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Trash or Treasure Trove? An In-Depth Analysis of the Application of Landfill Gas Technology to Meet Air Force Energy Requirements

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ABSTRACT

As we approach 2025, the Department of Defense (DoD) and its service branches are facing pressure from the public and Congress to improve renewable energy generation and consumption on DoD facilities. However, as the DoD's largest consumer of energy, the Air Force has a long path ahead if it hopes to be able to increase its renewable energy procurement and production to twenty-five percent of total demand by the statutory goal of 2025 imposed under 10 U.S.C. § 2911. Although the Air Force has had limited success implementing geothermal and photovoltaic energy systems on its installations, the Air Force as an institution has not maximized the use of other sources of renewable energy thus far.

This Article will analyze the various sources of renewable energy that are presently available and argue that the Air Force should seek to implement landfill gas-based energy systems on its existing installations in order to increase its renewable energy generation. This Article will also argue that landfill gas energy is the strongest form of

renewable energy that has yet to be fully developed given the Air Force's existing structure and requirements. Furthermore, this Article will explore the regulatory requirements associated with landfill gas energy, analyze siting issues specific to landfill gas energy, and explore methods in which the Air Force could more effectively develop and incorporate landfill gas energy into future energy sourcing and contracting efforts.

INTRODUCTION

The U.S. Air Force is no stranger to environmental change. In 2018, the Air Force experienced one of the most devastating mission disruptions in its nearly seventy-five years of existence when Hurricane Michael evolved into a Category 5 storm and destroyed significant portions of Tyndall Air Force Base (AFB), Florida.[1] Less than a year later in the Spring of 2019, Offutt AFB, Nebraska, was subjected to devastating damage due to uncharacteristic flooding in the Midwest that the Air Force has estimated will cost over $420 million to repair.[2] The effects of environmental and climate change is projected to only worsen over the next twenty years if progress is not made in combating the effects of global climate change.[3]

Although the federal government has arguably struggled to develop a consistent national policy in addressing climate change, one common discussion point for seeking to mitigate the effects of climate change is changing how the United States generates and consumes energy.[4] As

1 Staff Sgt. Magen M. Reeves, *Tyndall AFB Continues Rebuild Effort One Year After Hurricane Michael*, U.S. AIR FORCE (Oct. 10, 2019), https://www.af.mil/News/Article-Display/Article/1985948/tyndall-afb-continues-rebuild-effort-one-year-after-hurricane-michael/ [https://perma.cc/2CZ3-PV25].

2 The Associated Press, *Cost to Rebuild Offutt After the Flood Now Estimated at $420 Million*, AIR FORCE TIMES (May 2, 2019), https://www.airforcetimes.com/news/your-air-force/2019/05/02/air-force-increases-estimate-to-repair-and-rebuild-offutt-to-420-million/ [https://perma.cc/4CF3-3WBY].

3 The DoD anticipates that environmental impacts such as recurrent flooding and drought are likely to increase at Air Force installations over the next twenty years. *See* OFF. OF THE UNDER SEC'Y OF DEF. FOR ACQUISITION & SUSTAINMENT, DEP'T OF DEF., REPORT ON EFFECTS OF A CHANGING CLIMATE TO THE DEPARTMENT OF DEFENSE (2019), https://media.defense.gov/2019/Jan/29/2002084200/-1/-1/1/CLIMATE-CHANGE-REPORT-2019.PDF [https://perma.cc/X7BN-DSD6].

4 For example, after the previous President notified the United Nations that the United States would withdraw from the Paris Climate Agreement, environmentalists began pushing cities and states to make changes to their environmental programs to include further reliance on renewable energy sources to combat the effects of climate change. *See* Lisa Friedman,

the national conversation continues to look to alternative fuel sources as a means of addressing climate change, so too has the Air Force begun to increasingly rely on Renewable Energy (RE) sources.[5] Unlike the average consumer of electricity, however, the Department of Defense (DoD) has for many years been the single largest consumer of the nation's energy supply.[6] Furthermore, even within the DoD's pool of energy users, which includes the Marine Corps, the Navy, and the Army, the Air Force is by far the largest consumer of energy across all DoD military enterprises.[7] While the vast majority of this energy consumption is due to aviation fuel usage, the Air Force reports that fourteen percent of its combined energy usage also comes from facilities and vehicles.[8]

Recognizing the DoD's role in the nation's consumption of energy, Congress passed DoD energy policy legislation that mandates an outward goal for the DoD "to produce or procure not less than twenty-five percent of the total quantity of facility energy it consumes within its facilities during fiscal year 2025 and each fiscal year thereafter from renewable energy sources."[9] Based on this guidance, the Air Force developed an "Energy Flight Plan" (EFP) designed to generally address its energy initiatives and projects through 2036.[10]

Trump Serves Notice to Quit Paris Climate Agreement, N.Y. TIMES (Nov. 4, 2019), https://www.nytimes.com/2019/11/04/climate/trump-paris-agreement-climate.html [https://perma.cc/LV5K-AYEQ].

5 For example, the Air Force published an Energy Flight Plan in 2017 with the intent to outline its energy goals for the next several years. One of the Air Force's specific energy goals is to "assure supply," which focuses on how the Air Force acquires and consumes its energy. U.S. AIR FORCE, U.S. AIR FORCE ENERGY FLIGHT PLAN 3 (2017), https://www.safie.hq.af.mil/Portals/78/AFEnergyFlightPlan2017.pdf?ver=2017-01-13-133958-503 [https://perma.cc/E98L-ZQG6] [hereinafter ENERGY FLIGHT PLAN].

6 Cameron E. Tommey, *Moving Military Energy "Behind the Fence:" Renewable Energy Generation on U.S. Defense Lands*, 6 WASH. & LEE J. ENERGY, CLIMATE & ENV'T 592, 594 (2015).

7 ENERGY FLIGHT PLAN, *supra* note 5, at 5. For more information about the DoD's organizational structure, *see generally Military Units*, DEP'T OF DEF., https://www.defense.gov/Experience/Military-Units/ [https://perma.cc/NHG4-Z9GK] (last visited Nov. 9, 2021).

8 ENERGY FLIGHT PLAN, *supra* note 5, at 5.

9 10 U.S.C.A. § 2911(g)(1)(A) (West, Westlaw through Pub. L. No. 117-51); *see also* OFF. OF THE ASSISTANT SEC'Y OF DEF. FOR SUSTAINMENT, DEP'T OF DEF., DEPARTMENT OF DEFENSE ANNUAL ENERGY MANAGEMENT AND RESILIENCE REPORT (AEMRR) FISCAL YEAR 2018, at 33 (2019), https://www.acq.osd.mil/eie/Downloads/IE/FY%202018%20AEMR.pdf [https://perma.cc/VA8L-E92F] [hereinafter AEMRR].

10 *See* ENERGY FLIGHT PLAN, *supra* note 5.

Even with the EFP's instructive guidance,[11] it remains unclear whether the Air Force has taken the necessary steps to permanently improve its RE generation and consumption practices to meet the congressional mandate. In fact, as of Fiscal Year (FY) 2018, the Air Force has been able to perform only 6.9% of its 10 U.S.C. § 2911(g) goal of twenty-five percent "for both electric and non-electric energy used in FY 2018."[12] While the Air Force has invested heavily in *some* forms of RE, such as photovoltaic energy systems, other reliable forms of RE have arguably not been implemented or utilized to the maximum extent possible.[13] It would seem then that the Air Force will need to make significant changes to its existing energy procurement and generation systems in the coming years if it truly aims to meet the energy goals prescribed in 10 U.S.C. § 2911.[14] While each renewable resource has its own benefits and problems, the Air Force has focused very little attention on developing Landfill Gas (LFG) energy systems on or near its installations,[15] which could further the agency's progress toward its existing and future RE goals.

This Article explores the Air Force's renewable energy program and focuses on the development of LFG energy systems as a possible solution to the Air Force's RE development gap. This Article will start in Part I by providing the necessary background behind the DoD and Air Force's current energy initiatives. Subsection A of Part I will address the DoD's energy initiatives and the Air Force's recent policy and program changes designed to increase the agencies' reliance on RE sources. Subsection B of Part I will address specific Air Force energy constraints and how these issues have affected the agency's ability to meet its RE goals thus far. Subsection C of Part I will discuss existing Air Force renewable energy initiatives as described by the Air Force Civil Engineers Command (AFCEC).

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11 *Id.*

12 *See* AEMRR, *supra* note 9, at 40; 10 U.S.C.A. § 2911(g)(1)(A).

13 On the Air Force's public renewable energy website, a demonstrative graphic demonstrates which projects were operational or in development as of August 2017. *See Renewable Energy Projects*, AIR FORCE CIV. ENG'R CTR. (last updated Aug. 2017), https://www.afcec.af.mil/Home/Energy/Renewable-Energy/ [https://perma.cc/VA38-HARH] (follow "Renewable Energy Projects" hyperlink) [hereinafter *USAF Renewable Energy Projects*].

14 10 U.S.C.A. § 2911(g)(1)(A).

15 At the time of this writing, only three projects have been completed in the United States. *See USAF Renewable Energy Projects*, *supra* note 13.

Part II of this Article will describe four of the five current renewable energy initiatives in use or proposed by the Air Force. Subsections A through C will analyze solar/photovoltaic power, wind power, and geothermal power sources, and the benefits and limitations of relying on these energy sources as a solution to the agency's future energy needs. Subsection D of Part II will describe the multitude of benefits derived from incorporating LFG energy into Air Force energy operations after assessing both the technological and environmental requirements of this RE source.

Part III will analyze the legal challenges associated with developing LFG as a viable long-term solution to Air Force energy needs across the United States. Subsection A of Part III will address the possible geographic limits of attempting to develop LFG energy systems within the continental United States. Subsection B of Part III will discuss the various regulatory and statutory restrictions that could affect or limit development of LFG energy systems on Air Force lands. Subsection C of Part III will focus on four specific case studies across the DoD that demonstrate where and how LFG energy systems have been successfully implemented at other military installations previously. Lastly, Part IV will discuss future siting considerations, future LFG energy project contracting concerns, and provide final recommendations for future Air Force LFG energy programs.

Although the Air Force is significantly lagging in the attainment of the DoD's twenty-five percent by 2025 RE mandate,[16] investment in LFG energy is a necessary and appropriate additional step the Air Force can take to improve its RE portfolio. Through the varied use of additional RE sources such as LFG energy, the Air Force has the potential to not only meet its energy goals by 2025 but to exceed them.

I
REGULATORY BACKGROUND AND GUIDANCE

In order to understand how the Air Force could benefit from LFG energy generation, it is important to first analyze the various federal energy programs and mandates currently in place that affect how the DoD and the Air Force generate and consume energy. Because these programs affect how the Air Force will operate over the next several years, understanding how these statutory programs constrain the Air Force will help us in assessing the viability of new forms of RE use in order to satisfy these existing obligations in the future.

16 *See* AEMRR, *supra* note 9, at 40; 10 U.S.C.A. § 2911(g)(1)(A).

A. DoD and Air Force Renewable Energy Policies

The DoD and its component military service branches are subject to two primary RE-focused statutory goals: 10 U.S.C. § 2911(g) and section 203 of the Energy Policy Act (EPAct 2005).[17] Under the current iteration of 10 U.S.C. § 2911(g),[18] the DoD has a goal of "produc[ing] or procur[ing] not less than 25 percent of the total quantity of facility energy it consumes within its facilities during fiscal year 2025 and each fiscal year thereafter from renewable energy sources."[19] Under the terms of EPAct 2005, the DoD has a separate RE goal of relying on renewable electricity consumption "as a percentage of total facility electricity consumption, with the goal of 7.5 percent by 2013 and every FY thereafter."[20]

In an effort to comply with legislative and DOD-wide energy directives, the Air Force created and implemented the EFP.[21] In the EFP, the Air Force frames its approach to energy as three common goals: "Improve Resiliency, Optimize Demand, and Assure Supply."[22] According to the EFP, the Air Force sees the ability to "Assure Supply" as a commitment to "diversifying the types of energy and securing the quantities necessary to perform its mission."[23] The EFP also lists a series of strategic objectives, including the Air Force's desire to increasingly use clean energy facilities to meet the RE mandate of twenty-five percent by 2025.[24] As part of this strategy, the EFP places emphasis on renewable and other distributed energy technologies, "especially when projects are on site and capable of delivering continuous energy when the grid is disrupted."[25]

B. Air Force Renewable Energy Projects

In response to these agency-wide desires to improve the Air Force's RE development, AFCEC has developed a website that tracks Air

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17 *See* AEMRR, *supra* note 9, at 33 (citing 10 U.S.C. § 2911(g); 42 U.S.C. § 15852(a)).

18 10 U.S.C.A. § 2911(g).

19 *Id.*; AEMRR, *supra* note 9, at 33.

20 AEMRR, *supra* note 9, at 33; 42 U.S.C.A. § 15852(a) (West, Westlaw through Pub. L. No. 117-51).

21 *See* ENERGY FLIGHT PLAN, *supra* note 5, at 3.

22 *Id.* at 3.

23 *Id.* at 15.

24 *Id.*; *see also* AEMRR, *supra* note 9, at 33. The "25% by 2025" RE energy mandate is codified in the U.S. Code. *See* 10 U.S.C.A. § 2911(g) (West, Westlaw through Pub. L. No. 117-51).

25 ENERGY FLIGHT PLAN, *supra* note 5, at 20.

Force RE initiatives and programs.[26] On its public website, AFCEC reports that it "has implemented a very rigorous process to evaluate the viability of RE technologies and fields projects that have economic benefit."[27] Despite this rigorous process, AFCEC has found difficulty in implementing and relying on RE projects due to cost-effectiveness after considering the "high capital costs of renewable system components, [along with] the lack of supporting infrastructure and environmental restrictions limiting development."[28]

As of "[FY] 2017, the Air Force had approximately 340 renewable energy projects on 106 sites either in operation or under construction."[29] Among those 106 sites, AFCEC has described general reliance on four different types of renewable energy: LFG, wind, photovoltaic, and geothermal heat/electricity.[30] The vast majority of these projects are sited in the southwestern and northeastern regions of the United States, with a few other large projects sparsely scattered across the Midwest.[31] Regarding existing LFG projects in use by the Air Force, AFCEC's data indicates that only three sites have been developed as of 2017: one at Hill AFB, Utah, and a two-phase facility at Joint Base Elmendorf Richardson (JBER), Alaska.[32]

C. Agency Progress in Attaining Mandated Energy Goals

Given the emphasis across the DoD and the Air Force on energy initiatives, one might get the impression that the DoD is on track to meet its baseline 2025 renewable energy goals. However, the existing *data* provided by the DoD and the Air Force shows the Air Force's overall progress is far less optimistic and suggests that the Air Force is unlikely to meet its RE objectives if things do not change.[33]

In June 2019, the DoD published its Annual Energy Management and Resilience Report (AEMRR).[34] In reviewing its goal to "produce or procure more energy from renewable sources," and consistent with the mandate of 10 U.S.C. § 2911(g), the DoD was able to produce and

26 *See USAF Renewable Energy Projects*, *supra* note 13.

27 *Id.*

28 *Id.*

29 As of August 2017, the Air Force reports that thirty installations are currently using or developing some form of RE to generate power for these bases. *Id.*

30 Although the site lists five different energy sources, the Air Force has never developed a combined solar/wind project. *See id.*

31 *Id.*

32 *Id.*

33 *See* AEMRR, *supra* note 9.

34 *Id.*

procure approximately 15.76% of its overall energy from RE sources as of FY 2018.[35] While this demonstrates overwhelmingly positive progress, the report notes that the Air Force's renewable energy production and procurement have lagged behind *all* other DoD components at only 7.29% as of FY 2018.[36] The AEMRR further found that renewable energy consumption by the Air Force was measured at 6.79%, which fell below the DoD's 42 U.S.C. § 15852(a) goal of at least 7.5% consumption from renewable sources.[37] The AEMRR also noted that the Air Force's energy consumption increased from 55,005 Billion British thermal units (BBtu) to 56,080 BBtu in FY 2018, finding that harsher conditions in the winter of 2018 likely contributed to the increase.[38] These numbers are also consistent with the data reported by the Air Force in its EFP, which noted that the Air Force accounted for 48% of *all* DoD energy consumption.[39]

While the Air Force's progress toward RE development has not been as rapid as some of the other DoD components,[40] it is worth mentioning that the Air Force's fuel requirements likely account for a significant amount of energy consumption from nonrenewable sources. Indeed, according to the Air Force's energy cost breakdown in its EFP, eighty-six percent of its total energy needs are derived from aviation fuel requirements.[41] Nevertheless, even after accounting for fuel, it is undeniable that the Air Force is a significant source of energy consumption for the DoD, and the Air Force as an agency needs to improve on its RE generation and consumption. This would assist the Air Force in achieving its EFP energy goals and improve the likelihood that the DOD as a whole will meet its 10 U.S.C. § 2911(g) goals of twenty-five percent by 2025.[42]

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35 AEMRR, *supra* note 9, at 5; 10 U.S.C.A. § 2911(g) (West, Westlaw through Pub. L. No. 117-51).

36 *See* AEMRR, *supra* note 9, at 5.

37 *Id.*; 42 U.S.C.A. § 15852(a) (West, Westlaw through Pub. L. No. 117-51).

38 AEMRR, *supra* note 9, at 39.

39 ENERGY FLIGHT PLAN, *supra* note 5, at 5.

40 For a brief comparison of each agency's energy program progress, see AEMRR, *supra* note 9, at 5.

41 ENERGY FLIGHT PLAN, *supra* note 5, at 5.

42 10 U.S.C.A. § 2911(g) (West, Westlaw through Pub. L. No. 117-51).

