Lunar Heritage 1AC vs. Strake RC

1AC: Plan

Plan - Private entities ought not appropriate lunar heritage sites

We define lunar heritage sites as sites as any lunar area with artifacts from previous moon landings.

Zajackowski 20 Zajackowski, Diane . "Could the Moon's Cultural Heritage Be Inscribed on UNESCO's World Heritage List?" *Studies in Space Policy*, Springer, 4 May 2020, https://link.springer.com/chapter/10.1007/978-3-030-38403-6_2#:~:text=In%20the%20near%20future%2C%20human,first%20stages%20of%20space%20exploration.

Half a century after man's first step on the Moon, the landscape of space activities has considerably changed. At a time when access to outer space is widening, **commercial activities** are developing (suborbital tourism, resources exploitation, etc.) and Moon related projects are multiplying, our satellite becomes increasingly vulnerable. In the near future, human activities **could durably affect lunar physical properties and also damage what is now considered** as **the "cultural heritage of the Moon", i.e. the artifacts and tracks that people had left behind during their different space missions, especially those of the first stages of space exploration.** To preserve the traces of this major period, some experts have committed themselves to raising awareness among national authorities and the general public about the protection of these sites. Bringing their ideas to the attention, the media sometimes refer to UNESCO's World Heritage List, questioning the role that this organisation could play in this issue. This article has been written to answer this question through a fictional case which will enable the reader to know, once and for all, whether UNESCO could best guarantee the preservation of the cultural heritage of the Moon or not.

Harrington 19, Andrea J. "Preserving Humanity's Heritage in Space: Fifty Years after Apollo 11 and beyond." J. Air L. & Com. 84 (2019): 299. (Associate Professor and Director of the Schriever Space Scholars at USAF Air Command and Staff College)//Elmer

The **issue of humanity's cultural heritage in space has arisen** as one of many unanswered questions in space law, with **no international agreements specifically addressing it.** With the beginning of the space age fifty-six years ago and a series of remarkable achievements in space exploration behind us, it is necessary to determine what should be done regarding the "artifacts" of this exploration. **NASA** has **promulgated** their **recommendations** for spacefaring entities with the goal of protecting the lunar artifacts left behind by the Apollo missions.8 These **recommendations establish "keep-out zones"** of up to a four kilometer diameter with the aim of protecting the artifacts, particularly from dangerous, fastmoving particles that arise as a result of craft landings.9 Experience has shown that even artifacts that are sheltered by craters can be significantly sandblasted and pitted as a result of the moving particles.10 **These recommendations**, supposedly drafted in conformity with the Outer Space Treaty, however, **are completely nonbinding**.11 Legislation that has passed the U.S. Senate and is under consideration by the House of Representatives as of July 2019 would make these recommendations binding on U.S. entities seeking to land on the Moon.12 Accidental damage from unrelated missions, however, is only one of many threats to space artifacts. With the impending return to the Moon, **it is likely** that

individuals and corporations will be looking to turn a profit from space heritage, without concern for the protection of such heritage. **Tourists may disrupt sites** with careless expeditions and **landing sites may be desecrated so that the items can be sold**. A Russian Lunakhod lunar rover has already been sold at auction to a private party, though it has not yet been moved from its original position on the Moon.13 **While national heritage legislation can protect** space artifacts **from citizens of their own countries**, there is currently **no** effective **means** in the present space law regime by **which** a **country can protect its heritage from other countries**.14 Both California and New Mexico have added Tranquility Base to their list of protected heritage sites.15 However, this solution, and those proposed in the bill put forth to the U.S. House of Representatives, only serve to restrict the activities of a small subset of the potential visitors to the Moon. Though the Senate bill calls for the President to initiate negotiations for a binding international agreement, there is still a long road from this bill to a potential agreement.16 **A solution is needed to prevent** the damage, destruction, loss, or **private appropriation of** our **cultural heritage in space.**

1AC: Lunar Heritage Adv

The Advantage is Lunar Heritage:

Global Moon Rush by private actors is coming now.

Sample 19 Ian Sample 7-19-2019 "Apollo 11 site should be granted heritage status, says space agency boss" https://www.theguardian.com/science/2019/jul/19/apollo-11-site-heritage-status-space-agency-moon (PhD at Queens Mary College)//Elmer

But **protecting lunar heritage may not be straightforward**. On Earth, the United Nations Educational, Scientific and Cultural Organisation (Unesco) decides what deserves world heritage status from nominations sent by countries that claim ownership of the sites. Different rules apply in space. The UN's outer space treaty, a keystone of space law, states that all countries are free to explore and use space, but warns it "is not subject to national appropriation by claim of sovereignty". In other words, space is for all and owned by none. Wörner is not put off and sees no need for troublesome regulations. "My hope is that humanity is smart enough not to go back to this type of earthly protection. Just protect it. That's enough. Just protect it and have everybody agree," he said. A no-go zone of 50 metres around Tranquility base should do the job, he added. Martin Rees, the Cambridge cosmologist and astronomer royal, said there was a case for designating the sites so future generations and explorers were aware of their importance. "If there are any artefacts there, they shouldn't be purloined," he said. "Probably orbiting spacecraft will provide routine CCTV-style coverage which would prevent this from being done clandestinely." Beyond the dust-covered hardware that stands motionless on the moon, Lord Rees suspects future activity could drive calls for broader lunar protection. The Apollo 17 astronaut and geologist Harrison Schmidt has advocated strip mining the moon for helium-3, a potential source of energy. The proposal, which Rees suggests has raised eyebrows in the community, could potentially provoke a backlash. "There might be pressure to preserve the more attractive moonscapes against such despoilation, and to try to enforce regulations as in the Antarctic," he said. Fifty years on from Apollo 11, the moon is still a place to make statements. In January, the Chinese space agency became the first to land a probe on the far side. On Monday, India hopes to launch a robotic probe, the delayed Chandrayaan-2 lander that is bound for the unchartered lunar south pole. Far more is on the cards. Major space agencies, including ESA and Nasa, plan a "lunar gateway", described by Wörner as a "bus stop to the moon and beyond". His vision is for a "moon village", but rather than a sprawl of domes, shops and a cosy pub, it is more an agreement between nations and industry to cooperate on lunar projects. **The private sector is eager to be involved. Between now and 2024, at least five companies aim to launch lunar landers**. In May, **Nasa selected three companies to** design, build and **operate spacecraft** that will ferry scientific experiments and technology packages **to the moon. The** coming **flurry of activity may make protection more urgent**. Michelle Hanlon, a space lawyer at the University of Mississippi, co-founded the non-profit organisation For all Moonkind to protect, preserve and memorialise human heritage on the moon. While she conceded that not all of the sites that bear evidence of human activity needed protection, she said many held invaluable scientific and archaeological data that we could not afford to lose. "These sites need to be protected from disruption if only for that reason," she added. The protection should be far wider, and more formal, than Wörner calls for, Hanlon argues. "It is astounding to me that we wouldn't protect the site of Luna 2, the very first object humans crashed on to another celestial body, and Luna 9, the very first object humans soft-landed on another celestial body," she said. The Soviet Luna programme sent robotic craft to the moon between 1959 and 1976. "The director general has a much more optimistic view of human nature than I do," Hanlon said. "I completely agree that the entities and nations headed back to the moon in the near future will take a commonsense approach and give due regard to the sites and artefacts. However, that is the near future. **We have to be prepared for the company** or nation **that doesn't care. Or** worse, that **seeks to return to the moon** primarily **to pillage for artefacts that will** undoubtedly **sell for tremendous amounts of money** here **on Earth."**

Corporate development, tourism, and looting will destroy scientifically rich Tranquility base artifacts.

Fessl 19 Sophie Fessl 7-10-2019 "Should the Moon Landing Site Be a National Historic Landmark?" https://daily.jstor.org/should-the-moon-landing-site-be-a-national-historic-landmark/ (PhD King's College London, BA Oxford)//Elmer

When Neil Armstrong set foot on the moon on July 20, 1969, the pictures sent to Earth captured a historical moment: It was the first time that any human set foot on another body in our solar system. Fifty years later, experts are debating how to preserve humankind's first steps beyond Earth. Could a National Park on the moon be the solution to saving Armstrong's bootprints for future archaeologists? **Flags**, **rovers**, laser-reflecting **mirrors, footprint**—these are just a **few of the dozens** of **artifacts** and features that **bear witness to our exploration** of the moon. Archaeologists argue that these objects are a record to trace the development of humans in space. "Surely, those **footprints** are as important as those left by hominids at Laetoli, Tanzania, in the story of human development," the anthropologist P.J. Capelotti wrote in Archaeology. While the oldest then known examples of hominins walking on two feet were cemented in ash 3.6 million years ago, "those **at Tranquility Base could be swep**t away with a **casual brush of a space tourist's hand**." Fragile Traces Just how fragile humankind's lunar traces are was **seen already** during Apollo 12. On November 19, 1969, Charles "Pete" Conrad and Alan Bean manually landed their lunar module in the moon's Ocean of Storms, 200 meters from the unmanned probe Surveyor 3, which was left sitting on the moon's surface two years earlier, in 1967. The next day, Conrad and Bean hopped to Surveyor 3. As they approached the spacecraft, they were surprised: The spacecraft, originally bright white, had turned light brown. It was covered in a fine layer of moon dust, likely kicked up by their landing. Harsh ultraviolet light has likely bleached the U.S. flag bright white. Without Apollo 12 upsetting the moon dust, Surveyor 3 would likely have remained stark white. Unlike Earth, the moon has no wind that carries away the dust, no rain to corrode materials, and no plate tectonic activity to pull sites on the surface back into the moon. But the moon's thin atmosphere also means that solar wind particles bombard the lunar surface, and harsh ultraviolet light has likely bleached the U.S. flag bright white. The astronauts' first bootprints will likely be on the moon for a long time, and will almost certainly still be there when humans next visit—unless, by tragic coincidence, a meteorite hits them first. Had LunaCorp not abandoned the idea in the early 2000s, the company's plan to send a robot to visit the most famous sites of moon exploration could have done a lot of damage. And **with** Jeff **Bezos' recent unveiling of** a mock-up of the **lunar lander Blue Moon**, it is **only a matter of time before corporate adventurers and space tourists reach the moon**. Historians and archaeologists are keen to **avoid lunar looting**. Roger Launius, senior curator of space history at the National Air and Space Museum in Washington, D.C., warned: "What we don't want to happen is what happened in Antarctica at Scott's hut. People took souvenirs, **and nothing was done to try to preserve those** until fairly late in the game." On the other hand, there is a **legitimate scientific interest** in investigating how the equipment that's on the moon was affected by a **decades-long stay there**.

Private entities are a unique threat---universal rules key.

