## Nationalize SpaceX v3

### Inherency

#### SpaceX can beat China to the Moon and secure new Helium-3, but NASA can’t.

Berger 21

Eric Berger, reporter, CNN. Why China's space program could overtake NASA, CNN.com April 1, 2021. Eric Berger, a reporter and editor based in Houston, is the author of ["LIFTOFF: Elon Musk and the Desperate Early Days that Launched SpaceX."](https://www.harpercollins.com/products/liftoff-eric-berger?variant=32126620205090) After a long career at the Houston Chronicle, he joined Ars Technica in 2015 as the site's senior space editor, covering SpaceX, NASA and everything beyond. He was a Pulitzer Prize finalist for his coverage of Hurricane Ike in the Houston Chronicle in 2008. <https://www.cnn.com/2021/04/01/opinions/china-space-race-us-spacex-berger/index.html> -CAT

China has a good chance of becoming the dominant space power in the 21st century, and it's not just looking to copy NASA on the way to the top. Instead, the country is paying close attention to what innovative US companies like SpaceX are doing as well. To get ahead in space, communism is learning from capitalism. In the summer of 2019, a small Chinese rocket launched from an inland spaceport in the southern part of the country. Close-up photos, posted afterward on Chinese social media accounts, showed small grid fins affixed to the upper part of this Long March 2C rocket for the first time. They were virtually identical in design to the grid fins SpaceX uses to steer its Falcon 9 rocket through the atmosphere for landings on its ocean-based drone ships. A year after this test, China's main space contractor revealed plans to develop the ability to reuse its Long March 8 booster, which is powered by kerosene fuel, the same type of power that fuels SpaceX rockets. By 2025, Chinese officials said, this rocket would be capable of landing on a sea platform like SpaceX's Falcon 9 booster. And it is not just the Chinese government contractors that are emulating SpaceX. A growing number of semi-private Chinese companies have also announced plans to develop reusable rockets. Chinese firms such as LinkSpace and Galactic Energy have released schematics that seem to mimic SpaceX technology. None of this should be particularly surprising. Government-launched enterprises in both Russia and Europe also recently revealed plans to develop reusable rockets that are similar both in appearance and function to the Falcon 9 booster. But what makes the Chinese efforts to emulate SpaceX particularly notable is the country's expansive ambitions in space and its vast resources to back up these long-term goals. Earlier this month, the Chinese government signed an agreement with Russia to work together to build a Moon base. China has also begun planning to launch crewed missions to Mars and deploy a massive space-based, commercial-scale solar power plant by 2050. They're playing the long game, and they're playing to win. Based on China's recent accomplishments in space, it would be wise to take these grand ambitions seriously. In December, China became only the third nation to return Moon rocks to Earth. Later this spring, it will seek to join the United States as only the second country to land and operate a rover on the surface of Mars. All the while, China is racing across a number of other fronts in space, from building an orbital space station to maturing anti-satellite capabilities in space to establishing a base on the moon. As China advances in space, NASA has spent more than $20 billion building a large rocket, the Space Launch System, that could soon be obsolete. And flying this single-use rocket is so expensive that, in combination with its Artemis program, NASA could exceed its congressional funds by more than 43%. NASA could also abandon the International Space Station in a few years. Meanwhile, China is training European astronauts and teaching them Chinese so that they might visit its large, modular space station. Some of these European astronauts may subsequently join the China-Russia lunar exploration effort. Increasingly, the US' main advantage over China lies in its burgeoning commercial space industry, led by SpaceX. If America wants to compete, it should unleash the full potential of SpaceX and other commercial space companies that seek to go further in space, faster and for less money. This kind of public-private partnership has already worked in low-Earth orbit, with NASA buying services from companies such as SpaceX, Northrop Grumman and Boeing to deliver cargo and astronauts to the International Space Station. This is one reason why, about five years ago, China began backing dozens of companies to commercialize rockets and satellites. The 21st century space race, therefore, is not so much between China and NASA. Rather, it is between China and the US commercial space industry. Astronauts relocated a spacecraft outside the International Space Station Astronauts relocated a spacecraft outside the International Space Station Nearly a decade ago, SpaceX attracted international acclaim when it began to successfully land its Falcon 9 rockets, accomplishing an engineering feat many previously deemed impossible or impractical. While historically rocket boosters have been discarded in the ocean after they expend their fuel on the way to orbit, SpaceX figured out how to land its boosters upright on platforms at sea and on land, allowing the company to recover and refurbish the rockets and save money. Later, the company strapped three of these Falcon 9 cores together to build a larger and much more powerful rocket, called the Falcon Heavy. And it is now testing an even larger, reusable booster, its Starship vehicle, intended to ferry humans to and from Mars. In late February, China unveiled strikingly similar space plans. The country's space agency said it would build a triple core rocket, which looks like a SpaceX Falcon Heavy. And it also confirmed plans to move forward with its titanic Long March 9 rocket, capable of lifting as much as 140 metric tons to low-Earth orbit, the same amount as the Saturn V rocket, an American super heavy-lift launch vehicle that remains the most powerful rocket that has ever flown successfully. This massive rocket would be unlike anything NASA built, however; Chinese officials, taking a page from the SpaceX playbook, said they would like it to be reusable. And, they added, they aim to one day launch the Long March 9 to take its taikonauts to Mars. While SpaceX became a transformational space company, the US and China have been locked in an increasingly intense battle for influence and economic resources on Earth. That conflict, which has already emerged in low-Earth orbit, will extend to the Moon and eventually Mars in the coming decades. In the contest for geopolitical influence and economic wealth, space will come to represent the ultimate high ground. China is definitely going. For now, the US and NASA have the advantage of a more robust space program and a stronger commercial space industry. But for the last decade, the US commercial space industry has succeeded despite Congress, not because of it. Unless Congress and NASA more closely embrace commercial space and follow a bold plan of exploration, China's constancy of purpose and mimicking of Western strengths will overcome this head start.

#### Whoever gets to the Moon first will control all the Helium-3 in the world

Bilder 10

Richard B. Bilder, Foley & Lardner-Bascom Emeritus Professor of Law, University of Wisconsin Law School A LEGAL REGIME FOR THE MINING OF HELIUM-3 ON THE MOON: U.S. POLICY OPTIONS 33 Fordham Int’l L.J. 243 Fordham International Law Journal January, 2010 -CAT

A LEGAL REGIME FOR THE MINING OF HELIUM-3 ON THE MOON: U.S. POLICY OPTIONS During the past several years, the United States and three of the world’s other leading space powers, Russia, China, and India, have each announced their intent to establish a base on the Moon, in part with the purpose--or, in the case of the United States, at least the exploratory goal--of seeking to mine and bring to Earth helium-3 (“He-3”), an isotope1 of helium rarely found naturally on Earth but believed to be present in large amounts as a component of the lunar soil.2 The potential value of \*246 He-3 is that it is theoretically an ideal fuel for thermonuclear fusion power reactors, which could serve as a virtually limitless source of safe and non-polluting energy.3 For example, it is estimated that forty tons of liquefied He-3 brought from the Moon to the Earth--about the amount that would comfortably fit in the cargo bays of two current U.S. space shuttles--would provide sufficient fuel for He-3 fusion reactors to meet the full electrical needs of the United States, or one quarter of the entire world’s electrical needs, for an entire year.4 While the technological and economic feasibility of fusion-based nuclear energy, particularly fusion reactors utilizing He-3 \*247 as fuel, is still uncertain and contested, and its commercial realization at best decades away,5 the implications of such a development could be far-reaching and profound. Fusion energy could significantly reduce the world’s heavy dependence on fossil fuels, which are associated with environmental pollution, greenhouse gas emissions, and global warming--not to mention their rising price and role in recurrent geopolitical and economic tensions. Fusion energy could also provide a safer alternative to many countries’ growing reliance on energy generated from nuclear fission reactors, which hold the potential dangers of nuclear accidents, terrorism, weapons proliferation, and radioactive waste disposal. Moreover, in contrast to the prospect of depletion of terrestrial fossil fuels, it is estimated that there is sufficient He-3 present on the Moon to meet humanity’s rapidly growing energy needs for many centuries to come.6 Thus, despite the problematic future of He-3-based fusion energy, it is not surprising that the United States and other major powers are beginning to position themselves to ensure their future access to lunar He-3 resources. However, the growing interest in lunar He-3 poses its own problems. As yet, there is no international consensus on whether, or how, any nation or private entity can exploit or acquire title to lunar resources. The U.N.-developed 1967 Outer Space Treaty7 does not specifically address this question. The related U.N.-sponsored 1979 Moon Agreement8 purports to lay the groundwork for the eventual establishment of a regime for the exploitation of lunar resources, but that agreement has thus far been ratified by only a very few countries--not including the United States and none of which are currently leading space \*248 powers.9 Absent an agreed international legal framework, attempts by the United States or any other nation or private entity to acquire and bring to Earth significant quantities of He-3 could give rise to controversy and conflict. Indeed, without the security of an established legal regime, nations or private entities might well be reluctant to commit the very substantial money, effort, and resources necessary to mine, process, and transport back to Earth the amounts of lunar He-3 sufficient to support the broad-scale terrestrial use of He-3-based fusion energy. Consequently, it seems timely to revisit the issue of the legal regime potentially applicable to exploiting He-3 and other lunar resources.10 Part I of this Article will briefly discuss the technical \*249 and economic prospects for the development of He-3-based fusion energy. Part II lays out the present legal situation concerning the exploitation of lunar resources such as He-3. Part III analyzes whether it is prudent for the United States to seek an international lunar resource regime. Concluding that it would \*250 be, Part IV provides possible policy options for the United States concerning the establishment of an international legal regime capable of facilitating the development of He-3-based fusion energy. I. THE PROSPECTS FOR HE-3-BASED FUSION ENERGY11 He-3 is a component of the “solar wind” comprised of gas and charged particles continuously emitted by the sun into the solar system in the course of its thermonuclear fusion processes.12 During more than four billion years in which the solar wind has impacted the Moon, significant amounts of He-3, in addition to particles of other ionized components of the solar wind, have become embedded in the Moon’s regolith--the loose and dusty upper layer of rocks and soil comprising much of the Moon’s surface.13 While He-3 constitutes only a minute proportion of the lunar regolith,14 it is estimated that, altogether, there may be as much as one million metric tons of He-3 potentially recoverable \*251 from the Moon’s surface.15 This amount of He-3 is theoretically **e**quivalent to ten times the energy content of all of the coal, oil, and natural gas economically recoverable on Earth.16 Since the Earth, unlike the Moon, possesses a magnetic field and atmosphere that deflect the solar wind, He-3 is rarely found naturally on Earth.17 The small amounts of He-3 available for research and experiment on Earth are derived principally from the decay of tritium used in thermonuclear weapons.18 While interest in lunar He-3 relates to its potential use as a fuel for thermonuclear power reactors,19 the technological and economic feasibility of fusion power itself has yet to be demonstrated.20 Unlike the engineering and material requirements for power production in the uranium and plutonium-fueled nuclear fission reactors now operating in the United States and a number of other countries, the generation of power by thermonuclear fusion requires the containment of ionized plasmas at extremely high temperatures, a feat not easily or economically achievable at present with existing materials and technology.21 Nevertheless, the enormous potential of fusion \*252 energy continues to spur persistent and intensive efforts to overcome these obstacles. One of the most significant efforts is the recent establishment, by a consortium of the European Union (through the European Atomic Energy Community), Japan, the People’s Republic of China, the Republic of India, the Republic of Korea, the Russian Federation, and the United States, of the International Thermonuclear Experimental Reactor (“ITER”),22 a large-scale, international experimental research project designed to explore the scientific and engineering feasibility of magnetic containment fusion power production.23 The program will be located in Cadarache, France, and is expected to cost over US$12 billion and continue for thirty years.24 For a number of reasons, including the limited terrestrial availability of He-3 and the very high temperatures required to achieve He-3-based fusion, most current research, and any first generation fusion power reactors, will likely be based on a fuel cycle involving the fusion of deuterium (“D”) and tritium (“T”), \*253 two isotopes of hydrogen available on Earth and capable of fusing at considerably lower temperatures.25 However, an He-3-D fuel cycle, if and when technically achievable, theoretically offers significant advantages as compared with the D-T fuel cycle. Unlike a D-T fusion reaction, which results in considerable neutron radiation, an He-3-D fusion reaction would produce little radioactivity and a substantially higher proportion of directly usable energy.26 More specifically, the comparative \*254 advantages of an He-3-D fuel cycle over a D-T fuel cycle would include: (1) increased electrical conversion efficiency; (2) reduced radiation damage to containment vessels, obviating the need for frequent expensive replacement; (3) reduced radioactive waste, with consequent reduced costs of protection and disposal; (4) increased levels of safety in the event of accident; and (5) potentially lower costs of electricity production.27 In particular, an He-3-D fuel cycle would significantly reduce the risk of nuclear proliferation because an He-3-D reaction, unlike a D-T reaction, would produce few neutrons and could not be readily employed to produce plutonium or other weapons-grade fissile materials.28 Consequently, interest in developing He-3-fueled thermonuclear energy is likely to continue. How would lunar He-3 be extracted and transported to Earth?29 Because the solar wind components are weakly bound to the lunar regolith,30 it should be relatively easy to extract them utilizing reasonable extensions of existing technology. In one proposed scenario, once a lunar base is established, robotic lunar mining vehicles fitted with solar heat collectors would: (1) traverse appropriate areas of the Moon’s surface--probably, in particular, the lunar maria, or “seas”--scooping up the loose upper layer of the lunar regolith and sizing it into small particles; (2) utilize solar energy to process and heat the collected regolith to the temperatures necessary to release, separate, and collect in a gaseous state the He-3, along with certain other solar-wind elements embedded in the regolith particles; (3) discharge the spent regolith back to the lunar surface; and (4) return with the collected He-3 and other gaseous byproducts to the lunar base.31 \*255 The collected He-3 gas could then be liquified in the lunar cold and transported to Earth, perhaps in remotely-operated shuttles.32 Importantly, this type of mining operation could result in the collection not only of He-3 but also significant amounts of hydrogen, oxygen, nitrogen, carbon dioxide, and water, all potentially very useful--indeed, perhaps indispensable--for the maintenance of a lunar base or further outer space activities such as expeditions to Mars or other planets.33 Since He-3 is believed to comprise only a small proportion of the lunar regolith, it will probably be necessary to process large amounts of lunar regolith in order to obtain the quantities of He-3 necessary to sustain a large-scale terrestrial He-3-based power program. However, the extraction of He-3 and other solar wind components from the lunar soil seems in itself unlikely to have a significant detrimental impact on the lunar environment because the regolith will be discharged back to the Moon’s surface immediately after processing.34 Whether the production of lunar He-3-based fusion power will prove commercially viable remains a complex and disputed question. The commercial success of such a development will clearly depend, among other things, on the parallel and integrated achievement of both economically efficient He-3-fueled fusion power reactors and a sustainable lunar mining enterprise capable of economically extracting and returning to Earth an assured supply of He-3 to fuel such reactors; neither is worth pursuing without the other. However, the development of He-3-based fusion need not start from scratch, but instead will likely build on the substantial research and investment already committed to the development of fusion power more generally in ITER and other already ongoing projects. Moreover, the development of lunar He-3 mining can similarly build on--and indeed form an additional rationale for--the already existing \*256 commitment of various space powers to establish lunar bases. As indicated earlier, lunar mining activities may be worth developing not only to extract He-3 from the regolith, but also to obtain a variety of other byproducts highly useful for the support of lunar bases.35 Finally, the economic viability of He-3-based fusion power will, of course, depend on its eventual production cost relative to alternative sources of energy such as fossil fuel or other conventional sources of energy, energy produced by nuclear fission reactors, or other forms of fusion energy--all figures difficult to accurately predict at this time. Proponents of He-3-based fusion energy argue that, notwithstanding the substantial costs involved in developing He-3 fusion reactors, establishing a lunar mining operation, and transporting He-3 back to Earth, He-3-based fusion power will eventually be more than competitive with the cost of other types of energy resources and provide more than sufficient incentive for the participation of both government and private enterprise.36 But other \*257 commentators are more skeptical, doubting both the technical feasibility of such a complex and challenging development and the likelihood of He-3-based fusion power ever competing successfully with more traditional Earth-based energy systems.37 Suffice it to say, major space powers currently consider the potential of He-3-based fusion energy sufficiently promising as to warrant their serious interest and to furnish at least an additional rationale for their commitment to programs to establish national stations on the Moon.

#### Independently, NASA reliance on SpaceX is inevitable, but in the squo that puts national security dangerously dependent on private contractors.

