Aubree Derksen

Cumulative impacts definitely need to be updated to include the data center plans, especially regarding back-up generators and water. Please see the attached report on air pollution/emissions in regards to diesel generators. If the power goes out in the area the WWTF's generator will be added to whatever is happening at the data center plus DFA and Land O Lakes. Pine Island in particular will be hit very hard but air pollution impacts have a large spread.

Diesel Generators at Data Centers

Status, Impacts, and Protective Practices

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We welcome feedback, questions, and suggestions for future research and may revise this report as more information becomes available. Please reach out to us at info@betterdatacenterproject.com.

Contents

Introduction

As data center development grows at an unprecedented rate in the race to scale AI, so has their energy consumption and need for backup power. Energy consumption from data centers in the U.S. nearly tripled from 76 TWh in 2018 to ~200 TWh in 2024. Over the same period, **diesel generator capacity at data centers in the U.S. also nearly tripled from an estimated 20 GW to 55 GW.**[1] In Oregon, data centers have 6 GW in permitted and proposed diesel generators, which is double the average power usage of all the homes in the state.[2] Over 10,500 generator units have been permitted for data centers in Virginia as of the end of 2025,[3] with a total capacity of 27 GW. This capacity is equivalent to the power consumption of over 20 million U.S. homes;[4] Virginia has less than 4 million homes.

Even if used exclusively for emergency backup power, this quantity of diesel generators could create significant exposure to harmful air pollution, particularly in areas with many large data centers. But as surging data center electricity demand outpaces supply, the grid becomes increasingly stressed, and developers prioritize speed at all costs, the potential for diesel generators to be used more regularly grows. Already, federal and state policies promote diesel generators for demand response, while industry markets them for non-emergency use. This shift is particularly concerning in an era of deregulation and weakened environmental and public health protections.

This report was prepared in response to questions we've received from communities, state and local governments, and Tribes about the impacts of diesel generators and ways to limit harm. Our goal is to provide a comprehensive overview of how and why diesel generators are deployed for data centers, what the impacts can be, and some key ways to eliminate or minimize harm. We recognize that diesel generators are only one of many causes of data centers impacts—this narrow focus is not intended to de-emphasize other critical topics, including water use, energy use, bill impacts, land use, jobs, economics, and more. BDCP believes communities have a right to determine if and how data centers are developed and powered, and that everyone deserves clean air and water, healthy and comfortable surroundings, a sustainable local economy, and a stable climate.

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[1] These estimates are derived from the energy consumption figures in Shehabi 2024 assuming: 1) an average 50% power utilization, 2) 80% diesel market share, and 3) 50% power redundancy.
[2] https://www.oregon.gov/deq/aq/aqPermits/Pages/Data-Center-Permit.aspx
[3] As of Dec. 2025, half of all generator capacity in Virginia has been permitted since March 2023. See our analysis in the "*Virginia: Trends in diesel generators*" section for more details.
[4] Based on the average annual home energy consumption of 10,500 kWh from EIA figures.

Summary of practices to reduce harm

- ☐ **Use batteries:** deploy battery energy storage systems to eliminate or minimize diesel use. Several hours of battery capacity can serve as the backup power source for short grid disturbances, most outages, and demand response programs.
- ☐ **Alleviate grid stress:** to reduce the frequency of backup power use, invest in additive grid-scale renewable energy and storage, upgrades to aging or under-sized distribution and transmission facilities, and/or long-range transmission lines.
- ☐ **Reduce on-site backup power needs:** including through spatial load shifting, pausing or delaying workloads when needed, and/or efficiency measures.
- ☐ **If use of diesel generators is unavoidable, implement the most protective measures possible:**
  - ☐ **Require Tier 4:** use the lowest-emissions technology available.
  - ☐ **Prohibit non-emergency use:** ensure generators are operated only for true, unforeseen emergencies or required maintenance/testing, not for momentary grid disturbances, bridging power, demand response, planned outages, or primary power.
    - ☐ **Require ride-through capability:** ensure power controls which switch to backup power during momentary grid disturbances are programmed to ride-through these disturbances.
  - ☐ **Monitoring and transparency:** conduct pre-construction air quality and cumulative health impact assessments, track emissions and noise during operation, and make data publicly accessible.
  - ☐ **Site planning and mitigation:** require adequate setbacks from sensitive sites (homes, schools, etc.), enforce noise and visual screening requirements, and limit testing hours and frequency.

See "Key practices to reduce harm" section for additional details.

Why do data centers have backup power?

Large-scale data centers are designed with significant backup power so they can run continuously with minimal downtime from power outages. For example, the Uptime Institute, which sets widely used standards for data centers, says the least reliable data centers can be down for about 28 hours a year, while the most reliable ones are built to be down for only about 26 minutes a year.[5]

Data center developers have strong incentives to meet these availability targets because failing to do so can hurt profits and violate agreements with customers. Outages can cost companies over $1 million per hour. In some cases, outages can also affect critical infrastructure and services. For example, data center outages and related infrastructure failures have been linked to canceled flights and disruptions of hospital emergency services.

Backup power needs could in principle be lower for some AI data centers because of the higher flexibility of AI model training, which can be scheduled during off-peak hours, delayed during peak power demand, and relocated to areas with less grid stress. However, this "load shifting" can only be applied in certain circumstances and most large facilities continue to maintain extensive on-site backup power.

Why are diesel generators so ubiquitous?

Diesel generators are by far the most common source of backup power for data centers: some reports estimate a market share of 80%, while our analysis of permits in Virginia shows 99% of backup capacity is diesel. Diesel generators are employed so consistently that Business Insider used associated air permits to identify and map data centers in the US.

Data center operators favor diesel generators for backup power because they:

- Are reliable and can start quickly (within 10 seconds)
- Are powered by diesel fuel, which has a higher energy density than natural gas, so they can run for up to 96 hours using fuel stored on-site with no reliance on pipelines
- Have relatively low capital and operating costs for their size, runtime, and reliability

[5] Higher tiers are needed for critical infrastructure. Tier I data centers must achieve >99.671% uptime, while Tier IV requires >99.995% uptime.

- Are widely available, standardized, and well-understood, requiring minimal custom engineering
- Are quick to procure and install
- Align with existing regulations and guidelines, such as NFPA 110 and Uptime Institute which both have requirements for 12+ hrs of fuel storage on-site

While diesel dominates the market, there have been limited applications of natural gas generators. For example, a site in Remington, VA has 58 MW of natural gas generators, and a site in Cheyenne, WY has 120 MW of natural gas generators and 130 MW of diesel.[6]

What are typical diesel generator setups for data centers?

The number and size of generators will vary with the data center. **Large data centers can have hundreds of 2–4 MW diesel generators—each roughly the size of a train car—at a single site.** A typical site layout is shown in Figure 1.

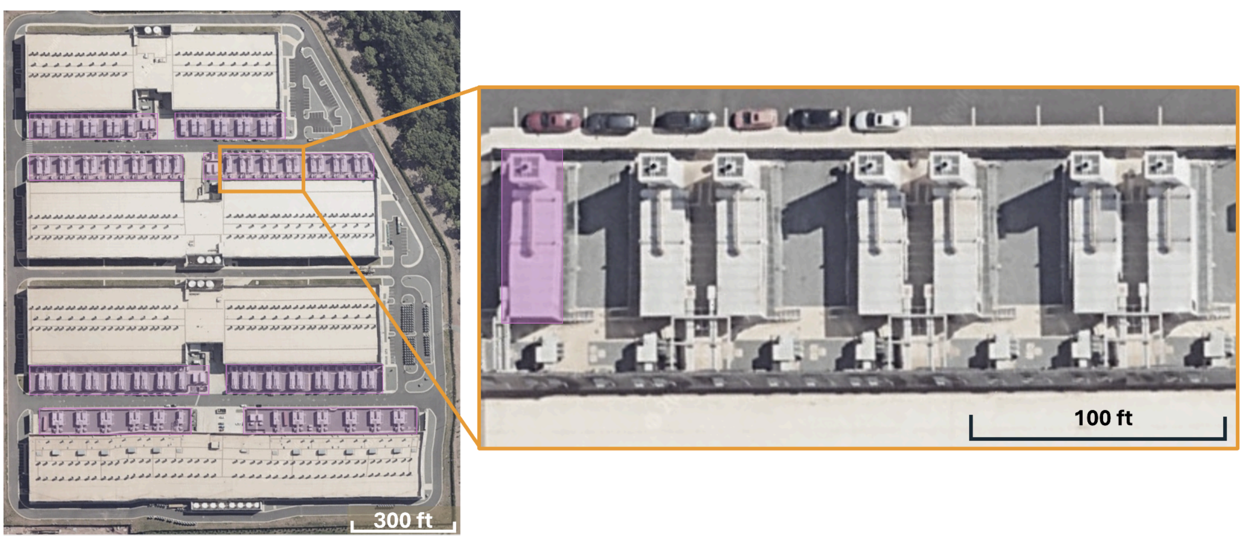

Figure 1. Satellite imagery of diesel generators and data center site layout
(Left) Satellite image of the Amazon data center at 10321 Tanner Way, Manassas, VA. This site has 93 Caterpillar 3516C-HD generators, each with a standby capacity of 2.5 MW. Purple highlights indicate where the generators are located. (Right) Detail showing seven generator units (in full enclosures) with one unit highlighted in purple. Source: Google Earth, 8/19/2023.