Hertzfeld and Pace 13 (, H. and Pace, S., 2013. International Cooperation on Human Lunar Heritage. [online] Cpb-us-e1.wpmucdn.com. Available at: <https://cpb-us-e1.wpmucdn.com/blogs.gwu.edu/dist/7/314/files/2018/10/Hertzfeld-and-Pace-International-Cooperation-on-Human-Lunar-Heritage-t984sx.pdf> [Accessed 18 January 2022] Dr. Hertzfeld is an expert in the economic, legal, and policy issues of space and advanced technological development. Dr. Hertzfeld holds a B.A. from the University of Pennsylvania, an M.A. from Washington University, and a Ph.D. degree in economics from Temple University. He also holds a J.D. degree from the George Washington University and is a member of the Bar in Pennsylvania and the District of Columbia. Dr. Hertzfeld joined the Space Policy Institute in 1992. His research projects have included studies on the privatization of the Space Shuttle, the economic benefits of NASA R&D expenditures, and the socioeconomic impacts of earth observation technologies. He teaches a course in Space Law and a course in microeconomics through the Economics Department at G.W. Dr. Hertzfeld has served as a Senior Economist and Policy Analyst at both NASA and the National Science Foundation, and has been a consultant to many U.S. and

international organizations, including a recent project on space applications with the OECD. He is the co-editor of Space Economics (AIAA 1992). Selected other publications include a study of the issues for privatizing the Space Shuttle (2000), an analysis of the value of information from better weather forecasts, an analysis of sovereignty and property rights published in the Journal of International Law (University of Chicago, 2005), and an economic analysis of the space launch vehicle industry (2005). Dr. Hertzfeld has also edited and prepared a new edition of the Study Guide and Case Book for Managerial Economics (Sixth Edition, W.W. Norton & Co.). Dr. Scott N. Pace is the Deputy Assistant to the President and Executive Secretary of the National Space Council (NSpC). He joined the NSpC in August 2017. From 2008-2017, he was the Director of the Space Policy Institute and a Professor of the Practice of International Affairs at George Washington University's Elliott School of International Affairs. From 2005-2008, he served as the Associate Administrator for Program Analysis and Evaluation at NASA. Prior to NASA, he was the Assistant Director for Space and Aeronautics in the White House Office of Science and Technology Policy. From 1993-2000, he worked for the RAND Corporation's Science and Technology Policy Institute, and from 1990-1993, he served as the Deputy Director and Acting Director of the Office of Space Commerce, in the Office of the Deputy Secretary of the Department of Commerce. In 1980, he received a Bachelor of Science degree in Physics from Harvey Mudd College; in 1982, Masters degrees in Aeronautics & Astronautics and Technology & Policy from the Massachusetts Institute of Technology; and in 1989, a Doctorate in Policy Analysis from the RAND Graduate School.)-rahulpenu

International Cooperation on Human Lunar Heritage The U.S. Apollo Space Program was a premier technological accomplishment of the 20th century. Preserving the six historic landing sites of the manned Apollo missions, as well as the mementos and equipment still on the Moon from those and other U.S. (e.g., Ranger and Surveyor) and Soviet Union (e.g., Luna) missions is important. Some of the instruments on the lunar surface are still active, monitored, and provide valuable scientifi c information. But recent government and **private-sector plans** to explore and potentially use lunar resources for commercial activity raise questions about the use of the Moon and potential accidental or purposeful threats to the historic sites and scientific equipment there. Although some steps to protect these sites have been proposed, we suggest a better way, drawing on international, not U.S. unilateral, recognition for the sites. Less than 2 years before the fi rst footsteps on the lunar surface on 20 July 1969 (see the image) , the United Nations Outer Space Treaty (OST) was drafted, ratifi ed, and came into force (1). Article II of the OST reinforced and formalized the international standard that outer space, the Moon, and other celestial bodies would not be subject to claims of sovereignty from any nation by any means, including appropriation. The OST prohibits ownership of territory or its appropriation by any state party to the treaty, which includes the United States, Russia, and 126 other nations. It does not prohibit the use of the Moon and its resources. In fact, the treaty emphasizes the importance of freedom of access to space for any nation and the importance of international cooperation in space exploration. These principles of the space treaties have enabled gains in science and technology and have contributed to international stability in space. New attention is being focused on the lunar surface. China has an active Moon exploration program and is considering sending astronauts (taikonauts) to the Moon**. Private firms** are contemplating robotic **missions** that could land in the vicinity of the historical sites of Apollo and other missions. Although we might assume the best of intentions for such missions, they could **irreparably disturb** the **traces of** the first **human visits** to another world. NASA has taken **steps to protect** the lunar landing **sites** and equipment and to initiate a process to create recognized norms of behavior. In July 2011, guidelines were issued for private companies competing in the Google Lunar X Prize that established detailed requirements for avoiding damage to U.S. government property on the Moon (2). H.R. 2617, The Apollo Lunar Landing Legacy Act, was introduced into the U.S. Congress on 8 July 2013 (3). In essence, it proposes to designate the Apollo landing sites and U.S. equipment on the Moon as a U.S. National Park with jurisdiction under the auspices of the U.S. Department of the Interior. Although the bill acknowledges treaty obligations of the United States, it would create, in effect, a unilateral U.S. action to control parts of the Moon. This would **create** a **direct conflict with i**nternational **law** and could be viewed as a **violation of** U.S. commitments under the **OST**. It would be an ineffective way of protecting historical U.S. sites, and it fails to address interests of other states that have visited and will likely visit the Moon. It is **legally flawed**, **unenforceable**, and **contradictory to** our national **space policy** and our international relations in space (4). There is a better way for the United States to protect its historic artifacts and equipment on the Moon. The fi rst step is to clearly distinguish between U.S. artifacts left on the Moon, such as fl ags and scientifi c equipment, and the territory they occupy. The second is to gain international, not unilateral, recognition for the sites upon which they rest. Aside from debris from crash landings (by Japan, India, China, and the European Space Agency), there are only two nations with "soft-landed" equipment on the lunar surface: the United States and Russia. China has plans to soft-land Chang'e 3 on the Moon in December 2013. All three nations (and any others wishing to participate) have much to gain and little or **nothing to lose from** a

multinational agreement based on mutual respect and mutual protection of each other's historical sites and equipment. Legal Issues Although ownership of planets, the Moon, and celestial bodies is prohibited, ownership of equipment launched into space remains with the nation or entity that launched the equipment, wherever that equipment is in the solar system. Under the OST, that nation is both responsible and liable for any harmful acts that equipment may create in space. There are no prescribed limits on time or the amount of damage a nation may have to pay. The U.S. government therefore still owns equipment it placed on the Moon. Ownership has the associated right of protecting the equipment, subject to using necessary and proportional means for protection. But, because no nation can claim ownership of the territory on which equipment rests, there is an open issue of how to control the spots on the Moon underneath that equipment, because the site is **integral to** the **historical signifi - cance**. In H.R. 2617, establishment of Apollo sites as a unit of the U.S. National Park System could be interpreted as a declaration of territorial sovereignty on the Moon, even though ensuing paragraphs specify the Park's components as the "artifacts on the surface of the Moon" at those sites. This problem needs international legal clarifi cation, achievable via a formal agreement among those nations that have the technological ability to directly access the Moon (5). Section 6(a) raises another legal issue. The bill proposes that the Secretary of the Interior shall administer the park in accordance with laws generally applicable to U.S. National Parks. It also requires the Secretary to act in accordance with applicable international law and treaties. The U.S. National Park System Act states that the Parks are "managed for the benefi t and inspiration of all the people of the United States" (6). The OST clearly emphasizes that the exploration and use of space by nations is to benefi t all peoples. The laws and space policies of the United States have always emphasized peaceful uses of space and the benefi ts of space for humankind. It may not be possible to implement and execute provisions of this Bill without raising important and fundamental questions about these contradictions between the language of the treaty and the mandates of our National Park Service. A third legal issue is raised in section (6) (c)(2) that allows private donations and cooperative agreements to "provide visitors centers and administrative facilities within reasonable proximity to the Historical Park." This **implies future private use** of the Moon **under rights granted by** the **U.S.** government. **Unilateral granting of lunar** territorial **rights to private individuals** and implicit sovereign protection of that territory **violates** the **OST.** Finally, section 8 of the bill requires the Secretary of the Interior to submit the Apollo 11 lunar landing site to the United Nations Educational, Scientifi c, and Cultural Organization (UNESCO) for designation as a World Heritage Site. This violates Article II of the OST. All current World Heritage Sites are located on sovereign territory of nations. The only exception is a separate treaty that allows UNESCO to designate underwater sites (such as sunken ships) as protected cultural sites (7). These designations are very limited, and although the convention has been ratifi ed by 43 nations, the United States, Russia, and China are not among them. Thus, any new treaty of this type specifi cally for outer space would have little chance of being ratifi ed by the major space-faring nations. A Proposal to Protect Lunar Sites Although a new U.N. treaty for space artifacts of signifi cant cultural and historic importance may be reasonable someday, this would start a very long process with unknown outcomes. Such a treaty could be delayed to a point beyond the time when nations and/or companies may be active on the Moon (8). Our suggested alternative is to create a bilateral agreement between the United States and Russia, offered as a multilateral agreement to other nations with artifacts on the Moon. This would be more legally expedient, politically sustainable, and would more likely meet and exceed the stated goals of the bill. It would also emphasize the important role of national laws to implement and enforce these international space agreements. **Any nation with assets** on the lunar surface will **endeavor to protect** those assets. This creates a situation where those nations have a **timely**, **current**, and **common interest** incorporating important implications for peaceful uses of outer space; **scientific research** and the advancement of **knowledge**; and **cultural and heritage value**, either presently or in the foreseeable future. The United States, Russia, and China all engage in multilateral cooperative space programs. They share many economic and trade dependencies adding to the international importance of promoting cooperation in space and commerce. In spite of today's charged political environment, an **agreement** of the type we propose may still be possible to negotiate because it **focuses on** the **culture of space**, the use of space to benefit humankind, and the **archaeological record** of our civilization. It specifi cally would not touch sensitive issues of real property rights, export controls, human rights, or the weaponization of outer space. **Cooperation** on recognizing and protecting each other's interests in historical sites and on equipment and artifacts also has no signifi cant security, prestige, or technological impediments. It reinforces the basic principles of the existing space treaties, avoids declarations of sovereignity on the Moon, and

encourages multilateral cooperation resulting in a more stable and predictable environment for private activities on the Moon. The best mechanism for implementing a new agreement would be direct negotiations at highest levels of government in the United States, Russia, and China, with priority to include Russian sites in a proposal that protects U.S. sites. It could be included in meetings of heads of state of those nations, either jointly or sequentially among the three nations. Such an agreement could be executed in a relatively short period of time, setting precedents for peaceful and coordinated research, exploration, and exploitation of the Moon (9). An international agreement on lunar artifacts among the United States, Russia, and China would be a far superior and long-lasting solution than the unilateral U.S. proclamation in H.R. 2617. Enforcement of the agreement would be through each nation's national laws, applying to those entities subject to the jurisdiction or control of the agreement members. Each nation's property would be protected and preserved. Other nations should be free to join the agreement, and particularly encouraged to do so if they have the ability to access the Moon. **An important result would be to develop a new level of trust** among nations that could **then lead to more comprehensive future cooperative agreements on space**, **science**, **exploration**, **commerce**, **and** the use of **the Moon** and **other celestial bodies**.