Thayer and Han 21

BRADLEY A. THAYER AND LIANCHAO HAN Will Biden's NASA win the space race with China? The Hill, May 2, 2021 *Bradley A. Thayer is the co-author of “*[*How China Sees the World: Han-Centrism and the Balance of Power in International Politics*](https://www.amazon.com/How-China-Sees-World-International/dp/1612349838)*.” Lianchao Han is vice president of* [*Citizen Power Initiatives for China*](https://www.citizenpowerforchina.org/)*. After the Tiananmen Square Massacre in 1989, he was one of the founders of the Independent Federation of Chinese Students and Scholars. He worked in the U.S. Senate for 12 years, as legislative counsel and policy director for three senators.* <https://thehill.com/opinion/international/550708-will-bidens-nasa-win-the-space-race-with-china> -CAT

At NASA Administrator Bill Nelson’s confirmation hearing before the Senate Commerce Committee, Sen. Marsha Blackburn (R-Tenn.) and several of her colleagues asked for his total commitment to tackling the pressing threat of China’s space policy. That speaks volumes about where America stands in the new space race with China.    For years, China’s government has stolen countless innovations in an attempt to close the gap in military superiority between itself and the United States. Much of this theft has revolved around space technology, which China sees as a critical component of future warfighting. China’s advances in space are decades in the making. China has made significant strides, including becoming the first country to successfully land a rover on the dark side of the moon and advancing plans to create a joint moon base with Russia. Because of China’s determination to establish bases on the moon, many experts reasonably fear that China’s efforts soon will surpass the United States. Former Lt. Col. Pete Garretson told Politico, “We don’t have this national program that is able to beat the Chinese” — in part because China has a “really, really clever” strategy. America does still lead in space, and the development of the U.S. Space Force is an important step, but the concern expressed by some members of Congress at Nelson’s confirmation hearing highlights the troubling signs that NASA may be tilting off the mark. For example, committee Chairwoman Sen. Maria Cantwell (D-Wash.) asked Nelson why, days before the hearing, NASA decided to hand off the U.S. moon project to a single contractor, one that has had several vehicle failures and has violated regulations. This is a significant and worrisome break from NASA precedent. The agency typically hands out agreements to multiple vendors to ensure efficiency, low costs and on-time deliveries. This time, though, NASA put all its faith in the SpaceX Starship prototype that unfortunately has blown up four times in five months.   Even in the era of trillion-dollar spending, this does not appear to be a wise use of $2.89 billion. NASA’s lack of quality control mechanisms for this moon landing is damaging not only to the efforts of the United States to maintain a viable and safe enterprise but also because space is an arena of great power competition. U.S. setbacks or failures will ultimately empower China’s communist regime, emboldening its aggressive space strategy that was created to strengthen China’s military prowess, harm the interests of the United States, and establish a permanent Chinese presence on the moon and, in time, Mars. This could allow China to set its own norms and rules for space exploration. It was encouraging, however, when Congress asked Nelson if he would commit to ensuring the resiliency of the human lander program — ostensibly, through operationalizing back-up vehicles, which would ensure the United States does not fall behind China in the event of setbacks — and he indicated that he would, stating that “competition is always good.” While that is positive, it is important to maintain that spirit because, unlike the first symbolic race to the moon with the Soviet Union, the one with China is significantly different. This time, the winning nation intends to stay once they land. The winner will get to stake a claim to the moon’s untapped minerals and other resources, which will be necessary for establishing a permanent base for scientific research and future missions to Mars. Allowing an adversarial power such as China to gain that position is unquestionably not in the interests of the United States. Most members of Congress understand what’s at stake, which is why a moon landing has become the priority of U.S. space policy. The U.S. plans an ambitious moon landing date of 2024 to stay ahead of China’s curve. Thus, it would be a tremendous loss to the standing of the United States if NASA effectively permits its careful deliberations and planning to fail because it did not ensure secure and reliable vehicles to realize its objectives. The United States can land on the moon before China and secure a base for future generations and our allies. This will happen only if President Biden’s new NASA head proceeds with equal measures of ambition and determination to realize U.S. strategic goals in space, scientific aims, and alacrity to the China threat.

#### But Elon Musk doesn’t care about he-3; he’s putting all of SpaceX’s resources into a Mars colony

Grush 17

Loren Grush, The Verge, “Elon Musk Plans to Put all of SpaceX’s Resources into its Mars Rocket,” Sep. 29, 2017. Loren Grush is a science reporter for The Verge, the technology and culture brand from Vox Media, where she specializes in all things space—from distant stars and planets to human space flight and the commercial space race. The daughter of two NASA engineers, she grew up surrounded by space shuttles and rocket scientists—literally. She is also the host of Space Craft, an original online video series that examines what it takes to send people to space. <https://www.theverge.com/2017/9/29/16378802/elon-musk-mars-plan-rocket-spaceship-colonization-iac-2017> -CAT

Today, SpaceX CEO Elon Musk said he hopes to finance his plans to colonize Mars by making SpaceX’s entire fleet of vehicles — the Falcon 9, the Falcon Heavy, and the Dragon spacecraft — obsolete. Speaking at the International Astronautical Congress, Musk said that SpaceX will eventually start stockpiling these vehicles and then focus all of its resources into developing the company’s next monster vehicle: the Interplanetary Transport System, codenamed the BFR (for Big Fucking Rocket). “WE BELIEVE WE CAN DO THIS WITH THE REVENUE WE RECEIVE FROM LAUNCHING SATELLITES AND SERVICING THE SPACE STATION.” “All our resources will turn toward building BFR,” Musk said. “And we believe we can do this with the revenue we receive from launching satellites and servicing the space station.” Musk also announced he’s planning to scale down the ITS, proposing 31 main engines this year. Last year at the same conference, Musk unveiled the combo rocket-and-spaceship’s design, which included 42 main Raptor engines that could send up to 450 metric tons to Mars. Most of the rest of the major design elements, such as in-orbit fueling and propulsive landing, remained the same. A rendering of the ITS deploying a payload into orbit. Image: SpaceX Musk also proposed a variety of new uses for the scaled-down rocket beyond just going to Mars. Supposedly, the ITS can be used to launch satellites, take cargo to the International Space Station, and even do lunar missions to set up a Moon base. SpaceX’s current Falcon 9 fleet is used to do a few of those things already, but Musk says eventually the company will turn to the ITS to do all of its space missions. MUSK ALSO PROPOSED A VARIETY OF NEW USES FOR THE SCALED-DOWN ROCKET “We can build a system that cannibalizes our own products, makes our own products redundant, then all the resources we use for Falcon Heavy and Dragon can be applied to one system,” he said at the conference. Musk says the cost of launching cargo on the ITS will be fairly cheap, too, since the rocket and spaceship will be a fully reusable system (unlike the Falcon 9, which is only 70–80 percent reusable). However, SpaceX will still keep the Falcon 9 and Falcon Heavy on hand in case customers want to launch on flight-proven vehicles once the ITS starts flying. Advertising how the ITS can be used for Moon missions is a savvy business move for Musk. It’s also a political one. While launching satellites and servicing the space station is lucrative, it probably isn’t enough to fund the rocket’s development, despite what Musk says. SpaceX will need other funds — and the US government is a good source of cash. That may explain the newfound interest in the Moon. Vice President Mike Pence, who is in charge of the new National Space Council, has hinted at directing NASA to return to the Moon. And a few key space advisors — including Scott Pace, the executive director of the council — have been vocal about their desire to do human lunar missions. OF COURSE, MUSK’S ULTIMATE GOAL IS STILL MARS And a lunar mission won’t require going solo, like Mars does: many national space agencies, such as Russia, China, and the European Space Agency, all have their sights set on the Moon. Recently, Russia and NASA signed an agreement to study concepts for stations that could be built near the Moon. Of course, Musk’s ultimate goal is still Mars, and he’s still making incredibly optimistic predictions about when the company is going to get there. Last year, Musk claimed the first crews would start flying to the Red Planet as early as 2024. This year, he said the first two cargo ITS ships will launch to Mars in 2022. That’s just five years to create an entirely new rocket, send it to another planet, and land it on the surface intact. If it does land successfully, it’ll be the heaviest vehicle to ever make it to the Martian surface in one piece. (The most we’ve ever landed on Mars weighed about 2,000 pounds, but the ITS can supposedly land between 20 to 50 tons.) It’s an unrealistic timeline. (Musk’s word for it was “aspirational.”) SpaceX has yet to launch any people into space, and the company has blown plenty of deadlines before. It was supposed to start sending astronauts to the International Space Station as early as this year. Now the absolute earliest is 2018 or 2019. Meanwhile, SpaceX initially promised to launch its new heavy-lift rocket, the Falcon Heavy, in 2013. The rocket hasn’t yet flown, though Musk said today it should launch before the end of the year. Its development was much more difficult than he’d originally expected, Musk said.

#### And even if Musk did care about mining He-3, he has no intention of cooperating with the government.

Roulette 21

Elon Musk’s SpaceX violated its launch license in explosive Starship test, triggering an FAA probe SpaceX’s upcoming test launches are getting extra scrutiny By Joey Roulette Jan 29, 2021, 5:56pm EST <https://www.theverge.com/2021/1/29/22256657/spacex-launch-violation-explosive-starship-faa-investigation-elon-musk> -CAT

SpaceX’s first high-altitude test flight of its Starship rocket, which launched successfully but exploded in a botched landing attempt in December, violated the terms of its Federal Aviation Administration test license, according to two people familiar with the incident. Both the landing explosion and license violation prompted a formal investigation by the FAA, driving regulators to put extra scrutiny on Elon Musk’s hasty Mars rocket test campaign. The December test launch of the “Serial Number 8” Starship prototype at SpaceX’s Boca Chica, Texas, facilities was hailed by Musk as a success: “Mars, here we come!!” the chief executive tweeted moments after the rocket exploded on its landing, celebrating SN8’s successful 8-mile-high ascent with his followers. The FAA, which oversees ground safety and issues licenses for private launches, was not so happy. THE FAA, WHICH OVERSEES GROUND SAFETY AND ISSUES LICENSES FOR PRIVATE LAUNCHES, WAS NOT SO HAPPY The so-called mishap investigation was opened that week, focusing not only on the explosive landing but on SpaceX’s refusal to stick to the terms of what the FAA authorized, the two people said. It was unclear what part of the test flight violated the FAA license, and an FAA spokesman declined to specify in a statement to The Verge. “The FAA will continue to work with SpaceX to evaluate additional information provided by the company as part of its application to modify its launch license,” FAA spokesman Steve Kulm said Friday. “While we recognize the importance of moving quickly to foster growth and innovation in commercial space, the FAA will not compromise its responsibility to protect public safety. We will approve the modification only after we are satisfied that SpaceX has taken the necessary steps to comply with regulatory requirements.” The heightened scrutiny from regulators after the launchpad spectacle has played a role in holding up SpaceX’s latest “SN9” Starship test attempt, which the company said would happen on Thursday. The shiny steel alloy, 16-story-tall rocket was loaded with fuel and ready to fly. But at the time, FAA officials were still going through their license review process for the test because of several changes SpaceX made in its license application, a source said. Musk, frustrated with the process, took to Twitter. “UNDER THOSE RULES, HUMANITY WILL NEVER GET TO MARS,” he said. “Unlike its aircraft division, which is fine, the FAA space division has a fundamentally broken regulatory structure,” he tweeted on Thursday. “Their rules are meant for a handful of expendable launches per year from a few government facilities. Under those rules, humanity will never get to Mars.” The license violation (and subsequent license review process) has escalated tensions between SpaceX and the world’s biggest transportation agency. For years, Musk and others in the space industry have bemoaned the age-old US regulatory framework for launch licensing as innovation and competition in space skyrockets. In response, the US Department of Transportation — which delegates its launch oversight duties to the FAA — unveiled new streamlined launch licensing regulations last year. They have yet to go into effect. In the meantime, Musk’s tweet, calling out the FAA to his 44 million followers, was the latest embodiment of the billionaire’s disgruntled attitude toward regulators that deal with his businesses’ rapid rate of development. SpaceX, founded by Musk in 2002, has sued the Air Force twice, once successfully in 2014 for the right to compete for Pentagon launches, and another unsuccessfully in 2018 for losing out on competitive development funds for Starship and the company’s other rockets. In 2018, when he was fined $20 million by the Securities and Exchange Commission for allegedly misleading Tesla investors via Twitter, Musk told 60 Minutes, “I do not respect the SEC. I do not respect them.” A few hours before the SN8 Starship test in December, while Musk was in Boca Chica securing approval for the FAA license that SpaceX ultimately violated, he was asked in a virtual interview with The Wall Street Journal what role government should play in regulating innovation. Musk replied: “A lot of the time, the best thing the government can do is just get out of the way.”

### Advantage – Nuclear Terrorism

#### It’s stupidly easy for terrorists to steal enough nuclear material construct a nuclear weapon; the way we stop that is through detecting nuclear smuggling

Bunn & Braun 03

Terrorism Potential for Research Reactors Compared With Power Reactors Nuclear Weapons, “Dirty Bombs,” and Truck Bombs GEORGE BUNN CHAIM BRAUN Center for International Security and Cooperation, Stanford University AMERICAN BEHAVIORAL SCIENTIST, Vol. 46 No. 6, February 2003 714-726 DOI: 10.1177/0002764202239150 © 2003 Sage Publications <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.842.7712&rep=rep1&type=pdf> -CAT