[6] Facility F025213, permit P0027701. Forty Jenbacher J620 (3 MW) natural gas generators are permitted.

Data centers typically install more generator capacity than their maximum power demand, so they can continue operating even if some generators are out of service. As a result, a data center with a peak electricity demand of 100 MW may install 120–200 MW of diesel generator capacity.[7] One campus in Loudoun county, VA with an estimated maximum grid load of ~360MW[8] has 245 generators with a total capacity of 715 MW.

Generators are classified by the U.S. Environmental Protection Agency (EPA) emissions tiers, with Tier 2 and Tier 4 relevant for data center use (see Table 1):

- **Tier 2:** Older EPA emissions standard that applies to emergency generators in most states. Allows higher levels of air pollutants. The emissions from Tier 2 generators are controlled by engine design[9] with no exhaust aftertreatment.
- **Tier 4:** The strictest existing EPA standard. Tier 4 systems reduce emissions of nitrogen oxides (NOx), particulate matter (PM), and CO by up to 90% from Tier 2 using advanced exhaust controls like catalysts and filters.[10]

Currently, the vast majority of installed backup generators at data centers in the U.S. are Tier 2.[11] However, some states and localities have begun to require or incentivize use of Tier 4 generators:

- Oregon's Department of Environmental Quality is incentivizing Tier 4 and/or Tier 2 + SCR[12] generators at data centers by streamlining permitting and decreasing processing timelines.
- Washington state's Department of Ecology has a draft "Data Center General Order" which would require Tier 4 generators.
- Virginia has a proposed requirement (pending governor approval) for Tier 4 generators for any data center air quality permit submitted after June 30, 2026.

Data suggest that some developers are increasing Tier 4 use, possibly in anticipation of future requirements: our analysis of VA permits (inset below) shows that the

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[7] *How Business Insider investigated the true cost of data centers*. June 17, 2025. Business Insider.

[8] This site is built to a 2N UPS redundancy according to Digital Realty, meaning the backup power system is built with two independent sides each capable of supplying the maximum grid load.

[9] E.g. optimizing fuel injection to reduce incomplete combustion (which forms CO and PM) and exhaust after-cooling to reduce NOx formation (which is formed at high temperatures)

[10] Tier 2 generators can also be retrofitted with SCR and/or DPF (see Terms and definitions). Often, retrofitted systems will only meet the Tier 4 standards for NOx emissions, and not the PM limits.

[11] See: https://jlarc.virginia.gov/pdfs/reports/Rpt598.pdf. By our analysis of VA permit data, 80–85% of installed generator capacity is Tier 2 as of the end of 2025, based on a 1–2 year construction timeline from permit issuance. However, the share of Tier 2 is decreasing, and 73% of permitted capacity in VA is Tier 2.

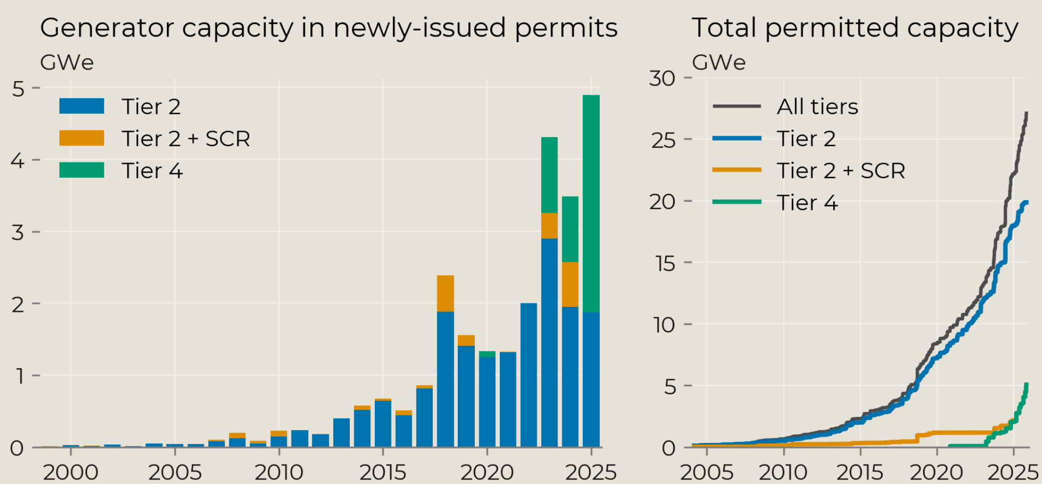
[12] Selective Catalytic Reduction (SCR) is a form of NOx emissions control that uses a catalyst and a reductant (such as urea) to convert nitrogen oxides into N_2, H_2O, and CO_2. SCR typically reduces NOx emissions by ~90%.

number of Tier 4 generator permits has been increasing significantly in the last 3 years, with 2025 being the first year when more than half of newly-permitted capacity was Tier 4.

Virginia: Trends in diesel generators

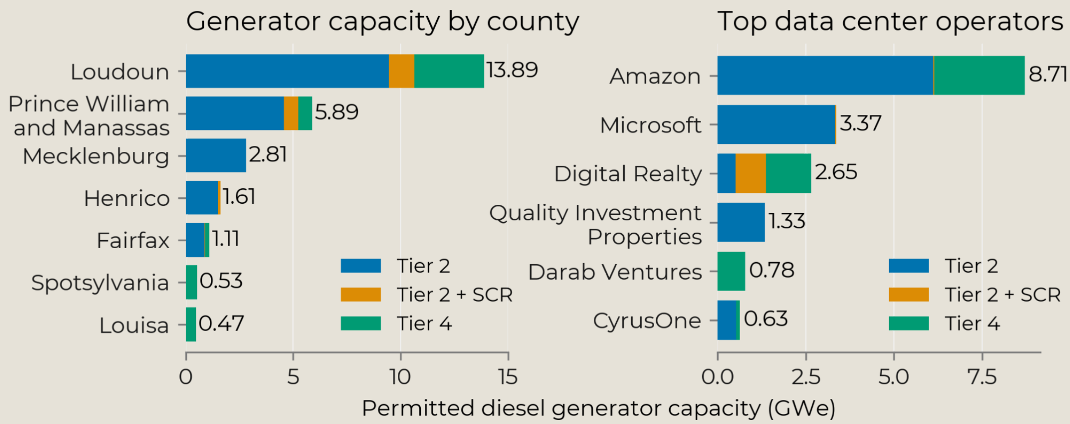
Virginia holds an estimated 25% of all U.S. data center capacity and, with this scale, may serve as a preview to national trends. We analyzed how Tier 2 and Tier 4 generator capacity has grown in VA over time, using data from all 173 air quality permits filed through 2025 for data center campuses in the state.[13]

- In total, VA has permitted **27 GW of diesel generators**,[14] **73% of which is Tier 2**, 8% is Tier 2 + SCR,[15] and 19% is Tier 4.
- In 2025, over half of newly-permitted capacity was Tier 4 for the first time.



Tier 4 generators have not been uniformly deployed by county or operator. Most Tier 4 generators have been permitted in Loudon county, driven by Amazon and Digital Realty build-outs. Microsoft, which primarily operates in the less populous Mecklenburg county, uses SCR in only 1% of its generator fleet.

[13] Each permit can cover multiple data centers: VA has 663 total with 595 planned or under construction.
[14] Since construction timelines are typically 1–2 years, the *installed* capacity in early 2026 is likely 17–22 GW.
[15] We distinguish between Tier 2 + SCR and Tier 4 because the former lacks controls for PM and VOCs.



The full dataset is available at github.com/jsbangsund/data-center-generator-permits/.

