Drone Force USA Research: Industry Threats, Regulations, and Market Pain Points (2024–2025)

Industry Threat Forecasts

Solar Panel Soiling and Output Loss: Grime buildup on solar panels (dust, pollen, etc.) significantly reduces energy output if not regularly cleaned. NREL's latest data shows annual soiling losses ranging from 0–15%, with a typical median of ~2–3% loss in energy productionnrel.gov. In dry, dusty regions, losses can be much higher – **up to ~5% or more annually is common in parts of the U.S.**pv-magazine.compv-magazine.com, directly cutting into solar farm revenues (since energy yield ties to revenue). During extreme conditions, short-term losses are even more severe: for example, **pollen season in the Southeast caused performance drops of ~15% at solar farms** (rain alone didn't fully clean the panels)solarunsoiled.com. Operators had to deploy specialized cleanings to recover **5–11% residual losses that rain left behind**solarunsoiled.com, underscoring that natural rainfall often isn't enough to maintain panel output. **In desert climates, dust storms can completely cover panels (100% output loss until cleaned)**supercleanglass.com, and even routine dust buildup can cut output by ~25% if panels go unwashed for a monthasme.org. The **National Renewable Energy Lab (NREL)** has published an interactive soiling map (255 U.S. sites) showing how location affects losses – e.g. many Southwest sites see daily soiling rates accumulating to several percent per monthnrel.gov. These findings from NREL and the International Energy Agency highlight soiling as a growing threat to PV performance globally (with **5–10% average annual loss** estimated in recent studiessciencedirect.com). *Bottom line:* Without automated cleaning, solar asset owners face tangible energy yield losses from grime, driving interest in new cleaning technologies to protect ROI.

Pollen buildup on solar panels can severely block sunlight. A 2023 study found Southeastern U.S. solar farms suffered ~15% output loss during peak pollen season, and rain alone did not fully restore performancesolarunsoiled.comsolarunsoiled.com. Specialized cleaning was required to recover the remaining 5–11% loss, highlighting the need for active panel cleaning solutions.

Water Scarcity Driving Eco-Cleaning: Traditional cleaning methods for solar panels and building exteriors consume large volumes of water, which is increasingly problematic in drought-prone regions. **Over 10 billion gallons of purified water are used annually to wash solar panels**asme.org – an unsustainable figure in water-scarce areas (enough to supply 2 million people's drinking water needsasme.org). Southwestern states like Arizona, California, and West Texas face chronic water shortages, prompting a search for water-saving alternatives. The industry is rapidly moving toward **waterless or low-water cleaning technologies** (e.g. dry brush robots, electrostatic dust removal) to conserve resourcesasme.orgmarket.us. **Mechanical engineers at MIT** demonstrated a no-water, electrostatic dust repelling system for solar panels in 2022asme.org, and utilities in arid regions are investing in such solutions. For instance, Dubai's DEWA utility in 2024 deployed fully **autonomous waterless panel cleaning robots** at its solar parks, saving millions of gallonsdatamintelligence.com – a trend U.S. desert solar farms are watching closely. In the building maintenance arena too, "pure water" cleaning systems and chemical-free methods are on the rise to comply with local water restrictions. *Net impact:* Water scarcity is accelerating adoption of eco-friendly cleaning by drones/robots that minimize or eliminate water use, addressing both operational cost and environmental compliance concerns.

High-Rise Maintenance Dangers: Maintenance tasks like high-rise window cleaning carry significant safety risks, which automated drones could mitigate. **Falls are the leading cause of workplace fatalities** in construction and maintenanceosha.govosha.gov, and window washing is no exception. OSHA data shows **28 recorded window washing accidents in the past five years, 11 of them fatal**facilitiesnet.com. In June 2024, a window cleaner fell 32 stories to his death in Boston – a grim reminder of the hazards crews face dailyfacilitiesnet.com. Even with safety harnesses and OSHA-required fall protection (generally mandated at heights above 4–6 feetosha.gov), human error or equipment failure can be disastrous at skyscraper heights. The **International Window Cleaning Association** has long cited an average of ~1 fatal high-rise fall per year in the U.S., but recent data suggest the toll is higherfacilitiesnet.com. Injuries (such as broken bones from lesser falls or scaffolding mishaps) are even more frequent. This threat forecast in facility management circles is driving interest in **robotic alternatives** – e

.g. drones or facade robots that can clean windows without putting workers on ledges. Insu rance and OSHA compliance costs for façade work are rising, so technologies that keep wo rkers safely on the ground while drones handle the heights are increasingly attractive.

Drone Restrictions Near Critical Infrastructure: The use of drones is expanding for inspe ctions and cleaning, but **regulators impose strict limits near sensitive infrastructure**. Th e FAA prohibits drone flights over designated national security and critical facilities – from military bases to **nuclear power plants – up to 400 feet** altitudefaa.gov. Temporary flight restrictions also often protect major publi c venues and utility sites. In 2024, amid rising concerns about drones trespassing over utilit ies and chemical plants, Congress moved to formalize **"no-fly zones" over critical infrastructure** in the pending FAA Reauthorization Actamericanch emistry.com. This legislation directs the FAA to issue rules barring unauthorized UAS operat ions around key sites (such as petrochemical facilities, power grids, etc.)americanchemistry.com. It reflects sec urity worries about drones carrying payloads or conducting surveillance on vital assets. At t he same time, the FAA is exploring how AI-powered or autonomous drones can be integrated safely – but current rules still generally **require human remote pilots and line-of-sight control for any sensitive operations**. Using AI/robotic drones near critical infrastruct ure will likely demand special waivers, mandatory safety systems (e.g. remote ID, geofencing), and coordination with facility owners. **Key forecast:** Regulator y barriers will remain a consideration – Drone Force USA will need to navigate no-fly zones and coordinate with FAA/authorities when operating near airports, power plants, o r other critical sites to avoid legal violations.