RESEARCH REACTORS In statements about nuclear terrorism, there have been repeated expressions of concern about terrorists’attacks on nuclear power reactors but few about such attacks on research reactors. However, about half of the research reactors in the world contain highly enriched uranium that can be used for making nuclear weapons (International Atomic Energy Agency [IAEA], 2000). Highly enriched uranium (HEU) is enriched to 20% or more in uranium-235. Power reactors do not contain HEU, and their fuel cannot be made into nuclear weapons without enrichment of fresh fuel to HEU or separation of plutonium from spent fuel, major added technological undertakings. 714 AMERICAN BEHAVIORAL SCIENTIST, Vol. 46 No. 6, February 2003 714-726 DOI: 10.1177/0002764202239150 © 2003 Sage Publications Downloaded from abs.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016 Typical small university research reactors that burn HEU may contain less than one fifth of the nuclear material necessary to make a simple Hiroshima HEU gun-type nuclear weapon, the easiest for terrorists to make. They are likely to have additional irradiated or unirradiated HEU, or both, stored near the reactor. All but two U.S. university research reactors have been converted from HEU to low-enriched uranium (LEU), which is not weapon-usable without enrichment (Travelli, 2000). There are much larger U.S. government research reactors that still burn HEU, but they are thought to be well protected from theft and sabotage (National Council on Radiation Protection and Measurement [NCRP], 2002; National Research Council [NRC], 2002). Conversion of research reactors around the world from HEU to LEU has not been as successful as conversion of university reactors has been in the United States. There are almost 100 research reactors around the world using HEU of 90% or greater enrichment, and about 20 more that use 50% to 90% HEU (IAEA, 2000). Many countries besides the United States have government or industry research reactors containing much larger amounts of HEU than the 2 kg to 5 kg that university HEU research reactors typically burn (IAEA, 2000). Research reactors in many countries around the world came from the United States pursuant to the “Atoms for Peace Program” proposed by President Eisenhower in 1953. He suggested that the Soviet Union and the United States transfer enriched uranium to a new international organization (what became the International Atomic Energy Agency or IAEA). These transfers would form an “atomic bank” from which other countries could withdraw uranium for their peaceful nuclear programs (Eisenhower, 1953). By then, in addition to the Soviet Union and the United States, Britain had tested a nuclear weapon, and Belgium, Canada, France, Sweden, Norway, Switzerland, and Italy had the beginnings of national nuclear programs (some had reactors for peaceful purposes and some had them for both peaceful and weapons purposes). The likelihood that Eisenhower’s proposed program would produce proliferation of nuclear weapons, not just of peaceful uses of atomic energy, was apparently not considered seriously by Eisenhower and his top advisers before the speech was given. The possible connection between peaceful uses and weapons came as a surprise to Secretary of State Dulles after the speech was made. No physicists with knowledge about nuclear weapons had been consulted before it was given (G. Bunn, 1992; Smith, 1987). Eventually, however, after modifying the original U.S. proposal, the United States, then the Soviet Union, and then France and other countries supplied research reactors and weapon-usable HEU to burn in them to many countries around the world. In addition, the IAEA was formed to provide information, assistance, training, and safeguards for the peaceful development of atomic energy. In 1978, the U.S. government started a program to convert the uranium it had supplied from HEU to LEU to prevent the HEU from being used to make nuclear weapons. At a conference on research reactors after September 11, Armando Bunn, Braun / RESEARCH REACTORS VS. POWER REACTORS 715 Downloaded from abs.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016 Travelli of Argonne National Laboratory, manager of the U.S. conversion program, had this to say (Travelli, 2002): In the past, our main concern [in the U.S. reactor conversion program] was that rogue nations or terrorist groups would develop nuclear weapons and that, by threatening to use those weapons, they would secure for themselves political and economic advantages that could drastically alter the world balance of power. . . . Today we know that if nuclear weapons were to fall in the hands of those who organized the September 11 attacks, there would be no threats or negotiations. . . . Innocent victims would die in a flash, without warning, killed by people driven by a twisted ideology and devoid of any respect for human life, including their own. Research reactors versus power reactors for making nuclear weapons. There are many research reactors around the world. According to the IAEA (2000), there were 283 operating and 270 shutdown research reactors in 74 countries. The total of these two figures is higher than the total number of power reactors in operation and closed down around the world. Most reactors of both kinds use fresh fuel elements made of uranium. As we have seen, the LEU in power reactors is too low in its uranium-235 enrichment to be useful directly for making nuclear weapons. But, almost half of the operating research reactors in the world use HEU and most of those now shut down did so and may still contain HEU. There are hundreds of kg of HEU in operating and shutdown civilian research facilities in 58 countries, sometimes in quantities large enough in one facility to make a nuclear weapon (M. Bunn & G. Bunn, 2002). The total is enough to make many nuclear weapons. The U.S. program begun in 1978 to convert reactors from HEU to LEU is called the Reduced Enrichment for Research and Test Reactors (RERTR) Program. Pursuant to it, 20 of the U.S.-supplied HEU research reactors outside the United States had been converted from HEU to LEU by March 2002. Except for one new HEU reactor in Germany, no new HEU research reactors have been built in the Western world since RERTR began. However, U.S.-supplied HEU reactors have not yet been converted in countries such as Argentina, Austria, Canada, France, Germany, Greece, Israel, Italy, Jamaica, Japan, Mexico, and Romania (Travelli, 2002). In 1978, the Soviet Union launched its own program to reduce the enrichment of research reactor fuels it supplied to Eastern European countries and to Iraq, Libya, North Korea, and Vietnam. This program moved even more slowly than the U.S. program during the 1980s and 1990s. France also supplied large research reactors to other countries including Israel (uranium without enrichment) and Iraq (HEU fueled). According to the IAEA, government or industry research reactors with large HEU inventories were located in the year 2000 in Argentina, Australia, Austria, Belgium, Canada, Chile, China, Czech Republic, France, Germany, Greece, Hungary, Romania, Russia, South Africa, Switzerland, Taiwan, Ukraine, United Kingdom, United States, Uzbekistan, Vietnam, 716 AMERICAN BEHAVIORAL SCIENTIST Downloaded from abs.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016 and Yugoslavia. Adding IAEA figures for operating research reactors to those that are shut down but may still house HEU fuel, there remain about as many HEU research reactors as LEU ones in the world (IAEA, 2000, 2002). Delays in conversion of the HEU-fueled reactors to LEU fuel have resulted for technical and financial reasons. Designing LEU research reactor fuel that can accomplish the tasks that HEU fuel can accomplish has taken years of development that is still going on. Although the program started in 1978, funding was cut off for several years. There have been recent patent issues arising from the development effort that have held up some conversions (Civiak, 2002; Travelli, 2002). The similar Russian conversion program also was held up by funding problems and the need to develop an LEU fuel that would do essentially what the HEU fuels did for research purposes. Only recently, when funding became available from the United States, was it possible to conduct research on what LEU fuel could be substituted in Russian-built reactors. Thus, for many reasons, the conversion programs have not moved forward as fast as post–September 11 concerns suggest they should have. As we have seen, to make a nuclear weapon from uranium, the weapon’s uranium-235 content must be more than 20%. Moreover, a considerably higher percentage makes it easer to build a dependable weapon. This is particularly true for a terrorist group, which may not be well versed in the fine points of designing and manufacturing such weapons. Indeed, the higher the enrichment level of the HEU, the more manageable the weapon will be in size and the more likely to explode rather than fizzle. Assuming a simple Hiroshima gun-type nuclear weapon, something more than 50 kg (110 pounds) of HEU of 90% or greater enrichment in uranium-235 may be needed to make one nuclear weapon. More HEU would be needed if the uranium-235 enrichment level was lower than 90%. On the other hand, if 90% or higher enrichment in uranium-235 were used with a neutron reflector or in an implosion weapon using modern high-power explosives, the amount needed for a critical mass might be 15 kg to 25 kg.1 According to DOE (1997), Several kilograms of plutonium, or several times that amount of HEU, are enough to make a bomb. With access to sufficient quantities of these materials, most nations and even some sub-national groups would be technically capable of producing a nuclear weapon. Most research reactors do not contain 50 kg or even 15 kg of 90% or higher HEU, although some government and industry reactors do. However, combining the HEU within a medium-sized government or industry reactor with the inventories of fresh and irradiated fuel available at the site of the reactor might produce enough. Moreover, if more than one research reactor exists in a country, that country could use the combined fissile content of its reactors to produce one or more weapons in a nuclear breakout situation. Iraq was trying to produce a nuclear weapon out of fresh and irradiated HEU fuel rods from one Bunn, Braun / RESEARCH REACTORS VS. POWER REACTORS 717 Downloaded from abs.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016 French-supplied research reactor and another Russian-supplied research reactor at the end of the Gulf War (Travelli, 2002; von Hippel, 2001). In 2000, there were almost 100 research reactors in the world with HEU enriched to 90% or more (IAEA, 2000). An earlier IAEA estimate was that HEU research reactors still outnumbered LEU reactors in Africa, the Middle East, Eastern Europe, Russia, and in the industrialized countries of the Western Pacific rim, but not in Western Europe (Ritchie, 1997). Research reactor fuel becomes very radioactive if it is irradiated continuously for a long time in a high neutron-flux environment. However, research reactor experiments are often of short duration and the reactor may be shut down between experiments. Some research reactors also may operate at low power. Moreover, the radioactivity of irradiated fuel reduces over time if it is not burned again. Used fuel in a research reactor pool may well include assemblies that are very radioactive, assemblies that are not radioactive at all, and others in between. Some irradiated fuel from research reactors may thus be usable for making nuclear weapons if the enrichment is high enough and the radioactivity is not too high, as was the case for the Iraqi bomb-making attempt. Power reactors typically operate more than 75% of the time. They are maintained in continuous operation as long as possible because they are needed to supply power and they are typically not shut down to reload fresh fuel until some of the fuel in the reactor has been burned for so long that its radioactivity has significantly increased. Thus, the spent fuel taken from power reactors is usually highly radioactive and dangerous to handle even for terrorists willing to take greater chances with their lives. Close exposure to the fuel for a short period could produce radiation sickness followed by painful death. On the other hand, as we have seen, research reactor fuel may be highly radioactive in some cases and much less radioactive in others. An educated terrorist with a dose rate meter could tell what used fuel could be handled with lower risk. There was great concern about a research reactor holding at least 50 kg of HEU in Vinca, Serbia, during the fighting in the Balkans but the HEU was recently returned safely to Russia. Not counting countries having nuclear weapons, research reactors with more than 20 kg of 90% HEU content exist in Argentina, Belarus, Belgium, Germany, Italy, Japan, and Ukraine. The reactors in Belarus and Ukraine were built when those countries were part of the Soviet Union. The research reactor in Belarus has more than 370 kg of HEU, including enough enriched to 90% to make several bombs. One reactor in the Ukraine also contains large amounts of 90% HEU. Up to two kg of 90% HEU was reported to have disappeared from a research reactor in the Abkhazia region of the former Soviet republic of Georgia during civil resistance there. HEU of somewhat lower U-235 enrichment level, probably stolen from one of the research reactors in Obninsk, Russia, was seized by police in Western Europe when arresting the alleged thieves, and LEU fuel rods were stolen from a research reactor in the Congo (M. Bunn, Holdren, & Weir, 2002; Civiak, 2002; Steinhausler & Zaitseva, 2002). 718 AMERICAN BEHAVIORAL SCIENTIST Downloaded from abs.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016 In sum, HEU from research reactors, particularly the larger ones operated by government and industry, could well be the source of the explosive material for a terrorist nuclear weapon if the nuclear fuel could be successfully stolen from the reactor. But the LEU burned in power reactors and in an increasing number of research reactors cannot be directly used to make nuclear weapons. Research reactors versus power reactors for making radiological weapons. Radiological dispersal devices (RDDs), or “dirty bombs,” are easier to make than nuclear weapons. One such potential device constructed by Chechens to scare the Russian authorities consisted of a container of radioactive material from medical or industrial sources attached to conventional explosives (Steinhausler & Zaitseva, 2002). The explosives were not exploded apparently because the Chechens wanted to gain Russian attention rather than cause major disruption by dispersing radioactive material. An RDD would probably not kill anyone not close enough to be killed by the high explosives. If effective as intended, however, it would disperse radioactive materials over a much wider area than the area in which people could be injured by the explosive force of the bomb. The size and shape of the area irradiated would depend on how large the explosion was, how well the radioactive particles were carried in the air, and what direction the wind was blowing. The dispersal could cause cancers eventually and, at the time, could cause panic in the irradiated area. It might require removal of the population from that area until the dispersed radioactive particles were cleaned away. The disruption to regular and business life and the economic loss could be great (NRC, 2002; Wald, 2002). In addition to being called dirty bombs, RDDs are sometimes referred to as weapons of “mass disruption” rather than “mass destruction.” Radioactive materials for making RDDs could probably be stolen from hospitals and industrial plants more easily than from research or power reactors. According to a committee of scientific experts, “Given the wide use of radiation sources in the United States and other countries, a determined terrorist would probably have little trouble obtaining material for use in an RDD” (NRC, 2002). However, typical hospital and industrial sources may contain only a few grams of easily available radioactive materials, and their dispersal by an explosion would be unlikely to cover a wide area. The area and concentration of dispersal of radioactivity might be too small and too low to cause major disruption. A knowledgeable radiological weapon maker who wanted major disruption would have to find a large quantity of radioactive materials. He or she could perhaps find a large supply of Cobalt 90 or some similar radioactive material used in large quantities by industry or attempt to collect many grams of radioactivity from several industrial and hospital sources. Although small amounts of radioactive material from hospital and industry sources might be the easiest to acquire (large industrial sources are likely to be better protected), collecting many small sources from many places would likely be necessary. Doing so might well take longer and involve more risks of Bunn, Braun / RESEARCH REACTORS VS. POWER REACTORS 719 Downloaded from abs.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016 apprehension than stealing used fuel rods from a poorly protected, shutdown, university research reactor. From a terrorist’s point of view, the fact that the used fuel from such a reactor is likely not to be as highly radioactive as the spent fuel from a nuclear power plant may be an advantage. The NCRP (2002) had this to say about making radiological dispersion devices: The most likely scenarios involve the use of a solid radioactive material that would be of low enough activity that the construction and delivery of the RDD will not seriously inhibit the terrorist carrying out the attack. Large sources of penetrating radiation [such as irradiated power reactor fuel] are difficult to handle safely and without detection by authorities. Shielding materials that are adequate to protect both the individuals who construct the devices and those who are to deploy them complicate the design and fabrication of effective weapons. (p. 15) Building an RDD from irradiated research reactor fuel may be within the reach of many terrorists, whereas making a nuclear weapon would take greater information and skill. The arrest of an alleged Al Qaeda terrorist who is reported to have studied how to make RDDs suggests the possible threat (Bridis, 2002). Spent reactor fuel that has been recently removed from a power reactor will typically have been irradiated for a long time and will be too hot to handle even for suicidal terrorists. The same may be true of spent fuel from large government or industrial research reactors. If the gamma ray and neutron dosage is high enough, the radiation could affect the central nervous system fairly quickly and make the bomb maker unconscious. But this level of radioactivity typically results from the high burn-up that happens in power reactors and some large research reactors more often than in small university research reactors. Thus, for fashioning RDDs intended to frighten and disrupt, spent reactor fuel from small university reactors or from little-used government or industry research reactors could be more attractive to terrorists than spent fuel from power reactors. With spent fuel from any reactor, terrorists would need to know the radioactive dose rate of the material to ensure against radiation sickness effects while working with it. Assuming the theft of research reactor fuel that had not been irradiated for too long a time or that had been out of the reactor long enough for its radioactivity to have cooled significantly—both of which are more likely with small university research reactors than with power reactors—making a radiological weapon out of used research reactor fuel seems more likely than making one from used power reactor fuel. Research reactors versus power reactors as terrorist attack targets. The typical power reactor is likely to have much more radioactive spent fuel in cooling ponds and to contain much more radioactivity within its core than the typical university research reactor or less-used large government or industry research reactor. A power reactor would likely be a more attractive target for a suicidal 720 AMERICAN BEHAVIORAL SCIENTIST Downloaded from abs.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016 terrorist truck bomber or airplane pilot because the radioactive dispersal possibilities could be large—if the attack was successful in breaking through the reactor’s containment building or into the spent fuel pool or in causing sufficient damage to other vital areas of the reactor. This dispersal seems far beyond what might be achieved in a successful terrorist attack involving a truck bomb or aircraft crash at a typical, less-well-protected research reactor. However, from the terrorists’ point of view, a university reactor may appear much more vulnerable because its protection barriers against attack are likely to be much lower than those of power reactors or government or industry research reactors and it is more likely to be located within or near a populated area. Protection barriers for nuclear fuel in research reactors versus those for power reactor fuel. Both irradiated and fresh nuclear fuel are likely to be less well protected from terrorist attacks at university research reactors than at power reactors for many reasons. First, typical research reactor fuel elements are much smaller than those for power reactors. The large size (perhaps 10 ft long) and weight (up to 1 ton) of power reactor fuel mean that a crane or other heavy machinery is needed to move an assembly. Taking it apart is not easy. On the other hand, research reactor fuel elements may be 4 ft long and weigh a few 10s of pounds. They can be disassembled more easily and can typically be moved by one person, properly shielded. Second, university research reactors tend to be located in or near cities—in places where there are many people going back and forth. Government and industry research reactors are more likely to be somewhat removed from populations and surrounded by stronger fences or walls than university research reactors. Power reactors tend to be both farther from cities and more likely to be surrounded by fences, open areas, and walls, which can delay attackers and provide opportunity to observe them before the attack if guards are on duty, as is typical at power reactors. Third, power reactors are ordinarily in operation all the time except for maintenance or when the fuel needs to be changed. Operating personnel are likely to be present during the day even when the reactor is shut down and guards are likely to be present both day and night. Many university research reactors are shut down and left unused for significant periods with only skeleton staff nearby. Power reactors are typically guarded by professional guards hired and trained for the purpose. That may also be true of government and industry research reactors, which are often in operation most of the time. University reactors, with intermittent operation, may rely on the university campus police who are usually present elsewhere and not trained adequately in antiterrorist procedures. When the research reactor is not in operation, they are not likely to check it often. Fourth, as we have seen, the irradiated fuel removed from university research reactors is likely to be less radioactive than that from power reactors. Moreover, many research reactors are not used as much as their suppliers or owners originally expected or are operated at a lower power level than originally anticipated. Bunn, Braun / RESEARCH REACTORS VS. POWER REACTORS 721 Downloaded from abs.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016 Indeed, many university reactors are no longer operated. If the fuel has been removed, as is the practice in the United States, they are not likely to constitute a risk. But this is not a uniform practice. There is probably a great deal of irradiated research reactor fuel accumulated from many years of past operation that is stored in or near research reactors around the world, fuel that is easier to handle for terrorists than power reactor fuel would be. Finally, research reactors, particularly those at universities, tend to have less effective security than power reactors and their fuel. Inadequate protection may result for several reasons. 1. There is no treaty requiring any level of protection for power or research reactors from terrorists. The relevant treaty, the Convention on Physical Protection of Nuclear Material, only provides protection standards to protect nuclear material from being stolen while it is in international transport. A consensus of most of the treaty’s parties to amend it to cover material used or stored domestically, and prohibit sabotage as well as theft, was achieved in general terms in May 2001. However, except for some general principles, no specific standards for domestic protection were specified in this consensus agreement. Such standards exist in the treaty now for international transport and for storage while awaiting international transport. But the parties have been unable to agree to apply those or any other specific standards to regular domestic operations. Without such standards, the amendment has much less value (G. Bunn & Zaitseva, 2002; M. Bunn & Bunn, 2002; NRC, 2002). 2. In 1999, the IAEA issued revised recommendations for protecting nuclear material from sabotage. These are in IAEA Information Circular 225, Revision 4. This revision contains general provisions on sabotage, such as, The objective of the physical protection system should be to prevent or delay access to or control over the nuclear facility or nuclear material through the use of a set of protective measures including physical barriers or other technical means [e.g., security alarms, closed-circuit TV cameras, electronic sensors, finger-print identification devices, etc.] or the use of guards and response forces so that the guards or response forces can respond in time to prevent the successful completion of sabotage. This lists detailed recommendations on how to guard against sabotage of power reactors, but it contains no specific recommendations for sabotage to research reactors. Moreover, unless it is brought into force by the bilateral agreement of the reactor supplier and the recipient country, it remains only general recommendations. Unless national legislation or regulations or bilateral supply agreements require these recommendations, research reactor operators may ignore them. 3. IAEA Information Circular 225, Revision 4, also contains recommendations for protection against theft of nuclear material by terrorists. These apply wherever the nuclear materials are located within a country, including storage at or within research reactors. They say that the level of protection should be based on what the country perceives the threat to be. This is called the “design basis threat.” Unlike the U.S. regulations issued for reactors by the U.S. Nuclear Regulatory Commission, these recommendations do not specify any minimum threat to guard against. Circular 225 divides nuclear material into categories and specifies the strongest protection recommendations for the most sensitive categories, one of which is HEU of 5 kg or more. Irradiated reactor fuel is not in this category but in the next most strongly protected category. The circular then sets forth some useful standards of protection against “unauthorized removal of nuclear material in use and 722 AMERICAN BEHAVIORAL SCIENTIST Downloaded from abs.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016 storage.” Again, however, these remain only recommendations except for countries subject to nuclear supply agreements where the supplier country has required adherence to them or where the country has otherwise adopted them through national regulations or legislation. In general, supply agreements suggest simply that the recipient country take these recommendations into account. 4. The Nuclear Suppliers’ Guidelines (Nuclear Suppliers Group, 1996), negotiated among various nuclear suppliers to apply to what they supply to other countries, summarize what protection against unauthorized use should be provided by recipients. The guidelines say HEU and spent fuel rods should be used and stored within a protected area, “an area under constant surveillance by guards or electronic devices surrounded by a physical barrier with a limited number of points of entry under appropriate control, or any area with an equivalent level of physical protection.” HEU of 5 kg or more should, in addition, be used and stored within a highly protected area inside the outer protected area with access restricted to persons whose trustworthiness has been determined and which [area] is under surveillance by guards who are in communication with response forces. Specific measures taken in this context should have as their objective the detection and prevention of any assault, unauthorized access or unauthorized removal of material. The guidelines suggest that these standards “should be” the subject of negotiation between the suppliers and recipients of nuclear reactors and nuclear fuel (Nuclear Suppliers’ Group, 1996). Provisions relating to them appear in many supply agreements, but they are not public knowledge and are not required to be submitted to IAEA inspectors so that the inspectors can check whether the recommended protections have in fact been provided. Moreover, they are not applicable to small university-type research reactors unless the total HEU present in or near the reactor is 5 kg or more. Because of provisions in federal legislation and U.S. practice, U.S. agreements with foreign recipients usually call for the possibility of occasional U.S. inspections of the facility to observe, among other things, the protection the recipient provides (Nuclear Nonproliferation Act, 1978; Atomic Energy Act of 1954). The Nuclear Suppliers’Guidelines themselves do not call for inspections, and other suppliers may not ask for them. Moreover, this requirement did not prevent the theft of U.S.-supplied research reactor fuel from a reactor in the Congo. 5. National statutes and regulations on physical protection of reactors vary a great deal around the world. A survey by the Nuclear Energy Agency of the international Organization for Economic Cooperation and Development (OECD) showed major differences from country to country (OECD, 2000). The 29 countries in the survey, mostly well-developed countries with significant nuclear programs, seemed to have a wide variety of security requirements set forth in reactor licenses, regulations, statutes, and royal decrees. The summary did not compare the requirements to the regulatory recommendations of the IAEA, and it is not possible to do that effectively from the information provided. The variations in regulatory requirements raise questions about such compliance. In most cases, the OECD nuclear programs began long before the current IAEA physical protection recommendations and Nuclear Suppliers’ Guidelines were issued, and some of the OECD respondents to the survey were themselves nuclear suppliers (OECD, 2000). 6. In a survey conducted by Stanford University, similar country variations appeared in actual physical protection practices for HEU research reactors (with 5 kg or more). Six of the responses to a questionnaire, mostly from less-developed countries than those covered by the OECD survey, relate to government research Bunn, Braun / RESEARCH REACTORS VS. POWER REACTORS 723 Downloaded from abs.sagepub.com at PENNSYLVANIA STATE UNIV on March 4, 2016 reactors. The countries were located in Latin America, Central and South Asia, and Eastern and Western Europe. Four of the five that answered questions on threat perception said their facilities faced major threats of armed violence from outsiders and that collusion by insiders (possibly involuntary collusion) with the outsiders was feared as well. However, despite considerable similarities in threat perceptions, there were great variations in the level of protection provided (barriers, sensors, etc.) for the protected area and the inner areas within the protected areas where the HEU was stored or used. For example, one respondent confirmed that the outer protected area could be accessed by climbing a wall or walking around the end of a fence or by crawling through a duct through a wall or something similar. Others described varying degrees of stronger protection. For the inner area where HEU should be kept, all said there were guards, at least during working hours. But two did not provide guns for the guards. Three said that during hours when the area was not in use for experiments or other purposes, there were “standard locks or better at critical access points” instead of guards. Another three, these with more nuclear experience and resources, said they used “ID actuated locks or better” when guards were not present. Contrast this with the Nuclear Suppliers Guidelines recommendation described above that recommend, for both spent fuel and HEU of more than 5 kg, “constant surveillance by guards or electronic sensors” (G. Bunn, Steinhausler, & Zaitseva, 2002). 7. The variation in actual practices for protection despite IAEA recommendations or Nuclear Suppliers’Guidelines was confirmed by experts who were participants in the first 10 missions of the IAEA’s “International Physical Protection Advisory Services” to review security at nuclear facilities—mostly in Eastern Europe where particular countries had requested assistance. The experts reported that their visits to nuclear sites showed that physical protection practices “will vary from State to State. Differences in culture, perceived threat, financial and technical resources, and national laws are some of the reasons for variations” (Soo Hoo et al., 2000). 8. Given these differences in the way states respond to similar threat perceptions; given the lower level of financial resources and importance usually provided to university and some little-used government research reactors as compared with power reactors; given the lack of specific provisions for protection from sabotage of research reactors in, for example, the Convention on Physical Protection of Nuclear Material and the IAEA recommendations; and given the intermittent operation of university and some government research reactors as compared with power reactors, it should not be surprising that the actual practices for protection of research reactors tend to be much weaker than those for power reactors. Conclusion. Research reactors and their fuel are more likely than power reactors to be the targets of well-informed terrorists seeking to make dirty bombs or nuclear weapons. On the other hand, the fuel from many of them is likely to be much less radioactive than that from power reactors. This means that their fuel will usually be easier for the terrorists to handle, and it is less likely to be adequately protected from theft or from external attacks by truck bombs and aircraft.

