



AUTONOMOUS. ELECTRIC. FULL POWER.

AREA SWEEPING SYSTEM



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01

VISION & PURPOSE

AUTONOMOUS SWEEPING SYSTEM

Trombia Free autonomous sweeping systems automate, electrify and modernise industrial and municipal cleaning. The Trombia sweeping technology uses 90% less energy and 95% less water than conventional street sweepers. Lifetime operating costs drop sharply. The chronic shortage of sweeper drivers stops being a problem. The work gets done.

The complete system comprises the **Trombia Free sweeper machines**, the **Trombia Free Docking Station** and the **Trombia Free Remote Operation Center**. Together, they allow modern industrial sites to automate their sweeping operations entirely.

On public streets, the same system delivers remote-operated, zero-emission sweeping, from heavy spring clean-up to fine PM2.5 dust capture.





NORDIC TECH. NORDIC DESIGN.

Trombia Free is built in Finland, the country consistently ranked among the world's most trusted in cybersecurity.

That matters when your sweeping fleet is connected, autonomous and operated remotely. Finnish engineering brings the rigour: every component considered, every system designed to work in the hardest conditions on earth.

Scandinavian design brings the rest: robust, functional, quietly clean. Nothing decorative. Nothing unnecessary.

Everything engineered to perform.

SMART CITIES

An aerial, top-down view of a modern city at night. The image shows a large, circular plaza in the upper half, illuminated by several bright, circular lights. Below the plaza is a wide, multi-lane highway with multiple lanes in each direction. The city streets are lit up, and there are some blurred lights from moving vehicles. The overall color palette is dominated by blues and greys, with the lights providing a warm contrast.

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The cities of the 2020s can no longer rely on heavy diesel vehicles for daily maintenance. Smart cities need street cleaning that is efficient, sustainable and genuinely clean. Zero emissions. Zero water waste. And real control over the fine dust particles that lift from road surfaces into the air people breathe. Trombia Free is built for exactly that.

**A NEW STANDARD.
FOR URBAN AND
INDUSTRIAL CLEANING.**

SMART INDUSTRY



Seaports, airports and industrial plants face constant, demanding cleaning work. Most of it has to happen off-hours, and all of it has to be done properly. At the same time, cutting CO2 emissions across industrial sites has become non-negotiable. Trombia Free meets both demands, indoors and out.

**A NEW STANDARD.
FOR URBAN AND
INDUSTRIAL CLEANING.**

YOUR BENEFITS AT GLANCE

UP TO

8000m²

Cleaned area per hour

100 % CO₂ emission saving

95 % Less water consumption for sweeping duty

85 % Less energy consumption

OVER

20db

Lower noise pollution



HIGH PERFORMANCE & AUTOMATED OPERATION



ALL WEATHER AUTONOMOUS



ZERO EMISSION, WITH NO COMPROMISES



WATERLESS PM2.5 DUST REMOVAL



HEAVY DUTY SWEEPING CAPABILITY



SMART WITH ECONOMY

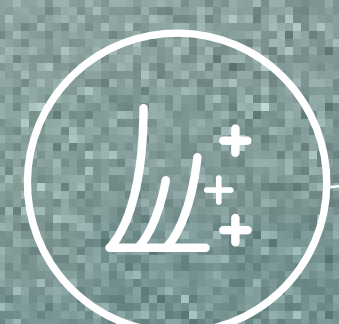
The background is a dark, textured surface. On the right side, there are several parallel, glowing blue lines that curve upwards and to the right, creating a sense of depth and movement. A small, white, rectangular object with a green light on its front is positioned on one of these lines. On the left side, there is a faint, glowing blue pattern that resembles a stylized 'C' or a series of concentric arcs.

02

PERFORMANCE & TECHNOLOGY

REVOLUTION OF AREA CLEANING

Trombia sweeping technology makes heavy-duty maintenance sweeping electric. At scale.



TROMBIA PERFORMANCE BROOM

Trombia Free combines two sweepers in one. A mechanical sweeper for heavy debris. A suction sweeper for fine dust. The Trombia Performance Broom lifts the heavier material and moves it straight to the container.



TROMBIA AIRKNIFE TECHNOLOGY

A high-velocity blade of air, directed at the dry surface. It lifts the finest dust particles off the ground and into the sweeping flow. No water. No wetting agents. Just air, doing the work.



TROMBIA CYCLONE TECHNOLOGY

Inside the sweeping chamber, a hardened-steel Trombia Cyclone separates dust from air. The particles drop out. The cleaned air is returned to the airknife, ready to work again. A closed loop.

REVOLUTION OF AREA CLEANING

Trombia Free is based on a globally patented Trombia sweeping technology that has been certified according to the highest European standards of PM2.5 dust cleaning.



WATERLESS SWEEPING

Trombia sweeps dry. No water sprayed on the surface. No water carried on board. Dust is lifted, captured and contained – not rinsed into the drains or left to dry back into the air.





MULTIPLE WEATHER CONDITIONS, INDOOR AND OUTDOOR.

Trombia Free sees its environment through a fusion of lidar and GPS. Millions of observations per object, accurate to within two centimetres. The machine knows where it is, what's around it, and how to respond – indoors, outdoors, and in the transition between.

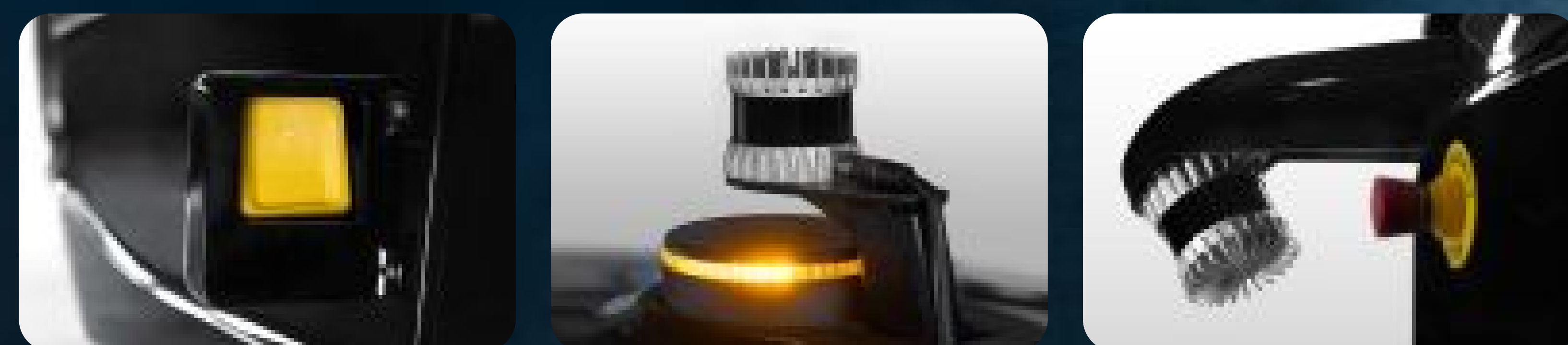
The real engineering challenge is weather. Rain, fog, airborne dust, shifting surroundings. Trombia Free's sensor fusion algorithm filters out that noise, so the machine's understanding of its position stays accurate in conditions that would confuse a lesser system.