Several other groups have published work and tools on the use of generators for backup power in VA, including this interactive map from The Piedmont Environmental Council and this research brief from Virginia Commonwealth University.

Are diesel generators used only for emergencies?

For many, the term "backup generator" is associated with use only in the case of emergencies like extended grid outages ("blackouts"). **Increasingly, we are seeing data centers use generators for more than these types of unforeseen emergencies, raising potential concerns for air quality, noise, and community impacts**, particularly in a period of deregulation and weakened environmental and public health protections. **State and federal policies are supporting this shift, and industry is increasingly marketing diesel and natural gas generators for non-emergency use.** This section summarizes ways that generators have been used beyond just emergency scenarios.

As far as we are aware, data demonstrating which of these scenarios result in the most substantial diesel generator use does not exist. We expect that historically, maintenance and testing activities would have constituted the majority of diesel generator run time in many cases. We also expect this is likely to evolve moving forward as more data centers come on line, the grid gets increasingly stressed, and climate change results in more extreme weather.

Short-term grid disturbances

Data centers are sensitive to very minor disturbances in grid power (i.e., changes in voltage and/or frequency, the kind that can cause the lights in your home to flicker). Because of this, they may disconnect from the grid during these disturbances and switch to backup diesel generator power.[16] The North American Electric Reliability Corporation (NERC) reports one example of this, where "*a transmission fault caused the simultaneous loss of approximately 1,500 MW of voltage-sensitive load, primarily from data centers…multiple data centers decreased consumption, switching some of their facility power to backup systems.*"[17] **Even though the actual grid disturbance may be very short (seconds or minutes), the switch to backup generation may last for much longer (e.g., hours).** While generation facilities—notably inverter-based generators like wind and solar which use many of the same power electronic controls as data centers—are required to "ride-through" these short-term grid disturbances, large loads are not. By disconnecting from the power grid, data centers not only increase their diesel generation use, they can also exacerbate the original grid disturbance, risking cascading power outages for others.

We are not aware of any data on how often and for how long data centers in the U.S. turn on diesel generators in response to short-term grid disturbances, but expect that grid disturbances themselves may increase over time as more large data centers interconnect and grid stress increases. NERC is currently studying the impacts of data centers disconnecting from the grid due to short disturbances and is in the process of developing recommendations for how data centers should ride-through these disturbances so they do not exacerbate the issue for other grid users.[18]

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[16] As described by The North American Electric Reliability Corporation (NERC), "Some large loads have internal protection and control systems that will disconnect from the grid during disturbances. For example, some data centers may switch to backup power systems after three transient voltage disturbances within one minute as observed at certain data centers in the [Eastern Interconnection] load transfer event. The intent behind such systems is usually to ensure the reliability of the large load's process (e.g., serving internet traffic) or protect equipment from damage by switching to a local backup power source."

[17] *Characteristics and Risks of Emerging Large Loads*. 2025. North American Electric Reliability Corp.

[18] NERC Large Loads Working Group Meeting, February 2026.

Demand response

When demand for power is larger than the grid can supply, data centers may be requested, incentivized, or required to temporarily reduce their power consumption. This is often referred to as "demand response"[19]. Increasingly, demand response is being explored as a way to manage power shortages amidst surging load growth, and/or to continue connecting large loads like data centers to the grid without building (as much) new generation or transmission infrastructure.[20]

Recently, federal and state policies have explicitly enabled diesel generator use for demand response. In May 2025, EPA issued a clarification that emergency diesel generators may be operated for up to 50 hours a year to participate in demand response in non-emergency situations. In Virginia, the Department of Environmental Quality counts demand response as an emergency use, enabling facilities to run generators during high-demand periods without violating their emergency classification. In Texas, new data centers can run backup generators during high-demand periods, enabling non-emergency operation.

As a recent example, Tier 2 diesel generators were used for demand response during the June 2025 heatwave in Virginia, which led to a wave of complaints from residents about noise and air quality issues.[21]

Bridging power

Energy demand for data centers continues to outpace the availability of both grid- and behind-the-meter supply capacity and infrastructure. Grid interconnection and the procurement of large natural gas turbines can take several years. Accordingly, **developers and operators are turning to temporary or "bridging" power sources to allow a data center to operate while waiting months or years for permanent grid connections or on-site primary power to be built.**[22]

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[19] "Demand response" refers to programs in which electricity customers temporarily change their usage in response to grid conditions or electricity cost, helping to balance supply and demand. For example, during a hot afternoon when air-conditioning use pushes electricity demand to its peak, a data center may reduce the power it draws from the grid for a few hours.

[20] *Rethinking Load Growth: Assessing the Potential for Integration of Large Flexible Loads in US Power Systems*. Feb. 2025. Nicholas Institute for Energy, Environment & Sustainability, Duke University.

[21] *Heat Wave Prompts Increased Data Center Generator Use; Turner Pushes for Tier 4 Upgrades*. July 16, 2025. Loudoun Now.

[22] *Bridging the power gap: Why data centers can't wait for the grid*. Oct. 1, 2025. Data Center Dynamics; and *Data centers seek flexible power solutions for resilience, sustainability*. July 23, 2025. Facilities Dive.

Industry has begun marketing generators specifically for bridging power applications, signalling the significant demand for this resource:

- Aggreko offers Tier 4 diesel and gas generators for short- and long-term bridging and demand response. In one project, they deployed 48 MW of diesel bridge power.
- Caterpillar markets generators including diesel specifically for data center bridging applications.
- Voltagrid promotes natural gas microgrids for bridging power.

While still relatively rare, recent examples show these approaches are being deployed, albeit more commonly with natural gas than diesel. Prometheus Hyperscale in Texas is planning to use a combination of gas-fired generators and batteries as bridging power for a 5 year period until they can connect to the grid.

Unplanned outages

Unplanned outages refer to unexpected losses of primary power. These can occur when equipment fails or when extreme weather (such as hurricanes, wildfires, or ice storms) disrupts grid infrastructure. In these situations—often lasting from several hours to multiple days—backup power systems can be used to maintain data center operations. This is the scenario most people typically associate with "emergency" generator use: rare but potentially prolonged events caused by severe weather or other grid failures.

The frequency and duration of unplanned outages depends on location and scenario (for example, whether the data center is grid connected or has behind-the-meter primary power). **In many places power outages are relatively rare, with monthly testing typically accounting for larger run-time than unplanned emergencies.** In Virginia, most operators reported zero to two outages over two years, typically lasting 1–5 hours.[23]

Planned outages

Planned outages are interruptions of primary power (either grid or behind-the-meter) that are scheduled in advance for maintenance or upgrades. Unlike unplanned outages, these events are coordinated ahead of time. During a planned outage, a data center may rely on on-site diesel generators to maintain continuous operations until work is completed.

[23] See also: *Explained: Reliability of the Current Power Grid*. 2024. NREL/FS-6A40-87297.

In Virginia, the Department of Environmental Quality is proposing to allow data centers to run backup diesel generators during planned outage events rather than the existing requirement of only during “sudden and reasonably unforeseeable events” or maintenance.[24]

Permanent primary power

Permanent primary power refers to the main, long-term source of electricity. While the majority of data centers in the U.S. are expected to use grid power as their primary power source, there has been a recent surge in data centers planning to build their own on-site primary power (often called “behind the meter”). According to Cleanview, 30% of current planned data center capacity in the U.S. will use behind the meter power (up from less than 5% in 2024), with about 75% of that using natural gas. While few known public examples exist, it is possible that generators (as opposed to turbines or other types of energy generating technologies) may be used as a primary power source at data centers. For example, VoltaGrid proposed to use natural gas generators as a primary power source for a relatively small (90 MW) data center in Covington, GA.[25] We are not aware of any current examples of *diesel* generators being used for permanent primary power, and do not expect this to become common due to higher fuel costs (diesel has 2–3x higher fuel costs per kWh compared to natural gas).

Testing and maintenance

Diesel generators at data centers are tested regularly and have periodic maintenance to ensure they can be readily deployed when needed. Generators are typically tested on a monthly and annual basis. Based on the NFPA 110 standard, emergency power systems must be tested monthly for at least 30 minutes at 30% capacity, and annually for at least 90 minutes at 50% and 75% of capacity.

Most air permits limit generator operation to a set number of hours per year, commonly around 100 hours annually for non-emergency use such as testing and maintenance, with actual limits varying by state and permit. Several states use more restrictive limits in the range of 20–50 hours.