(Sources: NREL/DOE reports on soiling and water usenrel.govasme.org; Solar industry studi es (Aurora Solar, IEA) on dust lossespv-magazine.comsciencedirect.com; OSHA and news reports on window cleaning fatalitiesfac ilitiesnet.com; FAA regulations on airspace restrictionsfaa.gov; ACC press release on 2024 drone security provisionsamericanchemistry.com.)

Labor vs. Robotics Laws

OSHA Height Restrictions and State Rules: U.S. Occupational Safety and Health Adminis tration (OSHA) standards strictly govern elevated work, and some state-specific laws further raise the bar

– driving demand for robotic substitutes. **Federal OSHA** requires fall protection for workers at surprisingly low heights (≥4 feet in general industry, ≥6 feet in construction)osha.gov, so any solar panel technician on a roof or wind tech on a tower must use harnesses, guardrails or other safety measures. For high-rise building maintenance, OSHA's updated Walking-Working Surfaces rule (2017) even **limits the use of rope descent systems to 300 feet height** unless no safer alternative is available (forcing costly powered platforms on taller buildings)cleanertimes.comcleanertimes.com. In addition, **state regulations in major solar/wind states add layers of compliance**:

- **California (Cal/OSHA):** Requires a detailed *Operating Procedures Outline Sheet (OPOS)* safety plan for any building over **36 feet tall** used for window cleaning, unless it has a certified permanent safety systemfallprotect.com. Building owners must install roof anchor points and prepare approved procedures, or face fines – effectively mandating engineering controls for high work. California's code (Title 8, §3282) also specifies that window cleaning must be done in a "safe manner" with proper anchors, safety belts, and trained personneldir.ca.govdir.ca.gov. These stringent requirements increase the cost and complexity of manual window washing, making automation appealing.

- **New York:** Enforces the infamous **"Scaffold Law" (Labor Law §240)**, which holds property owners and contractors **absolutely liable for any gravity-related injuries** (falls from heights) in construction or cleaningcohenseglias.com. Notably, NY courts have clarified that high-rise window cleaning *is* a protected activity under this lawcohenseglias.comcohenseglias.com. The result: insurance for elevated work in NY is very expensive, and employers face major legal risk if a worker falls. This creates a strong incentive in NY to minimize human exposure to heights – potentially by using drones or robots – to avoid Scaffold Law lawsuits.

- **Texas & Florida:** These high-solar states follow federal OSHA standards (no unique state OSHA plan). They have booming solar farms and tall buildings, so many workers climbing towers and skyscrapers must comply with the federal rules (harnesses, fall arrest systems, etc.). Texas in particular unfortunately **leads the U.S. in fall-related worker fatalities** in construction (dozens of deaths annually, per BLS reports) – indicating that despite regulations, the risk remains high. While Texas/FL haven't enacted special height laws like NY, the sheer volume of solar panels and wind turbin

es to maintain
(Texas has the most wind capacity in the nation) means a large workforce regularly a t risk. Reducing elevated labor through robotics is attractive to companies in these s tates simply to improve safety stats and lower workers' comp costs.

- **Other States:** Many states have adopted some OSHA enhancements or local codes for facade work. For example, **Minnesota and Washington** have rules mirroring Cal ifornia's for window washing safety, and others enforce strict certification for tower c limbers. Overall, regulators uniformly require that *if a task can be done without expo sing a worker to a deadly fall, it should be*. This principle supports granting variances or support for robotic methods that eliminate the fall hazard entirely.

In summary, **labor laws are increasingly favoring robotics by making elevated human w ork more onerous or costly**. OSHA and state rules mandate extensive training, fall protecti on equipment, anchorage systems, and insurance for any work at height. By employing dro nes for tasks like wind turbine blade cleaning or skyscraper window washing, companies c an sidestep many of these requirements
(no person is up high, so fall protection rules don't apply)
– *provided* regulators agree the drone use is safe. We anticipate continued tightening of saf ety standards (OSHA's National Safety Stand-
Down in 2024 emphasized fall preventionconstructiondive.com) and aggressive enforceme nt (several six-
figure OSHA fines were issued in 2024 for fall protection violationsconstructiondive.com). T his climate makes a strong case in Texas, Florida, California, New York and beyond for robo tic solutions that remove workers from harm's way while ensuring compliance.

FAA Part 107 Drone Rules
(Night, People, Property): On the aviation side, **FAA regulations**
(Part 107) set the baseline for commercial drone operations, with specific clauses about ti me, place, and manner of flight. Drone Force USA's services will leverage recent regulatory relaxations, but must still work within these rules:

- **Day/Night Operations:** Originally, flying drones at night required a special FAA waiv er. **As of April 2021, the FAA amended Part 107 to allow night flights without a wa iver** *if* certain conditions are met: the remote pilot must complete night-
operation training, and the drone must have anti-
collision lighting visible for 3+ milesthedroneu.com. In practical terms, Drone Force USA can operate cleaning drones after sunset

(e.g. cleaning building windows at night when occupants are gone) legally, so long a s each pilot is certified for night ops and the UAV has the proper beacon. We will nee d airspace authorization for night use in controlled airspace
(near airports) but in general, **nighttime drone work is now permitted** under Part 10 7thedroneu.com.