CERTIFIED SAFETY

LIDAR | GPS | PLD RADAR | SAFETY STOP | VIRTUAL BUMPER

Backing up the machine vision is an emergency radar system built to PLd, the highest functional safety standard in the industry. It runs independently of the rest of the machine. If every other system failed, the radar would still stop Trombia Free.

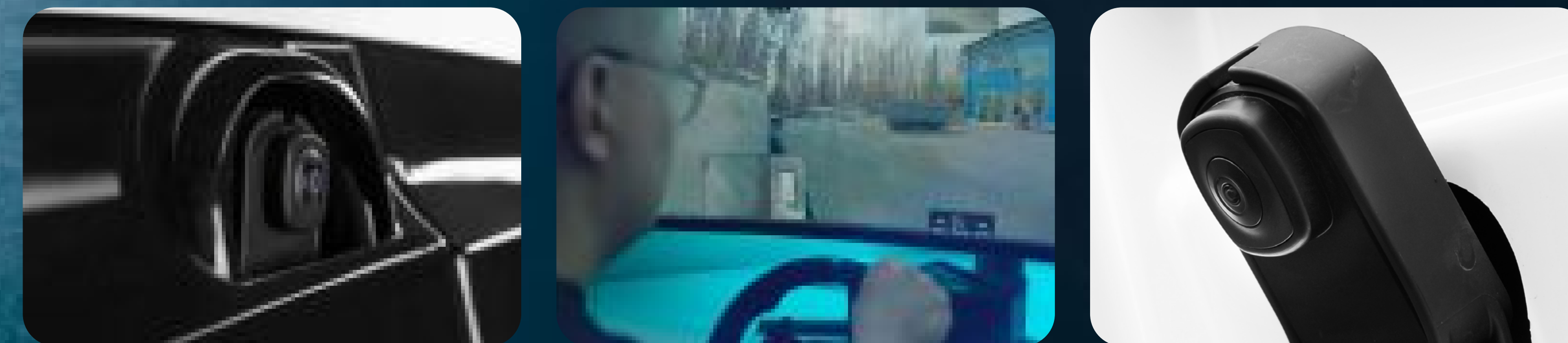
This redundancy is what makes Trombia Free fully compliant with ISO 3691-4 for driverless industrial trucks and with the Machinery Directive.



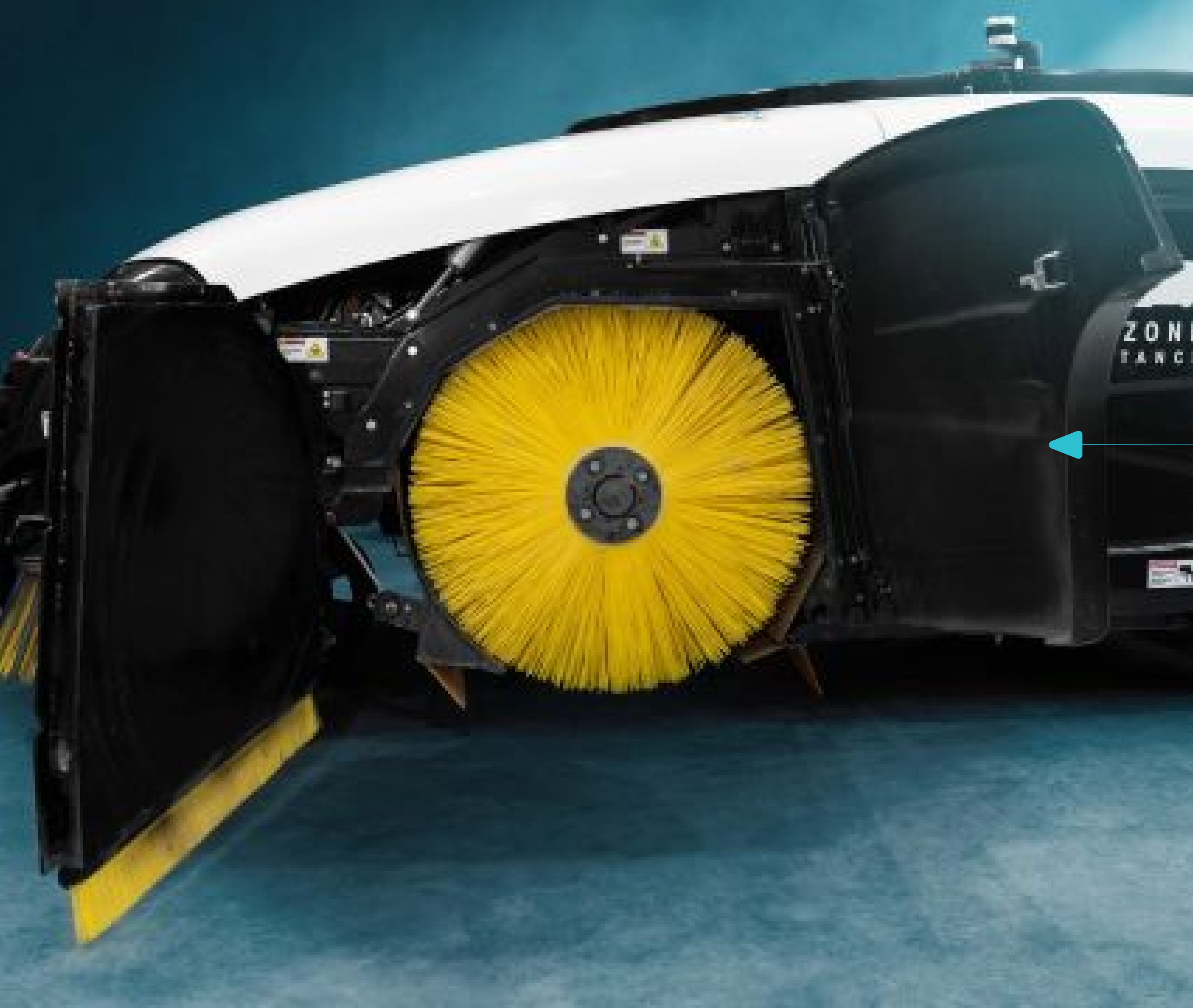


360

DEGREES CAMERA VIEW



A 360-degree camera array surrounds the machine. In the Remote Operations Center, the feeds are stitched into a single bird's-eye view, giving the operator complete visibility of the sweeper and everything around it.