Heritage Sites are critical for science research around Dust. OSTP 18

TING & PRESERVING APOLLO PROGRAM LUNAR LANDING SITES & ARTIFACTS" (The Office of Science and Technology Policy is a department of the United States government, part of the Executive Office of the President, established by United States Congress on May 11, 1976, with a broad mandate to advise the President on the effects of science and technology on domestic and international affairs.)//Elmer
https://csps.aerospace.org/sites/default/files/2021-08/Protecting%20Lunar%20Sites%20OSTP%20report%20Mar18.pdf

The Moon continues to hold great significance around the world. The successes of the Apollo missions still represent a profound human technological achievement almost 50 years later and continue to symbolize the pride of the only nation to send humans to an extraterrestrial body. The Apollo missions reflect the depth and scope of human imagination and the desire to push the boundaries of humankind's existence. The Apollo landing sites and the accomplishments of our early space explorers energized our Nation's technological prowess, inspired generations of students, and greatly contributed to the worldwide scientific understanding of the Moon and our Solar System. Additionally, other countries have placed hardware on the Moon which undoubtedly has similar historic, cultural, and scientific value to their country and to humanity. **Three Apollo sites** remain scientifically active and all the landing sites **provide** the **opportunity to learn about** the **changes associated with long-term exposure of human-created systems in** the **harsh lunar environment**. These sites offer **rich opportunities for biological, physical, and material sciences.** Future visits to the Moon's surface offer **opportunities to study** the **effects of long-term exposure** to the lunar environment **on materials and articles**, including **food** left behind, **paint, nylon, rubber, and metals. Currently**, **very little data exist that describe what effect temperature extremes, lunar dust**, **micrometeoroids**, **solar radiation**, etc. **have on** such **man-made material**, and **no data exist for time frames approaching** the **five decades that have elapsed since the Apollo missions**. While some of the hardware on the Moon was designed to remain operational for extended periods and successfully telemetered scientific data back to the Earth, much of what is there was designed only for use during the Apollo mission and then abandoned with no expectation of further survivability. **How these artifacts** and their constituent materials have **survived and** been **altered** while on the lunar surface **is of great interest to engineers and scientists**. **The Apollo artifacts and the impact sites have the potential to provide**

unprecedented data if lunar missions to gather and not corrupt the data are developed. These data **will be invaluable for helping to design future long-duration** systems for **operation on the lunar surface**. NASA has formally evaluated the possible effects of the lunar environment and identified potential science opportunities. For example, using Apollo 15 as a representative landing site, the crew left 189 individually cataloged items on the lunar surface, including the descent stage of the Lunar Module, the Lunar Roving Vehicle, the Apollo Lunar Surface Experiments Package, and a wide variety of miscellaneous items that were offloaded by the astronauts to save weight prior to departure. The locations of many of these items are well documented, and numerous photographs are available to establish their appearance and condition at the time they were left behind.

Moon Dust Research key to Moon Basing.

Smith 19 Belinda Smith 7-18-2019 "Who protects Apollo sites when no-one owns the Moon?" https://www.abc.net.au/news/science/2019-07-19/apollo-11-moon-landing-heritage-preservation-outer-space-treaty/11055458 (Strategic Communications Advisor at Department of Education and Training at University of Victoria)//Elmer

It's not just about history Alongside heritage value, the bits and pieces left on the Moon have **enormous scientific significance**. Take moon dust. It's a real problem for moon-bound equipment because it's **made of** fine, super sticky and highly **abrasive grains, which have a habit of clogging instruments** and spacesuits. But as Armstrong and Aldrin trotted across the surface, the **footprints** they **left behind gave us valuable information into the properties of moon dust**, Flinders University space archaeologist Alice Gorman said. **"The ridges on the boots were meant to measure how far they sank into the dust. "Then they used the light contrast between the ridges to measure the reflectance properties of the dust." A boot print in grey dust. T**his iconic photo of Buzz Aldrin's footprint is also a science experiment. (Supplied: NASA) It's data like this that will help **if we want a long-term base on the Moon** – we need to know how our gear **will stand up to lunar conditions**. Apart from the sticky, gritty dust, the lunar surface is also peppered with **meteorites and cosmic rays**. So, Dr Gorman said, one of the very few reasons to **revisit a moon site is to collect** some of the **equipment** left behind **and see how it fared**. "**What** has **happened to** this **material** in 50 years of sitting on the lunar surface? "This is going to be really interesting scientific information because it **will help planning for future missions** and get an understanding of long-term conditions." And NASA has already done this. The Apollo 12 mission, which landed on the Moon four months after Apollo 11, collected parts from the 1967 Surveyor probe and brought them back to Earth. An astronaut standing next to a piece of equipment on the lunar surface Along with rocks and soil samples, Apollo 12 astronauts collected pieces of the Surveyor 3 probe for analysis back on Earth. (Supplied: NASA) Another reason to preserve the equipment left on the Moon is to prove we really went there, Professor Capelotti said. "There's a lot of people out there who still don't believe it happened. "The stuff on the Moon is a testament to what we did and when we did it."

A lunar base is coming now but preservation of the environment is key.

Shekhtman 21 [Lonnie Shekhtman, Lonnie is a senior science writer for Nasa. 1-26-2021, "NASA's Artemis Base Camp on the Moon Will Need Light, Water, Elevation," https://www.nasa.gov/feature/goddard/2021/nasa-s-artemis-base-camp-on-the-moon-will-need-light-water-elevation/ accessed 2/12/22] Adam

American astronauts in 2024 will take their first steps near the Moon's South Pole: the land of extreme light, extreme darkness, and frozen water that could fuel NASA's Artemis lunar base and the agency's leap into deep space.

Scientists and engineers are helping NASA determine the precise location of the Artemis Base Camp concept. Among the many things NASA must take into account in choosing a specific location are two key features: The site must bask in near continuous sunlight to power the base and moderate extreme temperature swings, and it must offer easy access to areas of complete darkness that hold water ice.

While the South Pole region has many well-illuminated areas, some parts see more or less light than others. Scientists have found that at some higher elevations, such as on crater rims, astronauts would see longer periods of light. But the bottoms of some deep craters are shrouded in near constant darkness, since sunlight at the South Pole strikes at such a low angle it only brushes their rims.

These unique lighting conditions have to do with the Moon's tilt and with the topography of the South Pole region. Unlike Earth's 23.5-degree tilt, the Moon is tilted only 1.5 degrees on its axis. As a result, neither of the Moon's hemispheres tips noticeably toward or away from the Sun throughout the year as it does on Earth — a phenomenon that gives us sunnier and darker seasons here. This also means that the height of the Sun in the sky at the lunar poles doesn't change much during the day. If a person were standing on a hilltop near the lunar South Pole during daylight hours, at any time of year, they would see the Sun moving across the horizon, skimming the surface like a flashlight laying on a table.

"It's such a dramatic terrain down there," said W. Brent Garry, a geologist at NASA's Goddard Space Flight Center in Greenbelt, Maryland. Garry is working with engineers on a virtual reality tour of the Moon's South Pole to help immerse astronauts, scientists, and mission planners in the exotic environment of that region as they prepare for a human return to the Moon.

While a base camp site will require lots of light, it is also important for astronauts to be able to take short trips into permanently dark craters. Scientists expect that these shadowed craters are home to reservoirs of frozen water that explorers could use for life support. "One idea is to set up camp in an illuminated zone and traverse into these craters, which are exceptionally cold," said NASA Goddard planetary scientist Daniel P. Moriarty, who's involved with NASA's South Pole site analysis and planning team. Temperatures in some of the coldest craters can dip to about -391 degrees Fahrenheit (-235 degrees Celsius).

Initial plans include landing a spacecraft on a relatively flat part of a well-lit crater rim or a ridge. "You want to land in the flattest area possible, since you don't want the landing vehicle to tip over," Moriarty said.

The landing area, ideally, should be separated from other base camp features — such as the habitat or solar panels — by at least half a mile, or 1 kilometer. It also ought to be situated at a different elevation to prevent descending spacecraft from spraying high-speed debris at equipment or areas of scientific interest. Some scientists have estimated that as a spacecraft thrusts its engines for a soft landing, it could potentially spray nearly a million pounds, or hundreds of thousands of kilograms, of surface particles, water, and other gases across the surface.

"You want to take advantage of the landforms, such as hills, that can act as barriers to minimize the impact of contamination," says Ruthan Lewis, a biomechanical and industrial engineer, architect, and a leader on NASA's South Pole site analysis and planning team. "So, we're looking at distances, elevations, and slopes in our planning."

At the Moon, it's critical to keep the area around the landing site and base camp as pristine as possible for scientists. For instance, among the many interesting features of the South Pole region is its location right between the Earth-facing side of the Moon, or the near side, and the side we never see from Earth, known as the far side.

These two hemispheres are geologically very different, with the far side more heavily cratered and its crust thicker than on the near side. Scientists don't know why the two sides formed this way.

The Artemis Base Camp has to be on the Earth-facing side to make it easier for engineers to use radio waves to communicate with astronauts working on the Moon. But scientists expect that over billions of years of meteorite impacts to the Moon's surface, rocks, and dust from each hemisphere were kicked up and strewn about the other, so it's possible that astronauts could collect samples of the far side from their base camp on the near side.

Scenario 1 - Lunar Solar Power (LSP)

Terrestrial energy consumption is unsustainable and existing renewables are ineffective

Criswell 02 Criswell, David R. *Solar Power via the Moon* . 2002,

https://www.researchgate.net/publication/329718124_Solar_Power_via_the_Moon_2002.

David Criswell, a noted space physicist with many science publications and worldwide patents, as well as a former member of the science staff at the Lunar Science/Lunar and Planetary Institute, passed away on September 10. He was 78 years old. Criswell received his Ph.D. in 1968 from Rice University in the Department of Space Physics and Astronomy. His graduate research at Rice University included experimental work on auroral photometry and particle detection using rockets and satellites. He joined the technical staff of TRW Inc.-Houston Operations in 1968 and pursued a wide range of projects in support to the Apollo program. In 1970, Criswell came to the newly created Lunar Science Institute in Houston as a visiting scientist, becoming a senior staff scientist by the time the Institute was renamed as the Lunar and Planetary Institute. Criswell conducted research on Moon-solar wind interactions, dynamics of the soil regolith, lunar surface seismology, and related topics. He directed the only post-Apollo study funded by NASA during the 1970s on the conversion of lunar resources into basic industrial materials. He directed a number of LPI functions such as local and international scientific conferences and study groups, edited major proceedings and special journal issues, and operated the Lunar and Planetary Review Panel, which that reviewed more than 3000 research proposals submitted to NASA in the 1970s.https://www.lpi.usra.edu/publications/newsletters/lpib/new/david-criswell-1941-2019/

Prosperity for everyone on Earth by **2050 will require** a sustainable source of **electricity equivalent to 3 to 5 times the** commercial **power currently produced.** Because of the low average incomes in developing countries, however, **this** energy **must be provided at one-tenth the present** total **cost** per kilowatt-hour. Solar-power stations constructed on the moon from common lunar materials could provide the clean, safe, low-cost commercial electric energy needed on Earth. Currently, commercial **energy production on Earth raises concerns about pollution, safety, reliability of supply, and cost**. These concerns grow as the world's nations begin to expand existing systems to power a more prosperous world. Such **growth could exhaust coal, oil, and natural gas reserves in less than a century, while the production and burning of these fossil fuels pollute the biosphere.** Expanding nuclear fission power would require breeder reactors, but there is **intense political resistance to** that idea because of concerns about proliferation, **nuclear** contamination of the environment, and cost. Thousands of large commercial fusion reactors are highly unlikely to be built by 2050. **Terrestrial renewable systems** (hydroelectric, geothermal, ocean thermal, waves, and tides) **cannot** dependably **provide adequate power.** Using wind power would require capturing one-third of the power of the low-level winds over all the continents. Although energy coming directly to Earth from the sun is renewable, **weather makes the supply variable**. Very advanced technologies**,** such as 30% efficient solar cells coupled with superconducting power transmission and storage, imply solar arrays that would occupy selected regions totaling 20% of the area of the United States. Studies funded by the World Energy Council project that **terrestrial solar** energy **will provide less than 15%** of the electric power **needed** for global prosperity **by 2050.**

Lunar Solar Power (LSP) provides earth with the required amount of energy with microwave beams

Criswell 2 Criswell, David R. *Solar Power via the Moon* . 2002, https://www.researchgate.net/publication/329718124_Solar_Power_via_the_Moon_2002.