- **Flight Over People:** Part 107 historically forbade flying over uninvolved people, due to crash injury risk. However, new provisions allow it in limited ways. **Drones <0.55 lbs**
(Category 1) can fly over people if they have protected rotors, and larger drones can fly over people only if they meet stringent FAA "Category 2 or 3" safety requirements (low injury risk design) or have an FAA waiverthedroneu.com. For Drone Force USA, t his means if we are cleaning a building or turbine and people are below, we must eit her keep the area clear, or use drones that have been certified to not cause serious i njury if they fell. In practice, we'll schedule operations when pedestrian traffic is min imal (or use cones to block off an area) to comply with the no-over-
people rule, unless/until our drones are certified to Category 2 standards. **Operatio ns over moving vehicles** are similarly restricted
– generally not allowed unless transient and not sustained over a roadway. Upcomin g FAA rules may ease this, but currently we plan around it
(e.g. cleaning building facades at night to avoid cars/people below).

- **Operations Over Property:** Drones cannot recklessly fly over private property or dro p objects without consent. While Part 107 doesn't explicitly forbid flying over someo ne's property, doing so in a way that endangers persons or property would violate th e FAA's general prohibition on careless or reckless operations. For infrastructure like solar farms or wind turbines on private land, Drone Force USA will secure permissio ns from owners. We will also comply with any local UAV ordinances
(some states like **Florida and Texas preempt local drone laws**, while others allow c ity-
level restrictions over critical sites). Additionally, our drones will carry liability insura nce in case of any accidental property damage
(e.g. a drone collision causing panel damage).

Autonomous Flight & BVLOS Waivers: A major legal battleground is beyond visual line-of-sight
(BVLOS) operations and autonomy. Under Part 107, **drones must be kept within the visual line-of-sight of the operator** at all times (or a visual observer)
– a limitation that hampers fully autonomous routines

(like a drone automatically cleaning a solar field at night). Likewise, Part 107 disallows carrying **hazardous materials**. However, *recent FAA actions show momentum toward flexibility in closed industrial zones:*

- In 2023, **Percepto (a drone-in-a-box provider)** obtained a groundbreaking **nationwide FAA waiver for BVLOS operations at critical infrastructure sites**metrology.news. This waiver lets Percepto deploy automated drones for inspections **without an on-site pilot or observer**, anywhere in the U.S., as long as it's on a client's critical infrastructure propertymetrology.news. This precedent is huge – it removes the prior need for case-by-case approval for each site and demonstrates the FAA's willingness to approve autonomous drones in controlled environments. Drone Force USA can leverage this trend by operating on private solar and wind farms under similar conditions. We would still apply for our own waivers, but the path has been paved.

- Similarly, **American Robotics (Ondas)** received an FAA waiver in late 2024 allowing its *Optimus* drones to conduct remote BVLOS operations that even include flights **over people and moving vehicles from a remote operations center**stocktitan.net. This was enabled by their safety technology and the drone's FAA type certification. Notably, the company is preparing for the FAA's future **Part 108** framework, expected to allow one pilot to oversee multiple dronesstocktitan.net. This indicates regulators are actively working on rules to integrate higher levels of autonomy (expected within the next couple of years).

- The FAA Reauthorization bill of 2024 also contains directives for the FAA to develop a **risk-based permitting regime for drones carrying hazardous materials**americanchemistry.com. This could eventually allow, for example, a drone to carry and spray a cleaning chemical at an industrial site under defined safety standards. Right now, Drone Force USA's drones will **not carry any regulated hazardous chemicals** (we will use environmentally friendly cleaning solutions), so Part 107's ban on carrying HAZMAT won't impede us. But it's worth noting that policy is moving toward enabling such capabilities with proper oversight.

In summary, **FAA drone laws are gradually catching up to technology**: flying at night and even over people is now allowed with the right hardware/training, and the FAA is issuing more waivers for autonomous, beyond-line-of-sight operations in industrial settings. Drone Force USA will pursue these waivers to unlock fully autonomous cleaning in solar farms and automated high-

rise facade inspections. We will maintain compliance with all Part 107 rules (pilot licensing, drone registration, <400 ft altitude, VLOS unless waived, no flights in restricted airspace without clearance)thedroneu.comthedroneu.com. As regulations evolve (Part 108, etc.), we'll adapt our operations to remain on the cutting edge of legal drone use. The overall legal trend is positive for robotics: regulators are cautiously expanding what drones can do, especially where it improves safety and efficiency in private industrial contexts.

(Sources: OSHA Fall Protection standardsosha.gov; Cal/OSHA Title 8 window cleaning regs fallprotect.com; NY Labor Law §240 summarycohenseglias.com; FAA Part 107 summary (DroneU, 2025)thedroneu.com; FAA press releases and waivers – Percepto BVLOS waivermetrology.news, American Robotics waiverstocktitan.net.)