II
ASSESSING RE SYSTEMS FOR AIR FORCE COMPATIBILITY

Given the DoD's increased focus on expanding RE development across its military installations, the next question the Air Force needs to answer is which sources of RE will give the agency the best return on its investments. Of the four types of RE the Air Force has previously invested in, which include wind, photovoltaic, geothermal, and LFG,[43] LFG has remained relatively undeveloped by the Air Force.[44] However, despite more focused interest in wind, photovoltaic, and geothermal energy, these RE sources have additional weaknesses that make them less desirable as a primary solution to the Air Force's future RE needs. Accordingly, this Part discusses the four types of RE the Air Force could invest in and explains why LFG is the best approach to expanding the Air Force's RE capabilities on an institutional scale.

A. Abundance of Air Force Photovoltaic Initiatives

Out of the five renewable energy sources, the Air Force has predominantly focused on the development of photovoltaic energy.[45] In reviewing the Air Force's data from late 2017, twenty of the Air Force's thirty RE projects were focused on photovoltaic energy generation.[46] While terms like photovoltaic and solar energy initially appear to be interchangeable in nature, the technology at play for both varies considerably.[47] Photovoltaic energy is generated by "convert[ing] solar radiation directly into electrical current,"[48] whereas solar power typically refers to the process of using sunlight to produce steam at a plant that can then be "converted into mechanical energy in a turbine."[49] Over the last several years, the Air Force has focused its

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43 *USAF Renewable Energy Projects*, *supra* note 13.

44 According to AFCEC, only two installations out of thirty hosting RE technology have utilized LFG energy sources as of August 2017. *See id.*

45 *Id.*

46 *Id.*

47 For a helpful explanation of both processes, see *Solar Explained*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/solar/ [https://perma.cc/G3UQ-WD67] (last updated Dec. 9, 2020).

48 Robert Glennon & Andrew M. Reeves, *Solar Energy's Cloudy Future*, 1 ARIZ. J. ENV'T L. & POL'Y 91, 96 (2010); *see also Solar Explained*: *Photovoltaics and Electricity*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/solar/photovoltaics-and-electricity.php [https://perma.cc/F3DR-FW6V] (last updated Mar. 26, 2021).

49 *Solar Explained*: *Solar Thermal Power Plants*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/solar/solar-thermal-power-plants.php [https://perma.cc/ACL5-G7PY] (last updated Feb. 17, 2021); *see also* Glennon & Reeves, *supra* note 48, at 97.

efforts on developing photovoltaic energy systems rather than focusing on steam-based solar-powered RE projects.[50]

The Air Force's decision to increasingly rely on photovoltaic RE projects makes sense from a siting perspective. Although sunlight is received everywhere on the planet, "[l]atitude, climate, and weather patterns" can affect how much solar radiation an area receives.[51] Generally, arid lands in the Southwest generate the most solar radiation.[52] Thus, at bases located in the southwestern and western portions of the United States, the Air Force has a greater ability to maximize photovoltaic resources to generate energy.[53]

Another benefit of photovoltaic energy is the flexibility with which it can be deployed. Photovoltaic energy systems can be developed as part of a large-scale ground array system or on a smaller scale for commercial or residential uses on site.[54] Regarding small-scale uses, these projects can be "up and running in several months" if properly sited,[55] allowing for a relatively quick return on the decision to invest in this form of RE. Through a combination of large- and small-scale systems, the Air Force could generate a significant source of its energy requirements if solar resources are available.

Given these benefits, and the prevalence of photovoltaic projects currently in use by the Air Force, one would think photovoltaic power

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50 According to AFCEC, all Air Force solar projects as of August 2017 have utilized photovoltaic technology. *See USAF Renewable Energy Projects*, *supra* note 13.

51 *Solar Explained: Where Solar Is Found and Used*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/solar/where-solar-is-found.php [https://perma.cc/H3BH-HRLD] (last updated Mar. 26, 2021).

52 For helpful information on how much solar radiation is generated on average for any given part of the United States, see *Solar Resource Data, Tools, and Maps*, NAT'L RENEWABLE ENERGY LAB., https://www.nrel.gov/gis/solar.html [https://perma.cc/LH7H-YNZS] (last visited Apr. 15, 2020) (citing Manajit Sengupta et al., *The National Solar Radiation Data Base (NSRDB)*, 89 RENEWABLE & SUSTAINABLE ENERGY REVS. 51 (2018)).

53 In reviewing the Air Force's existing solar/photovoltaic energy initiatives, most of these resources are already concentrated in these portions of the country. *See USAF Renewable Energy Projects*, *supra* note 13. Nellis AFB, for example, "activated a 72,000 panel photovoltaic array in 2007" that is considered to be one of the largest solar arrays in the nation. Glennon & Reeves, *supra* note 48, at 93; *see also Nellis Air Force Base Solar Array Provides Model for Renewable Projects*, DEP'T OF ENERGY (Mar. 24, 2010), https://www.energy.gov/articles/nellis-air-force-base-solar-array-provides-model-renewable-projects [https://perma.cc/XN7Z-Q84U].

54 Uma Outka, *Siting Renewable Energy: Land Use and Regulatory Context*, 37 ECOLOGY L.Q. 1041, 1053 (2010).

55 Garrick B. Pursley & Hannah J. Wiseman, *Local Energy*, 60 EMORY L.J. 877, 899 (2011).

is a total solution to the Air Force's energy needs. However, focusing on photovoltaic power generation has drawbacks as well. From an energy production perspective, the greatest difficulty in relying on photovoltaic energy is that this power source is intermittent in nature, which can affect the reliability of the grid.[56] Factors such as daytime hours and weather conditions influence solar systems, and some sources estimate that even when combined with wind power, there is only a "10% to 40% range of hours and operating capacity during a week or month in which they are able to operate."[57] Furthermore, photovoltaic energy presently lacks the capability of storing the energy produced from these systems,[58] which may affect the reliability of this energy source during periods of low sunlight or darkness. Given these intermittency and storage issues, reliance on solar power as the Air Force's primary source of RE is likely insufficient as a permanent solution in its current technological state.

B. Lack of Air Force Wind Power Initiatives

In stark contrast to the nearly seventy percent reliance on solar power to supply the Air Force's recent RE needs,[59] the Air Force has not implemented a single wind project on or near any of its installations with flying missions.[60] Indeed, the only Air Force installation to date that has developed a wind energy project is F.E. Warren AFB in Cheyenne, Wyoming,[61] which is notable for the simple fact that it is one of the few installations without an active runway.[62] Given this lack of development in wind energy, it initially seems odd that the Air Force has never looked at wind energy as a viable option, especially

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56 Steven Ferrey, *Against the Wind—Sustainability, Migration, Presidential Discretion*, 44 COLUM. J. ENV'T L. 341, 390 (2019).

57 *Id.* (citing STEVEN FERREY, LAW OF INDEPENDENT POWER § 2:11 (47th ed. 2019)).

58 Glennon & Reeves, *supra* note 48, at 96–97.

59 Of the thirty RE projects referenced by AFCEC, twenty were dedicated to photovoltaic energy generation. *See generally USAF Renewable Energy Projects*, *supra* note 13.

60 *Id.*

61 2d Lt. Stacey Fenton, *Warren, Local College Bring Wind Energy to Base*, F.E. WARREN AIR FORCE BASE (Mar. 9, 2012), https://www.warren.af.mil/News/Article/331575/warren-local-college-bring-wind-energy-to-base/ [https://perma.cc/4HQU-WKMM].

62 F.E. Warren AFB has traditionally hosted missile defense systems rather than aircraft. *See generally History of F.E. Warren AFB*, F.E. WARREN AIR FORCE BASE (Feb. 27, 2018), https://www.warren.af.mil/About-Us/Fact-Sheets/Display/Article/331280/history-of-f-e-warren-afb/ [https://perma.cc/2Y9Z-GH6X].

compared to other service branches like the Army, which started installing wind turbines as early as 2010.[63]

Dissimilar to a solar array that can be of varied size and scale,[64] wind projects rely on wind turbines to generate power, which can be as high as 650 feet tall on top of a platform that can be up to fifty feet wide.[65] In addition to the complications associated with the sheer size and scope of a wind turbine, wind-based power suffers from the same intermittency issues that solar-based energy projects suffer from.[66]

Because wind energy projects utilize large turbines several hundred feet in the air to generate power, this technology can also have implications for mission effectiveness at aviation-based military facilities. First, turbine blades can be up to 200 feet long and rotate fast enough to create dangerous crosswinds for small aircraft.[67] Furthermore, when a wind turbine is placed near aviation activities, it can affect aviation operations by causing an effect known as "shadowing," which can lead to blockages in wave propagation or "interference in wave continuity of a radar beam."[68] Turbines have also caused "clutter," which can influence how radars receive and gather data on particular targets of interest.[69] These issues, when assessed collectively, can potentially obstruct or otherwise impact daily military operations, which has caused the DoD to explore mitigation options.[70]

As a result of these unique challenges to aviation operations, the DoD created the DoD Siting Clearinghouse, which was intended to "[p]rotect DoD mission capabilities from incompatible development . . . [in order] to prevent, minimize, or mitigate adverse impacts on military operations, readiness, and testing."[71] Whenever the

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63 Jeremy S. Scholtes, *On Point for the Nation: Army and Renewable Energy*, 34 ENERGY L.J. 55, 86 (2013).

64 Outka, *supra* note 54, at 1053.

65 Dillon Hollingsworth, *Tilting at Windmills: Reconciling Military Needs and Wind Energy Initiatives in the 21st Century*, 4 OIL & GAS, NAT. RES. & ENERGY J. 7, 13 (2018).

66 John Shelton, *Who, What, How, & Wind: The Texas Energy Market's Future Relationship with Wind Energy and Whether It Will Be Enough to Meet the State's Needs*, 11 TEX. TECH ADMIN. L.J. 401, 408–09 (2010).

67 Hollingsworth, *supra* note 65, at 13.

68 *Id.* at 13–14.

69 *Id.* at 14.

70 *Id.* at 20.

71 H. Brendan Burke, *Dynamic Federalism and Wind Farm Siting*, 16 N.C. J.L. & TECH. 1, 30 (2014) (citing Pub. L. No. 111-383, § 358(b)(1)(B), 124 Stat. 4198); *see also* Military Aviation and Installation Assurance Siting Clearinghouse, *About the Military Aviation and Installation Assurance Siting Clearinghouse*, OFF. OF THE ASSISTANT SEC'Y OF DEF. FOR

Clearinghouse makes a determination that a wind project could adversely impact operations, it will try to work with the project developer to engage in mitigation discussions.[72] While the Clearinghouse has rarely objected to proposed projects,[73] state legislators have begun granting protections to existing aviation activities in order to prevent wind sites from being developed near Air Force installations.[74] For example, in the last few years North Carolina has worked to effectively create a "soft-veto" authority for the DoD to prevent a permit from being issued for a wind energy site.[75] The state of Texas has removed tax exemptions for wind farms "installed or constructed within twenty-five miles of any military aviation facility."[76]

Revisions to 10 U.S.C. § 183a over the last few years arguably also have increased the burden of creating wind farm sites near Air Force installations.[77] Under the revised portions of 10 U.S.C. § 183a, developers are now required to provide "preliminary project layout[s] at least one year before expected construction of any project proposed within a military training route or within line-of-sight of any air route surveillance radar or airport surveillance radar or used by [DoD]."[78]

Given federal and state desires to strengthen DoD authority to block or alter proposed wind farm sites near military lands, further wind siting on or near existing Air Force bases is unlikely to be a viable solution to the agencies' RE needs. Furthermore, even if federal policy eventually shifts to favor wind energy siting near military aviation installations, this energy source does not make sense as a practical

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SUSTAINMENT, https://www.acq.osd.mil/dodsc/about/index.html [https://perma.cc/HUY3-5H9J] (last visited Nov. 1, 2021) [hereinafter DoD Clearinghouse].

72 Burke, *supra* note 71, at 35 (citing DEP'T OF DEF. SITING CLEARINGHOUSE, DEP'T OF DEF., ANNUAL REPORT TO CONGRESS 2 (2012), http://www.acq.osd.mil/dodsc/library/fy2012-rpt-to-congress.pdf [https://perma.cc/BZM5-PBWQ]); *see also* DoD Clearinghouse, *supra* note 71.

73 Hollingsworth, *supra* note 65, at 21 (citing Military Aviation and Installation Assurance Siting Clearinghouse, *Frequently Asked Questions*, OFFICE OF THE ASSISTANT SEC'Y OF DEF. FOR SUSTAINMENT, https://www.acq.osd.mil/dodsc/about/faq.html [https://perma.cc/64U7-JKVE] (last visited Nov. 9, 2021)).

74 *See* Burke, *supra* note 71, at 42.

75 *Id.*

76 Hollingsworth, *supra* note 65, at 27 (citing TEX. TAX CODE § 312.0021 (2018)).

77 *See generally* 10 U.S.C.A. § 183a (West, Westlaw through Pub. L. No. 117-51).

78 *Id.* § 183a(c)(6); *see also Promoting Our Energy Independence and Our National Security*, AM. CLEAN POWER ASS'N, https://cleanpower.org/wp-content/uploads/2021/01/Energy-Independence-Fact-Sheet.pdf [https://perma.cc/YU5R-ZYAM] (last visited Nov. 9, 2021).

matter for the Air Force to significantly invest in given the dangers wind turbines can present to aircraft and radar communications.[79]

C. Inability to Properly Utilize Geothermal Resources

The third RE source the Air Force could increasingly rely on is geothermal energy generation. Dissimilar to wind and photovoltaic energy generation, which both derive their energy from aboveground sources, geothermal energy is "heat derived *below* the earth's surface which can be harnessed to generate clean, renewable energy."[80] When properly extracted, geothermal energy is an effective renewable energy source that provides "power around the clock and emits little or no greenhouse gases."[81] This consistent source of energy makes geothermal power distinct from solar and wind resources that suffer from intermittency when the "sun is not shining or the wind is not blowing."[82] Presently, geothermal energy is normally used in one of two ways: as either a means of climate control within buildings via geothermal heat pumps,[83] or through electricity generated at a geothermal electricity plant.[84] However, while geothermal energy may someday prove to be an important aspect of RE generation for the Air Force, two significant limitations arguably impact the agency's ability to presently utilize geothermal energy to its full potential: geography and technology.

The first potential limitation in relying on geothermal energy is the geography-based limitations of this source of energy. While wind, solar, and even LFG energy can potentially be generated and collected

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79 *See* Hollingsworth, *supra* note 65, at 13–14.

80 *See Geothermal*, DEP'T OF ENERGY, https://www.energy.gov/science-innovation/energy-sources/renewable-energy/geothermal [https://perma.cc/ZG6A-BU3S] (last visited Apr. 1, 2020) (emphasis added).

81 *Id.*

82 Michael Saunders, *An Overview of Nevada's Renewable Energy Portfolio Standard*, 17 NEV. LAW. 6, 9 (2009).

83 Ben Tannen, *Capturing the Heat of the Earth: How the Federal Government Can Most Effectively Encourage the Generation of Electricity from Geothermal Energy*, 37 ENVIRONS ENV'T L. & POL'Y J. 133, 139 (2014); *see also Geothermal Explained*: *Geothermal Heat Pumps*, U.S. ENERGY INFO. ADMIN, https://www.eia.gov/energyexplained/geothermal/geothermal-heat-pumps.php [https://perma.cc/M2CP-CPTD] (last updated Dec. 5, 2019) [hereinafter *Geothermal Heat Pumps*].

84 Tannen, *supra* note 83, at 139; *see also Geothermal Explained*: *Use of Geothermal Energy*, U.S. ENERGY INFO. ADMIN, https://www.eia.gov/energyexplained/geothermal/use-of-geothermal-energy.php [https://perma.cc/LR2H-4KDU] (last updated Mar. 25, 2020) [hereinafter *Use of Geothermal Energy*].

anywhere the Air Force has land available to collect these resources, geothermal energy sufficient to power a geothermal power plant is typically found in underground geothermal reservoirs that are normally located "within a mile or two of the earth's surface."[85] Because these conditions are not present everywhere, geothermal electrical generation is typically centered in "geothermal hotspots" that have high underground temperatures.[86] In the United States, geothermal hotspots are primarily found in the western half of the country along the Pacific Rim.[87] According to the U.S. Energy Information Administration, only seven states—California, Nevada, Utah, Hawaii, Oregon, Idaho, and New Mexico—have constructed and begun operating geothermal power plants as of 2019.[88]

Despite the geographic limits of geothermal power plants, geothermal heat pumps may prove to be a better source of RE generation where other sources of geothermal energy are inaccessible or otherwise unavailable. Unlike geothermal power plants, which require a reservoir of geothermal energy "within a mile or two of the earth's surface[,]"[89] geothermal heat pumps can rely on constant temperatures mere feet below the surface to provide heat to buildings in the winter and cool air to buildings during the summer.[90] This means that geothermal heat pumps can essentially be "utilized anywhere in the United States."[91]

Although geothermal heat pumps *may* solve the geography problem associated with geothermal energy, technological problems currently constrain the wider use of heat pumps as a consistent source of RE. First, these systems are designed to provide heating and cooling at a

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85 *Use of Geothermal Energy*, *supra* note 84.

86 Joseph B. Rinaldi, *Fighting Fire with Fire: How Developing Geothermal Energy Plants on U.S. Protected Land Will Minimize the Effects of Global Warming*, 8 KY. J. EQUINE, AGRIC. & NAT. RES. L. 183, 188 (2016) (citing *How Geothermal Energy Works*, UNION FOR CONCERNED SCIENTISTS (Dec. 22, 2014), http://www.ucsusa.org/clean_energy/our-energy-choices/renewable-energy/how-geothermal-energy-works.html#bf-toc-0 [https://perma.cc/UXL3-2C67]).

87 *Id.* at 189 (citing *Plate Tectonics Map - Plate Boundary Map*, GEOLOGY.COM, http://geology.com/plate-tectonics.shtml [https://perma.cc/AR3H-RKSQ] (last visited Nov. 9, 2021)); *see also Use of Geothermal Energy*, *supra* note 84.

88 *See Use of Geothermal Energy*, *supra* note 84.