Lunar solar collectors

Fortunately, in the Lunar Solar Power (LSP) System , an appropriate, natural satellite is available for commercial development. **The** surface of Earth's **moon receives 13,000 TW of absolutely predictable solar power.** The **LSP** System **uses 10 to 20 pairs of bases**—**one** of each pair **on the eastern edge and the other on the western edge** of the moon, as seen from Earth—**to collect** on the order of **1% of the solar power reaching the lunar surface**. The **collected sunlight is converted to many low intensity beams of microwaves and directed to rectennas on Earth. Each rectenna converts the microwave power to electricity that is fed into the** local electric **grid. The system could easily deliver the 20 TW or more of electric power required by 10 billion people**. Adequate knowledge of the moon and practical technologies have been available since the late 1970s to collect this power and beam it to Earth. **Successful Earth–moon power beams** are already **in use by the Arecibo planetary radar,** operating from Puerto Rico. This radio telescope periodically images the moon for mapping and other scientific studies with a radar beam whose intensity in Earth's atmosphere is 10% of the maximum proposed for the LSP System. Each lunar power base would be augmented by fields of solar converters located on the back side of the moon, 500 to 1,000 km beyond each visible edge and connected to the Earthward power bases by electric transmission lines. The moon receives sunlight continuously except during a full lunar eclipse, which occurs approximately once a year and lasts for less than three hours. Energy stored on Earth as hydrogen, synthetic gas, dammed water, and other forms could be released during a

short eclipse. **Each lunar power base consists of tens of thousands of power plots** (Figure 1) distributed in an elliptical area to form a fully segmented, phased-array radar that is solar-powered. Each demonstration power plot consists of four major subsystems. **Solar cells collect sunlight, and buried electrical wires (not shown) carry the solar energy as electric power to microwave generators. These devices convert the solar electricity to microwaves of the correct phase and amplitude and then send the microwaves to** screens that reflect microwave beams toward **Earth**.

Hospitable environment Unlike Earth, the surface of the moon is compatible with the construction of extremely large areas of thin solar collectors and their dependable operation over many decades. No oxygen, water, atmospheric chemicals, or life is present to attack and degrade thin solar collectors. No wind, rain, ice, fog, sleet, hail, driven dust, or volcanic ash will coat and mechanically degrade them. Moonquakes and meteor impacts produce only tens of nanometers of ground motion. Micrometeors erode thin solar collectors less than 1 mm every 1 million years. To produce the lunar components, a few people and a Figure 1. In this lunar power base, sunlight hits the solar converter, which transmits power via underground wires to a microwave generator, which in turn illuminates a microwave reflector. All such reflectors, when viewed from Earth, overlap to form a "lens" that can direct a narrow power beam toward Earth. Microwave reflector Solar converter Habitat/ manufacturing units Mobile factory Microwave generator Assembly units small quantity of production machinery, components, and supplies must be transported to the moon. **The production machinery constructs the lunar power bases primarily from materials that are widely available on the moon.** Bulk **soil** and separated soil fractions can be melted by concentrated sunlight and **formed into thin glass sheets** and **fibers** or sintered into rods, tubes, bricks, **and more complex components**. **Silicon, aluminum, and iron can be chemically extracted from lunar soil** for fabrication of solar cells. Trace elements can be brought from Earth for doping solar cells. It is estimated that **a kilogram of materials transported** from Earth **to the moon would result in the delivery of 200 times as much electric energy** to Earth as a kilogram of a solar-power satellite. However, the power-per-kilogram ratio can be further increased because the requisite production machinery can be designed so that 90% or more is made on the moon from lunar materials. This further reduces the total mass that must be ferried from Earth and, hence, reduces the up-front cost of transportation. In this case, **1 kg of facilities and components sent to the moon will return approximately 1,400 times as much energy to Earth as 1 kg of a solar-power satellite deployed from Earth.** Earth hangs permanently in the sky just above the lunar horizon. As seen from Earth, the microwave reflectors of all the power plots of a power base appear to overlap and form an antenna 30 to 100 km in diameter. A lunar power base can efficiently deliver power to a rectenna as small as 400 m in diameter that outputs 25 MW of electric power. Larger rectennas will output proportionally more power. Note that 30 km is the maximum operational diameter of the Very Large Array (VLA) for radio astronomy, which is located 80 km west of Socorro, New Mexico. The VLA has operated automatically for more than 15 years and has routinely achieved 10 times the phasing accuracy required at the 12-cm wavelength by the LSP System. If the cost of the lunar activities—including the design and building of a delivery system—is restricted to $0.001/kWe•h, then as much as $140,000/kg can be invested in establishing and operating the LSP facilities and components. An LSP demonstration system could begin delivering commercial power within 10 years of program start-up. The cost and rate of growth of the LSP System are limited only by how clever we are in applying our industrial skills, not by the cost of transporting materials to the moon. Rectennas located on Earth between 60º N and 60º S can receive power directly from the moon approximately 8 hours a day. **Power could be received anywhere on Earth via a fleet of relay satellites in high-inclination,** eccentric orbits around Earth (Figure 2). **A** given **relay satellite receives a power beam** from the moon **and retransmits** multiple beams **to several rectennas** on Earth required by an alternative operation. **This enables** the region around **each rectenna to receive power 24 hours a day**. The **relay satellites would require less than 1% of the surface area needed by a fleet of solar-power satellites in orbit around Earth.** Synthetic-aperture radars, such as those flown on the Space Shuttle, have demonstrated the feasibility of multibeam transmission of pulsed power directed to Earth

from orbit. **The LSP System is a reasonable alternative to supply Earth's needs for commercial energy without the undesirable characteristics of current options.** The system collects sunlight on the moon's surface, converts it to usable energy, and beams the energy to receivers on Earth. **The system can be built on the moon from lunar materials and operated on the moon and on Earth using existing technologies**. More-advanced production and operating technologies than those described here will Figure 2. A "lens" at a base on one side of the moon (or at a linked base on the other side, if sunlight dictates) directs a microwave beam to a relay satellite or directly to a field of rectifying antennas (a rectenna) on Earth.

Absent LSP fossil fuels and CO2 emissions will maintain consistent growth

Adler 21 Adler, Kevin. "Global Energy Consumption to Rise 50%, Carbon Emissions 25% by 2050: US Eia." *IHS Markit*, 30 Nov. 2021, https://cleanenergynews.ihsmarkit.com/research-analysis/global-energy-consumption-to-rise-50-carbon-emissions-25-by-20.html.

The latest forecast from the US Energy Information Administration (EIA) reinforces messages that have been coming for the past year from international bodies, independent analysts, and climate advocates: at its current trajectory, **humanity will fall far short of the Paris Agreement** goal of reaching net-zero emissions by 2050. EIA's conclusion in its "International Energy Outlook 2021," released 6 October is that **global energy demand will rise by 50%** between 2020 and 2050, **and carry annual CO2 emissions** from this sector **24.7% higher. Annual energy CO2 emissions in 2050 will total 42.839 billion metric tons** (mt) globally, **representing a yearly average gain of 0.7%** from 2020 onwards. **"Even with growth in renewable energy,** without significant policy changes or technological breakthroughs, we project increasing energy-related carbon dioxide emissions through 2050," said EIA Acting Administrator Stephen Nalley in a press conference. EIA projects that renewable energy will make significant inroads in the global power mix by 2050, rising by 3.3% per year (compared with 1% for oil and 0.9% for natural gas). It says that batteries will contribute to reliability. Yet it states that gas and coal will be needed to meet power demand as well. Renewable generation will nearly triple from 65.1 quadrillion Btu in 2020 to 191.7 quadrillion Btu in 2050. This will place its share of the power market at about 58.4% in 2050, compared with about 27.6% today. Considering all end uses for energy—residential, commercial, industrial, and transportation—**fossil fuels still will provide a large share,** particularly for industry and transportation in 2050. However, it is worth noting that EIA places renewables' share of energy consumption (235.2 quadrillion Btu) nearly on par with hydrocarbon-based liquid fuels (248.5 quadrillion Btu), and ahead of gas and coal**. Rising consumption of fossil fuels will overwhelm the improvements anticipated** in the carbon intensity of energy production and usage, thus **leading to the net gain in CO2 emissions.**

IHS Markit perspective IHS Markit has been modeling global energy use and carbon emissions trends, taking into account the same technological advances, price forecasts, and potential policies that EIA has reviewed. IHS Markit's latest forecast is somewhat more optimistic than EIA's in terms of handling carbon emissions, but nonetheless identifies a large gap between what's needed to minimize the impact of climate change, and where industry and consumer use seems to be taking carbon emissions. The IHS Markit base case, known as "Inflections," was updated this summer. "Inflections shows growth in energy demand to 2050 of approximately 25%, but this is against a background of a global population increasing by approximately 2 billion, with most of those in emerging markets," Paul McConnell, research and analysis executive director, energy-wide perspectives, said. "Inflections does show a decline in GHG emissions over that same period, indicating the energy transition is well underway. But it's not enough to meet the goals of the Paris Agreement, nor reach net-zero emissions by 2050." OECD, non-OECD divide EIA broke down its forecast into two categories: the 38 developed countries that belong to the Organisation for Economic Cooperation and Development (OECD), and the non-OECD nations. This divide carries added significance heading into the UN COP26 meeting next month in Scotland, where pressure will be on the world's wealthy countries, which have generated most of carbon emissions historically, to commit to deeper emissions cuts.In fact, a report issued this week by Carbon Tracker states that the US is responsible for 20% of the world's CO2 emissions since the industrial revolution, followed by China (11%), Russia (7%), Brazil (5%), Indonesia (4%), Germany (4%), India (3%), and the UK (3%). Carbon Tracker's analysis indicates that the world has already emitted 86% of the CO2 it can release if global warming is to be