[24] *Proposed Increase to Data Center Diesel Generator Use*. Nov. 19, 2025. The Piedmont Environ. Council.
[25] *A new Georgia data center could be powered by RICE. It’s not the kind you eat*. Dec. 19, 2025. The Atlanta Journal-Constitution.

Regulations and Permitting

Because large data centers typically have hundreds of diesel generators, they generally require air permits due to the facility's total emissions, which are measured cumulatively rather than per individual generator. Even when generators are limited to emergency use and testing, the total emissions from a full fleet can exceed thresholds, making permits necessary. **Diesel generators are typically the largest source of air pollution at a data center** (excluding any on-site primary power generation); other equipment such as cooling towers or winter heating systems typically have negligible emissions in comparison.

Under the Clean Air Act, most states have been delegated authority by the EPA to issue air permits for stationary sources, including diesel generators, for the New Source Performance Standards (NSPS) and National Emissions Standards for Hazardous Air Pollutants (NESHAP).[26] In delegated states, generators generally must obtain a state permit if they exceed certain emissions thresholds, which vary by state and by local air quality status (i.e., attainment vs non-attainment of the NAAQS). States have discretion in how they implement permitting and can set limits on hours of operation, emissions, or generator size. In states without delegated authority, the regional EPA office issues and enforces air permits directly, using federal requirements for the same regulations.

Permitting requirements can differ depending on whether a generator is operated strictly for emergency power and testing or for extended/non-emergency use such as bridging power or demand response. Generators are typically classified as emergency or non-emergency under the U.S. EPA definition in New Source Performance Standards (NSPS) Subpart IIII - Standards of Performance for Stationary Compression Ignition Internal Combustion Engines. **Under this definition, emergency generators may be operated with the following limits: testing and maintenance is restricted to 100 hours per year, operations for other-non emergency purposes is restricted to 50 hours per year (and counts against the 100 hour allowance). They may operate for an unlimited time during emergencies.**

[26] See 42 U.S.C. §7470, in particular, and Clean Air Act (CAA), Title I, Part C, in general, for Prevention of Significant Deterioration (PSD) permitting program, and 42 U.S.C. §7503, in particular, and CAA, Title I, Part D, in general, for Nonattainment New Source Review (NSR). See 40 C.F.R. Part 51 Subpart I for more information on NSR programs. For the definition of a major stationary source, see 40 C.F.R. §51.165(a)(1)(iv)(A). Major stationary sources are subject to CAA Sections 111 and 129 (42 U.S.C. §§7411 and 7429) New Source Performance Standards (NSPS) and Section 112 (42 U.S.C. §7412) National Emissions Standards for Hazardous Air Pollutants (NESHAPs). These source category standards apply if the stationary source exceeds the major source threshold.

Virginia DEQ recently came under fire from residents for allowing facilities to run their emergency generators (mostly Tier 2) under a very relaxed definition of "emergency conditions" which allows any data center receiving less than 14 days notice of a planned outage to run on Tier 2 generators.

In many states, air permits for diesel generators are not readily available online and can often only be accessed through public records requests. Virginia is a notable exception, as its DEQ maintains a dedicated listing of air permits for data centers. Other states make permits searchable online (such as Wyoming's Open Air portal), but locating the right documents often requires knowledge of specific site details (like address, site name, or facility ID).

Examples of issued air permits that cover diesel generators include:

- *Virginia permit example*: Registration number 74303, approved March 12, 2025. Covers 166 Tier 4 and five Tier 2 generators at an Amazon Data Services data center campus in Leesburg, VA (Loudoun county).
- *Utah permit example*: Approval order DAQ-2025-002983 from June 17, 2025. Covers 310 Tier 2 generators (with SCR controls) at the Quality Technology Services data center in Eagle Mountain, Utah.

Diesel generators may also be subject to noise, water, and local land-use regulations. For example, local ordinances often include noise limits, setback requirements, and other requirements that apply to data centers.

What are the impacts?

Air pollution

Diesel generators emit air pollutants including particulate matter (PM_{10} and $PM_{2.5}$), nitrogen oxides (NO_X), carbon monoxide (CO), sulfur dioxide (SO_2) and volatile organic compounds (VOCs), and contribute to the formation of ground-level ozone. The U.S. EPA sets emissions standards that define how much of each pollutant a generator can release per unit of electricity produced. Table 1 shows the relevant limits for the large (≥560 kW) diesel generators used by data centers.[27]

[27] SO_2 emissions are excluded from Table 1 as they are not directly regulated for generators, despite having health impacts. SO_2 levels are driven by fuel sulfur content, typically regulated to <0.0015% by weight.

Table 1: Emissions standards for ≥560 kW diesel generators compared to typical natural gas generators

Tier	CO (g/kWh)	NOx (g/kWh)	PM (g/kWh)	VOC (g/kWh)
Tier 2	3.5	5.5[28]	0.2	0.9[22]
Tier 4 final (2015)[29]	3.5	0.67	0.03	0.19
% reduced from Tier 2 → 4	*0%*	*88%*	*85%*	*79%*
Natural gas generators[30]	0.05–0.21	0.03–0.30	0.01–0.04	0.01–0.21
% reduced Tier 4 → NGG	*94%–98%*	*55%–95%*	*0%–70%*	*0%–58%*

Sources: 40 CFR 1039, appendix I, table 2; EPA420-P-04-009, Table 5; 40 CFR 1039.101

Tier 4 is the cleanest available option for *diesel* generators, with significantly lower NOx and PM emissions than Tier 2 due to pollution control mechanisms such as Selective Catalytic Reduction (SCR), Diesel Oxidation Catalyst (DOC), and Diesel Particulate Filter (DPF) (see Appendix: *Terms and definitions*). Although natural gas generators are far less common than diesel for data center backup power, they are included in Table 1 for comparison. Natural gas generators generally emit less CO and NOx than Tier 4 diesel units, but their PM and VOC emissions can be similar, depending on generator model and configuration.

An important caveat to the Tier 4 limits is that NOx emission controls (SCR) are not active during startup and shutdown, so emissions can temporarily be much higher—often similar to a Tier 2 generator. This matters because even short periods of higher emissions can contribute to local air pollution, especially if generators start and stop frequently. **For Tier 4 generators, air quality permits often allow NOx emissions to be uncontrolled for up to 25% of the total operation time**.

[28] Tier 2 generators are regulated for the combination of non-methane hydrocarbons (NMHC) and NOx at 6.4 g/kWh (see Table 2 of 40 CFR 1039, appendix I). EPA modeling guidelines assume NOx emissions comprise 5.5 g/kWh (EPA420-P-04-009, Table 5).
[29] Tier 4 limits can be found in Table 1 of §1039.101 (40 CFR 1039.101).
[30] These ranges are based on permitted emissions limits for three models of natural gas generators, all with SCR and oxidation catalyst emissions controls: 400 kW Enchanted Rock NGE21.9L-CA, 2,485 kW Caterpillar G3520H, and 3,000 kW Jenbacher J620.

FAQ: Can we require Tier 5 generators to further reduce emissions?

Proposed Tier 5 final emissions standards—set to take effect in 2036[31]—are being drafted by the California Air Resources Board (CARB) and are unlikely to be considered by the U.S. EPA or other states in the near future.

As of February 2026, CARB has not yet finalized the standards, but their current proposal for large generators (>560 kW) would **lower the NOx emission limit by 50%** from Tier 4 (down to 0.35 g/kWh from 0.67 g/kWh) and **lower the PM emission limit by 70%** (to 0.008 g/kWh from 0.03 g/kWh).

These are meaningful reductions that would reduce air pollution and health concerns, but not eliminate them. We reiterate that at this time **no diesel generators which meet these standards are commercially available**. Our belief is that emissions-free backup power for data centers should be required to the greatest extent possible.

Tier 5 is sometimes confused with the European Union's Stage V requirements. The Stage V limits started in 2018 and are identical to Tier 4 for the large generators used by data centers.

Diesel exhaust is known to harm health, with well-documented links to increased lung cancer risk,[32] cardiovascular disease, worsened asthma symptoms, and premature mortality.[33] In 2012, The International Agency for Research on Cancer (part of the World Health Organization) classified diesel engine exhaust as carcinogenic to humans. A large body of research has also tied the individual pollutants from diesel combustion—$PM_{2.5}$, NO_X, SO_2, VOCs, and ozone—to reduced lung function, increased risk of developing asthma, and increased mortality from lung cancer and a range of cardiopulmonary diseases.[34]

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[31] Tier 5 initial (5i) standards will take effect as early as 2030, but do not change the >560 kW limits.