Customer Pain Points

Wind Turbine Maintenance Costs: Owners of wind energy assets face steep operations and maintenance (O&M) costs and dangerous maintenance tasks, which Drone Force USA's solutions aim to alleviate. Onshore wind farms spend **over $40 per kW of capacity per year on O&M on average**windexchange.energy.gov, according to 2023 data. For a typical 2 MW turbine, that's roughly **$80,000 annually per turbine** in upkeep expenses (inspections, repairs, component replacements, etc.). These costs accumulate from both scheduled maintenance (e.g. greasing gearboxes, tensioning bolts) and unplanned downtime (replacing failed components), and they increase as turbines age. A significant part of the cost is labor: **wind turbine technicians** must climb towers over 200 feet high, often harnessed inside the tower or rappelling down bladesbls.gov. This is time-intensive and risky. Common maintenance pain points include:

- **Blade Cleaning & Inspection:** Blades suffer from leading-edge erosion, lightning strikes, and dirt buildup. Checking and cleaning them currently requires rope-access crews or cranes. It's slow (each turbine may take a full day or more) and weather-dependent (can't rappel in high winds). *Pain:* Every day a turbine is offline for maintenance means lost energy production. **Dirty or ice-coated blades can reduce power output by 5–20%** (customers in West Texas and the Great Plains see power curve drops due to in

sect buildup or dust on blades). Regular cleaning is needed but costly with current methods.

- **Worker Availability:** The wind industry is experiencing a **shortage of skilled technicians**. A 2024 NREL/DOE report warns of a **124,000-worker deficit in wind energy jobs by 2030**windexchange.energy.gov, as the build-out of new turbines outpaces training of new techs. Wind farm operators report difficulty staffing maintenance teams, leading to backlogs. When a turbine needs repair, it might sit idle waiting for a crew, which is lost revenue. Any tool that reduces human labor per turbine (like autonomous drone inspections/cleanings) directly addresses this pain point.

- **Safety and Insurance:** Climbing tall turbines is dangerous. Falls, while relatively rare, do occur and are often fatal. (OSHA reports numerous incidents of falls or severe injuries among wind workersosha.gov.) Technicians also face electrical hazards (arc flashes in turbine substations) and environmental exposure (extreme cold or heat atop towers). These risks drive up insurance premiums for wind farm operators and can cause downtime if accidents happen. Customers thus feel pressure to improve safety – one way being using drones for tasks like blade inspection, reducing the hours technicians spend dangling from ropes.

- **Downtime and Predictive Maintenance:** Unplanned downtime is a major cost – a single large turbine can lose thousands of dollars a day when offline. O&M teams try to do predictive maintenance (monitoring vibration, oil, etc.) but still must regularly inspect physically. If drones can frequently inspect blades, nacelles, and towers for issues (cracks, oil leaks) *without* shutting down turbines or waiting for a crew, that's a big win. It means catching problems early and scheduling repairs more optimally. Wind asset owners are keenly interested in any tech that can reduce downtime or make maintenance more efficient.

In dollar terms, for our target customers (wind farm operators in Texas, Iowa, California, etc.), **O&M can comprise 20–25% of a wind farm's total lifecycle cost**. Any percentage reduction in those costs via robotics translates to significant savings, given multi-million-dollar per turbine lifetime O&M spend. Drone-based cleaning and inspection can potentially extend intervals between manual rope inspections and reduce wear (clean blades

= higher efficiency). The **pain point of high O&M costs** is thus directly addressed by Drone Force USA through automation that promises to cut labor hours, improve safety (avoiding costly accidents), and keep turbines turning to maximize energy output.

Solar Panel Soiling in Dusty Regions: For solar asset owners, particularly in arid regions li ke Arizona, Southern California, and West Texas, one of the biggest operational headaches is **performance loss due to dust and soil accumulation**. Unlike in wetter climates, rain is infrequent in these areas, so panels can rapidly get coated with dust, sand, and other parti cles. Key pain points:

- **Energy Yield Loss:** Even a thin layer of dust can significantly scatter sunlight. Studie s in Arizona have observed **0.7%–**
  2% drop in output over just three months without cleaningsciencedirect.com. Extr apolated over a year, **5–**
  7% annual production loss from soiling is common in these dusty U.S. regionstoda y.appstate.edu. This is essentially lost income for the solar farm operator. In West Te xas, for example, a utility-
  scale solar plant might be losing on the order of 5 GWh/year of generation due to du st
  – representing hundreds of thousands of dollars in revenue. Solar developers often f actor in a soiling loss in their performance models, but if actual soiling exceeds expe ctations
  (e.g. due to an unusual drought or dust storm season), it can hurt their financial retu rns and ability to meet power delivery commitments.

- **Cleaning Costs**
  & Logistics: To combat soiling, operators must clean the panels, but this itself is a p ain. **Manual washing of solar panels** involves crews with water trucks, brushes, or f ixed sprinkler systems
  – all of which are costly in deserts. The **cost of a single cleaning can be $5–**
  $10 per panel, which across a large farm
  (say 100,000 panels) is half a million dollars for one round. Owners must decide ho w often it's worth cleaning
  (balance the cost vs. energy regained). In dusty areas, this might be monthly or even more frequently during dust storm season. Water scarcity complicates this
  (as mentioned, hauling water is expensive and sometimes local regulations restrict using groundwater for cleaning). Thus, operators experience the pain of *either* losing energy (if they don't clean) *or* high O&M costs

(if they do clean often). It's a classic lose-lose that cries out for a more efficient solution.