limited to 1.5 degrees Celsius, the goal of the Paris accord. Aiming to meet that Paris goal, 90 nations plus the 27-state EU have announced tougher Nationally Determined Contributions (NDCs) in the last year. But analysis by the UN's climate agency in September found that those pledges would not reach the 2030 goal of a 45% cut in GHG emissions—and that's even if all of the NDCs were achieved. The UN report analyzed NDCs from 113 countries that represent 49% of annual global emissions (both OECD and non-OECD countries), finding that their total GHG reductions will increase about 12% from the 2010 baseline by 2030. **EIA's** outlook, which spans 195 countries, sees a continuation of that upward trend. Its base case **sees CO2 emissions** from non-OECD countries **increasing by 35% by 2050** compared with 2020 levels plus a 5% rise in OECD countries. For non-OECD countries, EIA projects net CO2 emissions will increase by 4.2 billion mt between 2020 and 2035, followed by an increase of 3.7 billion mt between 2035 and 2050, with the slower growth in the second half of the projection period "largely linked to increases in renewable energy and energy efficiency." OECD countries' CO2 emissions will increase by 175 million mt between 2020 and 2035 and by over 400 million mt between 2035 and 2050. For the US, EIA projects that CO2 emissions will peak in 2021 at 63.2 million mt, and fall to 46.4 million mt in 2050—far short of a net-zero goal.
Trends: EVs, crude oil, gas On the positive side, EIA predicts rapid adoption of electric vehicles (EVs) across the OECD, contributing to a flattening of emissions from the transportation sector. EIA said sales of internal combustion engine vehicles would peak in 2023 in OECD countries and in 2038 in non-OECD nations. The net result will be an estimated 780 million plug-in electrics or hybrids by 2050 across the OECD and non-OECD nations, out of about 2.1 billion light-duty vehicles. In the power generation arena, EIA said all post-2020 generation growth in OECD regions will come from renewables, with solar and wind "displac[ing] an increasing share of existing non-renewable, mostly fossil fuel-based, sources." For non-OECD regions, renewables will account for about 90% of new generation from 2020 to 2050. Because these nations will experience greater population growth and are continuing to provide energy to under-served parts of their population, their energy consumption growth rate will be 2.4% per year, compared with 0.6% in the OECD. Nonetheless, **oil and gas demand will rise** as well, driven by emerging Asian nations. **Global demand for oil will reach** 125.9 million b/d in 2050, up from 92.1 million b/d in 2020, or **a 1% annual gain.** Non-OECD countries will increase their demand by 1.5% per year (compared with 0.4% for OECD countries), and will be responsible for 78.4 million b/d of demand by 2050**.** The US, Russia, Canada, and **OPEC will meet those needs with overall increases of 50% in crude oil production**. **On the gas side,** the picture is similar. Global **growth will be 0.9% per year** through 2050, or a total of 30% during the period, to reach 186 trillion cubic feet/year. Non-OECD nations' needs will grow at 1.2% annually, compared with 0.5% for OECD countries. New demand for gas will present opportunities for all of the world's leading exporting nations and regions.

Warming causes extinction and nuclear war

Pester 21 (Patrick, staff writer for Live Science. His background is in wildlife conservation and he has worked with endangered species around the world. Patrick holds a master's degree in international journalism from Cardiff University in the U.K. and is currently finishing a second master's degree in biodiversity, evolution and conservation in action at Middlesex University London. Citing **Luke Kemp, a research associate at the Centre for the Study of Existential Risk at the University of Cambridg**e in the United Kingdom AND **Michael Mann, PhD, distinguished professor of atmospheric science at Penn State**. "Could climate change make humans go extinct?" https://www.livescience.com/climate-change-humans-extinct.html August 30, 2021)DR 21

According to Mann, a global temperature increase of 5.4 degrees Fahrenheit (**3** degrees **Celsius**) or more could lead to **a collapse of our societal infrastructure** and **massive unrest** and **conflict**, which, in turn, could lead to a future that resembles some Hollywood **dystopian films.**

One way climate change could trigger a societal collapse is by creating **food insecurity**. **Warming the planet has a range of negative impacts on food production, including increasing the water deficit and thereby reducing food harvests,** Live Science previously reported. Food production losses can increase **human deaths** and **drive economic loss** and **socio-political instability**, among other factors, that may trigger a breakdown of our institutions and increase the risk of **a societal collapse**, according to a study published Feb. 21 in the journal Climatic Change.

Related: Has the Earth ever been this hot before?

Past extinctions and collapses

Kemp studies previous civilization collapses and the risk of climate change. Extinctions and catastrophes almost always involve multiple factors, he said, but he thinks if humans were to go **extinct**, climate change would likely **be the main culprit.**

"If I'm to say, what do I think is the biggest contributor to the potential for human extinction going towards the future? Then climate change, no doubt," Kemp told Live Science.

All of the major **mass-extinction events in Earth's history have involved** some kind of **climatic change**, according to Kemp. These events include cooling during the Ordovician-Silurian extinction about 440 million years ago that wiped out 85% of species, and warming during the Triassic-Jurassic extinction about 200 million years ago that killed 80% of species, Live Science previously reported. And more recently, climate change affected the fate of early human relatives.

While Homo sapiens are obviously not extinct, "we do have a track record of other hominid species going extinct, such as Neanderthals," Kemp said. "And in each of these cases, it appears that again, climatic change plays some kind of role."

Scientists don't know why Neanderthals went extinct about 40,000 years ago, but climatic fluctuations seem to have broken their population up into smaller, fragmented groups, and severe changes in temperature affected the plants and animals they relied on for food, according to the Natural History Museum in London. Food loss, driven by climate change, may have also led to a tiny drop in Neanderthal fertility rates, contributing to their extinction, Live Science previously reported.

Climate change has also played a role in the collapse of past human civilizations. A 300-year-long drought, for example, contributed to the downfall of ancient Greece about 3,200 years ago. But Neanderthals disappearing and civilizations collapsing do not equal human extinction. After all, humans have survived climate fluctuations in the past and currently live all over the world despite the rise and fall of numerous civilizations.

Homo sapiens have proven themselves to be highly adaptable and able to cope with many different climates, be they hot, cold, dry or wet. We can use resources from many different plants and animals and share those resources, along with information, to help us survive in a changing world, according to the Smithsonian's National Museum of Natural History.

Related: How would just 2 degrees of warming change the planet?

Today, we live in a global, interconnected civilization, but there's reason to believe our species could survive its collapse. A study published on July 21 in the journal Sustainability identified countries most likely to survive a global societal collapse and maintain their complex way of life. Five island countries, including New Zealand and Ireland, were chosen as they could remain habitable through agriculture, thanks to their relatively cool temperatures, low weather variability and other factors that make them more resilient to climate change.

New Zealand would be expected to hold up the best with other favorable conditions, including a low population, large amounts of good quality agricultural land and reliable, domestic energy. So, even if climate change triggers a global civilization collapse, humans will likely be able to keep going, at least in some areas.

Turning on ourselves

The last scenario to consider is **climate-driven conflict**. Kemp explained that in the future, a scarcity of resources that diminish because of **climate change could** potentially **create conditions for wars that threaten humanity**. "There's reasons to be concerned that as **water resources dry up** and **scarcity becomes worse**, and the general conditions of living today become much, much worse, then suddenly, the **threat of potential nuclear war becomes much higher**," Kemp said.

Put another way, climate change impacts might not directly cause humans to go extinct, but it could lead to events that seriously endanger hundreds of millions, if not billions, of lives. A 2019 study published in the journal Science Advances found that **a nuclear conflict** between just India and Pakistan, with a small fraction of the world's nuclear weapons, could kill 50 million to **125 million people** in those two countries alone. Nuclear war would also change the climate, such as through temperature drops as burning cities fill the atmosphere with smoke, threatening food production worldwide and potentially causing **mass starvation**.

What's next?

While avoiding complete extinction doesn't sound like much of a climate change silver lining, there is reason for hope. Experts say **it isn't too late to avoid the worst-case scenarios** with significant cuts to greenhouse gas emissions.

"It is up to us," Mann said. "If we fail to reduce carbon emissions substantially **in the decade ahead**, we are likely committed to a worsening of already dangerous **extreme weather events**, inundation of coastlines around the world due to melting ice and rising sea level, more pressure on limited resources as a growing global population competes for less food, water and space due to climate change **impacts**. If we act boldly now, we can avoid the worst impacts."

Scenario 2 - XRAY Telescopes

The Lunar Based Xray Imager (LSXI) is key to observation of Earth magnetosphere which allows for early detection of solar flares and geomagnetic disturbances

Guo 21 Yihong GUO1 , Chi WANG1,2*, Fei WEI1 , Tianran SUN1 , Xizheng YU1 , Songwu PENG1 , Graziella BRANDUARDI-RAYMONT3 & Steven SEMBAY4. *A Lunar Based Soft X-ray Imager (LSXI) for the earth's magnetosphere,* National Space Science Center, Chinese Academy of Sciences 2021, **https://link.springer.com/article/10.1007/s11430-020-9792-5**

1. Introduction Solar activities are important driving factors that affect the Earth's space environment, namely space weather. The **space weather could** seriously interfere with the normal operation of communication, navigation and space-based technology systems, and **create** broad and **profound impact on social activities and economy.** The **solar wind squeezes or stretches the outer boundary of the Earth's magnetosphere** and couples with the near-Earth space environment, **causing geomagnetic disturbances** and dramatic changes in charged particles which endangers the space activities. **Observing the Earth's magnetosphere in a global view could significantly improve the ability of space weather forecast** (Collier et al., 2010). For the past fifty years, based on a number of magnetospheric satellites, we have built a revolutionary understanding of magnetosphere structure and the physical evolutionary process. At present, **the majority of our knowledge of magnetospheric response to solar activities comes from in situ measurements by satellites in different locations**, and theoretical model analysis. Missions, such as Cluster and Double Star, have provided important information about the local plasma (Credland et al., 1997; Liu et al., 2005). However, **due to the limited observation points, it is difficult to fully reveal the overall interactions of the solar wind with the magnetosphere** at the system level **and to predict the global dynamics.** Recently, a novel soft X-ray imaging technique has been developed, which is inspired by the lobster eye structure (Branduardi-Raymont et al., 2012; Collier et al., 2012; Walsh © Science China Press and Springer-Verlag GmbH Germany, part of Springer Nature 2021 earth.scichina.com link.springer.com SCIENCE CHINA Earth Sciences * Corresponding author (email: cw@nssc.ac.cn) et al., 2016). This new type of instrument is a wide-field of view soft X-ray telescope with spectroscopic capabilities, and the detection principle is based on the recent discovery of solar wind charge exchange (SWCX) X-ray emission. The Soft X-ray Imager payloads on missions, such as SMILE (field of view is 16°×27°), and the much smaller NanoSat CuPID (field of view is 5°×5°) , have adopted this technique and will become powerful diagnostic tools to study the geospace environment under various solar wind conditions in the future (Wang and Branduardi-Raymont, 2018; Camps, 2019). These missions will

be the breakthrough in this area. Nevertheless, **they have spatial and temporal limitations to monitor the global magnetosphere. For this reason, the next generation of X-ray imaging instruments, located outside of the Earth's magnetosphere with a large field of view and long-term observation capability, are urgently required. The Moon can be used as an ideal location to set the instrument for observation purposes**. China started the lunar exploration project-"Chinese Lunar Exploration Program" (CLEP) in 2004, which initially includes three Phases: Orbiting, Landing, and Returning. On 24th November 2020, Chang'e-5 was launched to implement lunar sampling and return on 17th December, which marks the completion of CLEP's first three Phases. Previously, on 3rd January 2019, Chang'e-4 lunar probe successfully landed on the far-side of the Moon and returned the world's first lunar far side close-up image (Wu et al., 2020). It was the first mission of Phase IVof CLEP, which starts a new chapter in the human lunar exploration. In addition, several missions will follow up, and complete the Phase IV of CLEP. Eventually, China will explore the polar region of the Moon and build a robotic lunar scientific research station, which can support long-term, large-scale scientific exploration for space science and space applications (Li et al., 2019; Zhao and Wang, 2019; Xu et al., 2019). In the context of CLEP Phase IV, one of the application objectives is Moon-based observation and research of the Earth. Here we propose a Lunar-based Soft X-ray imager (LSXI). Compared to satellite payloads in close or extended terrestrial orbits, **LSXI will achieve an unprecedented observational coverage of the magnetosphere and monitor the full chain interaction process of the solar wind and magnetosphere.** Besides, there are several additional favorable conditions for settling an X-ray imager on the Moon. As a stable facility, **LSXI is maintainable, so that it has much longer operation life time to cover more than one solar activity period. The temperature in the lunar polar region is low which is beneficial to the instrument thermal stability, and so on.** The project is proposed by National Space Science Center, Chinese Academy of Sciences, in collaboration with the Mullard Space Science Laboratory, University of Leicester (UK), and other research institutions and universities.