89 *Id.*

90 *See generally Geothermal Heat Pumps*, *supra* note 83; Robert J. Denicola, *Harnessing the Power of the Ground Beneath Our Feet: Encouraging Greater Installation of Geothermal Heat Pumps in the Northeast United States*, 38 COLUM. J. ENV'T L. 115, 117 (2013) (citing DAVID BANKS, AN INTRODUCTION TO THERMOGEOLOGY: GROUND SOURCE HEATING AND COOLING 56, 67, 71 (1st ed. 2008).

91 Denicola, *supra* note 90, at 117.

specific facility or building, rather than an entire installation,[92] thereby limiting the use of this energy on a larger scale. Second, and most importantly, although geothermal heat pumps can regulate building temperatures, heat pumps are incapable of generating electricity and often require energy usage to power the pump system.[93] The EPA also warns that absent an RE electrical generation method, utilizing geothermal heat pumps will likely require fossil fuel usage to some extent, which may be a downside if the Air Force is truly looking to power its installations with RE.[94]

Given the geographic limitations of large-scale geothermal energy plants and the technological constraints of smaller scale geothermal heat pumps, geothermal energy is likely insufficient to meet a significant portion of the Air Force's long-term RE needs. Although a portion of the Air Force's installations are located in sections of the country where a geothermal power plant *may* be feasible,[95] the vast majority of existing installations outside these areas of suitability would likely be unable to draw upon this energy source for the foreseeable future pending a significant improvement in geothermal power plant technology. Furthermore, although the Air Force has in limited circumstances taken advantage of geothermal heat pumps to heat buildings,[96] further utilization of these heating and cooling systems would only reduce the overall cost of base utilities without providing a reliable source of energy production for these installations.[97] Therefore,

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92 The EPA describes both the heating and cooling process as one that requires pumps to be installed in a particular building in order to get the system to properly output the desired temperatures. *See Geothermal Heating and Cooling Technologies*, EPA, https://www.epa.gov/rhc/geothermal-heating-and-cooling-technologies [https://perma.cc/NC83-PKTR] (last updated Dec. 19, 2016).

93 Denicola, *supra* note 90, at 120 (citing DAVID BANKS, AN INTRODUCTION TO THERMOGEOLOGY: GROUND SOURCE HEATING AND COOLING 56, 62 (1st ed. 2008)). *See also Geothermal Heating and Cooling Technologies*, *supra* note 92.

94 *See Geothermal Heating and Cooling Technologies*, *supra* note 92.

95 For a current list of active Air Force bases in North America, see *Locations*, U.S. AIR FORCE, https://www.airforce.com/lifestyle/locations [https://perma.cc/SD4Q-ASAW] (drag "drag to open" hyperlink; then select "USA" hyperlink) (last visited Nov. 9, 2021). For information about geothermal "hot spots," see Rinaldi, *supra* note 86, at 188 (citing *Plate Tectonics Map - Plate Boundary Map*, GEOLOGY.COM, http://geology.com/plate-tectonics.shtml [https://perma.cc/AR3H-RKSQ]); *Use of Geothermal Energy*, *supra* note 84.

96 As of August 2017, the Air Force has utilized geothermal heat pumps at Minot AFB, ND; Grand Forks AFB, ND; and Offutt AFB, NE. *See USAF Renewable Energy Projects*, *supra* note 13.

97 *See* Denicola, *supra* note 90, at 120 (citing DAVID BANKS, AN INTRODUCTION TO THERMOGEOLOGY: GROUND SOURCE HEATING AND COOLING 56, 62 (1st ed. 2008)); *Geothermal Heating and Cooling Technologies*, *supra* note 92.

while geothermal energy can provide some benefits to the Air Force in limited quantities, this RE source is unlikely to be a long-term solution to the Air Force's overall need to significantly increase RE generation on its existing military facilities.

D. LFG is Best Suited to Meet the Air Force's Future RE Needs

Lastly, the Air Force has the option of developing additional LFG systems to meet its future RE needs.[98] LFG refers to the gases formed from waste decomposition, which are "collected from wells imbedded into landfills."[99] The gases generated from municipal solid waste landfills consist of "approximately 50 percent methane and 50 percent carbon dioxide, mixed with a small amount of other gases."[100] Because methane is the primary component of the landfill's gas generation, it can "be captured and used for fuel" or electrical generation.[101] According to the EPA, landfill gas can be broadly converted into three separate energy projects, to include electricity generation, direct use of medium-Btu gas, and renewable natural gas.[102] Of these three categories, the EPA indicates that approximately seventy-two percent of current LFG projects focus on electricity generation, utilizing a variety of technologies, to include "reciprocating internal combustion engines [(RICE)], turbines, microturbines and fuel cells."[103] Finally, EPA notes that among the above-referenced technology systems, RICE is the most common "because of its relatively low cost, high efficiency and size ranges that complement the gas output of many landfills."[104]

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98 When this article refers to "LFG," it does not refer to the catch-all phrase "biomass energy." The term biomass energy is much broader in application and can include wood waste, such as forestry-related products and urban wood waste, agricultural waste, livestock waste, and municipal solid waste. For a brief description of what could be included under the umbrella definition of biomass energy, see generally *Biomass Explained*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/biomass/ [https://perma.cc/N4CD-GSGU] (last updated June 21, 2018); *see also* Sarah M. Hayter, *Climate Change Mitigation with "Renewable" Biomass: Shifting Legal Incentives Away from Electricity and Towards Cogeneration*, 31 MISS. COLL. L. REV. 429, 431 (2013).

99 Peter H. Ledford, *Practical Considerations in Implementing Renewable Energy: A Case Study of Fort Bragg, North Carolina*, 2 WAKE FOREST J.L. & POL'Y 533, 551 (2012).

100 *Id.*

101 Katherine A. Trisolini, *Waste Not, Want Not: Landfill Gas to Energy Projects, Climate Change, and the Clean Air Act*, 4 SAN DIEGO J. CLIMATE & ENERGY L. 139, 145 (2013); Landfill Methane Outreach Program, *Basic Information About Landfill Gas*, EPA, https://www.epa.gov/lmop/basic-information-about-landfill-gas#landfill [https://perma.cc/5D2G-NE7M] (last updated Mar. 10, 2020) [hereinafter LMOP Basics].

102 LMOP Basics, *supra* note 101.

103 *Id.*

104 *Id.*

While the technology certainly exists to utilize LFG electrical generation at existing landfills, the next question is whether it is beneficial to do so. From an environmental protection standpoint, LFG serves multiple purposes. First, by converting methane-heavy LFG into fuel or electricity, the amount of greenhouse gases (GHGs) generated from landfills will effectively be reduced as those GHGs that would otherwise escape the landfill and migrate into the atmosphere are instead being directly converted to energy.[105] According to the EPA, existing technology is capable of capturing "roughly 60 to 90 percent of the methane emitted from the landfill, depending on system design and effectiveness."[106] Because methane has a "global warming potential more than 25 times greater than [carbon dioxide],"[107] any actions specifically targeted to reduce methane emissions would provide significant beneficial effects on the fight against global warming. Furthermore, if the system is successful in producing a significant amount of energy, LFG also has the potential to displace other pollution from electrical generation facilities that rely on fossil fuels such as coal.[108] Finally, the EPA recognizes the additional benefit of reducing the likelihood of "explosion hazards from gas accumulation" in or near the landfill as well as eliminating additional "non-methane organic compounds" found in low concentrations in landfills not utilizing LFG capture technology.[109]

From an energy resilience perspective, LFG energy is equally beneficial. LFG energy can be utilized on site and would not necessarily be dependent on the viability of the nationwide energy grid.[110] In addition, once LFG energy recovery has begun, energy production continues for a stable rate for "as many as 20 to 30 years after [the waste] has been landfilled."[111] Therefore, with an active LFG project, the Air Force will not suffer from the intermittency issues

105 LMOP Basics, *supra* note 101; Trisolini, *supra* note 101, at 146.

106 Landfill Methane Outreach Program, *Benefits of Landfill Gas Energy Projects*, EPA, https://www.epa.gov/lmop/benefits-landfill-gas-energy-projects [https://perma.cc/9SYW-57SA] (last updated July 3, 2019) [hereinafter *LFG Benefits*].

107 *Id.*

108 Trisolini, *supra* note 101, at 146.

109 *LFG Benefits*, *supra* note 106.

110 Trisolini, *supra* note 101, at 146.

111 LANDFILL METHANE OUTREACH PROGRAM, EPA, LFG ENERGY PROJECT DEVELOPMENT HANDBOOK 1-2 (Mar. 2020), https://www.epa.gov/sites/production/files/2016-11/documents/pdh_full.pdf [https://perma.cc/89CZ-EWRA] [hereinafter LFG HANDBOOK].

experienced with other types of RE such as wind and solar/photovoltaic resources.[112] Furthermore, and dissimilar to the specific geographical limitations associated with developing geothermal energy power plants,[113] as long as a landfill with LFG energy capturing technology can be properly sited, it has the potential to provide a source of energy generation as long as the deposited waste continues to generate a recoverable amount of methane gas.[114] Finally, if LFG systems are not installed at a landfill, the alternative is to simply flare or combust the collected gases without creating energy.[115] Although flaring reduces the possibility of methane gases escaping the landfill, this approach does not prevent the release of carbon dioxide into the atmosphere, which would still result in an increased risk of global warming.[116] Flaring the LFG would also waste the methane that could otherwise be used for electricity generation.[117]

Given the significant benefits of developing LFG as a viable form of RE, the question remains whether such a move is feasible, practicable, and ultimately worthwhile for the Air Force to invest time, money, and resources into. Although the Air Force has successfully generated LFG energy at or near two of its existing installations,[118] the Air Force has lagged behind local and state-led initiatives moving toward this RE source.[119] This lag has continued to hold as recently as December 2019, where the Air Force still has not listed any pending or in-development LFG energy projects with the EPA.[120]

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112 *See generally* Saunders, *supra* note 82, at 9.

113 *See generally Use of Geothermal Energy*, *supra* note 84.

114 We could expect a landfill with LFG energy-capturing technology to last between twenty to thirty years under suitable conditions. *See* LFG HANDBOOK, *supra* note 111, at 1-2.

115 Trisolini, *supra* note 101, at 149–50.

116 According to the EPA, carbon dioxide has global warming potential and can last for thousands of years in the atmosphere once released. *See generally Understanding Global Warming Potentials*, EPA, https://www.epa.gov/ghgemissions/understanding-global-warming-potentials [https://perma.cc/MN62-ST3M] (last updated Feb. 14, 2017).

117 Trisolini, *supra* note 101, at 149–50.

118 *See USAF Renewable Energy Projects*, *supra* note 13.

119 The Air Force's three projects absolutely pale in comparison to the 564 operational energy projects throughout the United States as of March 2020. *See generally* LMOP Basics, *supra* note 101.

120 The Air Force currently has no planned or under-construction LFG energy projects according to the EPA's LFG Energy Project Data Files. *See generally* Landfill Methane Outreach Program, *Landfill Gas Energy Project Data*, EPA, https://www.epa.gov/lmop/landfill-gas-energy-project-data [https://perma.cc/5ESP-YC9G] (last updated Mar. 18, 2020**)** (follow "Under-construction or planned projects (XLSX) (March 2020)" hyperlink).

III
ASSESSING LFG ENERGY CHALLENGES SPECIFIC TO THE AIR FORCE

At first glance, it may seem striking that out of the reported 564 operational LFG energy projects in use in the United States today,[121] the Air Force has so far invested in this technology on only two of its existing installations.[122] However, unlike a small municipality or a large metropolitan area utilizing LFG energy, the Air Force is a large federal organization of over 325,000 active duty personnel with installations and facilities in nearly every state within the United States.[123] Given the sheer size of the Air Force's mission,[124] an installation's unique status as both a small or large city and in most cases a facility with an active flight line, and the fact that the Air Force's activities are subject to significant scrutiny as "major Federal actions,"[125] there are a number of significant legal hurdles that could impact any decisions by the Air Force to implement LFG energy across its operational spectrum.

This section focuses on the regulatory and statutory hurdles that could impact the Air Force's ability to implement LFG energy generation on a larger scale. Subsection A will discuss the existing siting and geographic difficulties associated with implementing LFG energy technology with the Air Force's existing landfill inventory. Subsection B will focus on addressing the federal and state-specific statutory schemes that could limit development of this technology at any given Air Force installation. Finally, Subsection C will focus on four DoD case studies demonstrating the numerous ways the Air Force could go about expanding its LFG program through a number of previously attempted and ultimately successful LFG energy projects.

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121 LMOP Basics, *supra* note 101.

122 *See USAF Renewable Energy Projects*, *supra* note 13.

123 According to the Air Force Personnel Center, there are currently 328,255 active-duty Air Force members as of January 1, 2020. *See Demographics*, U.S. AIR FORCE, https://www.afpc.af.mil/About/Air-Force-Demographics/ [https://perma.cc/Q2Z3-HPK6] (last visited Nov. 9, 2021) (follow "Military Demographics" hyperlink).

124 The Air Force Mission is to "fly, fight and win . . . in air, space and cyberspace." For information about the scope of this mission statement, see *About Us*, U.S. AIR FORCE, https://www.af.mil/About-Us/ [https://perma.cc/H3DY-FX2Q] (last visited Nov. 9, 2021) (follow "Learn more about the Air Force" hyperlink).

125 The "major Federal action" designation can have significant project impacts under the National Environmental Policy Act. *See generally* 42 U.S.C.A. §§ 4321–4370m-12 (West, Westlaw through Pub. L. No. 117-51).

A. Building LFG Systems on Existing Infrastructure

One of the critical questions regarding the Air Force's ability to implement LFG energy into its RE portfolio is whether the agency can rely on LFG from existing landfills or if it will have to develop LFG systems from newly constructed or currently in-development landfills. As of early 2020, the Air Force has only three LFG energy systems in operation on two military installations.[126] Thus, before determining whether the creation of additional landfills would even be required, we must first assess the Air Force's current inventory of existing landfills for possible sources of LFG energy.

For an existing facility to be capable of generating LFG energy, it would likely need to satisfy, at a minimum, two conditions. First, the facility needs to be capable of capturing the methane gases being released within the landfill.[127] Second, the facility requires an active source of methane gas to power the collection and energy processing facility.[128] Although landfills can typically begin methane generation in less than a year,[129] the facility may no longer be capable of methane extraction if the landfill has surpassed the methane generating life cycle for that particular landfill's size and characteristics.[130]

While data regarding prior landfill sites is scarce, Southern Research Institute (SRI) published a landfill database report for the DoD in June 2011.[131] As part of the institute's research methodology, SRI sought to review previous DoD landfill sites to determine if any existing sites were viable options for an LFG energy program that could utilize microturbines for energy generation.[132] In conducting its research, SRI created a national database to organize the materials it collected from

126 *See USAF Renewable Energy Projects*, *supra* note 13.

127 This would require use of any number of technologies that would make LFG capture and energy conversion possible. *See* LMOP Basics, *supra* note 101.

128 As some commentators have noted, an LFG energy project may not be profitable if the landfill is not large enough to produce sufficient amounts of methane capable of extraction. Trisolini, *supra* note 101, at 148.

129 *See* LMOP Basics, *supra* note 101.

130 All landfills will eventually cease generating productive methane gases. However, most landfills can output LFG for approximately twenty to thirty years after waste is placed in the facility. *See* LFG HANDBOOK, *supra* note 111, at 1-2.

131 *See generally* TIM HANSEN, S. RSCH. INST., DEPARTMENT OF DEFENSE LANDFILL DATABASE: A COLLECTION OF DOD-WIDE LANDFILL DATA FOR THE ASSESSMENT OF IMPLEMENTING THE FLEX ENERGY POWERSTATION FOR LANDFILL GAS TO ENERGY PROJECTS (2011), https://apps.dtic.mil/dtic/tr/fulltext/u2/a551872.pdf [https://perma.cc/H3DY-FX2Q] [hereinafter SRI LANDFILL REPORT].

132 *Id.*

several sources, including DoD record systems, EPA records, and state materials.[133]

SRI identified 471 landfill sites that they were able to gather data for.[134] Of those 471 sites, the Air Force owned 250, along with an additional eighty-five sites that lacked sufficient data to be assessed.[135] Notably, the Air Force's total inventory of landfills was highest in DoD and accounted for more landfill usage than all other DoD components combined.[136] However, of the 250 Air Force landfill sites, SRI estimated that only seven Air Force sites out of sixty-three possible DoD sites could operate a microturbine unit under consideration by DoD.[137] Given the fact that solid waste typically outputs methane for only twenty to thirty years,[138] this apparent lack of usable inventory makes sense if most of the Air Force's landfills were constructed several decades ago or are otherwise not large enough to provide a usable amount of methane for energy-generating purposes.

This information is important for two key reasons. First, this data highlights the contrast between having a large inventory of existing landfills and having sites specifically suitable for generating sufficient LFG to meet current and future energy needs. Although the Air Force has a considerable amount of landfills that have been constructed over the years,[139] only eleven percent were capable of generating usable amounts of methane for energy generation as of June 2011.[140] Furthermore, because the Air Force has only three active LFG energy facilities and less than a dozen possible existing sites that could have hypothetically been converted for LFG power creation nine years ago,[141] the overwhelming majority of Air Force LFG projects completed on installations in the future will have to be designed from

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133 *Id.* at 1–2.

134 *Id.* at 6.

135 *Id.* at 6–7.

136 *Id.*

137 *Id.* at 6–7, 11.

138 LFG HANDBOOK, *supra* note 111, at 1-2.

139 SRI LANDFILL REPORT, *supra* note 131, at 6–7.

140 This percentage is derived from the fact that only seven landfills out of sixty-three were capable of extracting LFG. *Id.* at 6–7, 11. As discussed previously, this is likely due to the age of these facilities resulting in a diminished amount of usable methane gas over time. *See* LFG HANDBOOK, *supra* note 111, at 1-2.

141 *USAF Renewable Energy Projects*, *supra* note 13; SRI LANDFILL REPORT, *supra* note 131, at 11.

the ground up, which will require adherence to a number of rigorous regulatory and statutory programs.