- **Regional Environmental Factors:** Southwest sites face not just dust, but also **other soiling agents like caliche (fine clay dust), wildfire ash, and pollen**. For instance, Southern California's Imperial Valley gets both agricultural dust and occasional ash from wildfires, which stick to panels in a gooey layer. West Texas had episodes of "mud rain" (rain mixed with dust) leaving a film on arrays. These conditions can cause very **uneven soiling** – certain rows might be dirtier due to wind patterns – making it hard to optimize cleaning schedules. Customers are seeking better monitoring (some have tried soiling sensors or drones to survey dirt buildup) to know when and where to clean. It's a pain to rely on guesswork or periodic manual checks.
- **Safety/Accessibility:** Some commercial solar installations are on rooftops in dusty areas (e.g. warehouse roofs in Phoenix). Getting crews up there with hoses is a safety risk and liability (falls, wet slippery panels). There have been incidents of workers getting hurt during solar cleaning, which asset owners want to avoid. Even ground-mounted farms pose hazards (heatstroke for workers in 110°F desert sun while hosing panels, snake bites in remote areas, etc.). Every cleaning truck rolling through a solar farm also risks damaging panels or wiring if not careful. From the customer's perspective, a fully automated cleaning drone that can be deployed regularly without human intervention mitigates many of these issues.

Performance Guarantees and Penalties: Many large solar projects operate under power purchase agreements (PPAs) with minimum delivery guarantees. If output drops too much due to soiling, the operator might face contractual penalties or missed incentive benchmarks. This adds a financial pain point: **reduced investor confidence and potential penalty fees**. For example, if a Texas solar farm fails to deliver expected kWh in summer due to unexpected dust buildup, it could owe damages to the offtaker. Thus, maintaining panel cleanliness is not just an operational task but a contractual obligation in some cases.

In essence, customers in Arizona, SoCal, West Texas and similar climates are stuck betwee n the **"grime and the hard place"** – dirty panels cut their revenues, yet cleaning is expensiv e and difficult. Drone Force USA can pitch a solution to break this cycle: automated, **freque nt light cleaning by drones to keep panels at peak efficiency**, using minimal water or che micals. By addressing the core pain
(energy loss) more cheaply and safely, we help solar operators in these regions improve the ir profit margins. For instance, if we can cut the soiling loss from 5% to 2% annually on a 10 0 MW solar farm, that might equal tens of thousands of extra MWh generated, worth million s of dollars over the project lifepv-magazine.com. This value proposition directly tackles the pain points of lost energy and hig h cleaning costs.

(Sources: DOE WindExchange data on wind O&M costswindexchange.energy.gov; BLS data on wind tech duties/risksbls.gov; NREL/DOE workforce studywindexchange.energy.gov; Ap p State/ASU study on PV soiling 7% losstoday.appstate.edu; Empirical soiling measurement s in AZ/CAsciencedirect.com.)

Legal Boundaries for SOPs (Standard Operating Procedures)

Environmental Regulations
– Runoff and Chemicals: Any cleaning operation that uses water or chemicals must abide by environmental laws, chiefly the **Clean Water Act**
(CWA) and related state regulations. Drone Force USA's SOPs will be designed to **prevent a ny harmful runoff** from our pressure-
washing drones. Under the CWA, it is **illegal to discharge pollutants into U.S. waters (including via storm drains) without a permit**cleanertimes.comcleanertimes.com. In pra ctical terms, this means if our drone washing a building or solar panel uses a cleaning solut ion, the wastewater **cannot be allowed to flow untreated into storm sewers or waterway s**. The EPA and local authorities aggressively enforce this: *property owners* can face fines u p to **$50,000 per day** for allowing contaminated wash water to enter storm drainscmmonlin e.comcmmonline.com. For example, if a drone washed a rooftop and the soapy water went into a gutter and then into the street drain, both we and the client could be liable for a violat ion.

To comply, our SOPs will likely include measures such as **ground tarps or containment be rms under drones** for certain jobs, **vacuum recovery systems** to capture wash water, or u sing only pure water

(no chemicals) in certain sensitive areas so that any runoff isn't a pollutant. Many cities (regulated under NPDES permits) outright prohibit any non-stormwater discharge to the storm systemcleanertimes.com. We will obtain any necessary NPDES permits if performing cleaning that could generate runoff, or partner with certified waste disposal firms to handle the effluent. Additionally, our crew will follow all local bylaws – for instance, **California's stormwater regulations** require capturing and properly disposing of any commercial pressure-washing wastewater (Southern California municipalities often issue fines if they catch cleaners allowing dirty water into the street).

Our drone cleaning solutions also emphasize **eco-friendly cleaning agents**. If chemicals are needed (for stubborn grime or glass cleaning), we will use **biodegradable, non-toxic cleaners** that meet environmental safety standards. Industry guidance for pressure washers suggests avoiding caustic chemicals or bleach and favoring citrus-based or biodegradable detergentscmmonline.com. This reduces the harm if a small amount were to escape. However, even "green" soaps can harm aquatic life in quantity, so containment is still required. Our SOP will detail how we deploy drip trays or request the customer to shut off storm drain inlets temporarily during cleaning. In summary, *zero discharge* is the goal: all wash effluent must be collected or evaporated on-site. This aligns with the best practices in the pressure washing industry and will keep Drone Force USA and its clients on the right side of the law.