FAST BRUSH REPLACEMENT

Side access doors open wide for quick brush changes. Minimal downtime. Minimal effort.

SMART DESIGN. MAXIMUM DURABILITY.

LESS MAINTENANCE, BY DESIGN

Lift the top covers and every maintenance point is in front of you. Power electronics. Control systems. All accessible from above, all in one place.

Conventional street sweepers live and die by their filters and conveyors. Parts that clog. Parts that tear. Parts that demand constant attention. Trombia Free has neither. The blower runs on cleaned air from the cyclone, so it stays clean itself. No filters to wash. No conveyors to repair.

Every key electronic component and enclosure is rated IP65 or IP67. Sealed against dust. Sealed against water.



CONFIGURED FOR PROCESS INDUSTRIES

In highly abrasive conditions, two hardened specifications are available. A polyurethane coating on the container and cyclone or the construction in AISI 316 acid-resistant steel.



PREMIUM COATING

Request your own premium coating or go with the premium Trombia Free pearl coating.



TRANSPORTATION MODE

When sweeping isn't the job, transport mode takes over. Activated remotely or autonomously, it gives the sweeper a smoother ride back to the dock, across site, or over obstacles in its path.

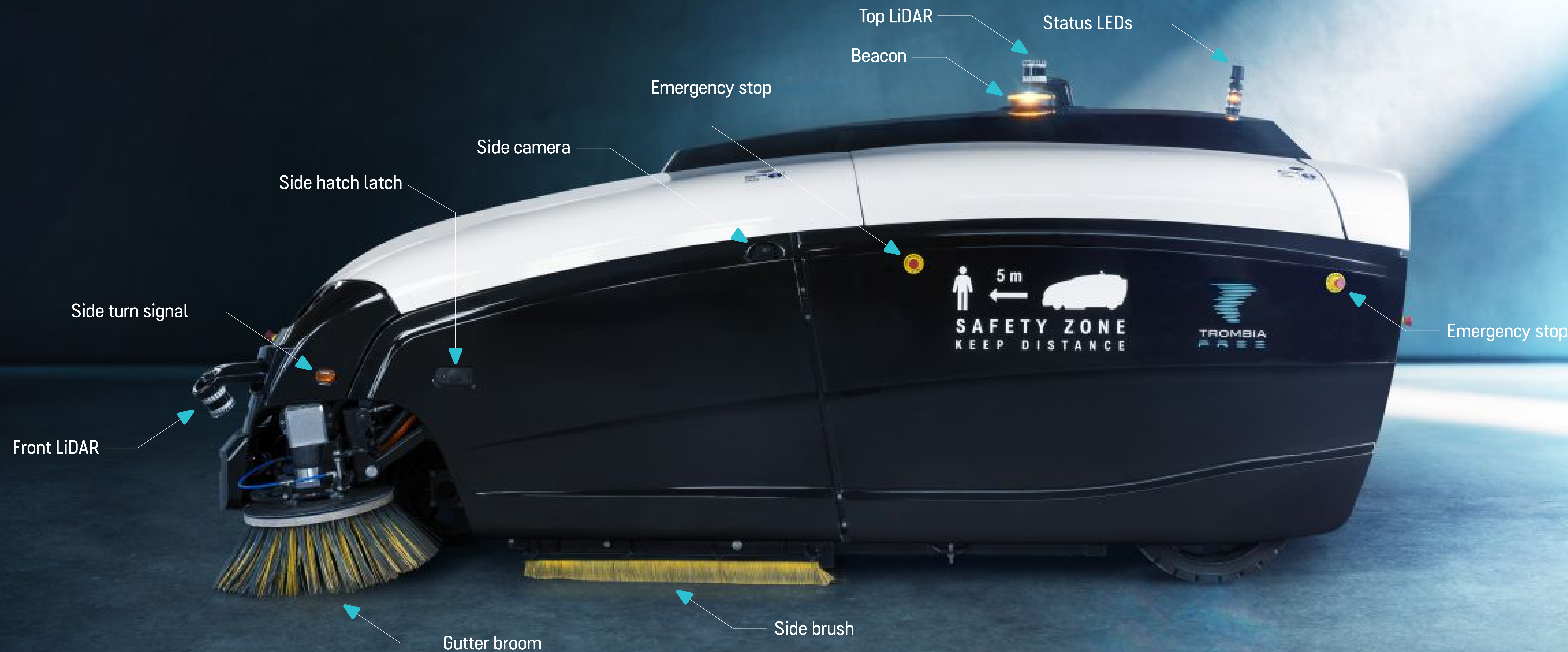


DUAL GUTTER BROOMS

Two side-mounted gutter brooms extend the sweeper's reach to walls, curbs and edges. Run them independently or together, depending on the work.

Specified in full plastic for standard surfaces, or in a steel-wire and plastic combination for heavier, more abrasive conditions.

EXTERIOR MAIN ELEMENTS



EXTERIOR MAIN ELEMENTS



EXTERIOR MAIN ELEMENTS





03

SYSTEM & OPERATIONS

DRIVERLESS SWEEPER UNITS

AUTONOMOUS | INDOOR & OUTDOOR | ALL ELECTRIC



TROMBIA FREE DOCKING STATION

CHARGING | EMPTYING | WASHING



**FULL SYSTEM
INTEGRATION**

A complete sweeping ecosystem



REMOTE OPERATIONS CENTER

MONITOR | TELEOPERATE | SCHEDULE



TROMBIA FREE EMPTYING RAMP

HOOK-LIFT | EMPTYING | WASHING

TROMBIA FREE REMOTE OPERATION CENTER

During commissioning, an on-site Remote Operation Center is installed and configured for your team. From there, your operators monitor the fleet, schedule routines and design new sweeping tasks.



TELEOPERATION

Teleoperate your Trombia Free devices.



SCHEDULE MISSIONS

Schedule sweeping duties for quiet time at your site.



MONITOR

Monitor the diagnostics, sweeping data or the operation over camera connection.