#### We need helium-3 to effectively detect nuclear smuggling; the only other option is far-fetched speculative technology

Strauss 14

Helium-3 Shortage Threatens Our Ability To Detect Radioactive Bombs ByMark Strauss 6/04/14 2:50PM <https://gizmodo.com/helium-3-shortage-threatens-our-ability-to-detect-radio-1586046335> -CAT

Most news stories about Helium-3 discuss its potential as a future energy source, due to its abundance on the Moon's surface. But, here on Earth, it's a rare substance that's getting rarer. And that worries the Pentagon, which uses Helium-3 as a key ingredient in equipment to detect nuclear smuggling. The sensors made with Helium-3 are designed to detect uranium and plutonium that could be components of "dirty bombs"—which would use conventional explosives to disperse radioactive material and potentially contaminate a densely populated urban area. The neutrons emitted by plutonium and uranium are difficult to detect, but when Helium-3 is hit by a stray neutron, it creates a charged particle, which is readily detected and measured. Although there are other ways to build detectors, engineers prefer Helium-3 because it is nontoxic, nonradioactive and extremely accurate. In space, Helium-3 travels along solar winds, but Earth's magnetic field pushes it away. (Thanks to its negligible magnetic field, the Moon doesn't suffer from this fate.) As such, the only way to obtain the substance on Earth is as a byproduct of the radioactive decay of tritium, which is a material used in nuclear warheads. Related Stories Jellystone's Heroic Doctors Are on the Scene in This Exclusive SDCC 2021 Clip Dune Series SDCC 2021 Panel Gives Us More of the Atreides Family Saga Oculus' New Experimental API Blends Virtual Reality With Your Real-World Surroundings But, over the years, as Helium-3 has been collected from aging warheads, the supply of the substance has dwindled as the U.S. arsenal has grown smaller. Unfortunately, the agency responsible for gathering Helium-3—the Nation Nuclear Security Administration—never shared information about this shortage with the Department of Energy, which had already spent $230 million on the development of detectors that depend upon, you guessed it, Helium-3. That has prompted the Pentagon's Defense Threat Reduction Agency to seek out new technologies that can be as accurate, or even better, than current detectors. The Global Security Newswire reports: The agency has awarded a $2.8 million contract to Alion Science and Technology of McLean, Va., to further its research into a next-generation detection system that utilizes bundles of thin copper tubes coated with boron….The current generation of Helium 3-powered detectors can alert authorities to the presence of a nearby radioactive source, but these systems cannot determine the direction from which the radiation is coming. Alion plans to use its Pentagon funding to give its boron-coated "straw" sensors the ability to pinpoint the direction of a source….beyond providing a drop-in replacement for Helium-3 detector components, this engineering effort opens up a number of possibilities for new or enhanced portable systems that can be carried into questionable areas or permanently installed to protect ports and depots. The other option, of course, would be establishing mining operations on the Moon—though that would involve a longer time-frame than the Pentagon has in mind.

#### Detecting nuclear terrorism K2 avoiding full-scale nuclear war scenarios

Gale and Armitage 18

SPECIAL REPORT Are We Prepared for Nuclear Terrorism? List of authors. Robert P. Gale, M.D., Ph.D., and James O. Armitage, M.D. [March 29, 2018](https://www.nejm.org/toc/nejm/378/13?query=article_issue_link) N Engl J Med 2018; 378:1246-1254 DOI: 10.1056/NEJMsr1714289 <https://www.nejm.org/doi/full/10.1056/NEJMsr1714289> -CAT