[32] Benbrahim-Tallaa, L., et al. 2012. *Carcinogenicity of diesel-engine and gasoline-engine exhausts and some nitroarenes*. The Lancet Oncology 13, 663–664. DOI: 10.1016/S1470-2045(12)70280-2; and *Diesel Exhaust and Cancer Risk*. Updated February 26, 2024. American Cancer Society.

[33] Sydbom, A., et al. 2001. Health effects of diesel exhaust emissions. Eur Respir J 17, 733–746. DOI: 10.1183/09031936.01.17407330; and Weitekamp, C.A., et al. 2020. A systematic review of the health effects associated with the inhalation of particle-filtered and whole diesel exhaust. Inhal Toxicol 32, 1–13. DOI: 10.1080/08958378.2020.1725187

[34] Integrated Science Assessment (ISA) for Oxides of Nitrogen – Health Criteria. 2016. U.S. EPA.; ISA for Particulate Matter. 2015. U.S. EPA.; ISA for Ozone and Related Photochemical Oxidants. 2015. U.S. EPA.

However, assessing the actual health impacts of air pollution from data center diesel generators at a particular site is complex and depends on many factors: generator type and number, hours of operation, proximity to people, underlying health conditions and risk factors, local air quality, and meteorological conditions.

Depending on the factors above, the risk of health effects from a single data center's diesel generators can be minor compared to other air pollution sources, such as major power plants and highways. **But these health effects can compound when multiple data centers are clustered in one region: a recent study from Virginia Commonwealth University found that in some neighborhoods of northern Virginia, emissions exposure from diesel generators at data centers can exceed that from a nearby 600 MW natural gas plant.**[35] In another study (still under peer review), the public health burden of data center emissions in northern Virginia alone was estimated to exceed $220 million per year.[36] In a Health Impact Assessment for a data center in WA, air quality modeling indicated that the combined emissions from four nearby data centers were responsible for 30%–75% of cancer risk from all major air pollution sources.[37] **We emphasize that even though VA data centers are currently only emitting 5–10% of their permitted limits, they're still becoming significant pollution sources.** If they were to increase how often they operated their generators for demand response or planned outages, these health impacts could easily increase by 5–20x.

In some cases, data centers are so large (and their associated backup diesel generators so numerous) that one site alone can have significant air quality impacts. In Delaware, the Department of Natural Resources and Environmental Control (DNREC) recently denied the application for a proposed 1.2 GW Data Center in Delaware City explicitly because of potential impacts from its 516 proposed diesel generators. In their statement, DNREC noted that "*under worst-case conditions of operating 500 hours per year…consistent with EPA guidance estimating that 500 hours is an appropriate default assumption for the number of hours that an emergency generator could be expected to operate under worst-case power outage conditions…the nitrogen oxides emissions associated with these generators could well be the largest*

[35] Pitt, D., et al. 2026. Localized Air Pollution Impacts from Data Centers in Northern Virginia. Institute for Sustainable Energy and Environment. They compared census blocks most impacted by data centers to those by the natural gas plant. The blocks most affected by the plant had less exposure than the blocks most affected by data centers.
[36] Han, Y., et al. 2024. The Unpaid Toll: Quantifying the Public Health Impact of AI. DOI: 10.48550/arXiv.2412.06288
[37] Health Impact Assessment Recommendation Document for CyrusOne Data Center in Quincy, WA. 2019. Washington State Department of Ecology. See Table 3. Cancer risk from data centers ranged from about 10–20 per million, compared to a risk of about 5–40 per million from major highways and rail.

source of such emissions in the Coastal Zone, and indeed in the entire state, with the sole exception of the Delaware City refinery."[38]

These examples highlight the need for project-specific studies to understand actual emissions and potential health impacts in a given community and the need for cleaner alternatives and strong limitations on run-time to reduce the potential for impact.

Noise pollution

Diesel generators can produce noise levels in the range of 80–100 dBA,[39] high enough to contribute to hearing loss and have significant impacts on quality of life. With high-quality noise controls—such as acoustic enclosures, mufflers, and sound-attenuating louvers—these levels can be reduced by at least 10 dBA (more than a 50% reduction in perceived loudness).[40] Site design, barrier walls, and setbacks can further reduce noise impacts at the property line.

While these noise levels can be significant, generators are typically not the main source of noise complaints at data centers;[41] most complaints are associated with cooling systems, HVAC, and other mechanical infrastructure which run continuously.

According to the APHA, chronic exposure to noise pollution can cause or exacerbate heart disease, type II diabetes, anxiety and depression, while also harming cognition, memory, learning, and productivity. When considering noise impacts, it is important to not only consider generator noise but the cumulative noise that nearby populations could experience. Noise standards are generally designed to prevent hearing loss, but they may not protect against noise levels that disrupt sleep, outdoor activities, or overall quality of life.

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[38] The worst-case assumption of 500 hours per year was addressed in the U.S. EPA memo from Seitz, J. S. (9/6/1995). *Calculating potential to emit (PTE) for emergency generators*.

[39] These manufacturer-specified noise levels are typically measured at 7 m (23 ft). Because noise dissipates with distance (by about 6 dBA with every doubling of distance), these values are higher than what would be experienced at the property line for a typical data center.

[40] Note that the EPA's emission tiers do not regulate noise levels of generators, and generally Tier 2 and Tier 4 generators produce similar noise levels. The equipment that treats the exhaust in Tier 4 generators can reduce noise in the exhaust stream, but noise produced by the radiator fans and air intake tends to outweigh exhaust noise according to ASHRAE.

[41] Extended operation of generators during longer outages, while rare, can cause excessive noise pollution and increase complaints, as in the case from the June 2025 heat wave in Loudoun county.

Potential spills and leaks from on-site storage of diesel fuel

Data centers typically store enough diesel fuel on-site to operate backup generators for 24–96 hours.[42] Most commonly, each generator is equipped with a belly tank[43] that can hold 6,000–9,000 gallons, for a total of 300,000 to over 1 million gallons of storage at a typical hyperscale campus. A proposal for a 1.2 GW data center in Delaware (also discussed above), would have more than 2.5 million gallons of stored diesel fuel for its over 500 backup generators. Tanks are usually equipped with secondary containment and leak detection.

Diesel leaks at data centers happen infrequently, but are not unheard of—we found reports of seven incidents at U.S. data centers since November 2022 (see Appendix: *Cases of diesel spills at data centers*). Most spills at data centers are relatively small (such as the 200 gallon spill at a Meta site in Iowa in December 2025), resulting only in localized soil contamination. But larger leaks, often from underground fuel tank failures, can reach waterways and contaminate storm drains: a 15,000 gallon leak at an AT&T data center in Bothell, WA in 2008 required remediation and monitoring of groundwater for over a decade; and a 600 gallon leak at a Digital Realty data center in Clifton, NJ in 2017 impacted nearby storm drains.[44]

Climate change

Across the U.S., surging energy demands from data centers are contributing to greater fossil fuel use by driving the construction of new natural gas plants[45] and delaying the retirement of coal plants. Recent analysis from the Global energy monitor found that the "U.S. nearly tripled its gas-fired capacity in development in 2025 totalling almost 252 gigawatts (GW)", surpassing China as the largest developer of gas plants in the world. More than a third of this planned capacity is for on-site power at data centers, and "many more on-grid projects are planned to meet an anticipated increase in energy demand from AI". Increased energy demand and fossil fuel use threaten to compromise climate goals: a 2025 report from the Center for

[42] At the proposed QTS Eagle Mountain data center in Utah, there are 310 gensets with a total capacity of 800 MWe. Each is equipped with a 8,400 gallon belly tank, for a total site storage of 2.6 million gallons of diesel. This allows for 48 hours of operation at 100% load, and about 90 hours for typical operating conditions (80% power utilization for an AI center, and 50% genset redundancy).

[43] Belly tanks are housed within each individual genset enclosure. This modular approach seems to be favored in current hyperscale designs. Some sites have central aboveground or underground storage tanks with distribution systems to supply each genset unit, but this practice is becoming less common.

[44] National Response Center (NRC) report Seq. No. 1189499.

[45] A recent study by Cleanview looked at data centers building behind-the-meter (BTM) power and found that it is overwhelmingly natural gas: "Nearly 75% of the generation equipment we could identify (23 GW) was natural gas-powered…~30% of all planned capacity is expected to come from BTM data centers."