B. Regulatory/Statutory Considerations for Developing New LFG Systems

Because the vast majority of future LFG projects utilized by the Air Force will likely need to be constructed rather than implemented into existing facilities,[142] policymakers for the Air Force seeking to expand LFG energy projects at Air Force facilities will need to be aware of the many regulatory requirements that could likely impact future LFG-based programs. Projects involving solid waste disposal and management implicate a number of federal environmental compliance programs, including federal restrictions related to airport operation,[143] the Resource Conservation and Recovery Act (RCRA),[144] "the Clean Air Act [(CAA)],[145] the Clean Water Act,[146] the National Environmental Policy Act [(NEPA)],[147] the Endangered Species Act,[148] the Safe Drinking Water Act,[149] the Comprehensive Environmental Response, Compensation and Liability Act,[150] and the Emergency Planning and Community Right-to-Know Act."[151]

Although there are several regulatory programs applicable to an LFG energy project, four statutory programs are of major significance for the Air Force's LFG energy siting purposes. First, because landfills

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142 As stated previously, only seven landfills were potentially capable of LFG energy extraction in 2011. *See* SRI LANDFILL REPORT, *supra* note 131, at 11.

143 Structures Interfering with Air Commerce or National Security, 49 U.S.C.A. § 44718(d) (West, Westlaw through Pub. L. No. 117-51).

144 Resource Conservation and Recovery Act, 42 U.S.C.A. §§ 6901–6992k (West, Westlaw through Pub. L. No. 117-51).

145 Clean Air Act, 42 U.S.C.A. §§ 7401–7671q (West, Westlaw through Pub. L. No. 117-51).

146 Clean Water Act, 33 U.S.C.A. §§ 1251–1388 (West, Westlaw through Pub. L. No. 117-51).

147 National Environmental Policy Act of 1969, 42 U.S.C.A. §§ 4321–4370m-12 (West, Westlaw through Pub. L. No. 117-51).

148 Endangered Species Act, 16 U.S.C.A. §§ 1531–1544 (West, Westlaw through Pub. L. No. 117-51).

149 Safe Drinking Water Act, 42 U.S.C.A. §§ 300f–300j-27 (West, Westlaw through Pub. L. No. 117-51).

150 Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C.A. §§ 9601–9675 (West, Westlaw through Pub. L. No. 117-51).

151 Community Right-to-Know Act, 42 U.S.C.A. §§ 11001–11050 (West, Westlaw through Pub. L. No. 17-51); Kim Diana Connolly, *Small Town Trash: A Model Comprehensive Solid Waste Ordinance for Rural Areas of the United States*, 53 CATH. U. L. REV. 1, 16 (2003).

are essentially waste repositories, any newly constructed landfills will need to comply with state and federal permitting requirements under RCRA.[152] Second, because LFG energy recovery requires combustion of the landfill's volatile airborne gases,[153] the CAA's requirements for permitting and nationwide emissions standards will have a significant effect on proposed development and construction of any future LFG energy projects.[154] The third requirement is somewhat unique to the Air Force's aviation-based operations system. Because LFG energy requires a nearby landfill,[155] the Air Force must consider how a large-scale LFG project could impact aviation operations and any applicable regulations imposed by the Federal Aviation Administration (FAA).[156] Finally, any proposed major federal action by the Air Force is likely to trigger NEPA review, which may influence the timing and ultimate success of a future LFG project proposed by the Air Force.[157]

1. Regulatory Issues Surrounding Waste Management

Before the Air Force can rely on the LFG generated within a newly developed landfill, the facility will first have to comply with regulatory obligations specific to landfill development and construction. Municipal landfills constructed and designed to receive nonhazardous household wastes are regulated under Subtitle D of RCRA.[158] These types of facilities are referred to as Municipal Solid Waste Landfills (MSWLFs).[159] As of 2009, there were approximately 1,908 MSWLFs

152 *See generally* Resource Conservation and Recovery Act, 42 U.S.C.A. §§ 6901–6992k (West, Westlaw through Pub. L. No. 117-51).

153 LMOP Basics, *supra* note 101.

154 *See generally* Clean Air Act, 42 U.S.C.A. §§ 7401–7671q (West, Westlaw through Pub. L. No. 117-51).

155 By design, LFG energy systems require the collection of gases generated from decomposing waste. *See* Ledford, *supra* note 99, at 551.

156 *See generally* Structures Interfering with Air Commerce or National Security, 49 U.S.C.A. § 44718(d) (West, Westlaw through Pub. L. No. 117-51).

157 *See generally* National Environmental Policy Act of 1969, 42 U.S.C.A. §§ 4321–4370m-12 (West, Westlaw through Pub. L. No. 117-51).

158 For more information about the specific requirements for nonhazardous solid waste disposal, see generally 40 C.F.R. §§ 239.1–259 (2021). For more information about the EPA's specific municipal solid waste landfill program, see *Municipal Solid Waste Landfills*, EPA, https://www.epa.gov/landfills/municipal-solid-waste-landfills [https://perma.cc/HD87-3QYX] (last updated Mar. 26, 2020) [hereinafter *MSWLF Webpage*].

159 *See MSWLF Webpage*, *supra* note 158; John H. Turner, *Off to A Good Start: The RCRA Subtitle D Program for Municipal Solid Waste Landfills*, 15 TEMP. ENV'T L. & TECH. J. 1, 1 (1996).

in operation within the continental United States.[160] Although all MSWLFs must meet minimum federal regulatory standards, these facilities are usually regulated and permitted at the state level and may be subject to tightened standards established at the state level.[161]

Federal regulations specific to MSWLFs were implemented in 1993 under 40 C.F.R. part 258.[162] As described by the EPA, MSWLFs are subject to seven major regulatory restrictions under this portion of the code, to include location restrictions, composite liners requirements, leachate collection and removal systems, operating practice restrictions, groundwater monitoring requirements, closure and post-closure care requirements, corrective action provisions, and financial assurance requirements.[163] In addition, if a facility receives over twenty tons of municipal solid waste on a daily basis, the facility is required to incorporate specific "dry tomb landfill" design criteria.[164] If a MSWLF fails to meet these federal requirements, the facility will be considered an open dump, which is prohibited under RCRA.[165] Although landfill safety at existing and future landfills has improved as a result of these regulatory restrictions, these new rules have also led to a dramatic increase in "the costs associated with permitting, design, construction, operation, maintenance, and closure/post-closure responsibilities."[166]

The applicability of 40 C.F.R. part 258 to proposed Air Force energy projects on an existing installation makes a few points noteworthy.[167] First, the Air Force would need to determine the appropriate size of a future MSWLF project. Although it is extremely unlikely the Air Force could construct a new landfill to host LFG energy technology without being subject to *any* regulation under 40 C.F.R. part 258 or some other

160 *MSWLF Webpage*, *supra* note 158.

161 *See State Authorization Under the Resource Conservation and Recovery Act (RCRA)*, EPA, https://www.epa.gov/rcra/state-authorization-under-resource-conservation-and-recovery-act-rcra [https://perma.cc/GDT3-X2A3] (last updated Nov. 20, 2019); Turner, *supra* note 159, at 1.

162 *See* 40 C.F.R. §§ 258.1–258.75 (2021); *MSWLF Webpage*, *supra* note 158; Turner, *supra* note 159, at 1.

163 *MSWLF Webpage*, *supra* note 158; Turner, *supra* note 159, at 4; 40 C.F.R. §§ 258.1–258.75.

164 Jessica L. Bayles, *Regulating Bioreactor Landfills to Decrease Greenhouse Gas Emissions and Provide an Alternative Energy Source*, 81 GEO. WASH. L. REV. 526, 532–33 (2013); 40 C.F.R. § 258.1(f)(1) (2021).

165 Turner, *supra* note 159, at 5 (citing 40 C.F.R. § 258.1(h)); *see also* 42 U.S.C.A. § 6945 (West, Westlaw through Pub. L. No. 117-51).

166 Turner, *supra* note 159, at 1.

167 *See generally* 40 C.F.R. §§ 258.1–258.75.

form of state-specific regulation,[168] it is possible that a reduced regulatory burden could take effect if a smaller facility were contemplated for construction.[169] However, despite the fact that a smaller facility could avoid a more robust regulatory regime,[170] such a move might paradoxically make it more difficult to achieve the energy production required to make an LFG energy project sustainable. Although the usable gas generated within a landfill from decomposition "increases slowly but steadily during the life of the landfill[,]"[171] if the facility is too small, it may be unable to generate enough LFG to productively and cost-effectively provide an alternative source of power for the installation.[172] Given this tension between regulatory compliance and creating a landfill capable of productive LFG energy generation, the Air Force would need to assess these factors for each facility prior to making a final decision about whether to proceed with project construction.

Second, the Air Force, in assessing its options, would need to determine which regulatory authority would ultimately make the permitting decision for a new landfill facility. Although every state has been approved by the EPA for an initial RCRA program,[173] each state program can vary in how it handles waste disposal.[174] Thus, the Air Force may be required to deal with a variety of regulators and entities, such as state officials, county officials, or even local district or municipal officials.[175] With each layer of state involvement and authority comes the possibility of further restrictions on waste disposal, additional fees and permitting requirements, and obligations that may

168 *Id.*

169 Landfills generating less than twenty tons of solid waste on a daily basis have a reduced regulatory burden. *See* Bayles, *supra* note 164, at 533 (citing 40 C.F.R. § 258.1(f)(1) (2021)).

170 *Id.*

171 *Id.* at 534.

172 This is reinforced by the fact that despite having such a large inventory of existing landfills, the Air Force has very few landfills capable of generating productive amounts of usable LFG. *See* SRI LANDFILL REPORT, *supra* note 131, at 7–11.

173 For more information about state authority to administer RCRA, see *State Authorization Under the Resource Conservation and Recovery Act (RCRA)*, EPA, https://www.epa.gov/rcra/state-authorization-under-resource-conservation-and-recovery-act-rcra [https://perma.cc/4B2A-2TWG] (last updated May 18, 2021).

174 For a discussion of how some states have approached this topic, see Connolly, *supra* note 151, at 14–15.

175 *See id.*

not have otherwise been anticipated.[176] Furthermore, while every state has its own process for determining how to regulate and permit MSWLFs,[177] larger facilities are likely to face more regulatory scrutiny because they tend to have a greater influence on emissions within the state. As a result, policymakers for the Air Force will need to evaluate the political and regulatory dynamics existing at the state and local level for these larger military installations.

2. Regulatory Issues Surrounding Air Quality

In addition to the regulations affecting landfill development,[178] the other primary regulatory requirements the Air Force will have to comply with are the standards imposed under the CAA.[179] Recognizing that the CAA has a multitude of requirements related to air quality,[180] this analysis will focus on which portions of the CAA apply specifically to landfills and LFG project development and what these requirements would entail. Regulating emissions from landfills has been a longstanding issue for regulators. Recognizing the harm caused by emissions from landfills several decades ago, the EPA passed the "Landfill Gas Rule" in 1996, which imposed New Source Performance Standards (NSPS) on large landfills "constructed or modified after May 30, 1991."[181] If NSPS requirements apply to the landfill, the EPA will impose "best demonstrated technology [requirements] for controlling emissions."[182] Under the existing NSPS requirements for landfills that exceed the specific design capacity requirements to fall under the rule, regulated landfills are required to capture LFG through collection systems so that the gas can be controlled.[183] Control measures for captured gas typically consist of flaring off the gas (i.e., burning it into the atmosphere),[184] using a treatment system to allow the gas to be sold or reused, or combusting the gas with a combustion device, such as a

176 For examples of how additional local requirements have varied from state to state, see Connolly, *supra* note 151, at 37–38.

177 The EPA works closely with states in regulating MSWLFs and authorizes state agencies to "set more stringent requirements" than the federal standards. *See Municipal Solid Waste Landfills*, EPA, https://www.epa.gov/landfills/municipal-solid-waste-landfills [https://perma.cc/HD87-3QYX] (last visited Nov. 9, 2021).

178 *See generally* 40 C.F.R. §§ 239.1–259 (2021).

179 *See generally* Clean Air Act, 42 U.S.C.A. §§ 7401–7671q (West, Westlaw through Pub. L. No. 117-51).

180 *Id.*

181 Trisolini, *supra* note 101, at 149; *see also* 40 C.F.R. §§ 60.750–60.759 (2019).

182 Trisolini, *supra* note 101, at 150.

183 *Id.* at 149; LFG HANDBOOK, *supra* note 111, at 5-9.

184 Bayles, *supra* note 164, at 529.

boiler, engine or turbine.[185] The purpose of this rule was not to encourage or require LFG-specific energy programs, but was instead intended to reduce "non-methane organic compounds emitted from landfills" in general.[186] However, even if the methane is flared in compliance with these NSPS requirements, this approach still results in the release of carbon dioxide into the atmosphere.[187]

In addition to general NSPS requirements for landfill construction, the CAA imposes regulatory requirements specific to the equipment used during LFG energy operations through National Emission Standards for Hazardous Air Pollutants (NESHAP).[188] The EPA currently has two primary NESHAP requirements in place for LFG energy programs.[189] If an LFG energy project utilizes RICE technology, the facility will be subject to the requirements of 40 C.F.R. part 63, subpart ZZZZ.[190] In the event an LFG recovery system is used for heating or boiling purposes, a secondary series of NESHAP requirements may also be imposed on those particular heating activities.[191]

Because RICE technology is the most frequent combustion method used in LFG energy projects,[192] the specific requirements under subpart ZZZZ warrant further attention.[193] In addition to "monitoring, recordkeeping and reporting requirements,"[194] subpart ZZZZ imposes two primary obligations on RICE systems.[195] First, depending on the size of the LFG RICE engine and the type of source using the LFG system, subpart ZZZZ may impose carbon monoxide emissions

185 Trisolini, *supra* note 101, at 149–50; LFG HANDBOOK, *supra* note 111, at 5-9.

186 Trisolini, *supra* note 101, at 150.

187 According to the EPA, carbon dioxide has global warming potential and can last for thousands of years in the atmosphere once released. *See generally Understanding Global Warming Potentials*, EPA, https://www.epa.gov/ghgemissions/understanding-global-warming-potentials [https://perma.cc/YQS9-NM23] (last updated Sept. 9, 2020).

188 LFG HANDBOOK, *supra* note 111, at 5-9.

189 *Id.*

190 *See* 40 C.F.R. §§ 63.6580–63.6675 (2021); LFG HANDBOOK, *supra* note 111, at 5-9.

191 For example, 40 C.F.R. pt. 63, subpts. DDDDD and JJJJJ both frequently impose additional requirements on heating activities relating to burning or combusting materials in an industrial boiler. *See generally* 40 C.F.R. §§ 63.7480–63.7575 (2021); 40 C.F.R. §§ 63.11193–63.11237 (2021); LFG HANDBOOK, *supra* note 111, at 5-9.

192 LMOP Basics, *supra* note 101.

193 *See generally* 40 C.F.R. §§ 63.6580–63.6675.

194 LFG HANDBOOK, *supra* note 111, at 5-9; *see generally* 40 C.F.R. §§ 63.6580–63.6675.

195 LFG HANDBOOK, *supra* note 111, at 5-9; *see generally* 40 C.F.R. §§ 63.6580–63.6675.

limitations while the engine is in operation.[196] Second, even if the source is small enough to avoid a specific carbon emissions limit, the source's RICE engine may still be required to utilize specific management practice standards rather than a carbon monoxide limit.[197]

The final CAA regulatory hurdle that may be applicable to LFG energy recovery facilities is the criteria pollutant program.[198] The standards of this program are triggered if the facility emits one of six enumerated criteria pollutants designated by the EPA, which currently include "ozone, nitrogen dioxide, carbon dioxide, particulate matter, sulfur dioxide[,] and lead."[199] According to the EPA, LFG energy combustion activities are known to produce "carbon monoxide, oxides of nitrogen and particulate matter."[200] One consequence of generating oxides of nitrogen is that the process contributes to "ambient ozone formation."[201] Because ozone is listed as one of the six criteria pollutants, more stringent control requirements are likely to be placed on an LFG energy site whenever facility emissions exceed the threshold for tightened regulation.[202] These controls will typically take the form of state permitting requirements,[203] and would be independent of, and possibly in addition to, any obligations to capture gas emissions under the Landfill Gas Rule's NSPS requirements.[204]

The specific CAA permitting process applicable to a particular project depends on the air quality of the area in which construction or modification is anticipated.[205] If the area currently meets the EPA's existing national ambient air quality standards (NAAQS),[206] the LFG

196 LFG HANDBOOK, *supra* note 111, at 5-9. Subpart ZZZZ includes several tables that explain the particular carbon dioxide limitations for different types of major source operators. *See* 40 C.F.R. pt. 63, subpt. ZZZZ, tbl.1a–2d (2013).

197 LFG HANDBOOK, *supra* note 111, at 5-9; *see generally* 40 C.F.R. §§ 63.6580–63.6675.

198 *See generally* 42 U.S.C.A. § 7408 (West, Westlaw through Pub. L. No. 117-51).

199 LFG HANDBOOK, *supra* note 111, at 5-10; *see also* 42 U.S.C.A. § 7408.

200 *See* LFG HANDBOOK, *supra* note 111, at 5-10.

201 *Id.* at 5-11.

202 *Id.*

203 The two primary permitting programs applicable to criteria pollutants are administered under the CAA's nonattainment and prevention of significant deterioration programs. *See* 42 U.S.C.A. §§ 7470–7504.

204 Facilities may be subject to additional permitting requirements even if they do not meet the threshold for mandatory LFG gas emissions capture. *See* Trisolini, *supra* note 101, at 145.

205 *See* LFG HANDBOOK, *supra* note 111, at 5-10; *see generally* 42 U.S.C.A. §§ 7470–7504.