SWEEPING PLANNER

Drive the route once, remotely. Trombia Free learns it, stores it, and can run it on demand from then on. Assign the task to any sweeper in the fleet. For more broader missions, define the path using the waypoint tools.



MANUAL TAKEOVER

Where needed, you can also take over autonomous sweeping duties, carry out manual sweeping and then return autonomous mode.

***One operator
can monitor
several
sweepers***

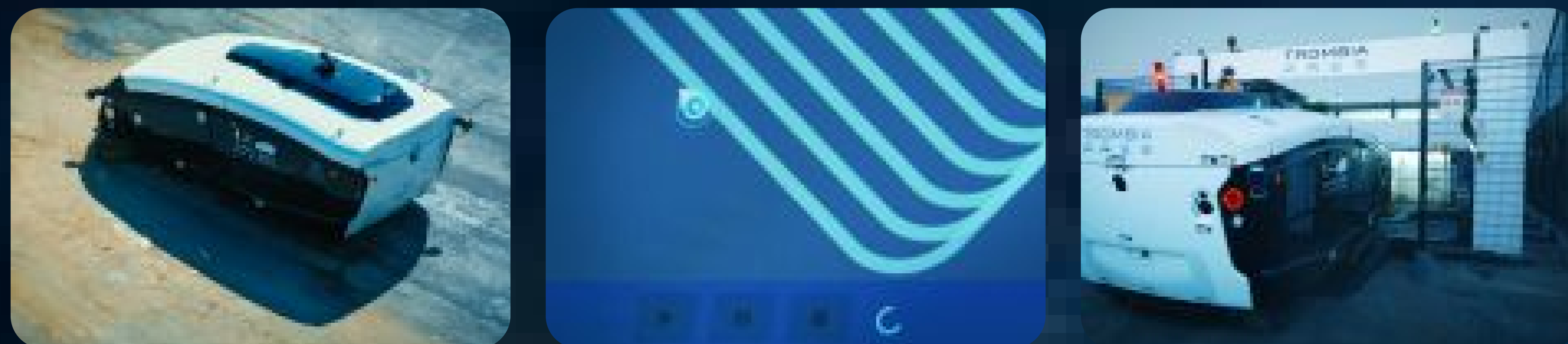


TROMBIA FREE REMOTE OPERATION SERVICE

Trombia Free is available as a pay-per-use service. One predictable price per acre or square metre. Everything included.

Turnkey installation. Route design. Remote operation, delivered by Trombia Fleet Services. Typically around 10% lower cost per acre than your current sweeping solution.

Contact Trombia sales for a rate and a proposal tailored to your site.



**TRANSPARENT
PRICING**



**EUR / USD
PER ACRE / SQM**



**TURN KEY
DELIVERED**



**ALL-INCLUSIVE
[SERVICE, PARTS, OPERATION]**

TROMBIA FREE DOCKING STATION

The Docking Station is home base for the fleet. Each sweeper returns here to empty, wash and charge – one station, three functions, handled in sequence.

Debris is unloaded directly onto a demountable skip, ready for collection. Then the machine is washed, charged and made ready for its next task. A single Docking Station can serve multiple sweepers across a site and can be mounted outdoors or indoors.





DRIVE INTO THE DOCK

The sweeper returns to the Docking Station autonomously, guided in by its onboard sensors. As it docks, it connects automatically to the water inlet for refill and washdown, and to the charging plate for opportunity charging.

DOCKING STATION FUNCTIONS

(MANUAL & AUTOMATED)

DOCK MOVEMENT ON THE SKIP

The dock lifts the sweeper and moves it into position over the skip. Automatically.