The moon is the perfect place for X-Ray observation of space weather, it's uniquely better than sats and existing tech

Guo 2 Yihong GUO1 , Chi WANG1,2*, Fei WEI1 , Tianran SUN1 , Xizheng YU1 , Songwu PENG1 , Graziella BRANDUARDI-RAYMONT3 & Steven SEMBAY4. *A Lunar Based Soft X-ray Imager (LSXI) for the earth's magnetosphere,* National Space Science Center, Chinese Academy of Sciences 2021, https://link.springer.com/article/10.1007/s11430-020-9792-5

5. Mission profile For the preliminary design, LSXI will be placed on the Moon's South Pole region. In order to obtain a global view of Earth's magnetosphere we required a FOV of 15°×30° (Figure 10). Compared with other orbital observation schemes, **a lunar platform has many advantages. Firstly, the Moon is in synchronous rotation with Earth,** and **thus** always shows the same side to Earth. **Therefore, the Moon becomes an excellent location for achieving a near-continuous observation of the solar wind-magnetosphere region**. **Secondly, the Moon is about 60 RE away from the Earth. Therefore,** the 15°×30° FOV of LSXI **could cover the whole magnetopause region** including the bow shock, magnetopause and cusps. **It will enable the global monitoring of the dynamic process of solar wind-magnetosphere interaction**. **Thirdly, the Moon is a permanent and stable observation platform. Its life cycle is not as limited as that of satellites. It is able to cover one complete or more than the 11-year cycle of solar activity.** The lunar surface is covered by dust, which will degrade the performance of the instrument. LSXI will be anticipated to have a door covering the aperture and once the dust has settled after being thrown up by the deployment system the door will be opened for normal operations. This door would also protect the instrument during transit. Furthermore, the electromagnetic shield will be anticipated to keep the lens surface clean

and extend the lifetime of the instruments (Díaz Gilete, 2014).The tracking turntable will be set to keep the telescope pointing at the magnetopause and cusps. At the same time, according to the observation requirements, an observation plan can also be set up by ground instructions to adapt to changes in different solar wind conditions. The entire instrument package weighs about 35 kg (excluding the turntable and battery or the solar panel). The detector usually requires cooling to under ~100°C for optimum performance. An actively cooled system is needed. The estimated total power consumption is about 50 W. The power supply on the Moon is also an important issue. It takes about 29.5 days for the Moon to orbit the Earth, and the orbital plane nearly coincides with the ecliptic plane. In one orbital period (Figure 7), LSXI can achieve continuous observation in the blue segment phase for about 22 days, and stands by due to the direct sunlight in the red segment phase. Moon moves to different positions corresponding to the front, side and back views of the magnetosphere. Here, the red/blue balls represent the North/South Cusps, the yellow ball stands for the position of the subsolar magnetopause, and the yellow line is the Sun-Earth line (Figure 11). 6. Summary After successfully executing the early phases of CLEP, China is now proposing follow-up plans. In this paper, we have illustrated the concept of LSXI. Taking advantage of the position change between the Earth and Moon**, LSXI will use the most advanced imaging technology to observe the global image of Earth's magnetosphere from multiple angles for a long time**. Furthermore, **combining space-based and ground based detection results, it will bring profound innovations to the research of magnetospheric physics, and it has direct application in predicting and mitigating space weather disasters. This mission is aimed for launch around 2027.** The LSXI mission is led by National Space Science Center, CAS, and in collaboration with institutions in China and abroad, including the Mullard Space Science Laboratory, University of Leicester (UK), and other research institutions.

Inevitable and unpredictable solar flares may wipe out the entire power grid causing catastrophic damage, only early detection can solve

Siegel 21 Ethan Siegel, "**A Giant Solar Flare Is Inevitable,** and Humanity Is Completely Unprepared." *Big Think*, 19 Oct. 2021, https://bigthink.com/starts-with-a-bang/giant-solar-flare/.

Ethan Siegel is a Ph.D. astrophysicist and author of "Starts with a Bang!" He is a science communicator, who professes physics and astronomy at various colleges. He has won numerous awards for science writing since 2008 for his blog, including the award for best science blog by the Institute of Physics. https://bigthink.com/people/ethansiegel/

From the 1600s through the mid-1800s, solar astronomy was a very simple science. If you wanted to study the sun, you simply looked at the light from it. You could pass that light through a prism, breaking it up into its component wavelengths: from ultraviolet through the various colors of the visible light spectrum all the way into the infrared. You could view the sun's disk directly, either by putting a solar filter over your telescope's eyepiece or by creating a projected image of the sun, both of which will reveal any sunspots. Or you could view the sun's corona during the most visually appealing spectacle that nature has to offer: a total solar eclipse. For over 250 years, that was it.That changed dramatically in 1859, when solar astronomer Richard Carrington was tracking a particularly large, irregular sunspot. All of a sudden, a "white light flare" was observed, with unprecedented brightness and lasting about five minutes. Approximately 18 hours later, the largest geomagnetic storm in recorded history occurred on Earth. Aurorae were visible worldwide, including at the equator. Miners awoke in the middle of the night, thinking it was dawn. Newspapers could be read by the light of the aurora. And troublingly, telegraph systems began sparking and igniting fires, even though they were disconnected entirely. This turned out to be the first-ever observation of what we now know as a solar flare: an example of space weather. **If an event similar to 1859**'s Carrington event **occurred** here on Earth **today, it would result in a multitrillion dollar disaster**. Here's what we all should know about it. When energetic charged particles from the sun interact with the Earth, the Earth's magnetic field tends to funnel those particles down around Earth's poles. The interactions between those solar particles and the upper atmosphere typically results in an auroral display, but the potential to severely change Earth's surface magnetic field, and induce currents, cannot be ignored. (Credit: Daniil Khogoev/pxhere) When we think about the sun, we normally think about two things: the internal source of its power, nuclear fusion in its core, and the radiation that it emits from its photosphere, warming and powering all sorts of biological and chemical processes on Earth and elsewhere in the solar system. These are two of the major processes involving our sun, to be sure, but there are others. In particular, if we take a close examination of the sun's outermost layers, we find that there are loops, tendrils, and even streams of hot, ionized plasma: atoms that are so hot that their electrons were stripped away, leaving only bare atomic nuclei. **These wispy features result from the sun's magnetic field**, as these hot, charged particles follow the magnetic field lines between different regions on the sun. This is very different than Earth's magnetic field. Whereas we are dominated by the magnetic field created in our planet's metallic core, the sun's field is generated just beneath the surface. This means that lines **enter and exit the sun chaotically**, with strong magnetic fields that loop back, split apart, and reconnect periodically. When these magnetic reconnection events occur, they can lead not only to rapid changes in the strength and direction of the field near the sun, but also the rapid acceleration of charged particles. **This can lead to the emission of solar flares, as well as** — if the sun's corona gets involved —

coronal mass ejections. Solar coronal loops, such as those observed by NASA's Transition Region And Coronal Explorer (TRACE) satellite here in 2005, follow the path of the magnetic field on the Sun. When these loops 'break' in just the right way, they can emit coronal mass ejections, which have the potential to impact Earth. (Credit: NASA/TRACE) What happens on the sun, unfortunately, doesn't always stay on the sun, but freely propagates outward throughout the solar system. **Solar flares and coronal mass ejections consist of fast-moving charged particles from the sun:** largely protons and other atomic nuclei. Normally, the sun emits a constant stream of these particles, known as the solar wind. However, these space weather events — in the form of solar flares and coronal mass ejections — can not only greatly enhance the density of charged particles that get sent out from the sun, but their speed and energy as well. Solar flares and coronal mass ejections, when they occur, often happen along the sun's central and mid-latitudes, and only rarely around the polar area**s. There seems to be no rhyme** or reason **to their directionality** — they're just as likely to occur in the direction of Earth as they are in any other direction. Most of the space weather events that occur in our solar system are benign, at least from our planet's point of view. It's only when an event comes directly for us that it poses a potential danger. Given that we now have **sun-monitoring satellites and observatories**, they're our first line of defense: to **alert us when a space weather event is potentially threatening** to us. That occurs when a flare points directly at us, or when a coronal mass ejection appears "annular," meaning that we only see a spherical halo of an event that's potentially directed right at us. When a coronal mass ejection appears to extend in all directions relatively equally from our perspective, a phenomenon known as an annular CME, that's an indication that it's likely headed right for our planet. (Credit: ESA / NASA / SOHO) Whether from a solar flare or a coronal mass ejection, however, a slew of charged particles headed towards Earth doesn't automatically mean disaster. In fact, we're only in trouble if three things all occur at once: The space weather events that occur have to have the proper magnetic alignment with respect to our own planet to penetrate our magnetosphere. If the alignment is off, Earth's magnetic field will harmlessly deflect the majority of particles away, leaving the remainder to do nothing more than create a mostly harmless auroral display. Typical solar flares occur only at the sun's photosphere, but ones that interact with the solar corona — often connected by a solar prominence — can cause a coronal mass ejection. If a coronal mass ejection is directed right at Earth, and the particles are moving rapidly, that's what puts Earth in the greatest amount of peril. There needs to be a large amount of electrical infrastructure in place, particularly large-area loops and coils of wire. Back in 1859, electricity was still relatively novel and rare; today, it's a ubiquitous part of our global infrastructure. As our power grids become more interconnected and far-reaching, our infrastructure faces greater threat from these space weather events. A solar flare from our Sun, which ejects matter out away from our parent star and into the Solar System, can trigger events like coronal mass ejections. Although the particles typically take ~3 days to arrive, the most energetic events can reach Earth in under 24 hours, and can cause the most damage to our electronics and electrical infrastructure. (Credit: NASA/Solar Dynamics Observatory/GSFC) In other words, most of the space weather events that have occurred throughout history would have posed no danger to humans on our planet, as the only discernable effects they would have would be to cause a spectacular auroral display. But today, **with the massive amounts of electricity-based infrastructure that now covers our planet, the danger is very**, very **real**. The concept is pretty easy to understand and it has been around since the first half of the 19th century: induced current. When we build an electric circuit, we typically include a voltage source: an outlet, a battery, or some other device that's capable of causing electric charges to move through a current-carrying wire. That's the most common way to create an electric current, but there's another: by changing the magnetic field that's present inside a loop or coil of wire. When you run a current through a loop or coil of wire, you change the magnetic field inside of it. When you turn that current off, the field changes again: a changing current induces a magnetic field. Well, as shown by Michael Faraday all the way back in 1831, 190 years ago, the reverse is also true. If you change the magnetic field inside a loop or coil of wire — such as by moving a bar magnet into or out of the loop/coil itself — it will induce an electric current in the wire itself, meaning it will cause electric charge to flow even without a battery or some other voltage source. When you move a magnet into (or out of) a loop or coil of wire, it causes the field to change around the conductor, which causes a force on charged particles and induces their motion, creating a current. The phenomena are very different if the magnet is stationary and the coil is moved, but the currents generated are the same. This wasn't just a revolution for electricity and magnetism; it was the jumping-off point for the principle of relativity. (Credit: OpenStaxCollege, CCA-by-4.0) That's **what makes space weather so dangerous** to us here on Earth: not that it poses a direct threat to humans, but **that it can cause enormous amounts of electrical current to flow through the wires connecting our infrastructure.** This can lead to: **electrical shorts fires explosions blackouts and power outages a loss of communications infrastructure many other damages** that **will appear downstream**. Consumer electronics aren't a major problem; if you knew a solar storm was coming and you unplugged everything in your home, most of your devices would be safe. The major issue is with the infrastructure set up for large-scale production and transmission of power; **there will be uncontrollable surges that will knock out power stations**