206 *See generally* 42 U.S.C.A. § 7409.

project would be required to comply only with Prevention of Significant Determination (PSD) permit requirements.[207] Alternatively, if the air quality in the area does not meet current NAAQS, then the LFG project will be required to comply with nonattainment permitting requirements.[208] Regardless of which permit program applies, source-specific requirements and objectives are almost always addressed at the state level through its CAA State Implementation Plan (SIP).[209] Generally speaking, however, requirements for major new source activities are typically greater than the requirements for minor source activities,[210] and being subject to nonattainment permitting requirements is typically seen as more onerous, due to the added regulatory burden associated with the nonattainment regulatory program.[211] Finally, federal facilities are subject to the EPA's national standards and state-specific permitting and compliance standards as captured by an applicable SIP.[212]

3. Regulatory Issues Surrounding Aviation Requirements

In addition to identifying suitable land for the creation of an LFG project, the Air Force must also comply with directives promulgated by the FAA.[213] Any restrictions or regulations affecting development of land near an active runway could restrict the Air Force's ability to develop LFG on or near an installation's fence line.

The FAA has traditionally relied on regulatory action and what the agency refers to as "Advisory Circulars" to control the development of municipal solid waste landfills near public airports.[214] In an effort to

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207 *See id.* §§ 7470–7492; LFG HANDBOOK, *supra* note 111, at 5-10.

208 LFG HANDBOOK, *supra* note 111, at 5-10; 42 U.S.C.A. §§ 7501–7504.

209 LFG HANDBOOK, *supra* note 111, at 5-10; 42 U.S.C.A. § 7410.

210 LFG HANDBOOK, *supra* note 111, at 5-10 to -11.

211 For example, if a source is subject to nonattainment standards, the state regulatory body has the authority to impose technology requirements, specific emissions rates, offsetting requirements, and other controls necessary to move the area toward compliance with NAAQS. *See* 42 U.S.C.A. § 7503.

212 *See generally Clean Air Act (CAA) and Federal Facilities*, EPA, https://www.epa.gov/enforcement/clean-air-act-caa-and-federal-facilities [https://perma.cc/LAT6-4NL4] (last updated Dec. 6, 2020).

213 *See* Structures Interfering with Air Commerce or National Security, 49 U.S.C.A. § 44718 (West, Westlaw through Pub. L. No. 117-51).

214 *See id.*; Federal Aviation Administration, *Construction or Establishment of Landfills Near Public Airports Advisory Circular*, U.S. DEP'T OF TRANSP. (Jan. 26, 2006), https://www.faa.gov/documentLibrary/media/Advisory_Circular/150_5200_34a.pdf [https://perma.cc/Q9T7-3M2H] [hereinafter *Advisory Circular*].

address the possibility of landfill creation near airports, Congress also enacted 49 U.S.C. § 44718(d) to allow the FAA to enforce "and plac[e] limitations on the construction or establishment of landfills near public airports for the purposes of enhancing aviation safety."[215] According to the FAA, municipal landfills pose potential hazards for aircraft operations because these types of facilities attract birds, which have caused thousands of reported aircraft strikes and millions of dollars in damages over the years.[216]

Three provisions under 49 U.S.C. § 44718 could affect or limit the Air Force's ability to develop LFG projects on existing or future installations.[217] First, 49 U.S.C. § 44718(d) applies specifically to municipal landfill *construction* and places a prohibition on this type of activity "within 6 miles of a public airport" under limited circumstances and subject to agency approval.[218] Second, 49 U.S.C. § 44718(f),[219] which references the DoD Clearinghouse requirements for approving energy projects,[220] requires a finding from the Secretary of Defense that the proposed landfill will not "result in an unacceptable risk to the national security of the United States."[221] Finally, 49 U.S.C. §§ 44718(a)–(b) serve as catch-all provisions to ensure all construction, alteration, or establishment of a structure or sanitary landfill are documented by the agency and reviewed to determine if they would affect the "safe and efficient use" of the navigable airspace.[222]

Although 49 U.S.C. § 44718(d) appears to be the most restrictive provision in the statute on landfill siting activities, it would likely not apply to DoD activities[223] because this provision is focused on *public* airports receiving federal grant money from other programs within Title 49 of the U.S. Code.[224] In the FAA's Advisory Circular regarding landfill construction, the agency further clarifies which types of airports are covered by the statute, which includes airports that receive federal grant funds, airports that are under control of a public agency,

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215 *Advisory Circular*, *supra* note 214, at 2.

216 *Id.*

217 *See generally* 49 U.S.C.A. § 44718.

218 *Id.* § 44718(d).

219 *Id.* § 44718(f).

220 *See* 10 U.S.C.A. § 183a (West, Westlaw through Pub. L. No. 117-51).

221 49 U.S.C.A. § 44718(f) (West, Westlaw through Pub. L. No. 117-51).

222 *Id.* § 44718(b).

223 *Id.* § 44718(d).

224 *Id.*; Chapter 471 of Title 49 addresses federal grants and other requirements for airport development. *See generally* 49 U.S.C.A. §§ 47101–47175 (West, Westlaw through Pub. L. No. 117-54).

and smaller aircraft operations with air carriers that normally operate aircraft with less than sixty seats.[225] Given the agency's characterization of public airports,[226] it is unlikely the DoD, which operates primarily military aircraft inaccessible to the general public, would qualify under this restriction.

Similarly, the DoD Clearinghouse restrictions encapsulated in 49 U.S.C. § 44718(f) are unlikely to significantly restrict the Air Force's ability to develop LFG on its installations.[227] The purpose of the Clearinghouse process is to give the DoD a system for evaluating energy projects and mission obstructions for compatibility with the DoD's testing, training, and operating requirements.[228] Therefore, while the DoD could theoretically permit the development of an energy project or landfill that the FAA would object to for other reasons, a project is unlikely to get approved by the FAA if the DoD specifically objects to the project under the DoD Clearinghouse process.[229]

The FAA's landfill approval process, in combination with DoD Clearinghouse requirements, poses an interesting dilemma for future landfill development.[230] If the DoD authorizes the development and construction of a landfill with LFG energy systems *within* the military installation's fence line, both the FAA's role under 49 U.S.C. § 44718(f) and the DoD Clearinghouse process would not necessarily preclude the project from moving forward, even if the landfill otherwise encroached within six miles of the Air Force's runways.[231] However, both the DoD and the FAA would have the ability to disrupt or even stop the development of a local or municipal landfill in close proximity to the Air Force's existing runway under the DoD Clearinghouse review process and the requirements of 49 U.S.C. § 44718(f).[232] Thus, whether the future landfill is created on or near the Air Force installation's perimeter can have a significant impact on the approval of the project and the timeline in which approval would be granted.

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225 *Advisory Circular*, *supra* note 214, at 3.

226 49 U.S.C.A. § 44718(d); *Advisory Circular*, *supra* note 214, at 3.

227 49 U.S.C.A. § 44718(f); *see also* 10 U.S.C.A. § 183a (West, Westlaw through Pub. L. No. 117-51).

228 DoD Clearinghouse, *supra* note 71; 10 U.S.C.A. § 183a.

229 *See* 49 U.S.C.A. § 44718(f); 10 U.S.C.A. § 183a.

230 *See Advisory Circular*, *supra* note 214; 49 U.S.C.A. § 44718(f); 10 U.S.C.A. § 183a.

231 *See* 49 U.S.C.A. § 44718(f); DoD Clearinghouse, *supra* note 71; 10 U.S.C.A. § 183a.

232 *See* 49 U.S.C.A. § 44718(f); DoD Clearinghouse, *supra* note 71; 10 U.S.C.A. § 183a.

4. Regulatory Issues Surrounding NEPA Compliance

Finally, as an agency of the federal government, any proposed actions by the Air Force to develop or construct LFG energy systems may trigger the requirements of NEPA.[233] NEPA affects any "major federal actions significantly affecting the quality of the human environment."[234] The definition of a major federal action has broad application and can trigger the requirements of a NEPA analysis for any action "undertaken, funded, or even authorized by the federal government."[235] If NEPA review is required, the Air Force would be required to "issue a detailed environmental statement,"[236] which could take the form of a "categorical exception, a (mitigated) [Finding of No Significance], an [Environmental Assessment], or an [Environmental Impact Statement]."[237]

For the purposes of this Article, NEPA poses two specific problems for the Air Force. The first issue is whether a new LFG energy project would even be subject to NEPA requirements. Given the broad interpretation of what constitutes a "major federal action[],"[238] it is very likely the Air Force would be exposed to *some* form of NEPA review. Thus, if the Air Force has any role in constructing, approving the project or its associated energy systems on DoD lands, or funding the project's development, there is a substantial likelihood that the project would require a NEPA analysis.[239]

Second, if the Air Force's LFG project constitutes a "major federal action," then the agency will need to determine what level of environmental review is necessary.[240] This determination will be largely dependent on the nature of the LFG project itself. If the proposed project is not expected to have a significant impact on the human environment, when viewed cumulatively or individually, the

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233 *See generally* National Environmental Policy Act of 1969, 42 U.S.C.A. §§ 4321–4370h (West, Westlaw through Pub. L. No. 117-51).

234 Nicole Rushovich, *Climate Change and Environmental Policy: An Analysis of the Final Guidance on Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews*, 27 B.U. PUB. INT. L.J. 327, 332–33 (2018) (citing National Environmental Policy Act of 1969 § 102, 42 U.S.C. § 4332 (2012)).

235 Connolly, *supra* note 151, at 18 (citing 40 C.F.R. § 1508.18 (2002)).

236 Rushovich, *supra* note 234, at 333 (citing 42 U.S.C. § 4332).

237 *Id.* at 335.

238 *See* Connolly, *supra* note 151, at 18 (citing 40 C.F.R. § 1508.18 (2002)).

239 *Id.*

240 Rushovich, *supra* note 234, at 332–33 (citing 42 U.S.C. § 4332). The level of environmental review could take one of several forms ranging from a categorical exclusion to an Environmental Impact Statement. *Id.* at 335.

project may be subject to a categorical exclusion and would not require an Environmental Impact Statement (EIS).[241] However, if it is unknown whether the proposed LFG project will significantly affect the human environment, or if the Air Force affirmatively determines the human environment will be significantly affected, then additional environmental analysis through an Environmental Assessment or EIS will likely be required.[242] At first glance, these additional requirements may not sound too onerous. However, NEPA reviews are notorious for their extremely slow timelines, and completing an EIS would likely be measured in terms of years, rather than weeks or months.[243] Furthermore although there have been attempts to reduce the review timeline under NEPA, there is considerable disagreement on what portions of the review process should be streamlined or modified in the future.[244] Therefore, Air Force policymakers will need to be keenly aware of possible environmental review timelines that may affect any proposals for developing or constructing LFG projects on or near existing Air Force installations.

C. Case Studies

Given the regulatory burden and the multistate and multiagency requirements the Air Force would likely have to comply with to fully incorporate LFG energy into its existing RE portfolio, this task may at first seem overwhelming. Fortunately, however, the Air Force can look to other DoD LFG energy initiatives, as well as the experiences at two facilities that have been developed by the Air Force previously,[245] in

241 *Id.* at 333 (citing 40 C.F.R. § 1508.4 (2005)).

242 If the impacts of the project are unknown, the agency will typically first conduct an Environmental Assessment. *See id.* (citing 40 C.F.R. § 1501.4 (2008)). If the project is ultimately found to have a significant impact on the human environment, an EIS is required under NEPA. *Id.*; *see also National Environmental Policy Act Review Process*, EPA, https://www.epa.gov/nepa/national-environmental-policy-act-review-process [https://perma.cc/VUB7-YRAR] (last updated Jan. 24, 2017).

243 Although every EIS moves on a case-by-case timeline, some scholars have noted that average agency completion times can take up to two to six years. *See* James R. Holcomb, IV, *NEPA and Climate Change: After the CEQ's Draft Guidance*, 41 TEX. ENV'T L.J. 259, 274–75 (2011).

244 For information about changes to the NEPA review process in recent years, see *CEQ Proposes to Restore Basic Community Safeguards During Federal Environmental Reviews*, COUNCIL ON ENV'T QUALITY, https://www.whitehouse.gov/ceq/news-updates/2021/10/06/ceq-proposes-to-restore-basic-community-safeguards-during-federal-environmental-reviews/ [https://perma.cc/L7NA-XVP7] (last visited Nov. 9, 2021).

245 For a list of Air Force facilities currently utilizing LFG energy systems, see *USAF Renewable Energy Projects*, *supra* note 13.

assessing whether LFG energy is a worthwhile venture. By looking at how these previous LFG energy facilities were developed, we can begin to see how a large-scale attempt by the Air Force to utilize LFG energy would be possible.

1. Department of the Navy

The Department of the Navy (DoN) is responsible for projects affecting both the Navy and the Marine Corps.[246] Two of the largest existing LFG endeavors by DoN are at Marine Corps facilities on separate coasts: Marine Corps Air Station Miramar (MCASM) outside of San Diego, California, and Marine Corps Logistics Base Albany (MCLBA) in Albany, Georgia.[247] Because these projects were developed at different times and with differing energy needs for these particular facilities,[248] DoN's experience with LFG provides a helpful demonstration of how LFG energy projects are not only possible but compatible with military operations and energy needs.

a. MCASM's LFG Energy Project

MCASM's LFG energy project has been operational since 1998.[249] The facility was built by Fortistar, LLC,[250] a private energy business that has run the facility since it went into operation.[251] After initially operating with four gas-powered engines,[252] the facility expanded

246 For more information about the DoD's organizational structure, see generally *Military Units*, DEP'T OF DEF., https://www.defense.gov/Experience/Military-Units/ [https://perma.cc/NHG4-Z9GK] (last visited Nov. 9, 2021).

247 For more information about these respective military installations, see generally *Marine Corps Air Station Miramar*, U.S. MARINE CORPS, https://www.miramar.marines.mil/ [https://perma.cc/JJ3Y-FCF8] (last visited Nov. 9, 2021); *Marine Corps Logistics Base Albany*, U.S. MARINE CORPS, https://www.albany.marines.mil/ [https://perma.cc/T54P-5RQX] (last visited Nov. 9, 2021).

248 MCASM's LFG project became operational in 1998, whereas MCLBA's LFG project became operational in 2011. *See generally MCAS Miramar*, FORTISTAR SUSTAINABLE PERFORMANCE, http://rng.fortistar.com/Miramar/ [https://perma.cc/KV9N-Y67V] (last visited Apr. 5, 2020) [hereinafter FORTISTAR LFG DATA]; LANDFILL METHANE OUTREACH PROGRAM, EPA, GREEN POWER FROM LANDFILL GAS 2 (2016), https://www.epa.gov/sites/production/files/2016-08/documents/green_power_from_landfill_gas.pdf [https://perma.cc/5JKJ-PSAY] [hereinafter GREEN POWER FACT SHEET].

249 *See* FORTISTAR LFG DATA, *supra* note 248.

250 For information pertaining to Fortistar, LLC, see generally FORTISTAR, https://fortistar.com/ (last visited Nov. 9, 2021).

251 *Fortistar Celebrates 20th Anniversary of Miramar Landfill Gas Utilization Projects*, BUS. WIRE (Oct. 31, 2018, 10:00 AM), https://www.businesswire.com/news/home/20181031005088/en/Fortistar-Celebrates-20th-Anniversary-Miramar-Landfill-Gas [https://perma.cc/K6C4-P6H3].

252 FORTISTAR LFG DATA, *supra* note 248.

operations in 2012 by adding two additional gas engines to the MCASM LFG energy complex.[253] The LFG energy system reportedly provides the installation with "3.2 megawatts of energy . . . [which is] enough to power about 2,000 homes."[254]

The MCASM LFG project is unique in both its size and scope, especially after considering how close the LFG energy plant is to MCASM's active runway. Despite the metropolitan community's generation of over 900,000 tons of trash on an annual basis,[255] the Miramar landfill is the City of San Diego's "only active landfill" spanning over 1,500 acres.[256] In addition to accepting an enormous amount of waste on an annual basis, the landfill is a large landmass.[257] For context, the City of San Diego recently assessed whether to increase the height of the western portion of the existing landfill from 485 feet to a height of 510 feet.[258]

At first glance, one could assume such a large facility would directly affect military operations and aeronautical activities in the region. However, the existence of the Miramar Landfill does not appear to have impacted MCASM's flying mission despite the close proximity of the landfill to the base's runway.[259] According to the City of San Diego, the FAA cleared the approval of a height extension to 510 feet, finding that the extension did not pose a hazard to air navigation under its 49 U.S.C. § 44718 review process.[260] In addition, MCASM updated its air installation compatible use zone footprint analysis in 2020, which a program initiated to "protect the public's health, safety and welfare and to prevent encroachment from degrading the operational capability of

253 *Id.*

254 *Landfill Providing Power for Miramar*, SAN DIEGO UNION-TRIB. (July 2, 2012, 1:14 PM), https://www.sandiegouniontribune.com/military/sdut-electric-independence-2012jul02-story.html. [https://perma.cc/GTB7-QJRZ]; *see also Fortistar Celebrates 20th Anniversary of Miramar Landfill Gas Utilization Projects*, *supra* note 251.

255 The county estimates "almost 910,000 tons of trash are disposed of yearly at the Miramar Landfill." Environmental Services Department, *Miramar Landfill*, CITY OF SAN DIEGO, https://www.sandiego.gov/environmental-services/miramar/#Location [https://perma.cc/ED55-A5DH] (last visited Nov. 9, 2021) [hereinafter *Miramar Landfill Data*].

256 *Id.*

257 *See generally* Karen Bucey, *Report to the Hearing Officer*, CITY OF SAN DIEGO (Nov. 27, 2019), https://www.sandiego.gov/sites/default/files/dsd_ho_19-107_west_miramar_landfill_phase_ii.pdf [https://perma.cc/82FJ-L9KB] [hereinafter *Report to the Hearing Officer*].

258 *Id.* at 1–3.

259 *Id.* at attach. 1–3.