Biological Diversity found that the projected buildout of data centers could "account for 10% of the economy-wide emissions and 44% of the power sector emissions allowable to meet the U.S. 2035 climate target."

Extended use of diesel generators for demand response, bridging power, or other non-emergency purposes can exacerbate this trend because diesel combustion is carbon-intensive. **Diesel generators typically emit 0.7–0.9 kg of CO_2 per kWh,[46] about 2 times more CO_2 per unit of electricity than the average U.S. grid mix (~0.37 kg CO_2/kWh).**

Key practices to reduce harm

Several potential approaches to limit harm from diesel generators are provided below. When proposing practices to reduce harm, we consider all impacts described in the preceding section. Many of the practices below can be implemented in conjunction (e.g., using batteries and investing in infrastructure to alleviate grid stress), and we recommend doing so to the greatest extent possible to achieve the greatest harm reduction.

It is important to note that most of these approaches are not currently standard practice and may be more costly, require newer technologies, and/or involve operational practices that are not typical in the industry today. We believe these reasons are not sufficient to delay adoption: that residents and businesses close to data centers should not be adversely impacted, and that this industry has sufficient resources to implement highly protective approaches even if it requires innovation and investment.

As a follow-on to this report, we are developing a guide for communities and governments to limit harm from diesel generators at data centers including language that could be used in ordinances, legislation, etc. This guide is being developed in collaboration with community, policy, and technical experts who are actively working on this topic. If you would like to collaborate, please reach out to us at info@betterdatacenterproject.com.

[46] This range is calculated from the load-dependent fuel consumption in manufacturer spec sheets (e.g. for Caterpillar 3516C), unit capacity in kW, and the EPA emission factor for diesel fuel (10.2 kg CO_2/gallon, Table C-1 to Subpart C of Part 98, Title 40). Emission intensity (kg CO_2/kWh) is highest at low loads.

Use batteries as backup power source

Battery energy storage systems (BESS) can serve as the backup power source and greatly reduce—or in some cases, completely eliminate—the use of diesel generators.[47] **Several hours of battery capacity could be used during short grid disturbances (seconds to minutes) and would cover the vast majority of longer-term power outages (typically 1–5 hours) experienced by data centers. They could also be used for demand response programs.** Even if data centers still had diesel generators, several hours of battery capacity could, in many cases, effectively limit diesel generator run time to ~30 minutes per month for maintenance (outside of extended outages from natural disasters).

Large-scale battery systems are starting to be deployed by data centers. For example:

- *Arizona, 2025 (Meta):* A BESS with 1,200 MWh capacity came online in 2024 to power a 300 MW Meta data center for up to four hours.
- *Tennessee, 2024 (xAI):* After public backlash against its unpermitted gas turbines, xAI deployed 168 Tesla Megapack battery systems (650 MWh) at its Memphis data center.
- *Texas, 2025 (Google):* In a Nov. 2025 announcement, Google unveiled plans for a co-located solar and battery energy storage plant at a data center in Haskell County, Texas.
- *Minnesota, 2026 (Google):* Xcel Energy and Google announced plans to install 30 GWh of Form Energy iron-air batteries, which will supply up to 100 hours of power to a 300 MW data center in Pine Island, MN. Installation is expected to begin in 2028.

We expect that data center developers would propose to maintain some diesel or gas generators if battery capacity provides shorter runtimes than the 12-hour fuel storage minimum defined by The Uptime Institute—or the 24–96 hours of fuel many operators actually store.

Capital costs are the main factor currently limiting battery runtimes: recent estimates from the National Renewable Energy Laboratory (NREL) place the cost for a 4-hour BESS at ~$1,300/kW. Extending this duration to 24 hours would increase capital costs 6-fold. By comparison, diesel generators typically have capital costs less

[47] Battery systems also have other benefits beyond backup power, such as allowing data centers to shave peak energy needs and participate in demand response, thus reducing grid stress and potentially the need to construct more baseload power capacity on the grid.

than $1,000/kW all-in,[48] while providing indefinite run time. However, BESS capital costs are declining rapidly, and their operating and maintenance costs are much lower than diesel generators. Based on studies of hybrid microgrids, total life cycle costs for BESS are likely to be lower than diesel-only backup power.[49]

FAQ: How much can on-site renewable energy offset power usage?

We support deployment of on-site renewables. However, for most large-scale data centers, they will not provide enough power to meaningfully reduce the need for on-site backup during a primary power outage.

Taking the Tanner Way campus in Figure 1 as an example, we estimate that on average **only 0.5%–2% of the campus's energy consumption could be covered by on-site solar.** This is based on satellite measurements of available area for solar (~10 acres), expected annual solar energy production for the site from NREL's PVWatts calculator, and power estimates from air permits. For a typical 100 MW hyperscale campus, site sizes are usually under 100 acres, but over 1,200 acres of solar would be needed to cover all energy usage. Wind energy requires even more land per MW,[50] and may not always be feasible at data center sites.

We acknowledge that communities have raised concerns with battery systems as well. Fires are the most prominent safety concern for communities where BESS are installed: thermal runaway can, in rare circumstances, occur with certain battery technologies, leading to fires that are difficult to contain and can release toxic fluoride gases. However, grid-scale BESS have strong safety measures and their rates of failure resulting in fire or other emergencies dropped by 97% from 2018 to 2023. Emerging battery chemistries, such as iron-air (Form Energy) and aluminum-air (AlumaPower, Phinergy), eliminate the risk of thermal runaway. Aside from local safety, mineral extraction and production for Li-ion batteries can have significant environmental impacts, including contaminating water sources, releasing heavy

[48] Capital costs for diesel generators are commonly estimated at $350–$500/kW, but enclosures, noise attenuation, and fuel tanks can increase costs by over $200/kW. NREL estimates total capital costs to range from $800–$1,100/kW, see: *Backup Power Cost of Ownership Analysis and Incumbent Technology Comparison* (2014, No. NREL/TP-5400-60732, 1163435), https://doi.org/10.2172/1163435.

[49] Marqusee, J., et al. 2021. *Resilience and economics of microgrids with PV, battery storage, and networked diesel generators*. Advances in Applied Energy 3, 100049. DOI: 10.1016/j.adapen.2021.100049

[50] While direct land use for wind energy (~2.3 acres/MW) is less than solar (~5 acres/MW), total land use is much higher at 18–60 acres/MW. See Table 5 of Mai, T., et al. (2025). *Land of opportunity: Potential for renewable energy on federal lands* (NREL/TP-6A40-91848). National Renewable Energy Laboratory.

metal pollutants, and depleting groundwater.[51] (Of course, fossil fuel extraction, processing, and transportation also have significant impacts throughout the supply chain, which we do not dig into here). Sodium-ion, iron-air, and aluminum-air batteries use more abundant and less toxic materials with fully domestic supply chains and much lower environmental impacts. We advocate for the continued development and deployment of battery technologies that have the lowest environmental impacts whenever possible, and reiterate that communities should shape if and how these technologies are deployed locally.

Invest in infrastructure to alleviate grid stress

As stress on the grid increases due to new large loads, electrification, aging infrastructure, and climate change, the need for backup power to support demand-response programs may increase. **Data center companies should pay to invest in infrastructure that would alleviate this grid stress (and thereby reduce the frequency of backup power use) by supporting new generation capacity, upgrades to aging or under-sized distribution and transmission facilities, and/or long-range transmission lines that import power for the entire host community.** In addition to reducing the need for demand response, these approaches would increase the capacity of the grid and thereby make it less susceptible to momentary disturbances.[52]

Reduce on-site backup power needs

Beyond batteries, data centers can in some cases minimize their reliance on diesel generators by reducing overall backup power requirements.

One potential approach is **spatial load shifting.** During extended outages or periods of high grid stress (e.g. due to heatwaves or cold snaps), critical workloads can sometimes be moved to another location that is less affected. By transferring operations rather than running diesel generators on-site, operators can maintain service while minimizing emissions and generator use. Not all workloads or sites can shift operations, but using this strategy helps reduce impacts where feasible.

Similarly, some data centers have workloads that are non-critical and can be paused or delayed during outages ("**temporal load shifting**"), reducing backup power

[51] United Nations Conference on Trade and Development, 2020. *Commodities at a Glance: Special Issue on Strategic Battery Raw Materials*. UN. DOI: 10.18356/9ba5e76c-en. See page 46.
[52] Folgueras, M., et al. 2017. *Grid Frequency Extreme Event Analysis and Modeling: Preprint (No. NREL/CP-5D00-70029)*. National Renewable Energy Laboratory.

requirements. Google has implemented both temporal and spatial load shifting since 2020 and Emerald AI has piloted temporal load shifting for AI workloads.[53]

FAQ: Are fuel cells an alternative to diesel generators?