and substations and pump far too much current into cities and buildings. Not only would **a big one** — comparable to 1859's Carrington event — be a multitrillion-dollar disaster, but it **could** also potentially **kill** thousands or even **millions** of people, depending on how long it took to restore heat and water to those most directly affected. In February of 2021, an estimated 4.4 million Texans lost power due to a winter storm. In the event of a grid-overloading space weather event, there could be over a billion people across the world left without power, a natural disaster without precedent in the world. (Credit: NOAA) The first thing we need to invest in, if we're actually serious about preventing the worst-case scenario for such an event, is early detection. **While we can look at the sun remotely, gaining estimates for when flares** and coronal mass ejections **could be potentially hazardous** to Earth, **we've been relying on incomplete data. Only by measuring the magnetic fields** of the charged particles traveling from the sun to Earth — **and comparing them with the orientation of Earth's magnetic field** at that particular moment — **can we know whether such an event would have a potentially catastrophic impact on our planet**. In past years, **we've been reliant on the sun-observing satellites** we've put up between the Earth and the sun: **at the L1** Lagrange **point**, some 1,500,000 km away from Earth. Unfortunately, **by the time the particles streaming from the sun get to L1, they've traveled 99% of the way** from the sun to Earth, **and will typically arrive between 15 and 45 minutes later. That's far from ideal when it comes to predicting a geomagnetic storm, much less engaging in measured to [and] mitigate one.** But all of that is changing as the first of the next-generation solar observatories has recently come online: the National Science Foundation's DKIST, or the Daniel K. Inouye Solar Telescope. Sunlight, streaming in through the open telescope dome at the Daniel K. Inouye Solar Telescope (DKIST), strikes the primary mirror and has the photons without useful information reflected away, while the useful ones are directed towards the instruments mounted elsewhere on the telescope. (Credit: NSO/NSF/AURA) The Inouye telescope is extremely large, with a 4-meter diameter primary mirror. Of its five science instruments, four of them are spectro-polarimeters, designed and optimized for measuring the sun's magnetic properties. In particular, it allows us to measure the magnetic field in all three of the sun's observable layers: photosphere, chromosphere, and throughout the solar corona. Armed with this information, we can know with great confidence what the orientation of a coronal mass ejection's magnetic field is from the moment it's emitted, and can then easily determine what sort of danger that ejected material poses to Earth. Instead of under an hour of lead time, we could have a warning of up to the full three to four days it typically takes ejected coronal material to travel to Earth. Even for a Carrington-like event, which traveled approximately five times as fast as typical coronal mass ejections, we'd still have ~17 hours of warning — far more than what we had prior to Inouye's first unveiling in 2020. Because it functions as a solar-measuring magnetometer, the Inouye telescope, which is the very first of our next-generation solar observatories, gives us greater warning of a potential geomagnetic catastrophe than we've ever had.When charged particles are sent towards Earth from the sun, they are bent by Earth's magnetic field. However, rather than being diverted away, some of those particles are funneled down along Earth's poles, where they can collide with the atmosphere and create aurorae. The largest events are driven by CMEs on the sun, but will only cause spectacular displays on Earth if the ejected particles from the sun have the correct component of their magnetic field anti-aligned with Earth's magnetic field. (Credit: NASA) It's important that we neither exaggerate nor downplay the dangers we face. Under normal circumstances, the sun emits charged particles, and occasionally, magnetic events drive the release of flares and, more uncommonly, coronal mass ejections. Under most circumstances, these particle streams are low-energy and slow-moving, taking about three days to traverse the Earth-sun distance. Most of these events will miss the Earth, as they're localized in space and the odds of striking our precise location are low. Even if they do hit the Earth, our planet's magnetic field will funnel them away harmlessly, unless the magnetic fields are serendipitously (anti-)aligned. But **if everything lines up in precisely the wrong way — and that's truly just a matter of time** and random chance — the outcome could be disastrous. Although these particles cannot penetrate the atmosphere directly and harm biological organisms directly, they could do tremendous damage to our electrical and electronics-based infrastructure**. Every power grid in the world could go down.** If the damage is bad enough, it could all need repair or even replacement; damage in the U.S. alone could reach ~$2.6 trillion. Additionally, **space-based infrastructure**, like satellites, **could be knocked offline, potentially leading to another disaster if low-Earth orbit gets too crowded: a cascade of collisions, rendered unavoidable if the systems responsible for collision-avoidance are knocked offline**. **The collision of two satellites can create hundreds of thousands of pieces of debris**, most of which are very small but very fast-moving: up to ~10 km/s. If enough satellites are in orbit, this **debris could set off a chain reaction, rendering the environment around Earth practically impassable**. (Credit: ESA/Space Debris Office) On June 23, 2012, the sun emitted a solar flare that was just as energetic as 1859's Carrington event. It was the first time that had occurred since we've developed the tools capable of monitoring the sun to the necessary precision. The flare occurred in Earth's orbital plane, but the particles missed us by the equivalent of nine days. Similar to the Carrington event, the particles traveled from the sun to the Earth in just 17 hours. If Earth had been in the way at the time, the global damage toll could have crested the $10 trillion mark: the first 14-figure natural disaster in history. It was only through luck that we averted catastrophe. As far as mitigation strategies go, **we're only slightly** better **prepared** today than we were nine years ago. We have insufficient grounding at most stations and substations to direct large induced currents into the ground instead of homes, businesses, and industrial buildings. **We could order power companies to cut**

off the currents in their electrical grids — a gradual ramp-down requiring ~24 hours — which could reduce the risks and severities of fires, but that has never been attempted before. And we could even issue recommendations for how to cope in your own household, but no official recommendations presently exist. **Early detection is the first step**, and we're making great scientific strides on that front. However, until we've prepared our power grid, our energy distribution system, an**d citizens of the Earth to be ready for the inevitable, the "big one"** will be paid for many times over, for years and even decades to come, because we failed to invest in the ounce of prevention we so sorely need.

Extinction from grid collapse

Greene 19 [Sherrell R. Greene Mr. Greene received his B.S. and M.S. degrees in Nuclear Engineering from the University of Tennessee. He is a recognized subject matter expert in nuclear reactor safety, nuclear fuel cycle technologies, and advanced reactor concept development. Mr. Greene is widely acclaimed for his systems analysis, team building, innovation, knowledge organization, presentation, and technical communication skills. Mr. Greene worked at the Oak Ridge National Laboratory (ORNL) for over three decades. During his career at ORNL, he served as Director of Research Reactor Development Programs and Director of Nuclear Technology Programs. . "Enhancing Electric Grid, Critical Infrastructure, and Societal Resilience with Resilient Nuclear Power Plants (rNPPs)." https://ans.tandfonline.com/doi/pdf/10.1080/00295450.2018.1505357?needAccess=true edited for ableist language in brackets[]]

Societies and **nations are examples of large-scale, complex social-physical systems**. Thus, **societal resilience can be defined as the ability of a nation**, population, or society **to anticipate and prepare for major stressors or calamities and then to absorb, adapt to, recover from, and restore normal functions** in the wake of such events when they occur. **A nation's dependence on its Critical Infrastructure** systems, **and the resilience of those systems, are therefore major components of national and societal resilience**.

There are a variety of events that could deal ~~crippling~~ [**Incapacitating**] **blows to a nation's Grid**, **Critical Infrastructure**, **and social fabric**. The types of **catastrophes** under consideration here **are "very bad day" scenarios that might result from severe GMDs induced by solar CMEs**, **HEMP** attacks, **cyber** attacks, etc.5

As briefly discussed in Sec. III.C, the probability of a GMD of the magnitude of the 1859 Carrington Event is now believed to be on the order of 1%/year. The Earth narrowly missed (by only several days) intercepting a CME stream in July 2012 that would have created a GMD equal to or larger than the Carrington Event.41 Lloyd's, in its 2013 report, "Solar Storm Risk to the North American Electric Grid," 42 stated the following: "A Carrington-level, extreme geomagnetic storm is almost inevitable in the future…The total U.S. population at risk of extended power outage from a Carrington-level storm is between 20-40 million, with durations of 16 days to 1-2 years…The total economic cost for such a scenario is estimated at $0.6-2.6 trillion USD." Analyses conducted subsequent to the Lloyd's assessment indicated the geographical area impacted by the CME would be larger than that estimated in Lloyd's analysis (extending farther northward along the New England coast of the United States and in the state of Minnesota),43 and that the actual consequences of such an event could actually be greater than estimated by Lloyd's.

Based on "Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack: Critical National Infrastructures" to Congress in 2008 (Ref. 39), a HEMP attack over the Central U.S. could impact virtually the entire North American continent. The consequences of such an event are difficult to quantify with confidence. Experts affiliated with the aforementioned

Commission and others familiar with the details of the Commission's work have stated in Congressional testimony that **such an event could "kill up to 90 percent of the national population through starvation, disease, and societal collapse**." 44,45 Most of **these consequences are either direct or indirect impacts of the predicted collapse of virtually the entire U.S**. **Critical Infrastructure system** in the wake of the attack.