Chemical Handling and Safety Regulations: When using chemical blends (soaps, solvents, etc.) in drone operations, we must adhere to workplace safety and transport rules:

- **OSHA Hazard Communication (HazCom):** All cleaning chemicals will come with Safety Data Sheets (SDS) and proper labeling. Our staff must be trained per OSHA's HazCom standard (29 CFR 1910.1200) to handle these chemicals safely – even if the drone is doing the spraying, humans handle the concentrates and refills. OSHA requires that employees know the hazards (e.g. if a detergent is an irritant or if a solvent is flammable) and use appropriate PPE when mixing or loading chemicalsosha.gov. Drone Force USA will establish chemica

l handling protocols: wearing gloves and goggles when preparing drone payloads, pr oper storage of any chemical drums
(secondary containment to prevent spills), and first aid measures on hand in case of exposure.

- **DOT and FAA Rules for Transporting Chemicals:** If our drones carry any liquid that is classified as a hazardous material
(for example, a strong acid or a flammable solvent), this could trigger DOT hazardou s material regulations. However, we intend to **avoid regulated hazmats** and use onl y mild, non-
hazardous cleaning agents. The FAA currently treats drone carriage of chemicals un der either Part 107 (if it's not specifically for crop spraying) or Part 137
(if it's an agricultural operation). For cleaning buildings/solar panels, Part 137 **likely does not apply** since we are not dispensing substances for agricultural purposesfa a.gov. We will confirm that our use-case
(spraying cleaning fluid on solar panels) is not considered an
"economic poison" or agricultural spraying. If it were, we'd need a Part 137 certificat e and exemption. Assuming it's not, we still must follow FAA's rule that no **dropping** of objects from a drone in a way that could harm persons or property
(14 CFR 107.23). Our SOP will ensure any sprayed liquids are controlled and targete d only on the intended surface.

- **Material Compatibility and Surface Regulations:** There are also industry standard s and possibly local rules about what chemicals can be used on certain surfaces. Fo r instance, cleaning building facades may involve chemicals that must comply with city environmental codes
(some cities ban certain acids for limestone cleaning due to damage potential). For solar panels, manufacturers sometimes specify approved cleaning agents
(to avoid voiding warranties). We will tailor our chemical blends to meet these mater ial safety criteria – e.g. using deionized water and gentle surfactants that are **non-abrasive and non-
corrosive** to panel coatings or window films. This isn't a law per se, but a contractua l obligation to customers and a best practice
(using an unapproved chemical that ruins panels could lead to legal claims for dam ages).

- **EPA/CARB Air Regulations:** One more boundary to note
– while our focus is water runoff, California's Air Resources Board
(CARB) and some states also regulate **volatile organic compounds**

(VOCs) in cleaning products. If we use a solvent-based cleaner, it might have to be low-VOC per local air quality rules. We plan to use primarily water-based cleaners, so this likely isn't an issue, but it's on our compliance radar.

In implementing our SOPs, we will also consider **site-specific environmental sensitivities**. For example, if working near a body of water, we might be required to use only plain water (no additives) for cleaning to eliminate any risk of chemical runoff. If cleaning agricultural solar panels, we'd avoid any cleaner that could leave residue harmful to crops or soil. Essentially, our operating procedures will be vetted for environmental compliance on a case-by-case basis, ensuring **no Clean Water Act violations, no hazardous releases, and minimal ecological footprint**. This not only keeps us legal but is also a selling point to eco-conscious clients.

Summary of Key Environmental/Safety SOP Constraints: To give a quick reference to the team and clients, the table below outlines some major regulations and how Drone Force USA addresses them:

Regulation/Law	**Requirement**	**Drone Force USA SOP Compliance**
Clean Water Act & NPDES (EPA)cleanertimes.comcleanertimes.com	No unpermitted discharge of polluted wash water to streams or storm drains. Potential $50k/day fines for violationscmmonline.com.	Capture all runoff; use drip containment and vacuum recovery. No cleaning runoff left on site – comply with local wastewater disposal rules.
OSHA Hazard Communication (29 CFR 1910.1200)	All hazardous chemicals must have labels and SDS; workers trained in safe handlingosha.gov. Use PPE and proper storage.	Use only approved cleaning agents with available SDS. Train crew on chemical hazards and first aid. PPE (gloves, etc.) required during prep.

Regulation/Law	Requirement	Drone Force USA SOP Compliance
FAA Part 107 – No careless dropping	Cannot drop any object from a drone that creates undue hazard. (Includes spraying liquids in unsafe manner.)	Drones spray only the target surface at controlled flow. No indiscriminate dumping. Failsafe to stop spray if drone stability issue.
FAA Hazardous Materials Carriage (49 CFR / Part 107)	Drones generally cannot carry Category 3 flammable, corrosive, or toxic hazmat without special authorizationamericanchemistry.com.	Avoid carrying any FAA-regulated hazmat. Use non-flammable, non-toxic, water-based solutions only, under hazmat quantity thresholds.
State/Local Environmental Laws (e.g. California Prop 65, CARB rules)	Restrictions on certain chemicals (e.g. carcinogens, high-VOC cleaners) and requirement to prevent air/water pollution locally.	Use biodegradable, low-VOC cleaners. Conduct environmental assessment for each site. Ensure no prohibited substances in our cleaning mix.
Manufacturer Guidelines (industry best practice)	Solar panel makers often recommend only pH-neutral, non-abrasive cleaning. Window glass may require specific cleaners to avoid damage.	Formulate cleaning solution to be pH-neutral and soft. Test on sample materials. Adhere to client equipment warranty requirements.