Was von Moltke right, or was Winston Churchill, who said “He who fails to plan is planning to fail”? Recent events have increased concern about the consequences of nuclear terrorism. Nuclear terrorism can take several forms, such as forceful takeover of a nuclear power facility by terrorists, targeting of a country’s nuclear power facilities by terrorists or rogue states using conventional or nuclear weapons or commercial aircraft, intentional detonation of a nuclear weapon by a terrorist organization or rogue state, or the use of radiologic dispersion or exposure devices (such as radioactive material from a stolen nuclear weapon or a conventional explosive device [“dirty bomb”]) by terrorists. Our focus in this report is on preparedness in the United States, but most concepts apply to other developed and developing nations. In 1945, the United States detonated two atomic weapons (A-bombs, or fission bombs) over Japan to end World War II. The bombs had an explosive force of approximately 13 kilotons and 22 kilotons of TNT (trinitrotoluene), respectively (approximately 50 to 100 terajoules). It is estimated that 120,000 to 250,000 persons in Hiroshima and Nagasaki died within 4 months, most of them immediately or within a few days after the explosions. Most of these deaths were caused by percussive force, projectiles, and thermal injuries from “superfires” (i.e., fires of approximately 100,000,000°C; for comparison, the surface of the sun is 6000°C), not by radiation. Nuclear fission reactions release approximately 10 million times more energy than equivalent-mass chemical explosions. However, less than 10% of the energy released by a nuclear weapon is in the form of ionizing radiation (mostly neutron and gamma [photon] radiation). Consequently, only a small fraction of the deaths after the detonation of a nuclear weapon are radiation-related.1 In addition, although there is concern about the long-term carcinogenic effects of radiation exposure, only approximately 5% of deaths from cancer among A-bomb survivors have been attributed to radiation exposure.2 Since the atomic bombings in Japan, and especially during the Cold War, people have been concerned about the threat of nuclear terrorism and nuclear war. However, beginning about 40 years ago, accidents at the Three Mile Island, Chernobyl, and Fukushima nuclear power facilities heightened this fear; the fear has been compounded by several recent events, including the acquisition of nuclear weapons capability (a thermonuclear weapon [H-bomb, or fusion bomb]) by North Korea and the seeming ability of that country to target the United States with an intercontinental ballistic missile, threats to dismantle the U.S.–Iran nuclear deal (Joint Comprehensive Plan of Action), the deterioration of U.S.–Russian nuclear arms–limitation agreements, and the recent decisions by the United States and Russia to upgrade their nuclear arsenals. In this report, we consider whether it is necessary to plan for nuclear terrorism and whether such plans will be effective. We conclude that although planning is potentially useful for a small-scale nuclear terrorist event, responses to large-scale events are difficult to plan effectively. We should not expect these events to play out as planned for, and prevention is key. Because the effectiveness of any nuclear terrorism emergency plan relates predominantly to exposure circumstances, we consider several scenarios below. Nuclear Power Facilities Exposure of fewer than 100 facility personnel to ionizing radiation from an incident or accident at a U.S. nuclear power facility is planned and trained for, as are measures to protect the surrounding population, including sheltering in place, evacuation (if appropriate), and distribution of iodine tablets to block uptake of radioactive iodine (reviewed by Christodouleas et al.3). The extent to which this is the case in all other nations with nuclear power facilities is uncertain and is affected by the level of societal development and political stability. However, the above scenario is a rather different from one in which terrorists commandeer a nuclear power facility or when a nuclear power facility is targeted with a hijacked commercial airplane or a conventional or nuclear weapon. Are these scenarios hypothetical? Unfortunately, no. In 1972, hijackers took control of a U.S. airliner and threatened to crash into the Oak Ridge nuclear weapons facility. In 1981, Iran and then Israel attacked and destroyed Iraq’s Osirak nuclear power facility before it could be fueled with enriched uranium. Iraq bombed Iran’s Bushehr nuclear plant six times between 1984 and 1987. The United States bombed a nuclear fuel enrichment facility and three nuclear reactors in Iraq in 1991. Also in 1991, Iraq used Scud missiles to target the Dimona nuclear power facility in Israel. In 2014, Hamas targeted the Dimona facility from Gaza. Several of these attacks were thwarted by Patriot missile defenses. Some threats to nuclear facilities have fortunately not been realized; for example, in the 1990s during the Balkan Wars, Slovenia shut down its Krško nuclear power plant, fearing a Serbian air force attack.4 In 2007, Israel launched an attack on a Syrian reactor that was under construction and not yet fueled. Beginning in about 2009, the Iran Natanz nuclear power facility was targeted by a cyberattack with the Stuxnet virus, presumably by Israel and the United States. And very recently, Yemeni rebels claimed to have targeted the Barakah nuclear power facility that is under construction near Abu Dhabi in the United Arab Emirates. Terrorist takeover of a nuclear facility can be prevented by counterintelligence, intervention, and adequate on-site security measures. Force-to-force exercises are performed at U.S. nuclear power facilities every 3 years. However, these measures are not foolproof. Recently, antinuclear activists entered nuclear power facilities in France and Belgium and set off fireworks to show the vulnerability of the facilities. The U.S. 9/11 Commission reported that the 9/11 terrorists initially considered targeting U.S. nuclear power facilities. The bottom line is that nuclear power facilities are no longer merely theoretical targets of terrorism or military targets. Furthermore, when we consider the possible consequences of terrorism against a nuclear power facility, radiation exposure is only part of the equation: infrastructure damage, mass evacuations, and public fear may be of a much greater magnitude than radiation-induced injuries. This is an example of potential terrorist gains from “mass distraction” and mass disruption rather than mass destruction. Figure 1. International Nuclear and Radiological Event Scale (INES) from the International Atomic Energy Agency. The concept of nuclear power facilities as military targets has been reviewed elsewhere.4 The International Atomic Energy Agency (IAEA) has an International Nuclear and Radiological Event Scale (INES), shown in Figure 1. The accidents at the Chernobyl and Fukushima nuclear power facilities were a 7 on this scale, whereas the event in Goiânia, Brazil (discussed below), was a 5 (www-ns.iaea.org/tech-areas/emergency/ines.asp. opens in new tab). Radiologic Exposure Devices Another scenario is one in which terrorists use a radiologic exposure device. In this scenario, terrorists steal a radioactive source — for example, material from a radiation therapy department, an inadequately secured nuclear weapons site, a nuclear power facility, or a politically unstable state — and place it in a public space. There are several reports of such thefts, including thefts of nuclear fuel rods from U.S. and U.K. nuclear power facilities. Some nations, fearing an invasion, have dispersed their nuclear weapons to many sites, which makes security more difficult. When terrorists use a radiologic exposure device, the radiation doses to the public are likely to be relatively low; few people are likely to be exposed to high doses. The most important issue is detection, which is easier if the device is stationary and more difficult if it is on a bus or train, where exposed persons enter and exit at different points. Physicians need to be alert to the signs and symptoms of radiation exposure, and coordination by an agency such as the Centers for Disease Control and Prevention might be needed to synthesize a cogent picture. The complexity of detecting such an event was evident to us in dealing with a stolen cesium-137 radiotherapy unit in Goiânia, Brazil, in 1987, a situation in which it took more than 2 weeks from the first exposure to detection.5 Paradoxically, delayed detection makes this strategy less useful to terrorists who rely on responses of the government and the public rather than radiation-induced casualties to achieve their political aims. Physicians should consider possible radiation exposure in persons who have a constellation of nonspecific signs and symptoms, including epilation and gastrointestinal symptoms. Low counts of blood granulocytes, lymphocytes, and platelets should increase suspicion. Guidance on how to detect radiation exposure is available from the IAEA, the World Health Organization (WHO) (www.who.int/ionizing\_radiation/a\_e/IAEA-WHO-Leaflet-Eng%20blue.pdf. opens in new tab), and elsewhere. Radiologic Dispersion Devices A third nuclear terrorist scenario involves radiologic dispersion devices. Such an attack can involve stealing radionuclides from a university laboratory or a nuclear medicine department and spreading them over a large area with a small plane, introducing radiation into a municipal water reservoir, or covering a conventional explosive device (e.g., one made with dynamite or TNT) with radioactive materials — a so-called dirty bomb. Thefts of radioactive materials are common. The IAEA has records of more than 2000 such incidents, including more than 100 in 2016. It is unlikely that intensive radiologically oriented medical interventions would be required for most victims of a radiologic dispersion device such as a dirty bomb, because percussion and projectile injuries will probably account for more injuries than radiation exposure. There may be a risk of unacceptable long-term radiation exposure at the detonation site, but this is unlikely and can be mitigated by decontamination, shielding, and, if needed, short-term or long-term evacuations. Radiologic dispersion devices are, again, more a matter of mass distraction and mass disruption than mass destruction. Terrorists’ goals for deploying such devices are predominantly political and psychological. Although few people will be harmed in terms of their health, there is likely to be widespread confusion and hysteria. This may result in possibly inappropriate government actions that could complicate or even worsen the situation, such as a conventional or nuclear attack against a foreign state that is perceived as encouraging or harboring the terrorists. U.S. actions against Afghanistan immediately after the 9/11 World Trade Center attacks is an example of potential cascading events. The most effective countermeasure to radiologic dispersion devices is, again, prevention. However, education of government officials, policymakers, and the public about securing radioactive sources, early detection of radiation exposures, and, perhaps most importantly, the potential risks associated with radiation exposure is an important measure. A guide to early response to radiologic dispersion devices is available at www.crcpd.org/mpage/RDD. opens in new tab. Improvised Nuclear Device Figure 2. Severity of Damage Associated with Nuclear Devices. Figure 3. Sizes of Regions Affected by Different Types of Nuclear Device. Things can get considerably worse. The U.S. Department of Homeland Security and the Federal Emergency Management Agency (FEMA) developed 15 Disaster Planning Scenarios to deal with potential terrorist attacks and natural disasters. Scenario 1 is entitled “Nuclear Detonation — 10 Kiloton Improvised Nuclear Device.” In this scenario, planners consider a situation in which terrorists from a “Universal Adversary” assemble a 10-kiloton nuclear device stolen from a nuclear facility in the former Soviet Union, smuggle the components into the United States, assemble it in a van, and detonate it in the center of Washington, D.C.6 What would happen? First, the percussive force, projectiles, and superfires would cause complete destruction or severe damage to buildings within 1 km of the epicenter and extending out to approximately 6 km. (A nuclear weapon is most effective when detonated approximately 1 km above the hypocenter rather than at ground level.) Communications would be disrupted by electromagnetic forces from the detonation. Many people within the immediate vicinity would be killed immediately, as would emergency and medical personnel, including many physicians and health care providers. Persons at greater distances, including first responders, would be exposed to high doses of neutron and gamma radiation from the initial blast and from radioactive fallout, which typically occurs after a ground detonation (Figure 2). Figure 3 compares the relative effects of a nuclear weapon, an improvised nuclear device, a radiologic dispersion device, and a radiologic exposure device. In the scenario of an attack with an improvised nuclear device, there would be approximately 100,000 immediate deaths and another 100,000 casualties requiring medical intervention. Guidelines for triaging these huge numbers of casualties have been published.7 Approximately half a million people would need to shelter in place for hours or days, after which they would leave the area in a planned and, hopefully, orderly evacuation. Although there are, of course, huge political, economic, social, psychological, and societal consequences associated with this scenario, our focus here is on medical preparedness and especially on dealing with radiation-induced bone marrow failure. If you think the notion of commandeering a nuclear weapon is far-fetched, consider this: during the recent attempted military coup in Turkey, dozens of U.S. nuclear weapons were at risk for takeover at the Incirlik Air Base, which is close to the border with Syria, where a civil war has been raging for 7 years. And although some argue that these weapons would be inoperable because of electronic safeguards (permissive action links), we and others are not convinced. Nuclear War The ultimate nuclear terrorism scenario is a nuclear war, which could be one weapon launched by a rogue state, an accidental or intentional strike with one or a few nuclear weapons by an adversary (real or perceived) or even an ally, or a full-scale nuclear war. The United States and Russia together have approximately 8500 stockpiled nuclear weapons, 3000 of which are operationally deployed. An attack or counterattack with even a fraction of these weapons is not properly defined as terrorism, and we do not discuss this scenario further. It is estimated that there are 1100 nuclear weapons in seven other countries, including the United Kingdom, France, India, Pakistan, Israel, and North Korea. The average destructive force of modern nuclear weapons is equal to approximately 1 megaton of TNT, but some weapons, such as the Soviet RDS-220 hydrogen bomb, is equivalent to 50 megatons of TNT or approximately 5000 times more powerful than “Little Boy,” the bomb that was dropped on Hiroshima. Planning an effective medical response to an attack with weapons like these is futile. Areas of fireball, percussive, and thermal damage for different targets of one or more nuclear weapons of sizes ranging from 100 tons to 100 megatons for an airburst at 3 km can be modeled at http://nuclearsecrecy.com/nukemap/. opens in new tab. Biologic Effects of Ionizing Radiation Exposure Exposure to high doses of ionizing radiation in one or more of the terrorist scenarios we describe has adverse biologic effects. Tissues such as the skin, lung, gastrointestinal tract, and bone marrow are the most severely immediately affected targets within a survival dose range. Persons exposed to less than 2 Gy of uniform whole-body ionizing radiation, equivalent to approximately 200,000 chest radiographs, generally do not require immediate medical intervention and will probably recover without medical intervention. At the other extreme, persons exposed to more than 12 to 15 Gy will probably die despite medical intervention. Consequently, the focus of medical preparedness for nuclear terrorism is on persons exposed to 2 to 10 Gy, in whom the most immediate problems are bone marrow failure and gastrointestinal damage. However, in many of the radiation-exposure scenarios we describe, victims will have concurrent injuries from percussive forces, projectiles, thermal burns, and chemicals. Interventions that might save some patients from death from bone marrow failure will be only partially effective because of these competing causes of death. In addition, trauma, especially burns, often increases mortality due to any level of radiation exposure in experimental models. This was seen among victims of the Chernobyl accident.8 There are also long-term consequences of radiation exposure, including diverse cancers (e.g., thyroid cancers and other thyroid disorders, leukemias, and solid cancers), infertility, and an increased risk of cardiovascular disease, all of which were seen among the A-bomb survivors. Radiation Dose Effective therapy for persons exposed to ionizing radiation requires an accurate dose estimate. Exposed persons will almost certainly not have radiation-monitoring devices. However, because many survivors have smartphones, it is possible to perform electron paramagnetic resonance spectroscopy on the display glass of smartphones and to perform optically stimulated luminescence analysis of smartphone resistors in order to estimate the dose of radiation.9 Other physical measurements include electron spin resonance measurements of dental enamel and some clothes (such as clothing made of cotton but not synthetic fibers) and neutron capture of urine samples. These physical measurements are technically demanding and not readily available, especially not quickly or on a large scale. Biologic dosimetry can be performed on blood or bone marrow samples, including analyses of dicentric chromosomes, micronuclei, premature chromosome condensation, gamma H2AX foci, and chromosome painting — but only if health care facilities are intact and trained technical personnel are available. Computer-based dose reconstruction with the use of source–dispersion models requires time and is rarely victim-specific. Even when a combination of these approaches is used, point estimates of dose are often inaccurate and have wide confidence intervals or credibility limits.10,11 These data may be sufficiently accurate for triage but not for some therapy decisions, such the decision about whether to perform transplantation. After the Chernobyl accident, we used a combination of clinical variables, including the kinetics of decline of blood lymphocytes and granulocytes. This approach, of course, is possible only if there are surviving medical personnel nearby to obtain serial blood samples, surviving machines to analyze the blood samples, and surviving experts to analyze the data. One or more of these conditions may not be met in the context of a major nuclear event. There is also confounding in the interpretation of these data when other injuries are present, as is likely to be the case. One simple way to triage large numbers of potentially exposed persons is to exclude those who have not had nausea and emesis within 4 hours. Not everyone with these symptoms has a radiation dose of more 2 Gy, but patients without such symptoms can be reasonably excluded.12 The consequences of inaccuracies in dose estimates vary. For some interventions, such as oral antibiotic or antiviral drugs, an inaccurate estimate may be inconsequential. This is less true for parenteral drugs, such as intravenous antibiotics, red-cell and platelet transfusions, and hematopoietic growth factors (e.g., filgrastim and sargramostim [granulocyte and granulocyte–macrophage colony-stimulating factors]), which use more health care resources and personnel and have greater associated risks of adverse events. There is far less tolerance for an inaccurate dose estimate in the context of contemplated hematopoietic-cell transplantation. Another issue is dose uniformity. Even if the estimated midline dose is accurate, there is no guarantee of uniform exposure. If a person’s arm or leg is shielded by an automobile or concrete, some of the bone marrow may be unexposed or less exposed, and hematopoietic-cell transplantation may not be required. Unfortunately, it is unlikely that physicians will be able to make correct informed decisions regarding the benefits and risks of diverse medical interventions, especially ones with substantial potential adverse effects, in many of the terrorist scenarios we describe (as discussed below). Medical Preparedness How do we best prepare for nuclear terrorism? Our focus is on major events, such as an attack with an improvised nuclear device or a limited nuclear strike, accidental or intentional. Although stockpiling drugs such as antibiotics, antivirals, and hematopoietic growth factors seems wise, deciding who needs these interventions and determining who is alive to estimate the radiation doses or to give parenteral drugs will be complicated if many or most health care and technical personnel are casualties and if a substantial part of the infrastructure, including hospitals, clinics, transportation facilities, and communications, is destroyed.13,14 (The Nagasaki A-bomb hypocenter, for example, was directly over the Nagasaki University School of Medicine.) Details of the U.S. Strategic National Stockpile (SNS) are reviewed elsewhere.15 Storing hematopoietic cells — for example, in a bank of umbilical cord blood cells — seems sensible, but not if the cells are exposed to the same high-dose ionizing radiation as the victims who might benefit from receiving them. It can be argued that cells could be transported from unexposed sites; this may be difficult in some instances and almost certainly would be impossible in the context of a multisite nuclear attack. Two other sources of hematopoietic cells for transplantation are HLA-haplotype–mismatched relatives and HLA-matched unrelated volunteers. However, there is a high likelihood that in a large-scale event, relatives of a radiation victim will also be exposed or injured. Identifying potential unrelated donors elsewhere in the United States or overseas is time consuming and requires intact telecommunications and computer networks, resources that are unlikely to be available soon after a major nuclear event. There are nation-specific and international plans and organizations for responding to radiation and nuclear incidents, including transporting patients with severe radiation exposure across state, provincial, or even international borders. The IAEA hosts an Incident and Emergency Centre (IEC) that coordinates international responses to nuclear or radiologic incidents and emergencies (www.iaea.org/topics/emergency-preparedness-and-response-epr. opens in new tab) and publishes preparedness guidelines (www-pub.iaea.org/MTCD/publications/PDF/Pub1055\_web.pdf. opens in new tab). There are also guidelines from the National Council on Radiation Protection and Measurements (NCRP) and the Health Physics Society.16,17 Another example is the U.S. Radiation Injury Treatment Network (https://ritn.net. opens in new tab), which provides diverse services, including educational materials for health care providers, advice regarding triage, access to centers with expertise in treating persons with bone marrow failure, and training exercises. These efforts are admirable. However, our experience after much smaller nuclear events, such as the Chernobyl and Fukushima nuclear power facility accidents and the accidents and incidents in Tokaimura, Japan, and Goiânia, Brazil, suggests that much of this planning is unrealistic and unlikely to be effective, especially in the instances of a large nuclear or radiologic terrorist event, and it is obviously useless in the context of the detonation of a nuclear weapon or even a limited nuclear war. There has been little progress made in educating government officials, policymakers, and the public about the real consequences of exposure to ionizing radiation. This oversight comes at our own peril. This knowledge gap has been and will continue to be exploited by rogue states and terrorists to further their political agendas. Politics and Public Policy Several recent trends and events beyond those already mentioned are disturbing. One is that the U.S. government considers Russia to be in violation of the 1987 Intermediate-Range Nuclear Forces Treaty, and Congress has approved measures to expand and increase the capability of nuclear weapons in the U.S. arsenal. The Trump administration recently gave the Air Force permission to develop a stealth nuclear cruise missile and approved funds to begin replacing the aging Minuteman missiles in silos across the United States. The United States recently decided to develop smaller nuclear weapons that could be used in tactical settings; the smaller size of the weapons increases the likelihood that they would be used and increases the number of weapons that could be stolen by terrorists and transported into the United States. Our treaties, such as the Strategic Arms Limitation Treaty (SALT), to limit, reduce, and eventually eliminate nuclear weapons are in disarray. We are not alone. Russia is taking parallel steps to increase its nuclear attack capabilities. Contrary to what one might have hoped for 25 years after the end of the Cold War, the Bulletin of the Atomic Scientists Doomsday Clock has been set 3 minutes closer to midnight than in 2014, reflecting global nuclear weapons modernization, outsized nuclear-weapons arsenals, and collapsing nuclear-weapons treaties, which pose extraordinary and undeniable threats to the continued existence of humankind. These scenarios, whether they result from an accident or from an intentional detonation of a nuclear weapon or a terrorist action, require diverse strategies that include policy decisions, public education, medical preparedness, and, as a last resort, medical interventions for an effective response. However, as in all of medicine, prevention is better than cure. Policy Implications Educating government officials, policymakers, and the public about the risk of nuclear terrorism is essential. Understanding what we can achieve — and especially what we cannot realistically achieve — with medical preparedness is also essential. Preventing nuclear terrorism is key but is unlikely to be universally successful. Several of the scenarios we describe can be dealt with by careful planning. At the other extreme are scenarios involving hundreds, thousands, or even millions of casualties, for which medical preparedness is likely to be ineffective and possibly dangerous in fostering the impression that we can respond successfully to these events. We believe the best approach is a carefully conceived, long-term plan within the public education system to provide lessons on radiation biology. Because this subject is usually not well taught in medical schools, health care providers, including physicians, also should be required to take an informational course, much as several states require for responses to child abuse, therapy options for breast and prostate cancer, and management of Alzheimer’s disease. Unfortunately, many medical schools lack appropriate educators to accomplish this task.18 Also needed after such an event are a well-informed command and control structure and credible, independent medical experts working in concert to provide instructions and information to the public when government credibility is compromised, as was the case after the Chernobyl and Fukushima accidents. We and others have published nontechnical books, directed toward people with a high school–level education, that may help.19 Conclusions There is increasing public concern over nuclear terrorism, an accident or attack against a nuclear power facility, intentional or unintentional use of a nuclear weapon, or the use of radiologic dispersion or exposure devices, such as a dirty bomb. Dealing effectively with these events requires diverse strategies, including policy decisions, public education, prevention, and, as a last resort, medical preparedness. Prevention is the most effective strategy. Planning for these events is important, but we should realize the limitations and not be misled into thinking that preparedness trumps prevention.