There are multiple types of fuel cells, with Solid Oxide Fuel Cells (SOFCs) and Proton Exchange Membrane Fuel Cells (PEMFC) being the most common. Both use *electrochemical conversion*, rather than combustion, to generate electricity from fossil fuels or hydrogen.[54] This approach can eliminate or greatly minimize air and noise pollution compared to traditional combustion power sources.[55]

Fuel cells have recently been deployed at data centers at the ~100 MW scale, with forthcoming projects at the GW scale,[56] for on-site prime power generation. Most of these projects use SOFCs for bridging power and/or as behind-the-meter power to supplement the grid. Aside from a few small scale examples (e.g. from eBay and Microsoft), **fuel cells have not been applied as a direct replacement to diesel backup power**.[57] One reason for this is that SOFCs can require over 30 minutes to warm-up (compared to less than 30 s for generators), meaning stable power is not readily available during an unexpected grid outage.

That said, on-site fuel cell systems are claimed by manufacturers to be more reliable than the grid, which could reduce how often diesel generators are run or minimize the required backup capacity. Overall, we anticipate fuel cells to be used more for primary power than backup power and therefore are not likely to be a widely-used replacement for diesel generators.

[53] Spatial and temporal load shifting are both mechanisms that can be used in "demand response". We use these terms here to emphasize the reduction in compute—and corresponding total power consumption—associated with these practices and distinguish from demand response approaches where compute load remains unchanged and reduction in grid power consumption is made up for with on-site generation.

[54] SOFCs, which usually run on natural gas, are also compatible with hydrogen. PEMFCs can only run on hydrogen. Lack of a robust hydrogen supply chain has limited the market penetration of hydrogen fuel cells, but PEMFCs have been piloted at the 1 MW scale with a 1 GW campus planned by a CA firm.

[55] Typically, SOFCs emit NOx at less than 0.03 g/kWh, 16x lower than Tier 4 generators and at least 2x lower than most modern natural gas turbines.

[56] Bloom Energy recently closed a $5 billion deal with Brookfield to supply SOFCs as behind-the-meter prime power for AI data centers. At current prices, this deal corresponds to about 1.5 GW of capacity (the average sale price for Bloom Energy fuel cells was $3,363/kW in 2024, see Q2 2024 Earnings Report)

[57] For example, the Novva data center site in West Jordan, Utah maintains diesel generators on-site for "black start" of Bloom Energy fuel cells, as well as 76 MW of diesel backup generators. See Utah DEQ approval orders DAO-2024-012126 and DAO-2025-004320.

Measures that **reduce overall electricity demand,** including more efficient hardware, optimized software, advanced power management, and improved cooling system design, can lower total load and reduce the corresponding amount of backup capacity required. In some cases, efficiency gains can come from more efficient cooling technologies; however, certain approaches (e.g., increased evaporative cooling) may reduce electricity use while increasing water consumption, creating trade-offs that must be carefully evaluated. While efficiency improvements are important and should be pursued aggressively, incremental gains alone are unlikely to substantially reduce on-site backup generation needs unless there are significant advances in both computational and cooling efficiency at scale.

If diesel generator use is unavoidable, implement the most protective measures possible

If use of diesel generators for backup power is unavoidable, robust protective measures must be put in place to reduce the impacts on local communities:

- **Require Tier 4 compliant generators:** all diesel generators should be the least polluting version available (currently Tier 4).
- **Restrict use to true emergencies and required testing:** generators should only operate for unforeseen, unplanned emergencies or required maintenance and testing. They should **not** be used as the power source during momentary grid disturbances, during planned outage events, as a bridging power source, to support demand response programs, or as a permanent source of primary power.
    - **Require ride-through capabilities for power controls:** the power controls which automatically switch data center operations to backup power in the event of momentary grid disturbances should be (re-)programmed to ride-through these events (particularly voltage and over-frequency[58] disturbances). This is one easy and very cost effective way to limit diesel generator use during momentary grid disturbances by instead using existing batteries/uninterruptible power supplies for the maximum amount of time possible before powering up diesel generators.

[58] Here, we distinguish between "under" and "over" frequency events. The majority of frequency disturbances are under-frequency events, which occur when load on the system exceeds available generation. During under-frequency events, it may be useful for data centers to drop offline to reduce load. Over-frequency events—when generation exceeds demand—are less frequent but can be catastrophic if data centers drop offline during these events.

- **Require pre-construction emissions modeling and health impact assessment:** Require emissions modeling, baseline air quality measurements, and a cumulative health *impact* assessment prior to approvals.
- **Require ongoing air monitoring:** Require continuous fenceline monitoring any time generators are running and make data—including emissions, runtime, and cause of generator use—publicly available.
- **Setbacks and buffers:** Locate generators far away (e.g., >2,000 feet) from schools, homes, and other sensitive sites.
- **Require additional protective measures including:**
  - Limiting testing to the lowest frequency possible, during daytime hours and post testing schedule in advance.
  - Minimizing sound and visual impacts by using acoustic enclosures, sound-attenuating louvers, landscaping, and other screening.

Some municipalities, air districts, state environmental agencies, and state legislatures are beginning to implement some of the above protections. See a full list of examples in the Appendix; several of these include:

- In Divide County, ND, noise limits for data centers at the nearest residential property are 50 dBA or lower during the day and 45 dBA or lower during nighttime. This ordinance also establishes data center-specific setbacks and requires sound buffers at property lines.
- Oregon is incentivizing Tier 4 generators at data centers, while both Virginia and Washington have draft requirements for Tier 4 generators.

Conclusion

As the unprecedented buildout of data centers accelerates in the race to scale AI, communities and governments face decisions that may fundamentally reshape local economies, environments, and energy systems. This report aims to provide an evidence-based, community-centered examination of one specific piece of that puzzle: the use and impacts of diesel generators. The topics and recommendations were developed directly in response to questions we have received from Tribes, frontline communities, and elected officials navigating data center buildouts.

This field is evolving at a rapid pace and many aspects of data center development remain in flux. However, the magnitude of diesel generator capacity already permitted and installed means that some communities will experience harm even if generators are used only for testing, maintenance, and rare emergency outages. The breakneck pace of data center development, combined with long interconnection timelines, growing electricity demand, and increasing grid stress, raises legitimate concerns that diesel generators could be used more frequently in the years ahead—for momentary grid disturbances, demand response events, planned outages, or bridging power.

We offer several approaches to reduce harm—including deploying battery energy storage systems, investing in grid infrastructure to alleviate stress, minimizing on-site backup power needs through operational flexibility and efficiency, and implementing the strongest possible safeguards if diesel use is unavoidable—but acknowledge that none of these approaches is impact-free, nor do they address the many other economic, environmental, and social impacts of data centers. BDCP believes that communities have a right to determine if and how data centers are developed, powered, and operated. We hope this report can support this decision-making.

Appendices

Examples of protective policies and ordinances

Below are examples of proposed and implemented protections by municipalities, air districts, legislatures, and state environmental agencies as of February 2026.

Tier 4 requirements and restrictions on generator use:

- In Virginia, counties have put restrictions on generator use, and a statewide requirement for Tier 4 generators is proposed:
  - Goochland County, VA implemented protections via zoning including requiring Tier 4 certified generators, prohibiting use outside of testing & defined emergencies, and requiring a variety of location, sound and visual impact mitigations.
  - Stafford County, VA limits generator use to backup and emergencies only.
  - Statewide, Virginia DEQ has a proposed requirement (pending governor approval) for Tier 4 gensets for any data center air quality permit submitted on or after July 1, 2026.
- Oregon DEQ is incentivizing the installation of Tier 4 emissions-equivalent gensets at data centers by streamlining application and permitting processes and decreasing processing timelines.
- Washington State's Department of Ecology has a draft "Data Center General Order" requiring that data centers use only Tier 4 gensets.
  - When their expected emissions exceed certain levels, Washington also requires data centers to prepare: "a health impact assessment of their toxic air pollution (diesel exhaust and nitrogen dioxide) [...] before a data center can be built or expanded."
- VA SB371 (proposed) prohibits the use of carbon-emitting generating resources to meet demand flexibility standards.