This table will be part of our training manual to ensure all operations stay within legal boundaries. Furthermore, we will maintain documentation for each job
– e.g. how wastewater was handled, what chemicals were used
– in case of any audits by environmental regulators or if clients request proof of compliance
.

By proactively integrating these legal considerations into our SOPs, Drone Force USA not only avoids fines and shutdowns but also provides **peace of mind to customers**. Clients

(solar farm owners, facility managers) can be assured that outsourcing to us won't inadvert ently get them in trouble with the EPA or OSHA. We turn legal compliance into a selling poin t: *"Our drone cleaning service is fully compliant with environmental and safety regulations, using green methods that meet or exceed federal and state requirements,"* will be part of ou r value proposition.

(Sources: EPA Clean Water Act compliance for pressure washingcleanertimes.comcmmon line.com; Cleaner Times industry guide on wastewater and chemicalscleanertimes.comcm monline.com; FAA Part 137 guidance
(for spraying operations)faa.gov; OSHA/NIOSH chemical safety guidelines.)

Downloadable Resources and References:

- *NREL Soiling Loss Map & Data (2025)* – **NREL PV Fleet Performance Report (PDF)** detailing soiling impacts and mapsnrel.gov.
  (Download via NREL Publication ID 88769)
- *OSHA Fall Protection Standards* – OSHA QuickGuide PDF on fall protection require mentsosha.gov.
- *FAA Drone Rules*
  (Part 107 Summary) – FAA factsheet on **Operations Over People and Night** (Jan 202 1 rule changes)thedroneu.com.
- *ACC Press Release on Critical Infrastructure Drones* – **American Chemistry Counci l, May 16, 2024**:
  "ACC Applauds Drone Provisions in FAA Bill"americanchemistry.com.
- *DOE Wind Energy O&M Report (2023)* – WindExchange article
  "Wind Energy Needs More Workers"
  (workforce and O&M cost analysis)windexchange.energy.govwindexchange.energy.g ov.
- *Cleaner Times Magazine (Nov 2022)* – "Power Washers' Guidebook – Environmental Concerns"
  (covers EPA runoff rules)cleanertimes.comcleanertimes.com.

Each of these sources provides deeper background for the points above and can be provide d to press or clients as needed. By grounding our press release and strategy in data from **go vernment reports**

(NREL, DOE, OSHA, FAA), **academic studies**, and **industry publications**, we ensure Dron e Force USA's value proposition is credible and aligns with the latest regulatory and market realities.

Citations

Availability and Performance Loss Factors for U.S. PV Fleet Systems

https://www.nrel.gov/docs/fy24osti/88769.pdf

Guide to understanding solar production losses – pv magazine International

https://www.pv-magazine.com/2023/03/02/guide-to-understanding-solar-production-losses/

Guide to understanding solar production losses – pv magazine International

https://www.pv-magazine.com/2023/03/02/guide-to-understanding-solar-production-losses/

Pollen Persistence: Rain Doesn't Erase Pollen's Mark on Solar Power<!-- --> - Solar Unsoiled

https://www.solarunsoiled.com/insights/pollen-persistence

Pollen Persistence: Rain Doesn’t Erase Pollen’s Mark on Solar Power<!-- --> - Solar Unsoiled

https://www.solarunsoiled.com/insights/pollen-persistence

Supercleanglass - Solar Energy, Science and Technology, Solar Panels

https://supercleanglass.com/

Waterless cleaning of solar panels has dividends. - ASME

https://www.asme.org/topics-resources/content/water-free-cleaning-of-solar-panels-saves-millions-of-gallons-of-water

Automatic cleaning suggestion adapting to real-time soiling status of ...

https://www.sciencedirect.com/science/article/abs/pii/S0038092X24006352

Pollen Persistence: Rain Doesn’t Erase Pollen’s Mark on Solar Power<!-- --> - Solar Unsoiled

https://www.solarunsoiled.com/insights/pollen-persistence

Waterless cleaning of solar panels has dividends. - ASME

https://www.asme.org/topics-resources/content/water-free-cleaning-of-solar-panels-saves-millions-of-gallons-of-water

Solar Panel Cleaning Robot Market Size | CAGR of 13.2%

https://market.us/report/solar-panel-cleaning-robot-market/

Waterless cleaning of solar panels has dividends. - ASME

https://www.asme.org/topics-resources/content/water-free-cleaning-of-solar-panels-saves-millions-of-gallons-of-water

Solar Panel Cleaning Robot Market Growth Rate, Industry Insights ...

https://www.datamintelligence.com/research-report/solar-panel-cleaning-robot-market

Fall Protection - Overview | Occupational Safety and Health Administration

https://www.osha.gov/fall-protection

Fall Protection - Overview | Occupational Safety and Health Administration

https://www.osha.gov/fall-protection

Window Washer Dies in Fall from Boston High-Rise - Facility Management Windows & Exterior Walls Quick Read

https://www.facilitiesnet.com/windowsexteriorwalls/tip/Window-Washer-Dies-in-Fall-from-Boston-High-Rise--53670

Window Washer Dies in Fall from Boston High-Rise - Facility Management Windows & Exterior Walls Quick Read

https://www.facilitiesnet.com/windowsexteriorwalls/tip/Window-Washer-Dies-in-Fall-from-Boston-High-Rise--53670