### Impact Calc

#### It’s inevitable but preventable

Allison 18

Nuclear Terrorism Did We Beat the Odds or Change Them? By Graham Allison Dr. Graham Allison is the Douglas Dillon Professor of Government at Harvard Kennedy School. <https://apps.dtic.mil/sti/pdfs/AD1056025.pdf> -CAT

It has been more than 13 years since the publication of Nuclear Terrorism: the Ultimate Preventable Catastrophe, which sounded the alarm about the clear and present danger of nuclear terrorism. The book made the case for two seemingly contradictory propositions: first, on the current path, nuclear terrorism is inevitable; second, nuclear terrorism is preventable by an agenda of actions that are feasible and affordable. Juxtaposition of these propositions presented a paradox that the book attempted to resolve. By highlighting the gap between what the United States, Russia, and other nations had been doing in the decade prior to 2004, and what could be done if they made preventing nuclear terrorism a first-order priority, I argued that on the current path we would likely see terrorists succeed in their aspirations for an “American Hiroshima.” At the same time, I argued, there existed a feasible, affordable agenda of actions the United States and other civilized nations could take that would reduce this risk to nearly zero. As reviewers later noted, the book “caught a wave.” During the 2004 Democratic presidential primary, the Nuclear Threat Initiative (NTI) led a concerted effort to raise the visibility of this issue. Former Senator Sam Nunn, a NTI co-chair, called the book “essential reading . . . calling citizens to arms against the real and rising threat of nuclear terrorism.” The world’s most successful investor, whose company’s share value has increased a thousand fold during the five decades he has managed the investment corporation, selected Nuclear Terrorism as the Berkshire Hathaway annual meeting’s “book of the year.” Warren Buffett declared: “Nuclear terrorism is by far the most important problem of our time. And this is the most important book that has been written on the subject.” In the final months of the 2004 presidential campaign, the question of what the United States should be doing to address the threat of nuclear terrorism became a compelling issue. Both contenders—John Kerry and George W. Bush—declared in their first debate that nuclear terrorism is the “single most serious threat to the national security of the United States.” By the time he had won a second term, President Bush not only understood the threat, but he had embraced it emotionally. As he frequently stated, he was determined to do everything possible to “keep the world’s most dangerous technologies out of the hands of the world’s most dangerous people.”1 His successor, President Barack Obama, also made preventing nuclear terrorism a priority, having read Nuclear Terrorism as a young senator who in 2005 accompanied Senator Richard Dr. Graham Allison is the Douglas Dillon Professor of Government at Harvard Kennedy School. 4 | FEATURES PRISM 7, NO. 3 ALLISON Lugar on a congressional delegation to inspect Russian nuclear sites.2 Not surprisingly, the book attracted critics as well. The most common objection focused on what skeptics argued was an irresolvable contradiction between the core claims of “inevitable” and “preventable.” If something is preventable, then it cannot be inevitable, they said. My attempt to answer their point was proving largely ineffective, since for the most part, I just kept repeating the argument stated in the book. But fortunately, I was rescued by none other than Buffett himself. In making judgments about buying stocks, and even more in owning and running several reinsurance companies, Buffett had become a legendary oddsmaker. Those businesses had also forced him to think seriously about nuclear terrorism as one of what investors call “fat tail” risks. He had concluded that such an event was virtually inevitable and that the consequences would be devastating. Thus he prohibited his companies from writing insurance against nuclear terrorism. The following two charts clarify Buffett’s argument. Chart 1 demonstrates that if the probability of a successful nuclear terrorist attack in the year ahead is 10 percent, and if that condition persists for 50 years, the likelihood of nuclear terrorism occurring is almost 100 percent (99.5 percent to be precise).3 But as Chart 2 illustrates, if actions were taken to reduce that likelihood from 10 percent a year to 1 percent, the probability that in the next 50 years there is no successful nuclear terrorist incident rises from almost zero to 60.5 percent. These extrapolations are, as Buffett explains, simple probability calculations.4

### Plan

#### Plan: Nationalize SpaceX.

#### That affirms, read our evidence before you read T:

#### “Nationalization is as American As Apple Pie”

Hanna 20

THOMAS M. HANNA. Thomas M. Hanna is research director at the Democracy Collaborative and the author of Our Common Wealth: The Return of Public Ownership in the United States Nationalization Is as American as Apple Pie https://d1wqtxts1xzle7.cloudfront.net/63286161/Nationalization\_Is\_as\_American\_as\_Apple\_Pie20200512-25727-13vjakz.pdf?1589297625=&response-content-disposition=inline%3B+filename%3DNationalization\_Is\_as\_American\_as\_Apple.pdf&Expires=1627160751&Signature=YWBoGuqqSwoqG0zve9gh~LkgNvYfmH8YGfxqyOQhBvnVqUHGCZQ9tjeLNnR5Y1YJDVr8PkY9tEUx6y-d6mVLLmqANi~bpUHIUrx9e8uKoZPHdUUN4IdIiXtJ4BLv6OvCIIDnJt1Wyb2jCAzrnmZHn~fcruFQYDgYptgmOeqQubYM1YBcsa4GwTxVnRAJymoyVnX2kLd~Q0vzufZywvng2SxpBpXGWRLjeA9rQHJtv~OjTBg37beafGJRAD2Kdsg-yDGlJ2XzbJDKnox2YE3RB0TAUN0FbOe2KFnydqFaRRMN2UViuBRvz2mOcoh8E~jA4~nfAI8z0dlMAuKcbmdAFw\_\_&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA-CAT

Nationalization might seem like an alien idea in the hyper-capitalist United States. But the country has a long history of nationalizing all sorts of industries — and we should revive that tradition today. December 2008, a month before the end of his presidency and with the smoldering embers of the world economy strewn around him, George W. Bush sat down for an interview with Fox News’s Bret Baier. Struggling to justify the massive economic interventions his administration had just engineered, Bush put his cards on the table. “I’m a free market guy,” he explained. “But I’m not gonna let this economy crater in order to preserve the free market system.” In a matter of months, decades worth of carefully constructed neoliberal narratives around the feebleness, ineffectiveness, and impropriety of government involvement in the economy came crashing down as first the Bush, then the Obama administrations took decisive action to stop the crisis and resuscitate the economic system. They pumped hundreds of billions of public dollars into the major financial companies, created trillions in new money, and, in some cases, took control of private and quasi-private corporations. The 2008–9 financial crisis demonstrated that far from being weak and subordinated to markets, government (and especially the federal government) has a variety of important economic tools at its disposal. One of the most powerful is nationalization — the process of bringing privately controlled assets (businesses, land, real estate, services, natural resources, etc.) under public authority. This shift can occur with a transfer of ownership, changes in legal and operational control, or both. Despite its power, however, nationalization has largely been off the table in recent decades as a policy option, in part due to a misconception that private ownership and free markets have always reigned supreme in the United States. In fact, in just the hundred years between 1909 and 2009, the federal government nationalized hundreds of businesses across a wide variety of economic sectors. Today, we are facing intensifying ecological, social, and political crises: the steady erosion of workers’ rights, pervasive racial injustice, ballooning inequality, ever-rising health care costs, growing disillusionment with democracy, and catastrophic climate change, to name but a few. It is critical we use every policy tool at our disposal. And while nationalization is certainly no panacea, and not universally applicable, it should be destigmatized and seriously considered as the solution to a variety of social ills. A Brief History of Nationalization In a new report for the Next System Project, I document the long and rich tradition of nationalization in the United States — from railroads, telephones, and arms manufacturers (such as Smith & Wesson) during World War I; to the Tennessee Electric Power Company (TEPCO) and gold and silver during the New Deal; to literally hundreds of companies in a wide swath of sectors during and after World War II; to steel mills during the Korean War; to passenger and freight railroads in the 1970s; to Continental Illinois Bank and the savings and loan industry in the 1980s; to banks and car manufacturers in the 2000s. While it would be impractical to reproduce this lengthy history here, a few illustrative examples may be useful. In December 1917, President Woodrow Wilson nationalized the nation’s railroads — at the time one of the country’s largest industries, employing around two million people and accounting for approximately one-twelfth of the entire economy. Under private ownership, the rail system was falling into disarray. The vast array of competing companies were in financial distress but continued to prioritize returns for their shareholders over investment in tracks, trains, and stations. Coordination problems flourished alongside crumbling infrastructure and poor service. Following the government takeover, the rail network was integrated, badly needed repairs were made to tracks and stations, and thousands of new cars and engines were ordered. Wages were also increased, ensuring that organized labor fully backed the effort. After the war, railroad unions endorsed an ultimately unsuccessful effort (the Plumb Plan) that would have instituted permanent public ownership and operation of the railroads through a multi-stakeholder board with equal representation from workers, officials, and the public. During World War II, the government nationalized hundreds of companies. John Ohly, author of the definitive account of wartime nationalization, writes that “seizing plants developed into a major government business … In the three months before V-J Day the government was taking over approximately one plant a week, and in a score of other situations seizures were averted only at the last minute or because the war ended.” Two of the more interesting examples concerned the Montgomery Ward department store chain and the Philadelphia transit system. Montgomery Ward’s anti-labor, free-marketeer chairman, Sewell L. Avery, refused to abide by contracts negotiated with unions and orders to do so from the National War Labor Board. So in early 1944, President Roosevelt ordered the Commerce Department to seize the company’s main factory in Chicago. Federal troops forcibly removed Avery from his office. Later that year, the government went further, nationalizing Montgomery Ward facilities in several states. Sewell sued the government but lost at the appellate court level, and by the time the case reached the Supreme Court, the war had ended and the company had been reprivatized. Another wartime example of nationalization dealt with the privately owned Philadelphia Transportation Company, which operated train, subway, tram, and bus networks in the city. The company was racially segregated, with black employees consigned to shop work. In 1944, the company finally agreed to accept federal orders to stop discriminating against black workers and applicants. However, the independent Philadelphia Rapid Transit Employees Union, which was jostling with the radical, CIO-affiliated Transport Workers Union for control of the company’s bargaining unit, began agitating white workers against desegregation. On August 1, 1944, when the first black operators were scheduled to begin work, many of the white workers went out on strike. With the walkout spreading to war plants and downtown office buildings, transportation at a standstill, war production halted, and growing fears of a white supremacist race riot, President Roosevelt ordered the company to be nationalized. The company, now under government authority, resumed desegregation through the training of black operators. Meanwhile, the CIO-affiliated union was strengthened through a quick, worker-supported contract negotiation (under the supervision of an NWLB mediator), and the company was forced to undertake a number of reforms. The system was then returned to private ownership, where it remained until 1968, when the state of Pennsylvania took it back into public ownership. By the late 1960s, the private railroads were again in disarray, with many facing bankruptcy. The number of passenger trains had plummeted to from around 20,000 in 1929 to only about 500. Following the collapse of one giant railroad corporation, Penn Central, Congress passed the National Railroad Passenger Service Act, which formed the National Railroad Passenger Corporation (now known as Amtrak). Privately owned railroads were given the option to transfer their passenger service to Amtrak, and ultimately twenty of twenty-six did. But nationalizing passenger rail service only solved one part of the problem. Some of the railroads, especially in the northeast, were still unviable financially. In 1973, Congress passed the Regional Rail Reorganization Act that, among other things, created the Consolidated Rail Corporation (Conrail) as a government-owned corporation. Conrail then acquired the lines and assets of dozens of bankrupt railroads and their subsidiaries. By the mid-1980s, Conrail had repaired the terrible state of the infrastructure and rolling stock it inherited from the private corporations, freed itself from price controls and other regulations, and streamlined its operations and management. In 1986–87, the profitable and efficient company was privatized by the Reagan administration in what was then one of the largest IPOs (initial public offering) in US history. Around the same time it was reprivatizing Conrail, the Reagan administration was nationalizing Continental Illinois National Bank and Trust Company, which had become the nation’s seventh-largest bank through aggressive (and at times risky) commercial and industrial lending. In 1984, the bank was in serious financial difficulty, and after a bailout failed a more radical solution was introduced. “The Bank would,” former FDIC Chairman Irvine Sprague recalled in 1986, “have to be, in effect, nationalized.” Ultimately, the government took an 80 percent ownership stake in the bank before slowly selling it off to the private sector (taking a $1.8 billion loss in the privatization process). Back to the Future In late 2008, the CEOs of two iconic US manufacturing companies, General Motors (GM) and Chrysler, were frantically begging Congress for a bailout. While GM’s CEO blamed the financial crisis for the company’s woes, many observers identified significant longer-term structural problems (including an “antique, closed corporate culture”). Ultimately, the Obama administration nationalized GM and Chrysler through bankruptcy court. New GM (NGMCO) emerged with 60.8 percent of its shares owned by the government (the remaining portions were held by the Canadian and Ontario governments and the United Auto Workers through their retiree health care fund). And while the US government was only a minority shareholder in the new Chrysler, by almost every measure it was the entity in control of the transition process. Fast forward ten years. In September, workers at the now-fully-reprivatized General Motors walked off the job in what turned into one of the largest and longest strikes in recent years. The walkout illustrated an important truth about nationalization: while it is a powerful policy tool, it cannot and will not improve things by itself. As Chris Kutalik puts it, “the US Treasury owned GM for three years — and managed to do virtually nothing to benefit the working class with it.” As with many institutions that have been nationalized over the years, the federal government was much more concerned with reprivatizing GM as quickly as possible (no matter how public money it lost in the process) than making any significant changes to the company’s management or business structure. Both purpose and execution are critical if nationalization is to be a viable strategy for achieving a more equitable and sustainable society. As Kutalik suggests, a renationalized GM could be restructured to radically democratize its internal governance and push it toward producing electric public transport vehicles as part of the Green New Deal. Similarly, nationalizing fossil-fuel corporations must be done with an eye toward decommissioning or converting those companies to renewable energy producers and supporting a just transition for workers and communities. And when the next financial crisis occurs, rather than simply bailing out or temporarily nationalizing the failing banks, we should demand long-term public ownership as a way to democratize our economy, break up large concentrations of capital, and provide essential funding for priorities like the Green New Deal. Nationalization has been used for decades in the United States for a variety of purposes, from dealing with financial collapse to intervening in labor-management disputes to saving jobs. With climate change bearing down on us and inequality at Gilded Age levels, we should turn again to nationalization to address the many interconnected crises we face.

#### Specifically SpaceX.

Aronoff 18

The Case for Nationalizing Elon Musk KATE ARONOFF FEBRUARY 8, 2018 KATE ARONOFF is a staff writer at The New Republic and author of Overheated: How Capitalism Broke the Planet — And How We Fight Back. She is co-author of A Planet To Win: Why We Need a Green New Deal and co-editor of We Own the Future: Democratic Socialism—American Style. Follow her on Twitter @katearonoff. <https://inthesetimes.com/article/elon-musk-spacex-tesla-falcon-heavy-launch> -CAT

On Tuesday, Elon Musk launched some stuff into space. The SpaceX Falcon Heavy rocket was shot into the Solar System, tailed by a Tesla Roadster blasting David Bowie songs, reportedly the fastest car ever to be released into orbit. Each Falcon launch is only expected to cost around $90 million — a bargain in the world of extraterrestrial exploration. Scientific American gawked, ​“Elon Musk Does It Again,” praising the ​“bold technological innovations and newfound operational efficiencies that allow SpaceX to not only build its rockets for less money, but also reuse them.” That view — shared by several other outlets — fits comfortably with the Tony Stark-like image Musk has crafted for himself over the years: a quirky and slightly off-kilter playboy genius inventor capable of conquering everything from outer space to the climate crisis with the sheer force of his imagination. One of Musk’s long-term goals is to create a self-sustaining colony on Mars, and make humanity an interplanetary species. He hopes to shoot two very wealthy people around the moon at some point this year. Musk has invested an awful lot of public money into making those dreams a reality. But why should Americans keep footing the bill for projects where only Musk and his wealthy friends can reap the rewards? Enter: the case for nationalizing Elon Musk, and making the U.S. government a major stakeholder in his companies. The common logic now holds that the private sector — and prodigies like Musk, in particular — are better at coming up with world-changing ideas than the public sector, which is allegedly bloated and allergic to new, outside-the-box thinking. Corporations’ hunt for profits and lack of bureaucratic constraints, it’s said, compel cutting-edge research and development in a way that the government is simply incapable of. With any hope, more of these billionaires’ breakthroughs than not will be in the public interest. The reality, as economist Mariana Mazzucato argues in her 2013 book The Entrepreneurial State: Debunking Public vs. Private Sector Myths, is very different. Many of the companies that are today considered to be headed by brilliant savants — people like Steve Jobs and, yes, Elon Musk — owe much of their success to decades of public sector innovation, through repackaging technologies developed over the course of several decades into new products. Take the iPhone, essentially a collection of Defense Department research and National Science Foundation-grant projects packed into one shiny machine. “The prospect of the State owning a stake in a private corporation may be anathema to many parts of the capitalist world,” Mazzucato writes, ​“but given that governments are already investing in the private sector, they may as well earn a return on those investments.” As she notes, Musk’s future-oriented empire — Tesla Motors, SolarCity and SpaceX — has benefitted from around $5 billion in local, state and federal government support, not to mention many years of foundational public research into programs like rocket technology. SpaceX itself exists largely for the sake of competing for government contracts, like its $5.5 billion partnership with NASA and the U.S. Air Force. The U.S. Department of Energy invested directly in that company, as well as in Tesla’s work on battery technology and solar panels. The latter is perhaps the biggest success story of the Department of Energy stimulus grant that also supported Solyndra, a solar energy company reliably held up by the Right as an example of the government’s failure to make wise investment decisions. ​“Taxpayers footed the bill for Solyndra’s losses — yet got hardly any of Tesla’s profits,” Mazzucato notes. As Mazzucato finds, the private sector hasn’t done much to earn its reputation as a risk-taker. Corporations and venture capitalists often adopt conservative thinking and fall into ​“path dependency,” and are generally reluctant to invest in important early-stage research that won’t necessarily turn a profit in the short-run. This kind of research is inherently risky, and the vast majority of this kind of protean R&D (research and development) fails. For every internet — birthed in the Defense Department — there are a well over a dozen Solyndras, but it’s virtually impossible to have one without the other. The problem runs deeper still. Whereas in the past public sector research has been able to attract top-tier talent, the myth that the private sector can do what the State can’t has created a negative feedback loop whereby bright young scientists and engineers flock toward a private sector that goes on to further its reputation for being the place where the real innovation is happening. The alternative Mazzucato suggests is to socialize risk and reward alike, rather than simply allowing companies that enjoy the benefits of public innovation to funnel their profits into things like stock buybacks and tax havens — or, for that matter, flamethrowers. When companies like SpaceX make it big, they’d be obligated to return some portion of their gains to the public infrastructure that helped them succeed, expanding the government’s capacity to facilitate more innovative development. All this is not to say that there isn’t a critical role to play for people like Jobs and Musk in bringing new technology to the market. In all likelihood, Tesla’s Powerwall and SolarCity panels will play a key role in our transition off of fossil fuels. But lionizing Musk as the sole creator of the Powerwall and this week’s space launch stands to perpetuate a dangerous series of myths about who’s responsible for such cutting-edge development. Through smart supply-and-demand-side policy, states can play a crucial role in shaping and creating markets for the technologies we’ll need to navigate the 21st century. This can happen not just through R&D but also through developments like fuel efficiency standards, which encourage carmakers to prioritize vehicles that run off of renewable energy. Given the mounting reality of climate change and the necessity to rapidly switch over to a clean energy economy, there’s also a bigger question about how actively the state should be encouraging certain kinds of research and manufacturing. During World War II, the United States essentially had a planned economy: By 1945, around a quarter of manufacturing in the country was under state control. The reason for that was simple — the U.S. government saw an existential threat, and directed some of its biggest corporations to pitch in to stop it or else risk getting taken over by the state. There’s some Cold War nostalgia to hoisting shiny objects into orbit — a telegenic show of America’s technological supremacy. But it may not be much solace to coastal residents forced to flee in the coming decades, whose homes are rendered unlivable by a mixture of extreme weather and crumbling, antiquated infrastructure. And if you’ve watched any number of big-budget sci-fi productions over the last several years, it’s not hard to imagine Musk’s Martian colony spinning off into some Elysium-style eco-apartheid, where the rich — for the right price — can escape to new worlds while the rest of us make do on a planet of dystopian slums, swamps and deserts. Today, the risk posed by climate change is greater still than that posed by fascism on the eve of World War II, threatening to bring about a planet that’s uninhabitable for humans, and plenty hostile to them in the meantime. In such a context, do we need to launch cars into space? Maybe not. If the public sector is going to continue footing the bill for Elon Musk’s fantasies, though, he should at least have to give back some credit, and a cut of the profits.