Noise restrictions:

- In Prince William County, VA, a draft ordinance stringently regulates noise pollution using octave bands and a dBC scale to better regulate low frequency noise.
- In Divide County, ND, noise limits for data centers at the nearest residential property are 50 dBA or lower during the day and 45 dBA or lower during nighttime. This ordinance also establishes data center-specific setbacks and requires sound buffers at property lines.

Cases of diesel spills at data centers

The following cases of diesel spills at data center sites are compiled from news reports, state agency clean-up sites, and the National Response Center (NRC) database of reported incidents (https://nrc.uscg.mil/). This is not an exhaustive list, as many incidents are only reported to state environmental agencies.

1. **8/1/2008**: 15,000 gallon diesel leak at an AT&T data center in Bothell, WA. The released fuel entered nearby storm drains; remediation and monitoring lasted over a decade. Washington state clean-up site 1089 (fined $57,000 by EPA).
2. **9/6/2017**: 600 gallon diesel spill at Digital Realty EWR21 data center in Clifton, NJ. Diesel discharged from an overflow vent of an underground storage tank and contaminated a nearby storm drain. (NRC Seq. No. 1189499)
3. **11/1/2022**: 1,800 gallon diesel leak at Equinix NY7 data center in North Bergen, NJ. Diesel leaked into the ground from a storage tank. (NRC Seq. No. 1351647)
4. **8/29/2023**: 3,600 gallon diesel leak at Evoque BO-1 data center in Watertown, MA. Diesel leaked from an underground storage tank; 3,000 gallons were recovered and 500 went into the ground. (NRC Seq. No. 1377806)
5. **1/24/2024**: 250 gallon diesel spill during construction of the Microsoft EAT03 data center in East Wenatchee, WA. Resulted in contaminated soil. Washington state clean-up site 17069.
6. **10/9/2024**: Diesel spill due to a fuel line failure at a QTS data center in San Antonio, TX. Occurred during fueling, leading to a spill and a fire.
7. **7/16/2025**: Diesel spill at a Bank of Ireland data center in Cabinteely, South Dublin, Ireland. Resulted in contaminated local waterways and affected wildlife. Spill volume not covered in media reports.
8. **7/22/2025**: 140 gallon diesel spill at Amazon Data Services PDX - 80939 Powerline data center in Umatilla, OR. Diesel discharged to gravel, likely due to overfilling of a tank. (NRC Seq. No. 1437739)
9. **12/3/2025**: 200 gallon diesel spill at a Meta data center in Altoona, Iowa. Spill occurred on an asphalt pad, with some reaching a stormwater retention pond.
10. **12/10/2025**: 100 gallon diesel spill at Amazon Web Services PDX - 994 Penney data center in Hermiston, OR. Diesel discharged due to a leak in the piping that feeds to a generator. (NRC Seq. No. 1450036)

Terms and definitions

Backup power terms and units

bhp Brake horsepower, the mechanical output power of the engine in units of horsepower. The electric power of a genset is typically ~91% of the brake power due to mechanical losses. 1 bhp = 0.7457 kW ≈ 0.68 kWe.

CI engines Diesel generators use compression-ignition (CI) engines, which are a type of reciprocating internal combustion engine (RICE) that ignite fuel using compression instead of a spark plug (like spark-ignition engines). CI engines compress air to high pressures and temperatures, causing fuel to auto-ignite when injected.

Diesel genset A diesel engine-generator set (or genset/gen-set) is a unit that combines an engine that combusts diesel with an electrical generator. Often the set is simply referred to as a generator.

kWe or ekW kilowatt-electric, the *electrical* output power of a generator in kW

Standby generators Most emergency gensets used by datacenters are rated as standby generators by manufacturers. These are designed to run at variable loads for up to 500 hours per year during emergency outages. These contrast from **prime generators** which are designed to operate continuously and provide power for unlimited hours per year.

Standby rated capacity The standby, or nameplate, capacity is the maximum power that can be drawn from a standby generator. Typically, the average power over a 24 hour period should not exceed 70% of the standby rated capacity. For example, a 3 MWe standby rated genset should average 2.1 MWe or less in power output. Put another way, if a data center wants to reliably source 100 MW of power, at least 140 MW of standby capacity is needed.

UPS Uninterruptible power supplies (UPS) are electrical systems which maintain the continuity of power in the event of input power (grid) failure. They consist of batteries, converters, and switches, and typically maintain power for a short period of time (seconds to minutes) until generators can be started up.

Pollutants

CO Carbon monoxide (CO) is formed from incomplete combustion of hydrocarbons into CO_2, At the levels emitted by diesel generators, CO does not pose a direct health risk. However, it can contribute to ozone formation (along with NOx and VOCs) and alter atmospheric chemistry.

NOx Nitrogen oxides, which can be a combination of nitric oxide (NO) and nitrogen dioxide (NO_2). NOx has direct adverse health effects on the respiratory system (e.g. aggravating asthma symptoms), but can also react with other pollutants to generate ozone and particulate matter.

NMHC Non-methane hydrocarbons. This is a measure of hydrocarbon emissions that excludes methane, which is a greenhouse gas but does not participate in ozone formation. For a diesel engine, NMHC typically consists of aromatic compounds (like benzene, toluene), alkanes, alkenes, and aldehydes.

PM Particulate matter (PM) is liquid or solid particles in the air, such as dust, dirt, smoke, pollen, or mold spores. Diesel combustion primarily generates **$PM_{2.5}$**, or particles less than 2.5 μm in diameter, which are linked to cancer and particularly harmful to health as they can enter the airways and the bloodstream. The particles in diesel exhaust typically consist of an elemental carbon core (soot), with adsorbed aromatic hydrocarbons, trace metals, and nitrates.

VOC Volatile Organic Compounds (VOCs): organic molecules with high vapor pressures at room temperature (i.e. they readily evaporate). Common VOCs emitted by diesel engines are methanol, formaldehyde, and alkynes. VOCs on their own can be hazardous to health, but they can also interact with nitrogen oxides to form ground-level ozone (O_3).

Note that VOCs are generally a subset of NMHC, as the EPA excludes non-ozone-forming compounds (such as methane, ethane, and acetone) from their definition of VOCs.

Emissions controls

cDPF In catalyzed DPF (cDPF), the filter is loaded with a catalyst. The main purpose is to oxidize soot and $PM_{2.5}$ particles at lower temperatures to passively regenerate the filter. However, cDPF also promotes oxidation of CO and hydrocarbons, thus reducing CO and VOC emissions.

Closed loop SCR This is a type of SCR which actively controls the injection rate of the reductant (urea) to minimize NOx emissions, using feedback from sensors that measure NOx and O_2 concentration in exhaust. **Open loop**

SCR, by contrast, does not use sensor feedback, making it less effective but cheaper to deploy.

DEF Diesel Exhaust Fluid (DEF) is the water-urea mixture used to deliver the reductant to the exhaust stream for SCR. Standards for DEF are set by ISO 22241, defining a concentration of 32.5% urea and 67.5% de-ionized water. It is also referred to as AUS 32 (aqueous urea solution 32%).

DOC Diesel Oxidation Catalyst (DOC) is a form of **CO, VOC and PM emission control**. DOC is essentially a catalytic converter that oxidizes CO, unburned hydrocarbons, and PM, reducing the emissions of each by 20–90%. DOCs also oxidize NO into NO_2, which can be more readily reduced by SCR downstream. These flow-through devices are placed in the exhaust stream and typically consist of a honeycomb structure coated with precious metal catalysts (like platinum or palladium).

DPF Diesel Particulate Filters (DPF) are **PM emissions controls** that trap particles in a flow filter substrate. Typically, DPFs are made of porous ceramics such as cordierite or silicon carbide. The collected particles are removed periodically during “regeneration” by increasing exhaust temperatures to burn off the particles.

SCR Selective Catalytic Reduction (SCR) is a form of **NOx emissions control** that uses a catalyst and a reductant (such as urea or ammonia) to convert nitrogen oxides into N_2, H_2O, and CO_2. SCR typically reduces NOx emissions by ~90%. SCR only operates efficiently at high temperatures (a typical threshold is 300 °C, or 572 °F), and thus generally doesn’t run during warm-up and cool-down periods of genset operation.

ULSD Ultra-Low Sulfur Diesel. The sulfur content of ULSD is specified to be less than <0.0015% by weight (or 15 ppm) by the American Society for Testing and Materials (ASTM) specification, D975, for grade ultra-low sulfur 2-D or grade 2-D S15. Limiting sulfur content in fuel is the only form of **SO_2 emissions control** employed in diesel generators.