Last, recent analyses by both the U.S. Department of Energy46 and the U.S. National Academies of Sciences, Engineering, and Medicine47 have concluded that cyber threats to the U.S. Grid from both state-level and substatelevel entities are likely to grow in number and sophistication in the coming years, posing a growing threat to the U.S. Grid.

These three "very bad day" scenarios are not creations of overzealous science fiction writers. A variety of mitigating actions to reduce both the vulnerability and the consequences of these events has been identified, and some are being implemented. However, the fact remains that events such as those described here have the potential to change life as we know it in the United States and other developed nations in the 21st century, whether the events occur individually, or simultaneously, and with or without coordinated physical attacks on Critical Infrastructure assets.

1AC: Framing

The Standard is maximizing expected wellbeing

1] Extinction outweighs under any framework

Pummer 15 [Theron, Junior Research Fellow in Philosophy at St. Anne's College, University of Oxford. "Moral Agreement on Saving the World" Practical Ethics, University of Oxford. May 18, 2015] AT

There appears to be lot of disagreement in moral philosophy. Whether these many apparent disagreements are deep and irresolvable, I believe there is at least one thing it is reasonable to agree on right now, whatever general moral view we adopt: that it is very important to reduce the risk that all intelligent beings on this planet are eliminated by an enormous catastrophe, such as a nuclear war. How we might in fact try to reduce such existential risks is discussed elsewhere. My claim here is only that we – **whether we're consequentialists, deontologists, or virtue ethicists** – should all agree that we should try to save the world. According to consequentialism, we should maximize the good, where this is taken to be the goodness, from an impartial perspective, of outcomes. Clearly one thing that makes an outcome good is that the people in it are doing well. There is little disagreement here. If the happiness or well-being of possible future people is just as important as that of people who already exist, and if they would have good lives, it is not hard to see how **reducing existential risk is easily the most important thing in the whole world.** This is for the familiar reason that there are **so many people who could exist in the future** – there are **trillions upon trillions**… upon trillions. There are so many possible future people tha**t reducing existential risk is arguably the most important** thing in the world, **even if the well-being of these possible people were given only 0.001% as much weight** as that of existing people. Even on a wholly person-affecting view – according to which there's nothing (apart from effects on existing people) to be said in favor of creating happy people – the case for reducing existential risk is very strong. As noted in this seminal paper, this case is strengthened by the fact that there's a good chance that many existing people will, with the aid of life-extension technology, live very long and very high quality lives. You might think what I have just argued applies to consequentialists only. There is a tendency to assume that, if an argument appeals to consequentialist considerations (the goodness of outcomes), it is irrelevant to non-consequentialists. But **that is a huge mistake.** Non-consequentialism is the view that there's more that determines rightness than the goodness of consequences or outcomes; **it is not the view that the latter don't matter**. Even John Rawls wrote, "All ethical doctrines worth our attention take consequences into account in judging rightness. One which did not would simply be irrational, crazy." **Minimally plausible versions of deontology and virtue ethics must be concerned in part with promoting the good**, from an impartial point of view. They'd thus imply very strong reasons to reduce existential risk, at least when this doesn't significantly involve doing harm to others or damaging one's character. What's even more surprising, perhaps, is that even if our own good (or that of those near and dear to us) has much greater weight than goodness from the impartial "point of view of the universe," indeed even if the latter is entirely morally irrelevant, we may nonetheless have very strong reasons to reduce existential risk. Even egoism, the view that each agent should maximize her own good, might imply strong reasons to reduce existential risk. It will depend, among other things, on what one's own good consists in. If well-being consisted in pleasure only, it is somewhat harder to argue that egoism would imply strong reasons to reduce existential risk – perhaps we could argue that one would maximize her expected hedonic well-being by funding life extension technology or by having herself cryogenically frozen at the time of her bodily death as well as giving money to reduce existential risk (so that there is a world for her to live in!). I am not sure,

however, how strong the reasons to do this would be. But views which imply that, if I don't care about other people, I have no or very little reason to help them are not even minimally plausible views (in addition to hedonistic egoism, I here have in mind views that imply that one has no reason to perform an act unless one actually desires to do that act). To be minimally plausible, egoism will need to be paired with a more sophisticated account of well-being. To see this, it is enough to consider, as Plato did, the possibility of a ring of invisibility – suppose that, while wearing it, Ayn could derive some pleasure by helping the poor, but instead could derive just a bit more by severely harming them. Hedonistic egoism would absurdly imply she should do the latter. To avoid this implication, egoists would need to build something like the meaningfulness of a life into well-being, in some robust way, where this would to a significant extent be a function of other-regarding concerns (see chapter 12 of this classic intro to ethics). But once these elements are included, we can (roughly, as above) argue that this sort of egoism will imply strong reasons to reduce existential risk. Add to all of this Samuel Scheffler's recent intriguing arguments (quick podcast version available here) that most of what makes our lives go well would be undermined if there were no future generations of intelligent persons. On his view, my life would contain vastly less well-being if (say) a year after my death the world came to an end. So obviously if Scheffler were right I'd have very strong reason to reduce existential risk. **We should also take into account moral uncertainty.** What is it reasonable for one to do, when one is uncertain not (only) about the empirical facts, but also about the moral facts? I've just argued that there's agreement among minimally plausible ethical views that we have strong reason to reduce existential risk – not only consequentialists, but also deontologists, virtue ethicists, and sophisticated egoists should agree. But even those (hedonistic egoists) who disagree should have a significant level of confidence that they are mistaken, and that one of the above views is correct. Even if they were 90% sure that their view is the correct one (and 10% sure that one of these other ones is correct), they would have pretty strong reason, from the standpoint of moral uncertainty, to reduce existential risk. Perhaps most disturbingly still, **even if we are only 1% sure that** the **well-being** of possible future people **matters,** it is at least arguable that, **from** the standpoint of **moral uncertainty, reducing existential risk is the most important thing in the world.** Again, this is largely for the reason that there are so many people who could exist in the future – there are trillions upon trillions… upon trillions. (For more on this and other related issues, see this excellent dissertation). Of course, it is uncertain whether these untold trillions would, in general, have good lives. It's possible they'll be miserable. It is enough for my claim that there is moral agreement in the relevant sense if, at least given certain empirical claims about what future lives would most likely be like, **all minimally plausible moral views would converge on the conclusion that we should try to save the world.** While there are some non-crazy views that place significantly greater moral weight on avoiding suffering than on promoting happiness, for reasons others have offered (and for independent reasons I won't get into here unless requested to), they nonetheless seem to be fairly implausible views. And even if things did not go well for our ancestors, I am optimistic that they will overall go fantastically well for our descendants, if we allow them to. I suspect that most of us alive today – at least those of us not suffering from extreme illness or poverty – have lives that are well worth living, and that things will continue to improve. Derek Parfit, whose work has emphasized future generations as well as agreement in ethics, described our situation clearly and accurately: "We live during the hinge of history. Given the scientific and technological discoveries of the last two centuries, the world has never changed as fast. We shall soon have even greater powers to transform, not only our surroundings, but ourselves and our successors. If we act wisely in the next few centuries, humanity will survive its most dangerous and decisive period. Our descendants could, if necessary, go elsewhere, spreading through this galaxy…. Our descendants might, I believe, make the further future very good. But that good future may also depend in part on us. If our selfish recklessness ends human history, we would be acting very wrongly." (From chapter 36 of On What Matters)

2] The state should be used as a heuristic to learn from it. Its the internal link to your pessimistic activism
Zanotti 14

Dr. Laura Zanotti is an Associate Professor of Political Science at Virginia Tech. Her research and teaching include critical political theory as well as international organizations, UN peacekeeping, democratization and the role of NGOs in post-conflict governance."Governmentality, Ontology, Methodology: Re-thinking Political Agency in the Global World" – Alternatives: Global, Local, Political – vol 38(4):p. 288-304,. A little unclear if this is late 2013 or early 2014 – The Stated "Version of Record" is Feb 20, 2014, but was originally published online on December 30th, 2013. Obtained via Sage Database.

By questioning substantialist representations of power and subjects, inquiries on the possibilities of political agency are reframed in a way that focuses on power and subjects' relational character and the contingent processes of their (trans)formation in the context of agonic relations. **Options for resistance to governmental scripts are not limited to ''rejection,''** ''revolution,'' or ''dispossession'' to regain a pristine ''freedom from all constraints'' or an immanent ideal social order. **It is found instead in** multifarious and **contingent struggles that are** constituted **within** the scripts of **governmental rationalities and at the same time exceed and transform them. This approach questions oversimplifications of** the **complex**ities of liberal **political rationalities** and of their interactions with non-liberal political players **and nurtures a** radical **skepticism about identifying universally good or bad actors or abstract solutions to political problems.** International **power interacts in complex ways with diverse political spaces** and within these spaces it is appropriated, hybridized, redescribed, hijacked, and tinkered with. **Governmentality as a heuristic** focuses on performing complex diagnostics of events. It **invites** historically situated explorations and **careful differentiations rather than overarching demonizations of ''power,'' romanticizations of the ''rebel''** or the ''the local.'' More broadly, theoretical formulations that conceive the subject in non-substantialist terms **and** focus on processes of subjectification, on the ambiguity of power discourses, and on hybridization as the terrain for political transformation, open ways for reconsidering political agency beyond the dichotomy of oppression/rebellion. These alternative formulations **also foster an ethics of political engagement**, to be continuously **taken** up **through plural and uncertain practices, that demand continuous attention to ''what happens'' instead of fixations on ''what ought to be.''83 Such ethics of engagement would not await the revolution** to come or hope for a pristine ''freedom'' to be regained. **Instead, it would constantly attempt to twist** the working **of power by playing with whatever cards are available and would require intense processes of reflexivity on the consequences of political choices**. To conclude with a famous phrase by Michel Foucault ''my point is not that everything is bad, but that everything is dangerous, which is not exactly the same as bad. If everything is dangerous, then we always have something to do. So **my position leads not to apathy but to hyper- and pessimistic activism.'**'84

3] The Role of The Ballot is to evaluate the fiated aff plan vs a competitive alternative or the status quo – anything is infinitely arbitrary, impact justified, and self-serving.

<u>UV</u>

1] <u>1AR Theory</u> –

---A] the aff gets it because otherwise the 1NC could be infinitely abusive which o/w,

---B] it's drop the debater because the 2AR is too short to win a shell AND substance so theory can only check abuse for the aff

---C] no neg RVI because otherwise they could dump on the shell for 6 minutes and get away with anything by sheer brute force,

---D] fairness is a voter and outweighs---necessary for competitive activities---every argument relies on the judge evaluating them fairly.

2] <u>Reasonability on T</u> – Use a brightline of disclosure and link or impact turn ground.

---A] Reciprocity – the neg gets exclusive access to topicality so its irreciprocal to hold it to the same standard as other theory,

---B] Engagement – reasonability encourages a refocus on substantive education – the brightline proves they had the ability to engage.

3] <u>Condo is a voting issue</u> – the time crunched 1AR can't read its best offense against multiple worlds with different uniqueness conditions – they collapse to what's undercovered which wrecks engagement.

4] <u>PICs aren't legit</u>– they're a voter bc they moot 99% of aff offense which is a massive time skew and sidetracks topic ed