260 *Id.* at 3, attach. 7; *see also* Structures Interfering with Air Commerce or National Security, 49 U.S.C.A. § 44718(d) (West, Westlaw through Pub. L. No. 117-51).

military air installations."[261] The analysis considered the proximity of the nearby landfill to air operations, but noted that the City of San Diego has "implement[ed] best management practices and other measures . . . to manage the risk of bird strikes."[262]

Another important aspect of the MCASM LFG project is that it demonstrates the flexibility in which the DoD can develop and operate LFG energy interests at future installations. First, the land where the landfill and LFG energy project were constructed is not owned by the state or the local municipality but is instead owned and leased to the City of San Diego by DoN.[263] Through this agreement, the City of San Diego previously constructed and continues to operate the Miramar Regional Landfill to this day within approximately two miles of the military installation's main entrance.[264] Second, although DoN owns the land used to construct both the landfill and the LFG energy project,[265] Fortistar, LLC is the operator of the LFG energy project and bears the responsibility for complying with California's CAA regulatory requirements.[266] Thus, the Navy was presented with an opportunity not only to collect rents on the lands used to generate LFG energy, but it was also placed in a favorable position to negotiate a long-term Power Purchase Agreement (PPA) with Fortistar to secure a resilient form of RE for the installation.[267]

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261 For information about MCASM's flight corridor, see *2020 AICUZ Footprint*, MARINE CORPS AIR STATION MIRAMAR, https://www.miramar.marines.mil/Resources/Encroachment/AICUZ/ [https://perma.cc/QQ86-8AN4] (last visited Nov. 9, 2021).

262 MARINE CORPS AIR STATION MIRAMAR, AIR INSTALLATIONS COMPATIBLE USE ZONES STUDY 2020 UPDATE 5-6 (2020), https://www.miramar.marines.mil/Portals/164/Docs/Final_MCAS_Miramar_AICUZ_JuneV5_2020.pdf?ver=kaIKo9xQzSOibXcRcU4r6Q%3d%3d [https://perma.cc/8K23-2YBC] [hereinafter AICUZ STUDY 2020].

263 *Id.*

264 *Id.*; *see also Miramar Landfill Data*, *supra* note 255. For more information on the proximity of the base to the landfill, see *Report to the Hearing Officer*, *supra* note 257**,** at attach. 1–3; Driving Directions from Miramar, CA, to Miramar Landfill, GOOGLE MAPS, https://maps.google.com (follow "Get Directions" hyperlink; then search "A" for "MCAS Miramar" and "B" for "Miramar Landfill;" then follow "Get Directions" hyperlink).

265 AICUZ STUDY 2020, *supra* note 262, at 5-6.

266 San Diego does not have publicly available copies of Fortistar's Title V Permit. However, Fortistar's Title V Permit Renewal Application from 2018 demonstrates its subsidiaries have previously managed and will continue to manage the business's regulatory responsibilities under the California Title V program. *See* EPA, TITLE V OPERATING PERMIT STATEMENT OF BASIS (2018) (on file with City of San Diego), https://www.sandiegocounty.gov/content/dam/sdc/apcd/notices/Neo-San-Diego-LLC-Statement-of-Basis.pdf [https://perma.cc/7CQQ-84P2].

267 The first power purchase agreement with Fortistar is scheduled to last for fifteen years and provides "a fixed amount of power from the landfill for a fixed price." *Landfill Providing Power for Miramar*, *supra* note 254.

b. MCLBA's LFG Energy Project

More recently, MCLBA implemented an LFG energy program in 2011 which has reportedly "saved approximately $1.3 million annually in utility costs" for the facility,[268] while also providing for at least twenty percent of the base's total energy requirements.[269] To complete the project, MCLBA partnered with Chevron Energy Solutions to build a "dual-fuel engine generator, a stack heat recovery steam generator and two dual-fuel boilers."[270] By using this technology, the plant has the capability of operating off LFG or natural gas to better promote energy security.[271]

Similar to the MCASM project, MCLBA's LFG project is a multi-organizational partnership.[272] Although Chevron Energy Solutions is responsible for managing the pipeline and LFG processing equipment,[273] the landfill is owned and operated by Dougherty County at a site that is approximately 2.5 miles from the base gate.[274] Dougherty County's landfill "receives approximately 100,000 tons of municipal solid waste . . . per year,"[275] and the responsibility falls on the County to extract the usable LFG for further processing at MCLBA.[276] The partnership has been viewed as a significant success story, and the County recently approved plans to spend approximately

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268 *Green Power Fact Sheet*, *supra* note 248, at 2.

269 Pamela Jackson, *Officials Flip Switch for Base's Landfill Gas-to-Energy Plant*, MARINE CORPS LOGISTICS BASE ALBANY (Sept. 29, 2011), https://www.albany.marines.mil/News/News-Article-Display/Article/508473/officials-flip-switch-for-bases-landfill-gas-to-energy-plant/ [https://perma.cc/G88Q-E7WQ].

270 *Chevron Energy Solutions and Marine Corps Logistics Base Albany Complete Navy's First Landfill Gas Power Plant*, CHEVRON (Sept. 23, 2011), https://www.prnewswire.com/news-releases/chevron-energy-solutions-and-marine-corps-logistics-base-albany-complete-navys-first-landfill-gas-power-plant-130408848.html [https://perma.cc/62J4-5B8J] [hereinafter *MCLBA Press Release*].

271 *Id.*

272 Public Affairs MCLB Albany, *MCLB Landfill Gas Energy Program Completed*, WALB NEWS (Sept. 23, 2011), https://www.walb.com/story/15533724/mclb-landfill-gas-energy-program-completed/ [https://perma.cc/85T2-AVBA].

273 *MCLBA Press Release*, *supra* note 270; Public Affairs MCLB Albany, *supra* note 272.

274 Public Affairs MCLB Albany, *supra* note 272. For more information about the distance between the landfill and MCLBA, see generally Driving Directions from Marine Corps Logistics Base Albany Main Entrance, GA, to Dougherty Count Landfill Office, GOOGLE MAPS, https://maps.google.com (follow "Get Directions" hyperlink; then search "A" for "Marine Corps Logistics Base Albany Main Entrance" and "B" for "Dougherty County Landfill Office;" then follow "Get Directions" hyperlink).

275 Public Affairs MCLB Albany, *supra* note 272.

276 *Id.*

$370,000 to improve its existing gas extraction systems to ensure the project remains productive for the parties for several years.[277]

The project has also resulted in regulatory and contractual successes for MCLBA. Although the military installation is the consumer of the energy generated from the Dougherty County LFG project, the County bears the regulatory responsibility for both the landfill and the LFG energy project.[278] The arrangement also allowed for MCLBA to enter into a twenty-year contract with Dougherty County to ensure the installation receives a reliable source of energy as long as the landfill continues to generate usable gas.[279] This arrangement is also viewed as a positive outcome for the County since it can now utilize the otherwise useless methane gas generated by its landfill while also helping to "reduce the use of fossil fuels."[280]

2. Department of the Air Force/Army

Reviewing DoN's past experiences is helpful to provide context for how LFG energy projects have been successful for the DoD. However, it should be noted that the vast majority of Air Force installations have active runways and a very different operational platform than most Naval and Marine Corps installations.[281] Therefore, it is equally important to review the Air Force's existing LFG projects to see if LFG energy is compatible with the Air Force's specific energy and operational needs on a larger scale. As previously indicated, the Air Force has implemented LFG at only two sites: Hill AFB, Utah, and JBER, Alaska.[282] Despite the Air Force's minimal reliance on this

277 Plans for the project upgrades were approved in November 2019. *See* Grason Passmore, *Dougherty Co. Landfill Continues to Turn Trash into Power*, WALB NEWS (Nov. 18, 2019, 10:40 PM), https://www.walb.com/2019/11/19/dougherty-co-landfill-continues-turn-trash-into-power/ [https://perma.cc/FPV5-ALUT].

278 For documentation concerning the county's Title V Clean Air Permits that cover the landfill and the LFG energy project, see Air Prot. Branch Env't Prot. Div., *Georgia Air Permit Search Engine*, GA. DEP'T OF NAT. RES., https://permitsearch.gaepd.org/ [https://perma.cc/Q76P-BKW3] (input "Dougherty County Fleming/Gaissert Rd MSW Landfill" for "Facility Name;" then select "Final Permit" link for "4953-095-0095-V-03-0" and "4953-095-0095-V-04-0").

279 This contract includes an optional five-year extension provision for both parties to consider. *See* Public Affairs MCLB Albany, *supra* note 272.

280 *Id.*

281 For a brief overview of the DoD's service components and the types of operations they engage in, see "About," DEP'T OF DEF., https://www.defense.gov/about [https://perma.cc/P5HJ-WR94] (last visited Nov. 9, 2021).

282 The most recent publicly available information regarding the Air Force's LFG energy projects is from August 2017. *USAF Renewable Energy Projects*, *supra* note 13. Although

technology to date, there are lessons that can be learned from the energy projects that have been developed and implemented at Hill AFB and JBER that may help inform whether the Air Force should invest in LFG energy in the future.

a. JBER's LFG Energy Project

JBER's LFG energy project has been in operation since August 2012.[283] The city of Anchorage describes this project as a "partnership between the Municipality of Anchorage Solid Waste Services Department and Doyon Utilities."[284] It was first contemplated after Anchorage sought to productively use LFG rather than continuing to flare it at a cost of approximately $60,000 a year to comply with applicable CAA requirements.[285] Doyon Utilities was selected as the utility company that would develop the project, and, after a contract was awarded in 2011, an LFG energy power plant was built and made operational in late 2012.[286]

JBER's involvement with the Anchorage Regional Landfill (ARL) LFG project has three components. First, the landfill, which receives the municipal solid waste for the municipality's population of almost 300,000 people,[287] is owned by the municipality of Anchorage rather than the DoD.[288] Although the municipality has owned and operated

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it is possible the Air Force is contemplating the development of additional LFG energy projects, the EPA has not received notice of any newly planned or under-construction projects specific to the Air Force as of March 2020. *See* Landfill Methane Outreach Program, *Landfill Gas Energy Project Data*, EPA, https://www.epa.gov/lmop/landfill-gas-energy-project-data [https://perma.cc/5B53-VXXB] (last updated Mar. 18, 2020**)** (follow "Under-construction or planned projects (XLSX) (March 2020)" hyperlink).

283 *Anchorage Landfill Gas to Energy Project*, MUN. OF ANCHORAGE, http://www.muni.org/Departments/SWS/Pages/AnchLandfillGastoEnergyPrj.aspx [https://perma.cc/AV9Q-CMTJ] (last visited Nov. 9, 2021) [hereinafter *Anchorage LFG Project*]; MUN. OF ANCHORAGE, ANCHORAGE LANDFILL GAS TO ENERGY PROJECT 4 (2013), https://www.muni.org/Departments/SWS/LandfillGas/Documents/Landfill_Gas_Utilization_Silver.pdf [https://perma.cc/S22N-DZ8W] [hereinafter LFG UTILIZATION AWARD SUBMISSION].

284 *Anchorage LFG Project*, *supra* note 283.

285 David Bedard, *JB Elmendorf – Richardson Turns Landfill Gas into Energy*, U.S. AIR FORCE (Sept. 5, 2012), https://www.af.mil/News/Article-Display/Article/110516/jb-elmendorf-richardson-turns-landfill-gas-into-energy/ [https://perma.cc/7Y5U-CE82]; LFG UTILIZATION AWARD SUBMISSION, *supra* note 283, at 2–3.

286 LFG UTILIZATION AWARD SUBMISSION, *supra* note 283, at 3–4.

287 SOLID WASTE SERVS., MUN. OF ANCHORAGE, INTEGRATED SOLID WASTE MASTER PLAN BRIEFING REPORT 2 (Sept. 2018), https://www.muni.org/Departments/SWS/Documents/Master%20plan%20executive%20summary.pdf [https://perma.cc/6X2Q-ZEH3] [hereinafter SOLID WASTE MASTER PLAN BRIEFING REPORT].

288 LFG UTILIZATION AWARD SUBMISSION, *supra* note 283, at 2.

the landfill since 1987,[289] the landfill was constructed on a "300 acre tract" previously owned by the U.S. Army.[290] Second, as part of the LFG energy project, a transmission pipeline was constructed in 2011 to allow for LFG transport over the 1.2 mile distance from the landfill to the LFG energy power plant.[291] Third, the power plant was constructed on the Fort Richardson side of JBER, which is "immediately adjacent to the ARL boundary."[292] Although the power plant is on JBER's property, the "project was financed and constructed by [Doyon Utilities] with the constructions costs to be recovered through monthly utility tariffs to JBER."[293]

The combination of the size of the landfill and the power plant's generator systems provides a significant amount of electrical power to JBER.[294] The landfill was designed for long-term use with a capacity of over 44 million cubic yards.[295] According to the municipality of Anchorage, the disposal rate for the facility is on average 1,200 tons per day or 310,000 tons per year.[296] However, despite the facility's modestly sized waste stream, the power plant utilizes five internal combustion engines to generate electrical power for JBER's operations.[297] With the gas pipeline and combustion engines in operation, the Anchorage LFG power plant is currently capable of generating enough electricity to meet "off-peak power demand for the Fort Richardson side [of military operations] and approximately 25% of the JBER-wide electrical demand."[298]

Furthermore, because of the particular technology in place at the LFG energy facility, the power plant can operate off LFG or "commercially available natural gas to ensure maximum reliability of the plant."[299] Therefore, although ARL is significantly smaller than

289 *Id.*

290 *Id.*

291 *Id.* at 8.

292 *Id.*

293 *Id.* at 10.

294 *See generally Anchorage LFG Project*, *supra* note 283.

295 *Id.*

296 *Id.* The size of the waste stream varies year to year. For example, the solid waste management office calculated waste disposal at over 330,000 tons in 2016. SOLID WASTE MASTER PLAN BRIEFING REPORT, *supra* note 287, at 2.

297 *Anchorage LFG Project*, *supra* note 283.

298 *Id.*

299 LFG UTILIZATION AWARD SUBMISSION, *supra* note 283, at 8.

LFG projects in place elsewhere, such as the facility on MCASM,[300] the project provides a significant amount of energy to meet the facility's needs and is expected to "produce commercial quantities of landfill gas for approximately 60 years" absent additional project expansions.[301]

Although the LFG project provides numerous benefits to JBER's operational needs, the project is not without some environmental impact. Notably, the LFG power plant is considered a major stationary source for CAA purposes according to the State of Alaska because it has the potential to "emit 250 tons or more of a criteria pollutant" per year.[302] Because of this designation, and based on the data provided by Doyon Utilities that simulated the potential emissions from plant operations, the facility was required to obtain a PSD major source permit and comply with the state's hazardous air pollutant emissions requirements.[303] However, although the facility was constructed and is currently operational on JBER land, the Air Force was not required to obtain a CAA permit from the state of Alaska.[304] Instead, Doyon Utilities, LLC, as the principal operator of the facility, is both the operator and permittee of the facility for CAA purposes.[305]

JBER's LFG project is significant in a number of ways. First, the JBER project demonstrates the flexibility of implementing LFG energy recovery systems into existing landfill operations. Although the facility

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300 For comparison, the landfill that provides LFG energy to the MCASM project accepts nearly 910,000 tons of trash on an annual basis. *See Miramar Landfill Data*, *supra* note 255.

301 *Anchorage LFG Project*, *supra* note 283. Solid Waste Services has proposed an expansion to the western quadrant of the ARL which could extend the site's life by an additional forty-five years. SOLID WASTE MASTER PLAN BRIEFING REPORT, *supra* note 287, at 4.

302 Kwame Agyei, *Technical Analysis Report for Air Quality Control Construction Permit AQ0237CPT04*, ALA. DEP'T OF ENV'T CONSERVATION 7 (May 8, 2013), https://dec.alaska.gov/Applications/Air/airtoolsweb/AirPermitsApprovalsAndPublicNotices/ [https://perma.cc/7AYC-6N3Q] (select "Owner" drop-down under "Active Permits & Approval Search" tab; then select "Doyon Utilities, LLC;" select "Show/Hide Results" from "Major Title I Construction (CPT);" then select "Final TAR" hyperlink).

303 *Id.* at 7–8.

304 *See generally* John F. Kuterbach, *Air Quality Control Construction Permit*, ALA. DEP'T OF ENV'T CONSERVATION (May 8, 2013), https://dec.alaska.gov/Applications/Air/airtoolsweb/AirPermitsApprovalsAndPublicNotices/ [https://perma.cc/MW6E-YBBP] (select "Owner" drop-down under "Active Permits & Approval Search" tab; then select "Doyon Utilities, LLC;" select "Show/Hide Results" from "Major Title I Construction (CPT);" then select "AQ0237CPT04P (AQ0237CPT04)" hyperlink) (detailing the CAA permitting obligations imposed on Doyon for this site).

305 *Id.*

was not initially designed to accommodate LFG energy generation,[306] local leaders and private business operators saw an opportunity to convert the otherwise useless methane-based LFG into an energy source for the community.[307] Second, this project shows that the Air Force does not have to be the primary stakeholder or operator of an LFG energy facility for the project to be successful or beneficial to the military installation. Rather than constructing a new landfill capable of LFG energy generation with federal funds and heightened regulatory scrutiny, the Air Force instead opted for a middle ground solution where the military installation could benefit from local generation through a local landfill as a consumer of the power, rather than as a state-permitted operator of an LFG energy power plant.[308]

b. Hill AFB

The other LFG energy project specific to the Air Force was developed at Hill AFB,[309] an Air Force installation located outside of Ogden, Utah.[310] Hill AFB "is the Air Force's second largest base by population and geographical size[,]"[311] with control over 1,000,000 acres, 1,700 facilities, and over 24,000 personnel.[312] Despite the massive size of the base and its control over so much land, Hill AFB does not have its own landfill system and instead accepts LFG generated at the nearby Davis County Landfill, which is owned and operated by the Wasatch Integrated Waste Management District.[313] The

306 Indeed, the municipality of Anchorage did not issue a request for proposals on an LFG project until 2010, which was several years after the landfill was constructed. *See* LFG UTILIZATION AWARD SUBMISSION, *supra* note 283, at 3.

307 *Id.*; Bedard, *supra* note 285.

308 *Anchorage LFG Project*, *supra* note 283; LFG UTILIZATION AWARD SUBMISSION, *supra* note 283, at 10.

309 *USAF Renewable Energy Projects*, *supra* note 13.

