Denmark (Via Greenland)
46 Russia, Norway, USA, Canada, Denmark, Finland, Sweden, and Iceland

Council *strives to promote consensus and cooperation, however as an international organization without a firm legal charter, the Council is constrained in what it can do and several of the Council's member states oppose broadening its mandate to deal with legal issue* (SIPRI, 2011).

7. FINDINGS

Space law derive from the desire of countries to derive benefits from what is called a common resource – outer space that has been likened to the high seas or the continent of Antarctica – a resource that no nations owns, however have a strong economic, political and even military interest for countries.

As access to outer space is now more accessible and more and more space faring nations are entering the space market, space treaties and conventions assist in the coordination on how countries view space and to a certain degree regulate its usage. Due to the growth of the space industry, this may be a complicated task. This can be exemplified by one major segment such as the coordination of the use of satellites for communication, remote sensing, navigation, meteorology, etc. Without coordination of how the various frequencies are used there would be interference and chaos. Further, if satellites deployed are not coordinated there would be difficulties of interference and possibly collision. To retain international cooperation and to avoid conflict, a specialized agency of the United Nations (UN) the International Telecommunication Union (ITU). The ITU's role is provide registration of radio frequencies used in outer space, to assign the usage of the various orbits, to set standards for the provision of various types of space services (Pelton et al. 2008:291-293).

8. CONCLUSION

The need for a safe, clean, and non-radioactive energy resource to serve all and especially people in extreme poverty. Even though the development of a helium-3 based fusion reactor is still under development, we still need to await an eventual establishment of an international treaty and sets the rules for all nations who wish to explore and exploit the universe for the benefit of human kind….in an orderly manner to enable a cooperative state of mind to all.

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