#### The public sector does it better—the squo causes path dependency

Ferguson 11

Ian Ferguson (defense industry analyst, recent graduate of Boston College's department of Arts and Sciences' political science graduate program). “Space Exploration Is Best In Hands of NASA, Not Private Sector.” MIC, November 4 2011. <https://www.mic.com/articles/2267/space-exploration-is-best-in-hands-of-nasa-not-private-sector>

Much is often made of the free market as a force for innovation, and rightly so. The constraints of the market have proven to be a great impetus for progress. Many are looking at the emergence of [Virgin Galactic](http://www.virgingalactic.com/news/item/sir-richard-branson-and-new-mexico-governor-susana-martinez-dedicate-the-virgin-galactic-gateway-/) and [Boeing’s](http://www.cnn.com/2011/10/31/us/florida-nasa-boeing-partnership/index.html) announcement of a commercial space business as proof that the private sector is the best avenue for progress in space travel. But the same constraints that make the free market such a powerful environment for change are not ideal for the long-term planning necessary for space travel. That is why **when it comes to space,** the government agency **NASA is better suited for innovation and progress.** In terms of innovation, the private sector is not suited to long term projects. This is because corporations are based on quarterly reporting. If a project takes 20 years to complete, or even just to show some progress, that project is less likely to receive continual funding. Managers will see money flowing into a program every quarter but with no return on investment. Often, this will lead to a program being cut. This is, of course, why the free market is such a force for innovation; only the most efficient programs or ideas survive under this system. But this strength is also a weakness. Because long term projects aren’t ideal in a private enterprise, innovation can become forced along paths that are not as effective in the long term. This can lead to [**path dependency**](http://en.wikipedia.org/wiki/Path_dependence), where a set of decisions made in the past can limit future options. The cost of going back to the other option can be prohibitive, leaving the group stuck with a less than optimal system. After all, an organization may have built an entire infrastructure around the first option. Creating path dependencies is easier in the private sector, as cost and quarterly reports are added constraints. A company might develop a less expensive idea to ensure a quicker return on an investment. This is where **government agencies** such as [DARPA](http://www.darpa.mil/) **have an advantage** over the private sector: they can afford to be more concerned with results than with costs. They still have to worry about path dependency, but fewer factors push them in a particular direction. Without a quarterly schedule and pressure for a return on an investment, agencies like DARPA can pursue seemingly outlandish ideas. [And they do.](http://www.theatlanticwire.com/technology/2011/08/darpas-very-expensive-sci-fi-projects-future/41427/)

### Framing

#### The standard is util. Prefer:

#### Util’s a prerequisite to all other moral theories; prefer robust neuroscience – pleasure and pain are the only intrinsic values and disvalues – everything else regresses

Blum et al. 18

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Pleasure is not only one of the three primary reward functions but it also defines reward. As homeostasis explains the functions of only a limited number of rewards, the principal reason why particular stimuli, objects, events, situations, and activities are rewarding may be due to pleasure. This applies first of all to sex and to the primary homeostatic rewards of food and liquid and extends to money, taste, beauty, social encounters and nonmaterial, internally set, and intrinsic rewards. Pleasure, as the primary effect of rewards, drives the prime reward functions of learning, approach behavior, and decision making and provides the basis for hedonic theories of reward function. We are attracted by most rewards and exert intense efforts to obtain them, just because they are enjoyable [10]. Pleasure is a passive reaction that derives from the experience or prediction of reward and may lead to a long-lasting state of happiness. The word happiness is difficult to define. In fact, just obtaining physical pleasure may not be enough. One key to happiness involves a network of good friends. However, it is not obvious how the higher forms of satisfaction and pleasure are related to an ice cream cone, or to your team winning a sporting event. Recent multidisciplinary research, using both humans and detailed invasive brain analysis of animals has discovered some critical ways that the brain processes pleasure [14]. Pleasure as a hallmark of reward is sufficient for defining a reward, but it may not be necessary. A reward may generate positive learning and approach behavior simply because it contains substances that are essential for body function. When we are hungry, we may eat bad and unpleasant meals. A monkey who receives hundreds of small drops of water every morning in the laboratory is unlikely to feel a rush of pleasure every time it gets the 0.1 ml. Nevertheless, with these precautions in mind, we may define any stimulus, object, event, activity, or situation that has the potential to produce pleasure as a reward. In the context of reward deficiency or for disorders of addiction, homeostasis pursues pharmacological treatments: drugs to treat drug addiction, obesity, and other compulsive behaviors. The theory of allostasis suggests broader approaches - such as re-expanding the range of possible pleasures and providing opportunities to expend effort in their pursuit. [15]. It is noteworthy, the first animal studies eliciting approach behavior by electrical brain stimulation interpreted their findings as a discovery of the brain’s pleasure centers [16] which were later partly associated with midbrain dopamine neurons [17–19] despite the notorious difficulties of identifying emotions in animals. Evolutionary theories of pleasure: The love connection BO:D Charles Darwin and other biological scientists that have examined the biological evolution and its basic principles found various mechanisms that steer behavior and biological development. Besides their theory on natural selection, it was particularly the sexual selection process that gained significance in the latter context over the last century, especially when it comes to the question of what makes us “what we are,” i.e., human. However, the capacity to sexually select and evolve is not at all a human accomplishment alone or a sign of our uniqueness; yet, we humans, as it seems, are ingenious in fooling ourselves and others–when we are in love or desperately search for it. It is well established that modern biological theory conjectures that organisms are the result of evolutionary competition. In fact, Richard Dawkins stresses gene survival and propagation as the basic mechanism of life [20]. Only genes that lead to the fittest phenotype will make it. It is noteworthy that the phenotype is selected based on behavior that maximizes gene propagation. To do so, the phenotype must survive and generate offspring, and be better at it than its competitors. Thus, the ultimate, distal function of rewards is to increase evolutionary fitness by ensuring the survival of the organism and reproduction. It is agreed that learning, approach, economic decisions, and positive emotions are the proximal functions through which phenotypes obtain other necessary nutrients for survival, mating, and care for offspring. Behavioral reward functions have evolved to help individuals to survive and propagate their genes. Apparently, people need to live well and long enough to reproduce. Most would agree that homo-sapiens do so by ingesting the substances that make their bodies function properly. For this reason, foods and drinks are rewards. Additional rewards, including those used for economic exchanges, ensure sufficient palatable food and drink supply. Mating and gene propagation is supported by powerful sexual attraction. Additional properties, like body form, augment the chance to mate and nourish and defend offspring and are therefore also rewards. Care for offspring until they can reproduce themselves helps gene propagation and is rewarding; otherwise, many believe mating is useless. According to David E Comings, as any small edge will ultimately result in evolutionary advantage [21], additional reward mechanisms like novelty seeking and exploration widen the spectrum of available rewards and thus enhance the chance for survival, reproduction, and ultimate gene propagation. These functions may help us to obtain the benefits of distant rewards that are determined by our own interests and not immediately available in the environment. Thus the distal reward function in gene propagation and evolutionary fitness defines the proximal reward functions that we see in everyday behavior. That is why foods, drinks, mates, and offspring are rewarding. There have been theories linking pleasure as a required component of health benefits salutogenesis, (salugenesis). In essence, under these terms, pleasure is described as a state or feeling of happiness and satisfaction resulting from an experience that one enjoys. Regarding pleasure, it is a double-edged sword, on the one hand, it promotes positive feelings (like mindfulness) and even better cognition, possibly through the release of dopamine [22]. But on the other hand, pleasure simultaneously encourages addiction and other negative behaviors, i.e., motivational toxicity. It is a complex neurobiological phenomenon, relying on reward circuitry or limbic activity. It is important to realize that through the “Brain Reward Cascade” (BRC) endorphin and endogenous morphinergic mechanisms may play a role [23]. While natural rewards are essential for survival and appetitive motivation leading to beneficial biological behaviors like eating, sex, and reproduction, crucial social interactions seem to further facilitate the positive effects exerted by pleasurable experiences. Indeed, experimentation with addictive drugs is capable of directly acting on reward pathways and causing deterioration of these systems promoting hypodopaminergia [24]. Most would agree that pleasurable activities can stimulate personal growth and may help to induce healthy behavioral changes, including stress management [25]. The work of Esch and Stefano [26] concerning the link between compassion and love implicate the brain reward system, and pleasure induction suggests that social contact in general, i.e., love, attachment, and compassion, can be highly effective in stress reduction, survival, and overall health. Understanding the role of neurotransmission and pleasurable states both positive and negative have been adequately studied over many decades [26–37], but comparative anatomical and neurobiological function between animals and homo sapiens appear to be required and seem to be in an infancy stage. Finding happiness is different between apes and humans As stated earlier in this expert opinion one key to happiness involves a network of good friends [38]. However, it is not entirely clear exactly how the higher forms of satisfaction and pleasure are related to a sugar rush, winning a sports event or even sky diving, all of which augment dopamine release at the reward brain site. Recent multidisciplinary research, using both humans and detailed invasive brain analysis of animals has discovered some critical ways that the brain processes pleasure. Remarkably, there are pathways for ordinary liking and pleasure, which are limited in scope as described above in this commentary. However, there are many brain regions, often termed hot and cold spots, that significantly modulate (increase or decrease) our pleasure or even produce the opposite of pleasure— that is disgust and fear [39]. One specific region of the nucleus accumbens is organized like a computer keyboard, with particular stimulus triggers in rows— producing an increase and decrease of pleasure and disgust. Moreover, the cortex has unique roles in the cognitive evaluation of our feelings of pleasure [40]. Importantly, the interplay of these multiple triggers and the higher brain centers in the prefrontal cortex are very intricate and are just being uncovered. Desire and reward centers It is surprising that many different sources of pleasure activate the same circuits between the mesocorticolimbic regions (Figure 1). Reward and desire are two aspects pleasure induction and have a very widespread, large circuit. Some part of this circuit distinguishes between desire and dread. The so-called pleasure circuitry called “REWARD” involves a well-known dopamine pathway in the mesolimbic system that can influence both pleasure and motivation. In simplest terms, the well-established mesolimbic system is a dopamine circuit for reward. It starts in the ventral tegmental area (VTA) of the midbrain and travels to the nucleus accumbens (Figure 2). It is the cornerstone target to all addictions. The VTA is encompassed with neurons using glutamate, GABA, and dopamine. The nucleus accumbens (NAc) is located within the ventral striatum and is divided into two sub-regions—the motor and limbic regions associated with its core and shell, respectively. The NAc has spiny neurons that receive dopamine from the VTA and glutamate (a dopamine driver) from the hippocampus, amygdala and medial prefrontal cortex. Subsequently, the NAc projects GABA signals to an area termed the ventral pallidum (VP). The region is a relay station in the limbic loop of the basal ganglia, critical for motivation, behavior, emotions and the “Feel Good” response. This defined system of the brain is involved in all addictions –substance, and non –substance related. In 1995, our laboratory coined the term “Reward Deficiency Syndrome” (RDS) to describe genetic and epigenetic induced hypodopaminergia in the “Brain Reward Cascade” that contribute to addiction and compulsive behaviors [3,6,41]. Furthermore, ordinary “liking” of something, or pure pleasure, is represented by small regions mainly in the limbic system (old reptilian part of the brain). These may be part of larger neural circuits. In Latin, hedus is the term for “sweet”; and in Greek, hodone is the term for “pleasure.” Thus, the word Hedonic is now referring to various subcomponents of pleasure: some associated with purely sensory and others with more complex emotions involving morals, aesthetics, and social interactions. The capacity to have pleasure is part of being healthy and may even extend life, especially if linked to optimism as a dopaminergic response [42]. Psychiatric illness often includes symptoms of an abnormal inability to experience pleasure, referred to as anhedonia. A negative feeling state is called dysphoria, which can consist of many emotions such as pain, depression, anxiety, fear, and disgust. Previously many scientists used animal research to uncover the complex mechanisms of pleasure, liking, motivation and even emotions like panic and fear, as discussed above [43]. However, as a significant amount of related research about the specific brain regions of pleasure/reward circuitry has been derived from invasive studies of animals, these cannot be directly compared with subjective states experienced by humans. In an attempt to resolve the controversy regarding the causal contributions of mesolimbic dopamine systems to reward, we have previously evaluated the three-main competing explanatory categories: “liking,” “learning,” and “wanting” [3]. That is, dopamine may mediate (a) liking: the hedonic impact of reward, (b) learning: learned predictions about rewarding effects, or (c) wanting: the pursuit of rewards by attributing incentive salience to reward-related stimuli [44]. We have evaluated these hypotheses, especially as they relate to the RDS, and we find that the incentive salience or “wanting” hypothesis of dopaminergic functioning is supported by a majority of the scientific evidence. Various neuroimaging studies have shown that anticipated behaviors such as sex and gaming, delicious foods and drugs of abuse all affect brain regions associated with reward networks, and may not be unidirectional. Drugs of abuse enhance dopamine signaling which sensitizes mesolimbic brain mechanisms that apparently evolved explicitly to attribute incentive salience to various rewards [45]. Addictive substances are voluntarily self-administered, and they enhance (directly or indirectly) dopaminergic synaptic function in the NAc. This activation of the brain reward networks (producing the ecstatic “high” that users seek). Although these circuits were initially thought to encode a set point of hedonic tone, it is now being considered to be far more complicated in function, also encoding attention, reward expectancy, disconfirmation of reward expectancy, and incentive motivation [46]. The argument about addiction as a disease may be confused with a predisposition to substance and nonsubstance rewards relative to the extreme effect of drugs of abuse on brain neurochemistry. The former sets up an individual to be at high risk through both genetic polymorphisms in reward genes as well as harmful epigenetic insult. Some Psychologists, even with all the data, still infer that addiction is not a disease [47]. Elevated stress levels, together with polymorphisms (genetic variations) of various dopaminergic genes and the genes related to other neurotransmitters (and their genetic variants), and may have an additive effect on vulnerability to various addictions [48]. In this regard, Vanyukov, et al. [48] suggested based on review that whereas the gateway hypothesis does not specify mechanistic connections between “stages,” and does not extend to the risks for addictions the concept of common liability to addictions may be more parsimonious. The latter theory is grounded in genetic theory and supported by data identifying common sources of variation in the risk for specific addictions (e.g., RDS). This commonality has identifiable neurobiological substrate and plausible evolutionary explanations. Over many years the controversy of dopamine involvement in especially “pleasure” has led to confusion concerning separating motivation from actual pleasure (wanting versus liking) [49]. We take the position that animal studies cannot provide real clinical information as described by self-reports in humans. As mentioned earlier and in the abstract, on November 23rd, 2017, evidence for our concerns was discovered [50] In essence, although nonhuman primate brains are similar to our own, the disparity between other primates and those of human cognitive abilities tells us that surface similarity is not the whole story. Sousa et al. [50] small case found various differentially expressed genes, to associate with pleasure related systems. Furthermore, the dopaminergic interneurons located in the human neocortex were absent from the neocortex of nonhuman African apes. Such differences in neuronal transcriptional programs may underlie a variety of neurodevelopmental disorders. In simpler terms, the system controls the production of dopamine, a chemical messenger that plays a significant role in pleasure and rewards. The senior author, Dr. Nenad Sestan from Yale, stated: “Humans have evolved a dopamine system that is different than the one in chimpanzees.” This may explain why the behavior of humans is so unique from that of non-human primates, even though our brains are so surprisingly similar, Sestan said: “It might also shed light on why people are vulnerable to mental disorders such as autism (possibly even addiction).” Remarkably, this research finding emerged from an extensive, multicenter collaboration to compare the brains across several species. These researchers examined 247 specimens of neural tissue from six humans, five chimpanzees, and five macaque monkeys. Moreover, these investigators analyzed which genes were turned on or off in 16 regions of the brain. While the differences among species were subtle, there was a remarkable contrast in the neocortices, specifically in an area of the brain that is much more developed in humans than in chimpanzees. In fact, these researchers found that a gene called tyrosine hydroxylase (TH) for the enzyme, responsible for the production of dopamine, was expressed in the neocortex of humans, but not chimpanzees. As discussed earlier, dopamine is best known for its essential role within the brain’s reward system; the very system that responds to everything from sex, to gambling, to food, and to addictive drugs. However, dopamine also assists in regulating emotional responses, memory, and movement. Notably, abnormal dopamine levels have been linked to disorders including Parkinson’s, schizophrenia and spectrum disorders such as autism and addiction or RDS. Nora Volkow, the director of NIDA, pointed out that one alluring possibility is that the neurotransmitter dopamine plays a substantial role in humans’ ability to pursue various rewards that are perhaps months or even years away in the future. This same idea has been suggested by Dr. Robert Sapolsky, a professor of biology and neurology at Stanford University. Dr. Sapolsky cited evidence that dopamine levels rise dramatically in humans when we anticipate potential rewards that are uncertain and even far off in our futures, such as retirement or even the possible alterlife. This may explain what often motivates people to work for things that have no apparent short-term benefit [51]. In similar work, Volkow and Bale [52] proposed a model in which dopamine can favor NOW processes through phasic signaling in reward circuits or LATER processes through tonic signaling in control circuits. Specifically, they suggest that through its modulation of the orbitofrontal cortex, which processes salience attribution, dopamine also enables shilting from NOW to LATER, while its modulation of the insula, which processes interoceptive information, influences the probability of selecting NOW versus LATER actions based on an individual’s physiological state. This hypothesis further supports the concept that disruptions along these circuits contribute to diverse pathologies, including obesity and addiction or RDS.