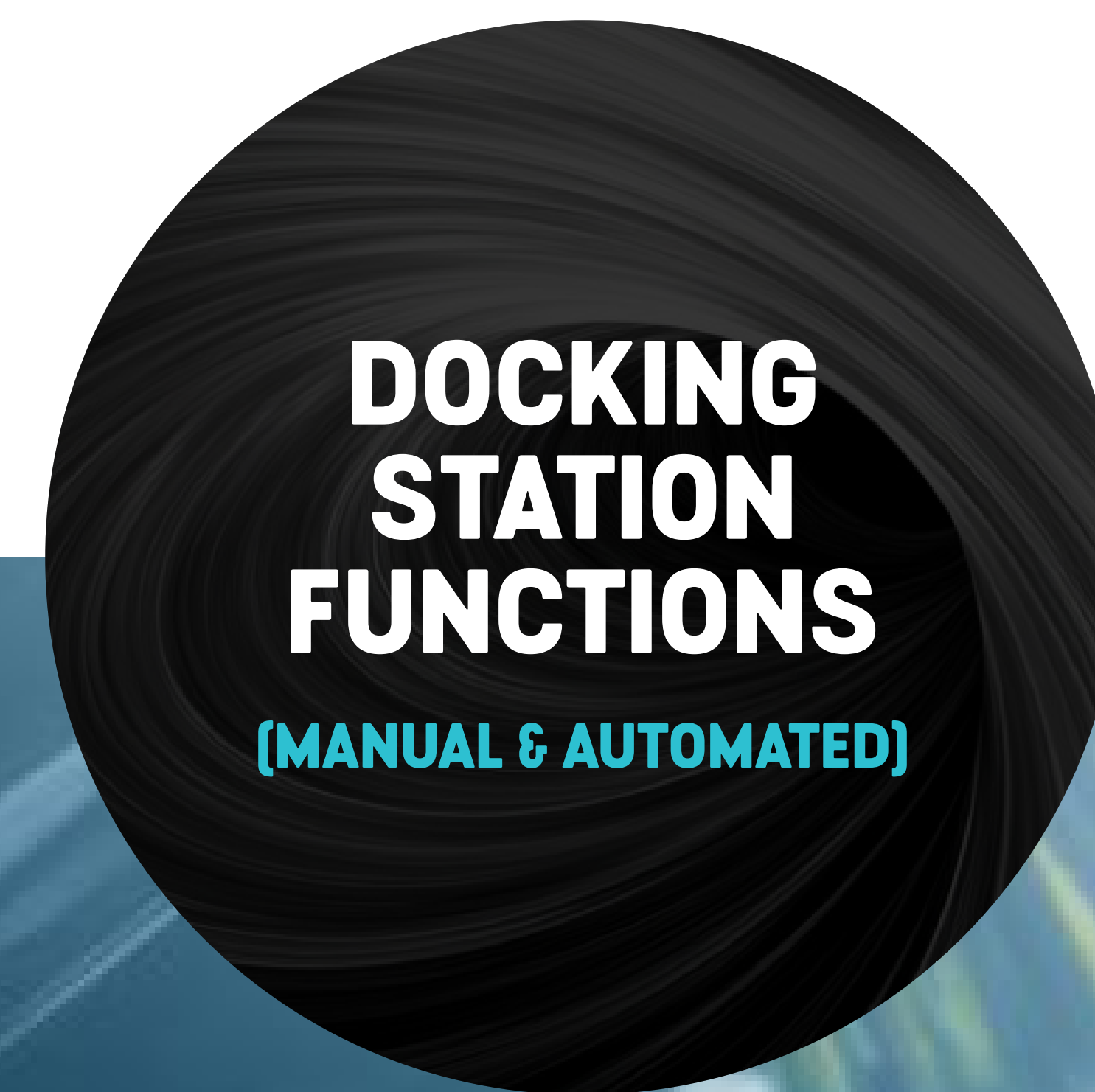
SAFETY CONTROL

Every entry to the Docking Station is controlled by RFID pairing. If an unauthorised person or object enters the station, the system halts all operations immediately. Fully compliant with EN 1570-1:2024.



EMPTYING OF THE TROMBIA FREE HOPPER

Positioned over the skip, the hopper doors open and the sweeper unloads directly. The cyclone and the dirt container empty simultaneously. One movement. Both cleared.



AUTOMATED CHARGING

Once docked, the sweeper connects to the charging plates automatically. 9-18 kW at 400-480 V. No cables. No operator action.



WASHING

Once emptied, an automated wash cycle runs through the hopper and the cyclone. The cycle is programmable, so it can be tuned to your site's conditions and cleaning demands.

TROMBIA FREE **MOBILE EMPTYING RAMP**

For operators working across multiple sites, Trombia Free is available with a mobile emptying ramp built on a standard hook-lift system. The sweeper and ramp travel together on a standard trailer, ready to deploy wherever the work is.

While Trombia Free handles the sweeping, your operator is free to focus on other facility duties. The machine can be pre-loaded with maps and routines for every site it serves, all managed through a single operator interface.

The hook-lift connector can be specified to fit the most common logistics vehicles – so the system integrates with the fleet you already run.



Deploy.
Map.
Operate.

04

COMMISSIONING

MANAGING A NEW SWEEPING SITE



MAPPING

H U M A N - A S S I S T E D

Every sweeping site is mapped into Trombia Free's memory on the first day of work. If you already have 3D point cloud data of the area, we can use yours directly. For larger sites, advanced mapping tools complete the job in a fraction of the time.

Once the site is mapped, the sweeping trajectory is recorded – either through the remote control way-point system, or on-site using the radio mode.

MANAGING A NEW SWEEPING SITE



CLEANING

A U T O N O M O U S L Y

Sweeping is carried out fully autonomously. Each Trombia Free pod executes its assigned duties to the recorded instructions, without supervision.

When something unexpected arises, your operator is already connected. Through the Remote Operation Center or on-site radio, they can monitor the pod's progress and step in to resolve any challenge the machine encounters.

MANAGING A NEW SWEEPING SITE



LOGISTICS I N T E G R A T E D

Disposal and emptying logistics are connected autonomous method that will integrate to your existing logistics and area maintenance operations. Trombia Free emptying station is built based on a universally standardized dumpsters and dirt containers - on which the machine will automatically empty.

REQUIREMENTS



INFRASTRUCTURE AGNOSTIC

- ▶ No pre-requirements for the infrastructure

CONNECTIVITY REQUIREMENTS

- ▶ Stable 4G network or industrial Wifi for remote-driving.
- ▶ Autonomous drive of the sweepers operates without 4g/Wifi
- ▶ Remote control and RTK navigation require a stable 5G connection:
10 Mbit/s uplink, 10 Mbit/s downlink
- ▶ Lidar-based navigation runs locally, without connectivity

TROMBIA FREE DOCKING STATION

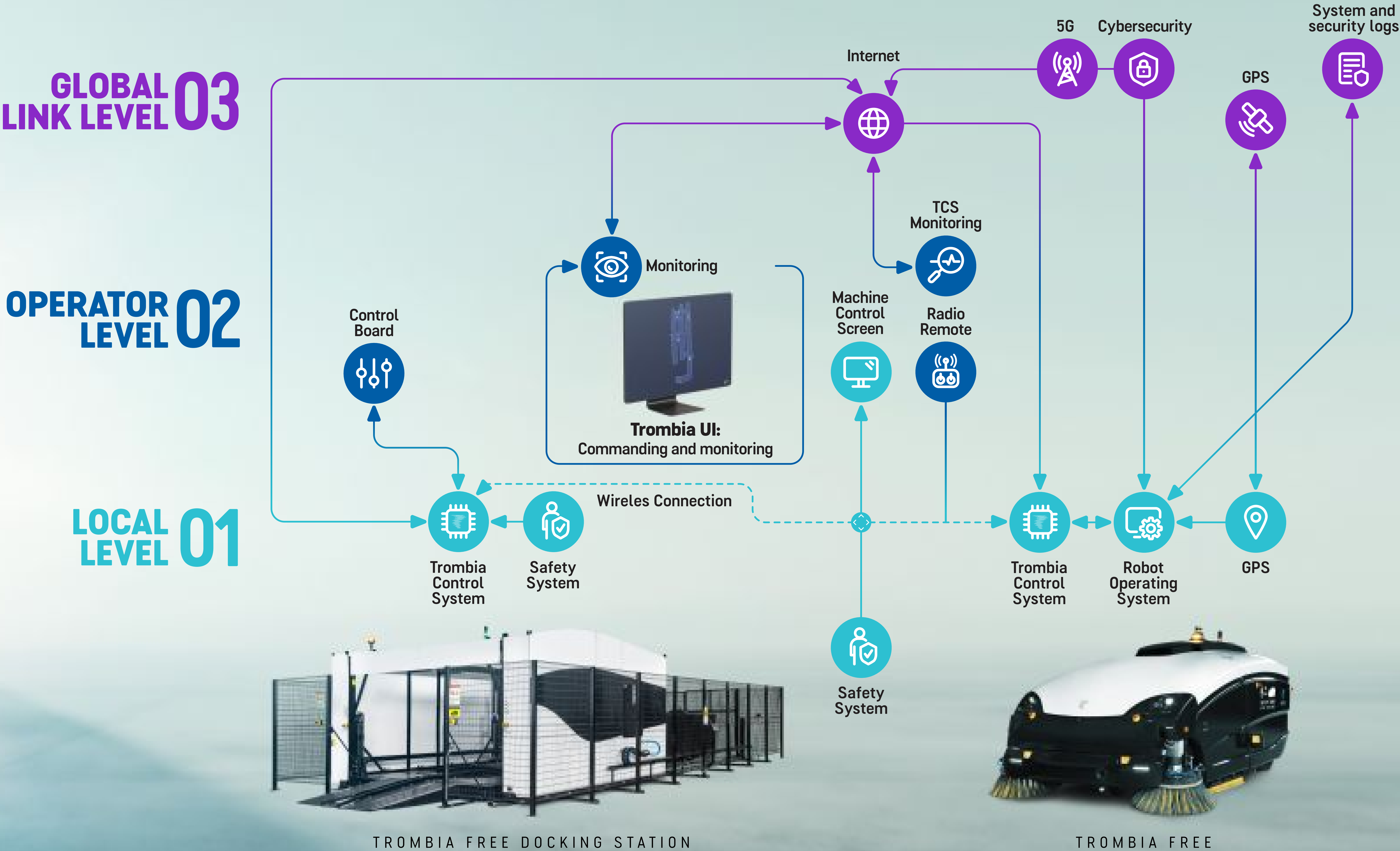
- ▶ Bolt-on assembly on concrete base or asphalt
- ▶ Max. slope allowed: 2:100
- ▶ Surface flatness: Max. 10mm (0.4 inches)
difference /per 1 m (3.28ft)