310 For a brief historical description of Hill AFB, see generally *A Short History of Hill Air Force Base*, HILL AFB (Jan. 8, 2008), https://www.hill.af.mil/About-Us/Fact-Sheets/Display/Article/397240/a-short-history-of-hill-air-force-base/ [https://perma.cc/AE3Q-P848].

311 *75th Air Base Wing Fact Sheet*, U.S. AIR FORCE, https://www.hill.af.mil/Portals/58/documents/75%20ABW%20Fact%20Sheet.pdf [https://perma.cc/A26F-JBFD] (last visited Nov. 9, 2021).

312 *Id.*

313 *See* U.S. AIR FORCE, RENEWABLE ENERGY CASE STUDY 5, https://www.afcec.af.mil/Portals/17/documents/Energy/AFD-121207-056.pdf [https://perma.cc/WN3W-MGED] [hereinafter AFCEC CASE STUDY]. For information about the ownership of the Davis County Landfill, see Waste Mgmt. & Radiation Control, *Davis Class I Landfill Fact Sheet*, UTAH DEP'T OF ENV'T QUALITY, https://deq.utah.gov/businesses-facilities/davis-class-i-landfill-fact-sheet [https://perma.cc/F3RT-EL8Q] (last updated Dec. 5, 2018). For brief

methane generated within the landfill is chilled and filtered before being shipped to a facility on Hill AFB that uses three "Caterpillar engines" to convert the gas to electricity.[314] According to the Utah Geological Survey, the three LFG combustion engines create a nearly uniform output of energy year-round.[315]

The Hill AFB LFG project required the involvement of multiple parties. First, the Air Force negotiated with, and secured a contract with, Ameresco Federal Solutions (Ameresco) to construct the LFG energy recovery system on Hill AFB.[316] In order to then secure initial funding for the project, the Air Force worked with the Department of Energy to obtain an Energy Savings Performance Contract (ESPC),[317] which enabled the Air Force to obtain a $3 million contract "[w]ith no upfront capital costs to the Air Force."[318] Finally, and rather than creating a separate power system, the Air Force entered into a PPA with PacifiCorp, the local electric utility company, to put the generated power back into the grid.[319] According to the Air Force, this arrangement has allowed the installation "to get paid to produce the power that offsets the public utilities distribution grid[,]"[320] thus paying down the ESPC project contract cost.[321] Aside from cost savings, this arrangement has also allowed the Air Force to increase the resilience

information about the organization running the regional landfill, see WASATCH INTEGRATED WASTE MGMT. DIST., https://www.wasatchintegrated.org/ [https://perma.cc/ASR2-REB2] (last visited Nov. 9, 2021).

314 Larry Weist, *Alternative Energy for Hill AFB*, DESERET NEWS (Apr. 29, 2005, 12:00 AM), https://www.deseret.com/2005/4/29/19888625/alternative-energy-for-hill-afb [https://perma.cc/J7ZN-9HXA]. Although the project started with two engine systems, a third was developed in 2008. *See Biomass, Wind, and Other Power Plants in Utah*, UTAH GEOLOGICAL SURV., https://geology.utah.gov/resources/energy/utah-energy-and-mineral-statistics/#toggle-id-5 [https://perma.cc/V2V3-4DLD] (last updated Nov. 8, 2019) (select "Chapter 5: Electricity;" scroll down to "5.8;" then select "pdf file" hyperlink); AFCEC CASE STUDY, *supra* note 313, at 5.

315 Each engine generates a different megawatt return from the LFG combusted through the system, and the output varies within 1/10th of a megawatt year-round. *See Biomass, Wind, and Other Power Plants in Utah*, *supra* note 314.

316 AFCEC CASE STUDY, *supra* note 313, at 5.

317 *Id.* For more information about the ESPC system, see generally Office of Energy Efficiency & Renewable Energy, *Energy Savings Performance Contracts for Federal Agencies*, DEP'T OF ENERGY, https://www.energy.gov/eere/femp/energy-savings-performance-contracts-federal-agencies [https://perma.cc/6MRW-ZT5V] (last visited Nov. 9, 2021).

318 AFCEC CASE STUDY, *supra* note 313, at 5.

319 *Id.*

320 *Id.*

321 *Id.*

of its energy supply by providing a source of energy that can be drawn from even if the local power grid experiences a service disruption or impacts from a natural disaster.[322]

From a cost-benefit perspective, the Hill AFB LFG project demonstrates that LFG projects can be successfully funded through several different financing mechanisms while still ensuring the base population, and the installation as a whole, can benefit from the RE generated from the LFG electricity systems. However, from a regulatory burden perspective, Hill AFB is both the generator of the LFG-based energy supply and the permitted entity with the state of Utah.[323] Because of this distinction, Hill AFB is required to comply with a multitude of CAA requirements, including applicable New Source Performance Standards, RICE NESHAP obligations, and Title V permitting requirements as a major source of air pollution.[324] To Hill AFB, the regulatory burden associated with this project *may* be worth the benefits reaped from the project. However, undertaking such an endeavor may prove much more challenging at other localities with more resistant state and local regulators and in areas where the air quality is considerably impaired.[325]

3. Case Study Takeaways

The DoD's previous LFG energy endeavors demonstrate the importance of flexibility and open-minded siting when developing LFG energy projects. Though each of these projects vary in size and scope, there are several shared traits these projects have in common. First, in each of the above-described examples, the DoD took a cooperative approach to developing these energy projects by coordinating efforts with local municipalities or third-party businesses. In developing energy generation and distribution for on-base energy needs, these projects demonstrated the necessity for cooperation and

322 *Id.*

323 The most recent modification to Hill AFB's Title V Operating Permit for its LFG energy facility was approved in 2017. *See generally* Utah Air Quality Board, *Title V Operating Permit*, UTAH DEP'T OF ENV'T QUALITY, http://eqedocs.utah.gov/ [https://perma.cc/3BK7-C97J] (input "DAQ" under "Division" search tab; input "Operating Permits" under "Program" tab; input "Hill Air Force Base-Main Base" under "Facility Name" tab; then select "Search Now" hyperlink; then scroll to "Doc #" "DAQ-2017-014781;" then select "View" hyperlink).

324 *Id.* at 32.

325 Davis County was designated as an ozone attainment area in 1997, which makes the regulatory burden under the CAA slightly less onerous for permitted entities. *See Air Pollutants*, UTAH DEP'T OF ENV'T QUALITY, https://deq.utah.gov/air-quality/air-pollutants [https://perma.cc/T2BP-M27Z] (last updated July 12, 2019, 8:00 AM).

utilization of both local stakeholders and industrial expertise to effectively plan and implement LFG energy projects at the local level. Furthermore, rather than attempting to utilize existing open space on each of these military installations, these DoD facilities were developed by either allowing outside parties to construct landfill systems on leased DoD lands like MCASM,[326] or by working with outside business and municipal actors to either generate on, or distribute energy to, the installation from a landfill off the installation.

Finally, when communities were weighing how to meet their regulatory obligations, LFG energy was viewed as a solution to eliminating potent methane gases, rather than simply flaring the methane as a useless byproduct of waste decomposition.[327] Given the lessons learned from these past projects, LFG energy projects can absolutely be effective in the military setting. The Air Force likely has the necessary information to successfully develop additional LFG systems provided some important policy decisions and project approval processes are implemented going forward.

IV
ADDITIONAL CONSIDERATIONS AND RECOMMENDATIONS

Given the regulatory and technological limitations of implementing LFG energy, as well as utilizing the lessons learned from previous DoD LFG initiatives, LFG energy systems appear to be a beneficial means of working toward the Air Force's existing and future RE energy goals. However, to capitalize on this source of RE, the Air Force will likely need to take additional steps to begin the LFG project development process on its existing military installations. This section provides a final series of recommendations on how best to proceed with LFG energy projects going forward.

Subsection A will first analyze the various methods by which the Air Force could invest in LFG energy systems and provide recommendations for the best course of action after considering cost, regulatory burden, and siting compatibility. Subsection B will then briefly consider the Air Force's energy contracting policies and provide input on how to ensure future energy contracts could best incorporate LFG energy into the

326 AICUZ STUDY 2020, *supra* note 262, at 5-6; *Miramar Landfill Data*, *supra* note 255.

327 At JBER for example, flaring the LFG would have cost the city over $60,000 per year without any energy savings or electricity generation. LFG UTILIZATION AWARD SUBMISSION, *supra* note 283, at 2–3.

installations' energy procurement process. Finally, Subsection C concludes with a brief description of additional steps the Air Force can take immediately to ensure the agency is working toward incorporating LFG energy into its existing energy infrastructure.

A. Future Siting Considerations

In increasing its reliance on LFG energy technology, the first decision the Air Force will have to make is where and how to site LFG energy systems on existing installations. After considering the previous examples of successful LFG projects and the regulatory burden associated with developing LFG energy systems, this Article argues that the Air Force should implement a three-step process for developing and expanding LFG energy recovery projects. First, the Air Force should reevaluate its existing landfills to determine if any active or recently closed landfills are capable of being retrofitted for LFG energy recovery technology.[328] Second, once the Air Force has tapped into the potential of any suitable existing landfills on Air Force lands,[329] the agency should next look *beyond* the fence for opportunities to use or generate LFG energy for its operational needs. Finally, and after exhausting all other available avenues for exploring LFG energy recovery, the Air Force should look *within* the fence line for opportunities to develop LFG projects.

Before planning a significant construction project, the Air Force needs to first assess its current landfill inventory for usability. Although a previous study found only seven Air Force landfill sites suitable for installing a microturbine unit,[330] the Air Force had at the time over 250 landfill sites with available data for review.[331] With this information, we can identify two separate opportunities for the Air Force to capitalize on. First, the Air Force should work to take immediate steps to make LFG recovery possible at the remaining sites that were found suitable, but undeveloped, for microturbine LFG recovery.[332] Second, the remaining landfill sites that were not found suitable for microturbine LFG recovery should be re-evaluated to determine if any recent technological developments or improvements would make LFG energy extraction currently feasible through an

328 *See generally* SRI LANDFILL REPORT, *supra* note 131.

329 *Id.*

330 *Id.* at 11.

331 *Id.* at 6–7.

332 At the time of the initial SRI study, the landfills were specifically evaluated to determine if they could be retrofitted with microturbine energy recovery systems. *Id.* at 1.

alternative power recovery source.[333] With every passing year, these landfills are likely to have less usable methane gas for energy recovery, which could result in wasted energy potential.[334]

Once the Air Force has identified all existing landfills capable of being retrofitted for LFG energy recovery, the agency should move to the second phase of its analysis by identifying siting opportunities beyond the fence line. While it may initially appear counterintuitive to first identify possible energy sources outside the installation, focusing on development beyond the fence line provides multiple benefits toward meeting the Air Force's energy needs. First, while there is unlikely a scenario where the Air Force could avoid *all* environmental compliance requirements,[335] shifting the development of LFG energy projects to existing outside sources would significantly ease the regulatory burden on the Air Force's proposed construction.[336] Seeking LFG recovery systems off or near military installations also reduces the likelihood that the Air Force will become a permittee under a state-administered CAA licensing program.[337] As demonstrated by the LFG recovery systems in use at MCLBA and JBER, the military can be a beneficiary of the LFG energy project without being specifically subjected to environmental permitting requirements at the state level.[338]

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333 The SRI report was published in June of 2011, which increases the likelihood that newer, more efficient LFG energy recovery systems have been developed in the intervening time period. *See generally id.*

334 The EPA estimates methane gas is generated within a landfill for up to thirty years after the waste has been landfilled. *See* LFG HANDBOOK, *supra* note 111, at 1-2.

335 If the Air Force coordinates or assists in project development and construction, even if accomplished off military property, CAA and NEPA requirements would likely be triggered. *See* LFG HANDBOOK, *supra* note 111, at 5-9 to -11. For information on CAA state planning requirements, see 42 U.S.C.A. § 7410 (West, Westlaw through Pub. L. No. 117-51). For information on CAA permitting programs, see *id.* §§ 7470–7504. For information about what type of federal action would trigger NEPA review, see Connolly, *supra* note 151, at 18 (citing 40 C.F.R. § 1508.18 (2002)).

336 Though the CAA would still impose regulatory obligations through NESHAPs and requirements specific to whether the particular site is meeting the existing NAAQS for any criteria pollutants that would be produced by the LFG process, this burden pales in comparison to the requirements of developing a new landfill. For information about existing NESHAPs and NAAQS requirements, see generally 40 C.F.R. §§ 63.7480–63.7575 (2021); 40 C.F.R. §§ 63.11193–63.11237 (2021); 40 C.F.R. §§ 63.6580–63.6675 (2021); LFG HANDBOOK, *supra* note 111, at 5-9. For information about NSPS requirements for new landfill construction, see generally Trisolini, *supra* note 101, at 149; LFG HANDBOOK, *supra* note 111, at 5-9.

337 For information on CAA permitting programs, see 42 U.S.C.A. §§ 7470–7504.

338 Dougherty County specifically holds permitting requirements for the MCLBA facility. *See Georgia Air Permit Search Engine*, *supra* note 278. Doyon Utilities, LLC, is

Finally, because 10 U.S.C. § 2911(g) allows for the production *or* procurement of RE sources in order to satisfy the twenty-five percent by 2025 requirements in the statute,[339] the Air Force would still be moving toward compliance with this statutory program even if it procured LFG energy from a non-DoD source in order to meet its existing energy needs.

In contrast to focusing on off-base LFG energy project development, the Air Force could also consider developing new landfill projects within the fence line that would be capable of extracting LFG energy. Constructing an LFG system on a number of installations is likely geographically feasible if the Air Force has a considerable amount of land it could set aside for future landfills within an installation.[340] Creating an enclosed LFG recovery system that stores its energy-generating waste and the systems that extract the LFG would also be beneficial to the Air Force for energy resilience purposes.[341] As one of the Air Force's three strategic energy goals for the future,[342] establishing an energy supply that is consistent so long as gas is being generated and collected, while also protected from outside vulnerabilities or disruptions, would be a significant step in meeting these resilient energy goals. Finally, because the Air Force can work with the FAA to determine landfill safety on its own installations, regulations designed to limit or affect landfill construction near an active runway would likely have minimal to no impact on planned Air Force LFG energy development.[343]

Despite these anticipated benefits, the regulatory burden on the Air Force in building new landfills with corresponding LFG energy

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responsible for the permitting requirements for the JBER facility. *See generally* Kuterbach, *supra* note 304.

339 10 U.S.C.A. § 2911(g) (West, Westlaw through Pub. L. No. 117-51).

340 Indeed, many of the Air Force's installations have acreage in the hundreds of thousands in any given state. *See generally* Andy Kiersz, *Here's How Much Land Military Bases Take Up in Each State*, BUS. INSIDER (Nov. 10, 2014, 12:00 PM), https://www.businessinsider.com/how-much-land-military-bases-take-up-in-each-state-2014-11 [https://perma.cc/5SNP-8SX7].

341 The Air Force defines resilience as "the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from energy disruptions." ENERGY FLIGHT PLAN, *supra* note 5, at 6 (citing Exec. Order No. 13,693, 80 Fed. Reg. 15,871 (Mar. 19, 2015)).

342 *See generally id.*

343 *See* Structures Interfering with Air Commerce or National Security, 49 U.S.C.A. § 44718 (West, Westlaw through Pub. L. No. 117-51). However, the Air Force would still have to comply with other compatible use requirements, such as those in place at MCASM. *See 2020 AICUZ Footprint*, *supra* note 261.

systems on existing installations is likely too onerous to make financially and operationally feasible. In stark contrast to retrofitting an existing landfill for LFG recovery, constructing a new landfill capable of capturing LFG for energy would require compliance with the applicable state's RCRA program for municipal landfill construction and permitting.[344]

Creating a new landfill would also greatly expand the regulatory burden under the CAA.[345] At the very least, a newly constructed facility would need to comply with the NSPS for the landfill itself,[346] comply with the particular NESHAP requirements applicable to the equipment used to engage in LFG energy recovery,[347] and obtain permission from the state's permitting entity to proceed with construction after evaluating the project's effect on the region's air quality status.[348] In addition, if the installation is in an area of ozone nonattainment,[349] the regulatory burden will likely be even more restrictive and subject to additional requirements at the state permitting level.[350] Further complicating this process is the fact that the Air Force has operations across North America in a variety of urban and rural areas,[351] which would likely cause the possible regulatory burden from site to site to vary dramatically.

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344 For new landfill RCRA requirements, see *MSWLF Webpage*, *supra* note 158; Turner, *supra* note 159, at 4; 40 C.F.R. §§ 258.1–258.75 (2021).

345 Clean Air Act, 42 U.S.C.A. §§ 7401–7671q (West, Westlaw through Pub. L. No. 117-51).

346 Trisolini, *supra* note 101, at 149; LFG HANDBOOK, *supra* note 111, at 5-8 to -9.

347 *See generally* 40 C.F.R. §§ 63.7480–63.7575 (2021); 40 C.F.R. §§ 63.11193–63.11237 (2021); 40 C.F.R. §§ 63.6580–63.6675 (2021); LFG HANDBOOK, *supra* note 111, at 5-9.

348 For information on state planning, see 42 U.S.C.A. § 7410. For information on permitting programs, see *id.* §§ 7470–7504.

349 For more information on how the EPA categories ozone nonattainment for CAA purposes, see *Nonattainment Areas for Criteria Pollutants (Green Book)*, EPA, https://www.epa.gov/green-book [https://perma.cc/B9CZ-XS2Q] (last updated Mar. 31, 2020); *see also* LFG HANDBOOK, *supra* note 111, at 5-10; 42 U.S.C.A. §§ 7501–7504 (West, Westlaw through Pub. L. No. 117-51).

350 For example, if a source is subject to nonattainment standards, the state regulatory body has the authority to impose technology requirements, specific emissions rates, offsetting requirements and other means of moving the area toward compliance with NAAQS. *See* 42 U.S.C.A. § 7503; LFG HANDBOOK, *supra* note 111, at 5-10 to -11.