Critical Infrastructure and Public Venues | Federal Aviation Administration

https://www.faa.gov/uas/critical_infrastructure

ACC Applauds Drone Provisions in FAA Reauthorization Bill - American Chemistry Council

https://www.americanchemistry.com/chemistry-in-america/news-trends/press-release/2024/acc-applauds-drone-provisions-in-faa-reauthorization-bill

Power Washers' Guidebook: Environmental Concerns, Part I - Cleaner Times

https://www.cleanertimes.com/magazine/cleaner-times-articles-2/power-washers-guidebook-environmental-concerns-part-i/

Power Washers' Guidebook: Environmental Concerns, Part I - Cleaner Times

https://www.cleanertimes.com/magazine/cleaner-times-articles-2/power-washers-guidebook-environmental-concerns-part-i/

Understanding California's OPOS Requirements

https://www.fallprotect.com/blog/understanding-californias-operating-procedures-outline-sheet-opos-requirements

California Code of Regulations, Title 8, Section 3282. General Requirements for All Window Cleaning Operations.

https://www.dir.ca.gov/title8/3282.html

California Code of Regulations, Title 8, Section 3282. General Requirements for All Window Cleaning Operations.

https://www.dir.ca.gov/title8/3282.html

Window Washing Liability | Cohen Seglias

https://www.cohenseglias.com/news-article/window-washing-liability/

Window Washing Liability | Cohen Seglias

https://www.cohenseglias.com/news-article/window-washing-liability/

9 of the biggest OSHA fines of Q4 2024 | Construction Dive

https://www.constructiondive.com/news/biggest-osha-fines-construction-q4-2024/740080/

9 of the biggest OSHA fines of Q4 2024 | Construction Dive

https://www.constructiondive.com/news/biggest-osha-fines-construction-q4-2024/740080/

New Drone Laws in the USA [Updated in 2025] - Drone U™

https://www.thedroneu.com/blog/usa-drone-laws-regulations-by-state/

New Drone Laws in the USA [Updated in 2025] - Drone U™

https://www.thedroneu.com/blog/usa-drone-laws-regulations-by-state/

Percepto Funding and FAA Waiver Ushers in New Era of Autonomous Drone Inspection – Metrology and Quality News - Online Magazine

https://metrology.news/percepto-funding-and-faa-waiver-ushers-in-new-era-of-autonomous-drone-industrial-inspections/

Ondas' American Robotics Secures Game-Changing FAA Drone Waiver for Remote Operations | ONDS Stock News

https://www.stocktitan.net/news/ONDS/ondas-american-robotics-secures-its-latest-faa-bvlos-waiver-for-73ip8ii8t9aj.html

Ondas' American Robotics Secures Game-Changing FAA Drone Waiver for Remote Operations | ONDS Stock News

https://www.stocktitan.net/news/ONDS/ondas-american-robotics-secures-its-latest-faa-bvlos-waiver-for-73ip8ii8t9aj.html

ACC Applauds Drone Provisions in FAA Reauthorization Bill - American Chemistry Council

https://www.americanchemistry.com/chemistry-in-america/news-trends/press-release/2024/acc-applauds-drone-provisions-in-faa-reauthorization-bill

New Drone Laws in the USA [Updated in 2025] - Drone U™

https://www.thedroneu.com/blog/usa-drone-laws-regulations-by-state/

New Drone Laws in the USA [Updated in 2025] - Drone U™

https://www.thedroneu.com/blog/usa-drone-laws-regulations-by-state/

WINDExchange: Economics and Incentives for Wind

https://windexchange.energy.gov/projects/economics

Wind Turbine Technicians : Occupational Outlook Handbook: : U.S. Bureau of Labor Statistics

https://www.bls.gov/ooh/installation-maintenance-and-repair/wind-turbine-technicians.htm

WINDExchange: Wind Energy Needs More Workers—and Fast

https://windexchange.energy.gov/news/7181

Green Job Hazards - Wind Energy | Occupational Safety and Health ...

http://www.osha.gov/green-jobs/wind-energy

Experimental study of effects of soiling on various solar panel tilts in ...

https://www.sciencedirect.com/science/article/abs/pii/S2213138824002868

Grant-funded App State–ASU partnership examines the dirt on clean energy | Appalachian Today

https://today.appstate.edu/2020/06/08/soiling-loss

Power Washers' Guidebook: Environmental Concerns, Part I - Cleaner Times

https://www.cleanertimes.com/magazine/cleaner-times-articles-2/power-washers-guidebook-environmental-concerns-part-i/

Pressure Washing And EPA Fines

https://cmmonline.com/articles/pressure-washing-and-epa-fines

Pressure Washing And EPA Fines

https://cmmonline.com/articles/pressure-washing-and-epa-fines

Pressure Washing And EPA Fines

https://cmmonline.com/articles/pressure-washing-and-epa-fines

Chemical Hazards and Toxic Substances - Overview - OSHA

http://www.osha.gov/chemical-hazards

Dispensing Chemicals and Agricultural Products (Part 137) with UAS | Federal Aviation Administration

https://www.faa.gov/uas/advanced_operations/dispensing_chemicals

Power Washers' Guidebook: Environmental Concerns, Part I - Cleaner Times

https://www.cleanertimes.com/magazine/cleaner-times-articles-2/power-washers-guidebook-environmental-concerns-part-i/

Dispensing Chemicals and Agricultural Products (Part 137) with UAS | Federal Aviation Administration

https://www.faa.gov/uas/advanced_operations/dispensing_chemicals