THREE LAYERS. ONE SYSTEM.

Every Trombia Free installation operates across three connected levels. At the **local level**, the sweeper and the Docking Station run their own control and safety systems – fully autonomous, fully self-sufficient, no network required. The most critical site data is always stored on-site, within the machine itself. At the **operator level**, your team monitors the fleet, drives remotely when needed, and manages tasks through a single Trombia UI. At the **global level**, the system connects over 5G to Trombia’s cybersecurity-hardened infrastructure, GPS positioning, and continuous system logging. Each layer works independently. Together, they deliver autonomous sweeping that is supervised, traceable, and secure by design.

LOCAL NETWORK INSTALLATION

For the most security-sensitive environments, the entire system can be deployed on a closed local network – operating in full, without any external connection.





05

TECHNICAL SPECIFICATIONS

T R O M B I A F R E E

SWEEPER UNIT

POWERTRAIN

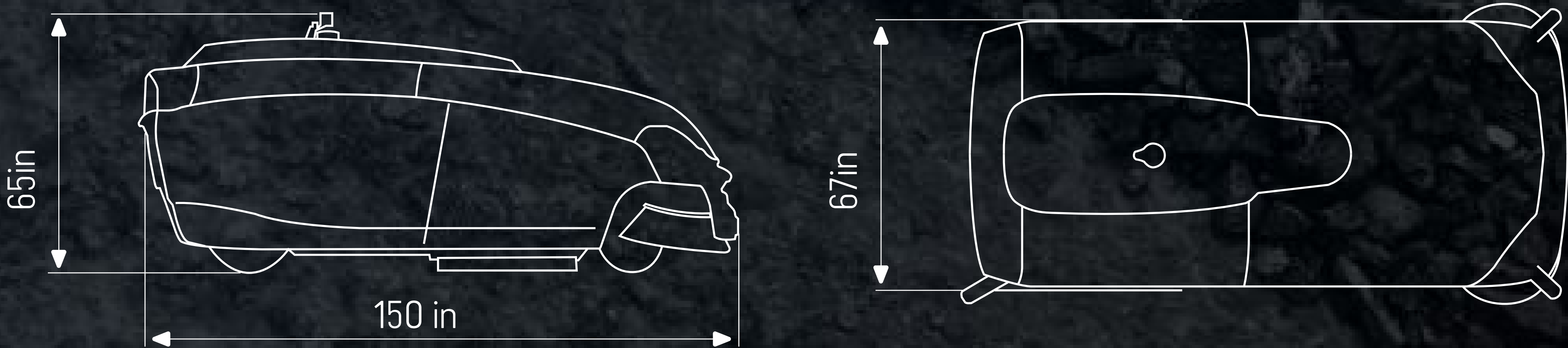
Drive	Different 3-wheel
Power battery	Lithium-ion
Battery [kWh]	34 kWh
Power requirement [kW, tatal, drive+sweeping]	3 - 7 kW
Autonomy, EN-15429	8 hours
Autonomy, continuous sweeping	6 hours
Charging system	1x32A - 230-240vac
Charging system, automated charging	1x32A - 400-480vac
Charging time [1x32A - 230vac]	5h [0% → 100%]
Charging time, automated charging [1x32A 480VAC]	2 - 3h [10% → 100%]
CO ² emissions	0 kg CO ²

WEIGHT AND DIMENSIOS

Weight	2300 kg / 5070 lbs
Lenght	3820 mm / 150"
Width	1700 mm / 67"
Height	1660 mm / 65"
Hopper capacity	1,2 m3 / 1.57yd3

PERFORMANCE

PM2.5 dust removal width	160 cm / 62"
Sweeping width	160 cm / 62"
Sweeping width [dual gutter brooms]	200 cm / 79"
Dust removal efficiency [PM2.5]	> 95 %
Sweeping efficiency / hour	4000 - 8800 m ² / h / 1 - 2 acres / hour
Sweeping efficiency / charge	20 000 - 50 000 m ² / charge / 5 - 10 acres / charge
Airknife velocity	15 - 25 m/s / 33 - 55 mph
Water consumbtion	0 - 70 l / h / 0 - 20 gal / h
Noise level, outside [1 m - front side]	73db / 67db
Noise level, outside [5 m - front side]	69db / 61db
Noise level, outside [10 m - front side]	67db / 52 bd