351 For a current list of active Air Force bases in North America, see *Locations*, *supra* note 95.

Given the significant regulatory burden imposed under the CAA,[352] the Air Force, as an institution, will have to weigh the benefits derived from LFG energy generation against the costs of regulatory compliance. Because the Air Force has fiscal constraints that affect when and how it spends agency funds, and because compliance with the CAA's burdensome regulatory requirements would be extremely costly in the aggregate,[353] the Air Force needs to critically evaluate where to site and build future LFG energy projects.

Finally, because a newly constructed landfill with an associated LFG energy facility created on the installation would almost certainly amount to a "major federal action,"[354] NEPA review requirements would likely attach to the proposed project.[355] Although NEPA requirements are site specific,[356] the construction of a large landfill capable of generating methane gas for several decades is likely to require an EIS,[357] which is, as of this writing,[358] a time-consuming process.[359]

Regardless of which approach to implementing LFG energy the Air Force takes, there is likely no scenario where a future project outside the fence line with local cities and municipalities avoids regulation entirely. If the Air Force contracts to receive LFG energy from an outside source, it would likely still be required to develop power lines or gas pipelines to transmit the gas to the military installation, which the EPA has specifically noted could separately trigger, at a minimum, the requirements of the Historic Preservation Act of 1966 or the

352 Clean Air Act, 42 U.S.C.A. §§ 7401–7671q (West, Westlaw through Pub. L. No. 117-51).

353 *Id.*

354 Major federal action has been broadly defined when applied to proposed projects. *See* Connolly, *supra* note 151, at 18 (citing 40 C.F.R. § 1508.18 (2002)).

355 *Id.*

356 NEPA requires some form of environmental review for every "recommendation or report on proposals for legislation and other major federal actions." 42 U.S.C.A. § 4332(c) (West, Westlaw through Pub. L. No. 117-51).

357 An EIS is required whenever the agency determines "a categorical exception, FONSI, or mitigated FONSI are not applicable, or an EA concludes that an EIS is required." Rushovich, *supra* note 234, at 334 (citing 40 C.F.R. § 1501.4 (2005)).

358 As stated previously, the extent of a large-scale NEPA analysis is still in flux after the recent change in presidential administrations. *See CEQ Proposes to Restore Basic Community Safeguards During Federal Environmental Reviews*, *supra* note 244.

359 These documents are known for consisting of thousands of pages and taking "several years to finalize." *See* Helen Leanne Serassio, *Legislative and Executive Efforts to Modernize NEPA and Create Efficiencies in Environmental Review*, 45 TEX. ENV'T L.J. 317, 320 (2015).

Endangered Species Act.[360] Furthermore, the very act of contracting with an outside organization or municipality could still subject the project to *some* form of NEPA review as a proposed major federal action.[361]

However, given the regulatory hurdles of building a new facility from the ground up, any decision to develop an LFG project on an existing Air Force installation would require significant environmental compliance, would likely take years to become fully operational,[362] and would require host installations to incur considerable costs. It is likely because of these logistical and regulatory hurdles that the DoD has never independently developed an LFG energy project on its own land to meet installation energy needs and has instead leased land to the local community to develop LFG energy projects, similar to the approach taken at MCASM,[363] or partnered with nearby local communities to obtain LFG energy from an off-base landfill source.[364]

B. LFG Energy Integration into Future Energy Contracts

Because the path to utilizing LFG energy systems will likely be overly burdensome for the Air Force if it attempts to construct and install new landfill facilities on existing installations, the Air Force will need a method for determining how best to enter into energy contracts with municipalities and/or private sector organizations to meets its future energy needs. But how the Air Force evaluates and selects these energy contracts could have significant effects on *which* energy sources are utilized to ensure military installations are sufficiently powered. Therefore, in order for the Air Force to fully utilize LFG energy technology moving forward, additional attention needs to be given to contracting mechanisms that would allow for more innovative energy sources such as RE and LFG energy to be developed.

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360 LFG HANDBOOK, *supra* note 111, at 5-13; *see generally* Historic Preservation Act of 1966, 54 U.S.C.A. §§ 300101–320303 (West, Westlaw through Pub. L. No. 117-51); Endangered Species Act, 16 U.S.C.A. §§ 1531-1544 (West, Westlaw through Pub. L. No. 117-51).

361 The term "major federal action" has been given broad application and can affect any action "undertaken, funded, or even authorized by the federal government." Connolly, *supra* note 151, at 18 (citing 40 C.F.R. § 1508.18 (2002)).

362 The NEPA process could set the project back years before shovels ever touch the ground to begin construction. *See* Serassio, *supra* note 359, at 320.

363 *See* 2020 AICUZ FOOTPRINT, *supra* note 262, at 5-6.

364 For real-world examples of this LFG energy recovery method, see Public Affairs MCLB Albany, *supra* note 272; *Anchorage LFG Project*, *supra* note 283.

1. Energy Contracting Options

Although the Air Force is constrained in how it can approve energy contracts, there are several available options at the agency's disposal for source selection. The Air Force has previously relied on PPAs to meet its energy contracting needs.[365] Under a PPA, the Air Force enters into an agreement or contract to purchase RE by allowing a "'developer to build, own, operate, and maintain a renewable generation system[] on, or near, a customer's property' [before] then sell[ing] the power to that customer."[366] These contracts can be negotiated to up to thirty years in duration.[367]

Another source selection option is to utilize an ESPC.[368] These types of contracts allow the federal government to partner with an Energy Service Company (ESCO) to identify methods of saving energy and construct energy projects that will meet the agency's needs.[369] In a stand-alone ESPC, the ESCO typically receives payment from one of the Department of Energy's funding mechanisms, which is then repaid through the energy cost savings generated from the project "over the term of the contract."[370] Under current law, these contracts are authorized for terms of up to twenty-five years.[371] Once the contract ends, the agency benefits by accruing all cost savings thereafter.[372]

Finally, the Air Force has recently shown interest in a new energy contracting model referred to as "Energy-as-a-Service (EaaS)."[373] Under this approach, the Air Force contracts with a single provider that would be "responsible for optimizing the integration of the

365 For a list of RE projects that have previously relied on PPA mechanisms, see generally AEMRR, *supra* note 9, at 40.

366 Tommey, *supra* note 6, at 627 (citing Kevin McAllister, BARRIER TO MILITARY INSTALLATIONS UTILIZING DISTRIBUTED GENERATION FROM RENEWABLE ENERGY RESOURCES: THIRD PARTY POWER PURCHASE AGREEMENTS 2 (2011)).

367 Scholtes, *supra* note 63, at 78 (citing 10 U.S.C. § 2922a (2012)).

368 Office of Energy Efficiency & Renewable Energy, *About Federal Energy Savings Performance Contracts*, DEP'T OF ENERGY, https://www.energy.gov/eere/femp/about-federal-energy-savings-performance-contracts [https://perma.cc/PU4M-475G] (last visited Nov. 9, 2021) [hereinafter *ESPC Program*].

369 *Id.*

370 *Id.*

371 Scholtes, *supra* note 63, at 78 (citing Energy Policy Act of 1992, 42 U.S.C. § 8287(a)(1) (2010)).

372 *ESPC Program*, *supra* note 368.

373 *See generally* OFF. OF THE DEPUTY ASSISTANT SEC'Y FOR ENV'T, SAFETY, AND INFRASTRUCTURE, ENERGY-AS-A-SERVICE (Jul. 2021), https://www.safie.hq.af.mil/Portals/78/documents/IEE/Energy/EaaS_2021%20DAF%20fact%20sheet_final.pdf?ver=MrlKqQIKI6GKPpl9B-nTnw%3d%3d [https://perma.cc/6VUF-KJX8] [hereinafter EAAS FACT SHEET].

energy delivery chain . . . , which covers commercial energy supply procurement, distribution, onsite generation, and load management."[374] According to the Air Force, the EaaS program is designed to "deliver reliable and resilient energy to installation mission owners more cost effectively than is done through current DAF energy management and procurement approaches."[375]

2. Flaws in the EaaS Contracting Approach

Any of the previously discussed approaches to contracting may offer an opportunity for the Air Force to contract with third parties to meet its existing energy needs. However, additional consideration should be given to RE development and specifically to LFG energy capabilities before these types of agreements are signed in the future. Of the three contracting options discussed, EaaS in its current limited state may present added difficulty, rather than additional benefits, in moving toward initiatives to promote and increase RE use and LFG-based systems.

The first potential problem with the EaaS system is that the source of energy generated is tied to the limitations of the utility ultimately selected under the EaaS contract.[376] Dissimilar to a mix of energy systems that could be separately developed and constructed with the assistance of and in coordination with municipalities and outside business interests, EaaS is instead focused on a single utility contract where the EaaS provider would be "responsible for optimizing the integration of the energy delivery chain."[377] This is not to say that an EaaS contractor would never be capable of implementing RE and LFG-based energy systems. However, if the provider simply lacks the ability to incorporate RE technology into its existing energy system, the Air Force would be locked into a long-term contract without the ability to make independent assessments regarding the implementation of this form of RE development.[378]

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374 *Id.* at 1.

375 *Id.*

376 The Air Force notes the EaaS program is intended to align its energy procurement needs under a single utilities contract. *Id.*

377 *Id.*

378 This hypothetical example is reinforced by the outcome of the EaaS pilot project at Altus AFB, where the project was ultimately canceled in May 2021 after the Air Force evaluated a technical and pricing proposal from Western Farmer's Electric Cooperative. *See id.* at 2.

Furthermore, if the EaaS provider has an incentive in the contract to reduce costs as a means of increasing profits, it is possible the provider would choose to invest in energy systems that would be cheaper to develop at scale rather than innovative RE programs such as LFG energy technology that may have a significant start-up cost.[379] Therefore, for the EaaS program to be successful, these contracts should include provisions or contingencies that require a certain percentage of investment into RE as part of the energy investment strategy for a particular installation.

Finally, the EaaS model arguably shifts the focus away from innovative and collaborative projects between the Air Force, the local community, and private business in exchange for streamlined contracts with a single provider in hopes of receiving upfront cost savings. Previously, the Air Force and the DoD as a whole used PPAs and ESPCs to better structure how RE projects, to include LFG energy systems, were developed and paid for over the life of the contract.[380] Recognizing these systems have significant start-up costs, ESPCs and PPAs could continue to be used to ensure RE projects are developed and eventually paid for in a way that benefits the Air Force and its energy partners.[381] If the Air Force shifts to an EaaS model, however, this innovative and collaborative process could be lost if the EaaS provider primarily focuses on cost savings rather than finding ways to develop RE capabilities for the installation. Such a shift in focus could also have significant effectss on the viability of future LFG energy projects with local municipalities because the Air Force would no longer be capable of coordinating and contracting directly with municipalities or counties to obtain energy from nearby landfills.[382]

In the end, EaaS may be a very effective means of reducing costs and improving electrical generation capabilities. As it stands, however, the program may end up limiting Air Force initiatives to increase its RE development if the concerns raised above are not adequately addressed prior to entering into long-term EaaS contracts with providers. Therefore, for the EaaS program to be successful, the Air

379 The Air Force's EaaS fact sheet places the focus on cost effective "reliable and resilient energy," but does not specifically indicate an increased desire to develop RE systems at or near Air Force installations. *See id.* at 1.

380 For example, Hill AFB utilized both a PPA and ESPC contract to secure its LFG energy project. *See* AFCEC CASE STUDY, *supra* note 313, at 5.

381 Hill AFB's LFG contracts were so successful, the Air Force was able to reduce the payback period for these contracts from 17.8 years to 7.26 years. *Id.*

382 In all four of the case studies analyzed above, local involvement was critical toward developing each of these LFG projects. *See supra* Part III.C.

Force must focus not only on cost-effectiveness but also on the need to use all available technologies to best meet its 10 U.S.C. § 2911 RE mandate.[383]

C. Final Recommendations

LFG energy is a beneficial, yet underutilized, form of RE that the Air Force could significantly benefit from in the coming years. Although the Air Force has failed to capitalize on LFG energy systems in previous years,[384] it is not too late to shift the agency's focus toward increasing LFG energy production and consumption on existing military installations. This section addresses final recommendations that the Air Force could benefit from implementing to ensure LFG energy systems are used to the maximum extent possible.

The first action the Air Force could take is to specifically endorse LFG energy projects as a significant policy focus for the next several years. Although the EFP states the Air Force is interested in RE development,[385] more emphasis needs to be placed on the types of RE the Air Force intends to invest in. At present, the Air Force indicates it is researching and preparing "Installation Energy Plans" for at least 23 installations within the continental United States.[386] This presents the agency with a marked opportunity to research and potentially prioritize the development of LFG energy systems as part of the energy initiatives being assessed on several existing installations.[387]

Next, the Air Force should complete another survey of its landfill inventory to determine how many systems based on LFG energy can be converted to generate power. Although the 2011 SRI Landfill Report provided valuable information to the DoD about the viability of existing landfills for LFG energy recovery,[388] a new DoD or Air Force-specific study would be beneficial given the changes in technology that

383 *See generally* 10 U.S.C.A. § 2911(g) (West, Westlaw through Pub. L. No. 117-51).

384 As stated previously, the Air Force's three projects absolutely pale in comparison to the 564 operational energy projects throughout the United States as of March 2020. *See generally* LMOP Basics, *supra* note 101.

385 *See generally* ENERGY FLIGHT PLAN, *supra* note 5.

386 For details concerning the Air Force's energy planning initiatives, see *Planning Projects*, AIR FORCE OFF. OF ENERGY ASSURANCE: PROJECTS AND ENGAGEMENTS, https://afgeobase.maps.arcgis.com/apps/MapSeries/index.html?appid=36e638c63ed3415b8c24498b5ef72475 [https://perma.cc/VK4D-U96V] (last visited Nov. 9, 2021) (follow "Planning Projects" hyperlink).

387 *Id.*

388 *See generally* SRI LANDFILL REPORT, *supra* note 131.

may have occurred since then and the fact that landfill conditions and methane output have likely changed over the last nine years.[389] More importantly, because the regulatory burden of developing LFG energy systems within the fence line will create significant hurdles to project development,[390] any new studies should instead focus on the viability of landfills *outside* the installations' fence lines to determine which communities have the best landfill conditions to warrant an LFG project partnership between local governments and the Air Force.

Finally, recognizing that LFG energy is simply a part of the solution rather than the *entire* solution to meeting the Air Force's RE mandate of twenty-five percent by 2025,[391] the Air Force should find ways to combine or incorporate LFG technology with other sources of RE on existing installations. Although landfills must eventually be closed, future landfill siting can account for closure through what has been described as "mixed-use redevelopment," whereby the land where the landfill was built can later be used to site additional RE generation through energy systems such as solar or wind arrays.[392] In situations where the Air Force has landfills that no longer produce methane, mixed-use redevelopment would allow the Air Force to reutilize this land in a way that continues to meet RE energy goals. Furthermore, in situations where the Air Force contemplates constructing new landfills, LFG energy and other RE energy sources can be incorporated into the planning phase of the project to ensure the landfill is a long-term source of RE well after the landfill closes. Regardless of how the Air Force chooses to site LFG energy projects moving forward, consideration should be given to how best to maximize these projects in relation to other sources of RE in order to meet current and future energy needs for decades to come.

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389 Landfills are expected to generate usable methane for approximately twenty to thirty years only, making it likely that a nine-year gap in use would impact the viability of many of these existing sites. *See* LFG HANDBOOK, *supra* note 111, at 1-2.

390 *See generally supra* Part III.

391 In all four cases reviewed previously, none of the installations were able to meet all their existing energy needs through LFG energy alone. *See supra* Part III.C. The "25% by 2025" RE energy mandate is codified in the U.S. Code. *See* 10 U.S.C.A. § 2911(g) (West, Westlaw through Pub. L. No. 117-51).

392 The Navy has contemplated using this type of mixed-use redevelopment for previously closed landfills. *See* NAVAL FACILITIES ENG'G COMMAND, SUSTAINABLE LONG-TERM MANAGEMENT OF LANDFILLS UNDER THE NAVY'S ENVIRONMENTAL RESTORATION PROGRAM (Apr. 2016), https://www.navfac.navy.mil/navfac_worldwide/specialty_centers/exwc/products_and_services/ev/erb/ltm.html [https://perma.cc/6SJT-5F4V] (scroll to and select "Publications;" follow "Sustainable Long-Term Management of Landfills under the Navy's Environmental Restoration Program (April 2016)" hyperlink).

CONCLUSION

Moving into the new decade, the Air Force has a policy interest and statutory mandate to ensure its energy generation and consumption becomes more focused on RE capabilities.[393] While the Air Force has several options at its disposal for accomplishing this mandate, to include solar, wind, and geothermal RE sources, LFG energy is an underutilized and extremely beneficial RE source the Air Force should invest in to meet its RE generation and consumption needs.

This is not to say that LFG energy comes without its hurdles or limitations. Indeed, as has been discussed previously, LFG energy requires the use of landfills and a source of combustion to obtain the energy from methane gases stored underground, which comes with a host of regulatory issues.[394] Furthermore, moving toward the development and construction of LFG energy systems would likely be costly, taxing on a regulatory level, and time-consuming. Yet despite these difficulties, the Air Force and other DoD components have proven that LFG energy is not only viable within the DoD but can also generate beneficial outcomes and reliable sources of RE for all parties involved.[395]

Given these benefits, the Air Force will need to shift some of its RE priorities and energy contracting endeavors to ensure LFG energy can be suitably developed and incorporated into existing installation energy plans. In addition, regardless of which approach the Air Force ultimately takes in attempting to expand its LFG portfolio, a keen awareness to regulatory and statutory compliance will need to be considered given the technical complexity of landfill construction, management, and energy generation from LFG. However, given the possible benefits and the fact that these gases will likely be produced regardless of the use of LFG technology,[396] the Air Force has an opportunity to capitalize on the usefulness of LFG technology if it chooses to do so.

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393 *See* 10 U.S.C.A. § 2911(g).

394 *See supra* Part III.B.

395 *See supra* Part III.C.

396 The decomposition of waste in landfills results in "approximately 50 percent methane and 50 percent carbon dioxide, mixed with a small amount of other gases." Ledford, *supra* note 99, at 551.