#### Epistemic modesty – you can’t be 100% sure about any framework, so you must keep people alive to make future ethical determinations.

Bostrom 12

[Nick Bostrom, Faculty of Philosophy & Oxford Martin School University of Oxford. “Existential Risk Prevention as Global Priority”. 2012. www.existential-risk.org/concept.html]

These reflections on moral uncertainty suggest an alternative, complementary way of looking at existential risk; they also suggest a new way of thinking about the ideal of sustainability. Let me elaborate. Our present understanding of axiology might well be confused. We may not now know — at least not in concrete detail — what outcomes would count as a big win for humanity; we might not even yet be able to imagine the best ends of our journey. If we are indeed profoundly uncertain about our ultimate aims, then we should recognize that there is a great option value in preserving — and ideally improving — our ability to recognize value and to steer the future accordingly. Ensuring that there will be a future version of humanity with great powers and a propensity to use them wisely is plausibly the best way available to us to increase the probability that the future will contain a lot of value. To do this, we must prevent any existential catastrophe.

#### In a crisis state, all ethical decisions collapse to consequentialism.

**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

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 that 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)

#### Err heavily Aff on existential threats because of innate cognitive biases

GPP 17 (Global Priorities Project, Future of Humanity Institute at the University of Oxford, Ministry for Foreign Affairs of Finland, “Existential Risk: Diplomacy and Governance,” Global Priorities Project, 2017, <https://www.fhi.ox.ac.uk/wp-content/uploads/Existential-Risks-2017-01-23.pdf>,

1.2. THE ETHICS OF EXISTENTIAL RISK In his book Reasons and Persons, Oxford philosopher Derek Parfit advanced an influential argument about the importance of avoiding extinction: I believe that if we destroy mankind, as we now can, this outcome will be much worse than most people think. Compare three outcomes: (1) Peace. (2) A nuclear war that kills 99% of the world’s existing population. (3) A nuclear war that kills 100%. (2) would be worse than (1), and (3) would be worse than (2). Which is the greater of these two differences? Most people believe that the greater difference is between (1) and (2). I believe that the difference between (2) and (3) is very much greater. ... The Earth will remain habitable for at least another billion years. Civilization began only a few thousand years ago. If we do not destroy mankind, these few thousand years may be only a tiny fraction of the whole of civilized human history. The difference between (2) and (3) may thus be the difference between this tiny fraction and all of the rest of this history. If we compare this possible history to a day, what has occurred so far is only a fraction of a second.65 In this argument, it seems that Parfit is assuming that the survivors of a nuclear war that kills 99% of the population would eventually be able to recover civilisation without long-term effect. As we have seen, this may not be a safe assumption – but for the purposes of this thought experiment, the point stands. What makes existential catastrophes especially bad is that they would “destroy the future,” as another Oxford philosopher, Nick Bostrom, puts it.66 This future could potentially be extremely long and full of flourishing, and would therefore have extremely large value. In standard risk analysis, when working out how to respond to risk, we work out the expected value of risk reduction, by weighing the probability that an action will prevent an adverse event against the severity of the event. Because the value of preventing existential catastrophe is so vast, even a tiny probability of prevention has huge expected value.67 Of course, there is persisting reasonable disagreement about ethics and there are a number of ways one might resist this conclusion.68 Therefore, it would be unjustified to be overconfident in Parfit and Bostrom’s argument. In some areas, government policy does give significant weight to future generations. For example, in assessing the risks of nuclear waste storage, governments have considered timeframes of thousands, hundreds of thousands, and even a million years.69 Justifications for this policy usually appeal to principles of intergenerational equity according to which future generations ought to get as much protection as current generations.70 Similarly, widely accepted norms of sustainable development require development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs.71 However, when it comes to existential risk, it would seem that we fail to live up to principles of intergenerational equity. Existential catastrophe would not only give future generations less than the current generations; it would give them nothing. Indeed, reducing existential risk plausibly has a quite low cost for us in comparison with the huge expected value it has for future generations. In spite of this, relatively little is done to reduce existential risk. Unless we give up on norms of intergenerational equity, they give us a strong case for significantly increasing our efforts to reduce existential risks. 1.3. WHY EXISTENTIAL RISKS MAY BE SYSTEMATICALLY UNDERINVESTED IN, AND THE ROLE OF THE INTERNATIONAL COMMUNITY In spite of the importance of existential risk reduction, it probably receives less attention than is warranted. As a result, concerted international cooperation is required if we are to receive adequate protection from existential risks. 1.3.1. Why existential risks are likely to be underinvested in There are several reasons why existential risk reduction is likely to be underinvested in. Firstly, it is a global public good. Economic theory predicts that such goods tend to be underprovided. The benefits of existential risk reduction are widely and indivisibly dispersed around the globe from the countries responsible for taking action. Consequently, a country which reduces existential risk gains only a small portion of the benefits but bears the full brunt of the costs. Countries thus have strong incentives to free ride, receiving the benefits of risk reduction without contributing. As a result, too few do what is in the common interest. Secondly, as already suggested above, existential risk reduction is an intergenerational public good: most of the benefits are enjoyed by future generations who have no say in the political process. For these goods, the problem is temporal free riding: the current generation enjoys the benefits of inaction while future generations bear the costs. Thirdly, many existential risks, such as machine superintelligence, engineered pandemics, and solar geoengineering, pose an unprecedented and uncertain future threat. Consequently, it is hard to develop a satisfactory governance regime for them: there are few existing governance instruments which can be applied to these risks, and it is unclear what shape new instruments should take. In this way, our position with regard to these emerging risks is comparable to the one we faced when nuclear weapons first became available. Cognitive biases also lead people to underestimate existential risks. Since there have not been any catastrophes of this magnitude, these risks are not salient to politicians and the public.72 This is an example of the misapplication of the availability heuristic, a mental shortcut which assumes that something is important only if it can be readily recalled. Another cognitive bias affecting perceptions of existential risk is scope neglect. In a seminal 1992 study, three groups were asked how much they would be willing to pay to save 2,000, 20,000 or 200,000 birds from drowning in uncovered oil ponds. The groups answered $80, $78, and $88, respectively.73 In this case, the size of the benefits had little effect on the scale of the preferred response. People become numbed to the effect of saving lives when the numbers get too large. 74 Scope neglect is a particularly acute problem for existential risk because the numbers at stake are so large. Due to scope neglect, decision-makers are prone to treat existential risks in a similar way to problems which are less severe by many orders of magnitude. A wide range of other cognitive biases are likely to affect the evaluation of existential risks.75

### ROJ/ROB

#### The role of the judge is to adjudicate the hypothetical consequences of enacting the Aff plan.

#### That means you use util to compare the Aff plan to hypothetical alternatives from the same agent.

Strait and Wallace 08

L. Paul Strait, University of Southern California and Brett Wallace, George Washington University. “ACADEMIC DEBATE AS A DECISIONMAKING GAME: INCULCATING THE VIRTUE OF PRACTICAL WISDOM”. Contemporary Argumentation and Debate. The Journal of the Cross Examination Debate Association, Vol. 29 (2008): 1-36.

Like all arguments in the negative’s arsenal, counterplans have the burden to be relevant to the question posed by the affirmative plan (disadvantages accomplish this by having a compelling ‘link’). For this reason, counterplans must be competitive but we argue that competition is necessary but not sufficient to demonstrate relevance. Lichtman and Rohrer (1975) observe that negative fiat should have a limited scope, relating to the logic of who is making the decision: It is assumed, of course, that decision-makers being addressed have the power to put a counterplan into effect. An individual or governmental unit can reasonably be asked to reject a particular policy if an alternative promises greater net benefits. If, however, a counterplan must be adopted by another individual or unit of government, the initial decision-maker must consider the probability that the counterplan will be accepted. Debate propositions often affirm that a particular policy should be adopted by the federal government. Even if adoption of this policy by the individual state governments would be more beneficial, a reasonable critic would still affirm the resolution if state adoption were highly unlikely. The federal government should refrain from acting only when the net benefits of state and local action, discounted by the probability that such action will occur, are greater than the net benefits of federal action. (p. 74, footnote 13). Expanding upon this common sense approach, Korcok (2002) reasons that advantages and disadvantages relating to political ramifications, resources, policy effectiveness, enforcement, and so on, all depend upon whose task it is to take the desired action. Therefore, questions of the substantive desirability of the affirmative, along with questions of the educational value of learning general governmental processes, are incoherent without first specifying who is making the decision. Consider what it means when a judge votes affirmative or negative. Supposing the affirmative has presented a topical plan, the judge votes affirmative when the plan is shown to be net-advantageous when compared to the status quo or a competitive alternative, and the judge votes negative when the plan is shown to be less desirable than the status quo or a competitive alternative. If testifying before Congress, this judge could reasonably say: “Based on the arguments I have heard over the last hour and a half, it would be better for you to do X than Y.” In other words, after the debate is concluded, one entity could make a decision based on the information presented. This is not to say that Congress (or anyone else) should make decisions based on the outcomes of scholastic debate rounds. What matters is that the debaters will have made an informed decision. This is utterly impossible if the negative advocates action by some agent other than the affirmative’s. Since the point of fiat is to bracket off questions of ‘would’ in order to focus completely on questions of ‘should,’ questions of probability never get discussed (Broda-Bahm, 2002). From the perspective of the agent identified in the plan, the probability is 100%: if the agent decides to adopt the mandates of the plan, there is an absolute guarantee that it will in fact do so. Yet, if the plan is compared to a counterplan in which Japan, rather than the United States, attempts to solve the advantage(s), there is never a situation where the United States could make a decision based on a 100% probability that Japan would take action if the United States did not. Thus, if Congress failed to consider the chance that that decision-making body would not in fact take the desired action, it would hardly be engaging in what Aristotle (c. 330bce/1941a) calls “correctness of thinking,” the substance of practical wisdom.

#### The role of the ballot is to identify whether the benefits of the Aff plan outweigh the costs. Prefer:

#### 1] Roleplaying the state doesn’t endorse it but teaches the language of power to enable internal resistance strategies

Coverstone 05

Alan Coverstone (masters in communication from Wake Forest, longtime debate coach) “Acting on Activism: Realizing the Vision of Debate with Pro-social Impact” Paper presented at the National Communication Association Annual Conference November 17th 2005 <https://www.natcom.org/> -CAT

An important concern emerges when Mitchell describes reflexive fiat as a contest strategy capable of “eschewing the power to directly control external actors” (1998b, p. 20). Describing debates about what our government should do as attempts to control outside actors is debilitating and disempowering. Control of the US government is exactly what an active, participatory citizenry is supposed to be all about. After all, if democracy means anything, it means that citizens not only have the right, they also bear the obligation to discuss and debate what the government should be doing. Absent that discussion and debate, much of the motivation for personal political activism is also lost. Those who have co-opted Mitchell’s argument for individual advocacy often quickly respond that nothing we do in a debate round can actually change government policy, and unfortunately, an entire generation of debaters has now swallowed this assertion as an article of faith. The best most will muster is, “Of course not, but you don’t either!” The assertion that nothing we do in debate has any impact on government policy is one that carries the potential to undermine Mitchell’s entire project. If there is nothing we can do in a debate round to change government policy, then we are left with precious little in the way of pro-social options for addressing problems we face. At best, we can pursue some Pilot-like hand washing that can purify us as individuals through quixotic activism but offer little to society as a whole. It is very important to note that Mitchell (1998b) tries carefully to limit and bound his notion of reflexive fiat by maintaining that because it “views fiat as a concrete course of action, it is bounded by the limits of pragmatism” (p. 20). Pursued properly, the debates that Mitchell would like to see are those in which the relative efficacy of concrete political strategies for pro-social change is debated. In a few noteworthy examples, this approach has been employed successfully, and I must say that I have thoroughly enjoyed judging and coaching those debates. The students in my program have learned to stretch their understanding of their role in the political process because of the experience. Therefore, those who say I am opposed to Mitchell’s goals here should take care at such a blanket assertion. However, contest debate teaches students to combine personal experience with the language of political power. Powerful personal narratives unconnected to political power are regularly co-opted by those who do learn the language of power. One need look no further than the annual state of the Union Address where personal story after personal story is used to support the political agenda of those in power. The so-called role-playing that public policy contest debates encourage promotes active learning of the vocabulary and levers of power in America. Imagining the ability to use our own arguments to influence government action is one of the great virtues of academic debate. Gerald Graff (2003) analyzed the decline of argumentation in academic discourse and found a source of student antipathy to public argument in an interesting place. I’m up against…their aversion to the role of public spokesperson that formal writing presupposes. It’s as if such students can’t imagine any rewards for being a public actor or even imagining themselves in such a role. This lack of interest in the public sphere may in turn reflect a loss of confidence in the possibility that the arguments we make in public will have an effect on the world. Today’s students’ lack of faith in the power of persuasion reflects the waning of the ideal of civic participation that led educators for centuries to place rhetorical and argumentative training at the center of the school and college curriculum. (Graff, 2003, p. 57) The power to imagine public advocacy that actually makes a difference is one of the great virtues of the traditional notion of fiat that critics deride as mere simulation. Simulation of success in the public realm is far more empowering to students than completely abandoning all notions of personal power in the face of governmental hegemony by teaching students that “nothing they can do in a contest debate can ever make any difference in public policy.” Contest debating is well suited to rewarding public activism if it stops accepting as an article of faith that personal agency is somehow undermined by the so-called role playing in debate. Debate is role-playing whether we imagine government action or imagine individual action. Imagining myself starting a socialist revolution in America is no less of a fantasy than imagining myself making a difference on Capitol Hill. Furthermore, both fantasies influenced my personal and political development virtually ensuring a life of active, pro-social, political participation. Neither fantasy reduced the likelihood that I would spend my life trying to make the difference I imagined. One fantasy actually does make a greater difference: the one that speaks the language of political power. The other fantasy disables action by making one a laughingstock to those who wield the language of power. Fantasy motivates and role-playing trains through visualization. Until we can imagine it, we cannot really do it. Role-playing without question teaches students to be comfortable with the language of power, and that language paves the way for genuine and effective political activism. Debates over the relative efficacy of political strategies for pro-social change must confront governmental power at some point. There is a fallacy in arguing that movements represent a better political strategy than voting and person-to-person advocacy. Sure, a full-scale movement would be better than the limited voice I have as a participating citizen going from door to door in a campaign, but so would full-scale government action. Unfortunately, the gap between my individual decision to pursue movement politics and the emergence of a full-scale movement is at least as great as the gap between my vote and democratic change.