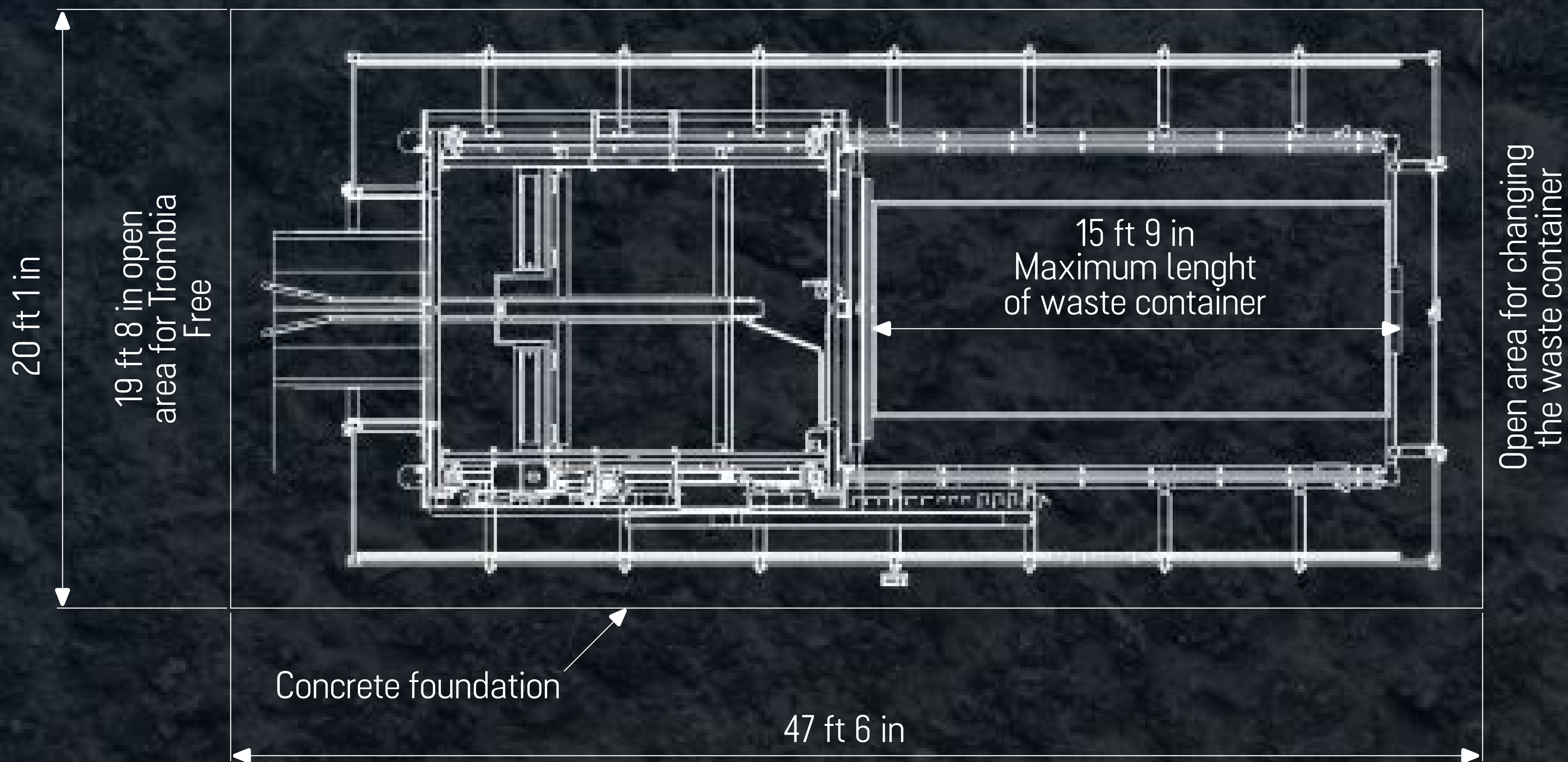


TROMBIA FREE

DOCKING STATION

OPERATING CONDITIONS AND TECHNICAL DATA

Condition/Technical information	Qualifier	Use in dry conditions	Yes	Mounting platform	Concrete [C12/15] or Asphalt
Operating temperature	32- 111 °F	Use in potentially explosive atmospheres [ATEX]	No	Short-circuit power of the feeding network	No requirement
Air Humidity	90% max	Minimal installation space	21' x 49' + space for logistics	Electrical connection	32A 480VAC
Use in the rain	Yes	Max surface slope	2:100	Water connection	115psi - 145psi / 13 gpm or Pressure increase pump by Trombia
Use in heavy rain	No	Surface flatness	max 0.4 in per 3'3"	Max load	8820 lbs (Trombia Free)
Use in a storm	No	Water supply locally	Yes	Noise level at the place of use	LAeq 63,7 dB
Maximum wind speed	30 mph	Water supply from the tank	Yes	Noise level next to the largest sound source (1 m)	LAeq 72.0 dB
Use in light snow	Yes min. 32°F	Outdoor use	Yes	The noise level of the warning sound from the place of use	LAfast 84,4 dB
Use in heavy snow	No	Indoor use	Yes	Length x Width x Height	44'6" x 19'8" x 9'3"

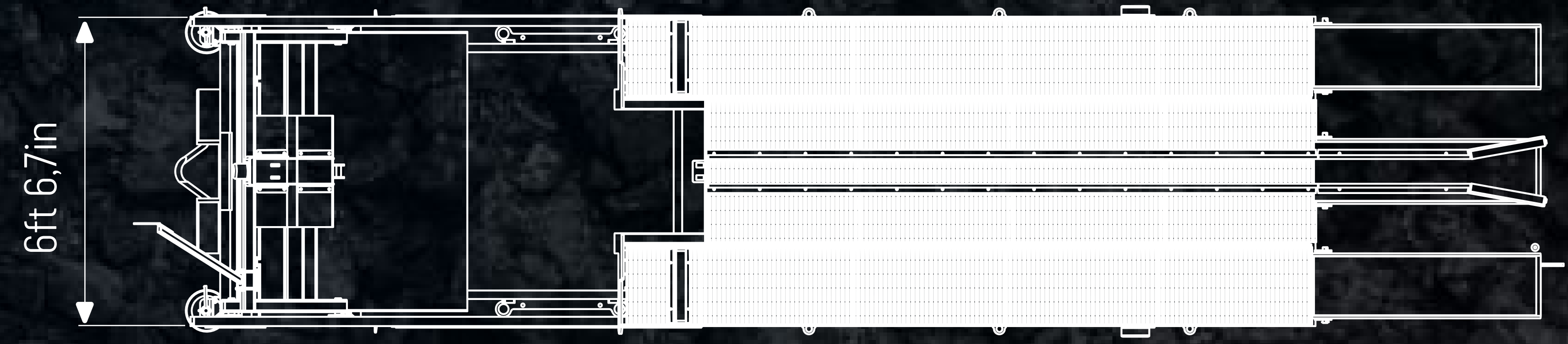
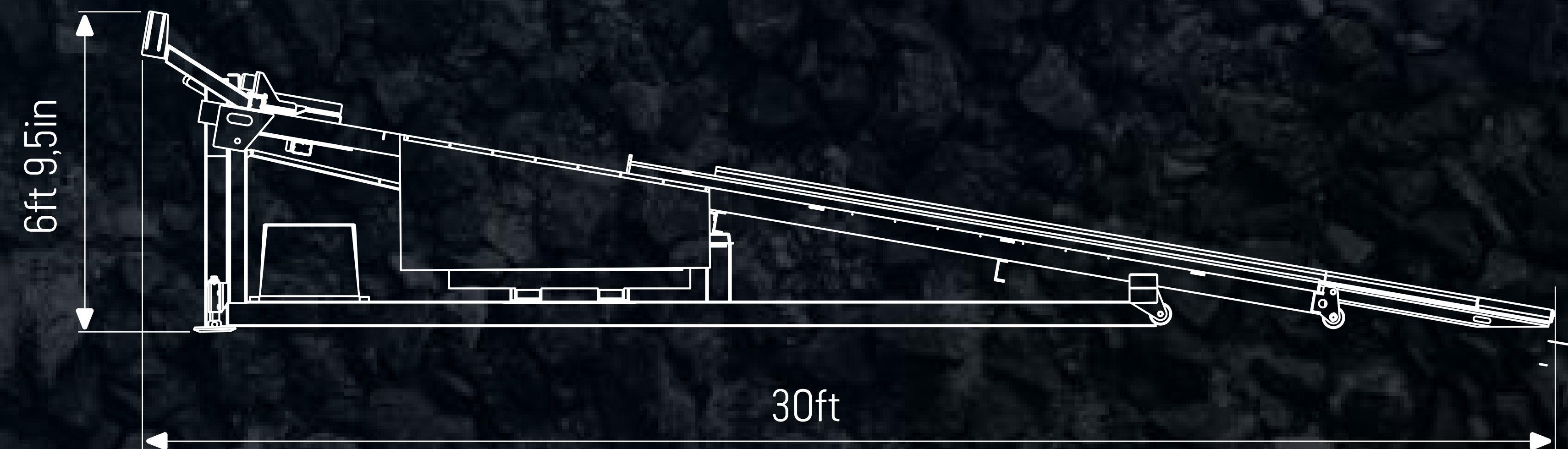
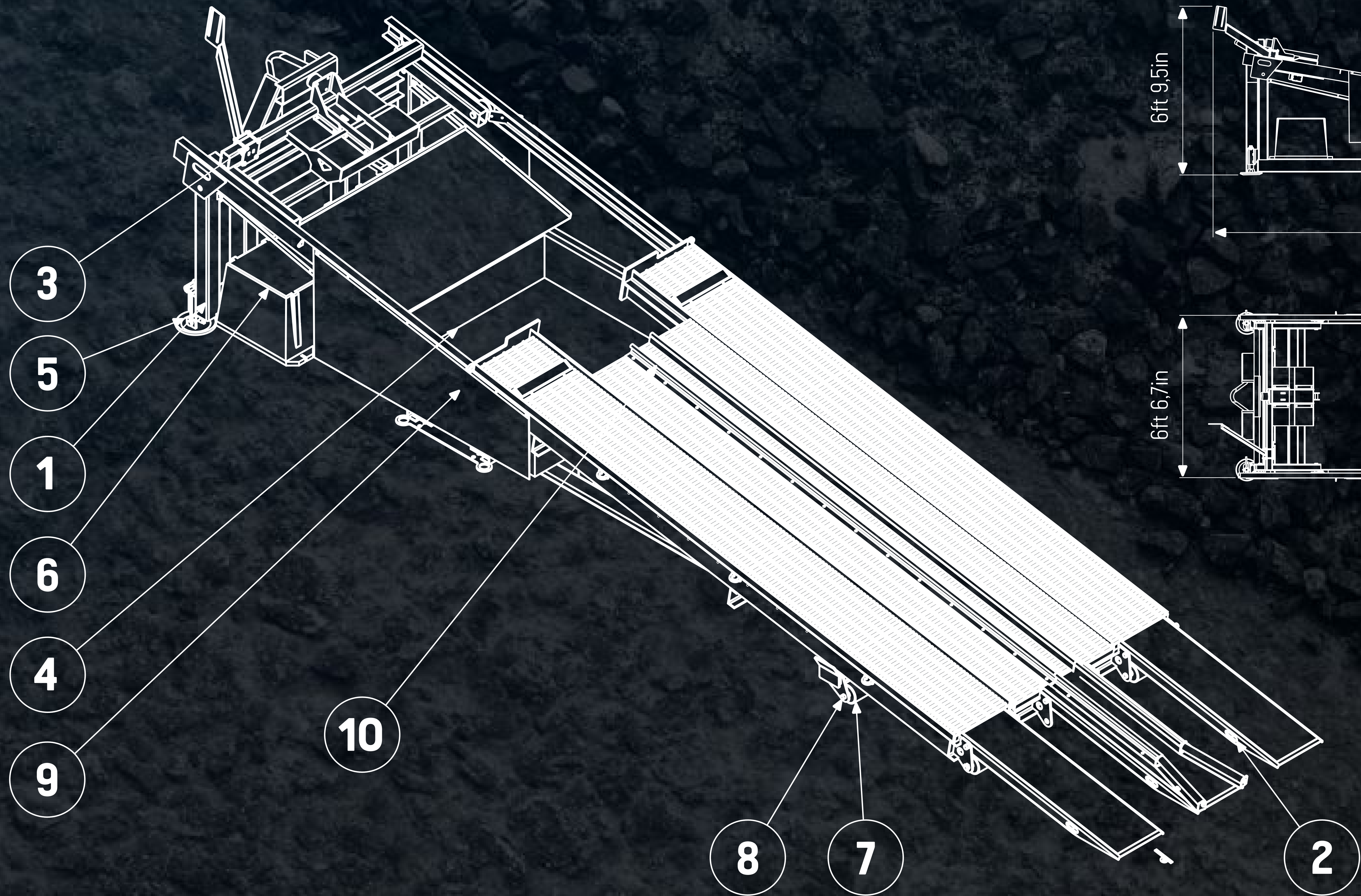


TROMBIA FREE

MOBILE EMPTYING RAMP

KEY COMPONENTS

- 1. Frame
- 2. Base
- 3. Plane
- 4. Tank
- 5. Foot
- 6. Tank, 500l
- 7. Roll
- 8. Axle
- 9. Cover
- 10. Guidance



Trombia Technologies

Kuopio, Finland

sales@trombia.com

www.trombia.com/free



